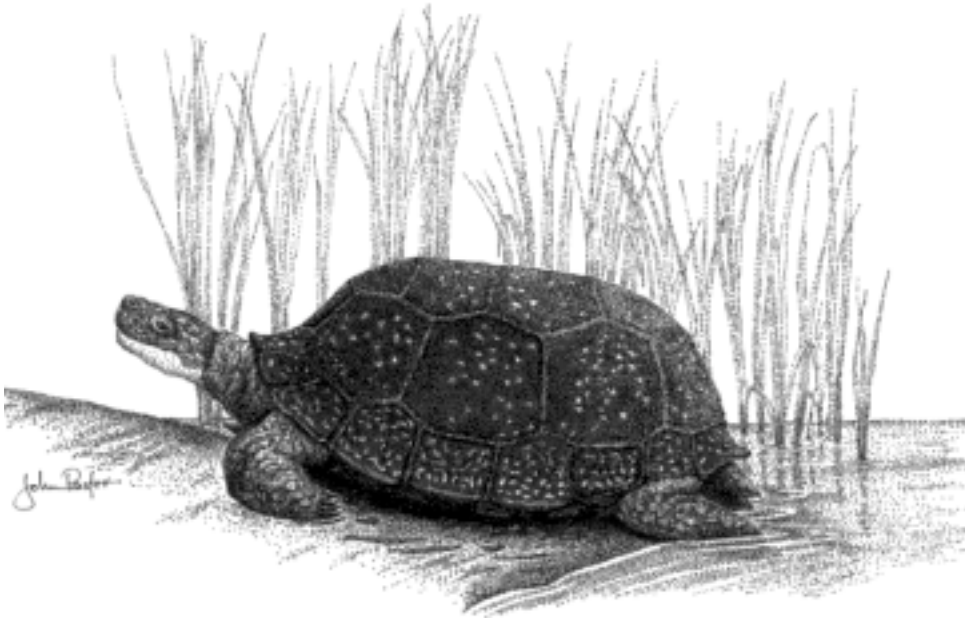
17th Annual Meeting of the
Society for Conservation Biology

Book of Abstracts



Duluth Entertainment Convention Center
Duluth, Minnesota, USA
28 June - 2 July 2003

O Presentation Types and Session Titles

Abstracts are organized alphabetically by first author. Abstract numbers represent the type and sequence of presentations. See page 201 for an index of presenting and contributing authors.

C – Contributed Oral Sessions

C01 Alien and Invasive Species I: Ecosystem Impacts
C02 Conservation Genetics I
C03 Conservation Issues Concerning Herpetofauna I
C04 Community Ecology
C05 Conservation Area Planning and Management I
C06 Alien and Invasive Species II
C07 Conservation Genetics II
C08 Wetland Ecology
C09 Spatial Ecology and Conservation I
C10 Education and Outreach
C11 Alien and Invasive Species III
C12 Economic and Social Issues of Conservation Biology I
C13 Conservation Issues Concerning Herpetofauna II: Mortality and Malformation Issues
C14 Spatial Ecology and Conservation II: Wetlands and Riparian Zones
C15 Conservation Area Planning and Management II
C16 Economic and Social Issues of Conservation Biology II
C17 Pathogens and Populations
C18 Inventory and Monitoring I
C19 Conservation Issues Concerning Herpetofauna III: Distribution and Habitat Use
C20 Conservation Area Planning and Management III
C21 Endangered Species I
C22 Conservation Issues Concerning Mammals I
C23 Conservation Issues Concerning Birds I: Forested Systems
C24 Conservation Area Planning and Management IV
C25 Spatial Ecology and Conservation III
C26 Bridging the Gap Between Scientists and Managers
C27 Conservation Issues Concerning Mammals II
C28 Conservation Issues Concerning Birds II
C29 Disturbance Ecology
C30 Spatial Ecology and Conservation IV: Habitat Isolation and Metapopulations
C31 Conservation Area Planning and Management V
C32 Conservation Issues Concerning Fish
C33 Marine Conservation Issues I: Fisheries Management
C34 Inventory and Monitoring II
C35 Conservation Issues Concerning Invertebrates
C36 Population Dynamics
C37 Economic and Social Issues of Conservation Biology III
C38 Endangered Species II
C39 Marine Conservation Issues II
C40 Restoration Ecology I
C41 Population Viability Analysis
C42 Ecosystem Management
C43 Endangered Species III
C44 Conservation Genetics III
C45 Aquatic Ecology
C46 Conservation Issues Concerning Global Climate Change
C47 Conservation in the Face of Urbanization
C48 Conservation Genetics IV
C49 Conservation Issues Concerning People
C50 Conservation Biology in Grassland Systems
C51 Conservation Issues Concerning Birds III
C52 Landscape Ecology I

C53 Science and Policy in Conservation Biology I
C54 Biogeography
C55 Indigenous Knowledge and Conservation
C56 Conservation Issues Concerning Birds IV
C57 Landscape Ecology II
C58 Science and Policy in Conservation Biology II
C59 Restoration Ecology II
C60 Conservation Issues Concerning Plants

P – Posters

NOTE: Some numbers not represented due to late cancellations.
P001 - 004 Aquatic Ecosystem Assessment and Conservation
P005 - 012 Inventory and Monitoring
P013 - 019 Conservation Issues Concerning Birds
P020 - 024 Landscape Ecology
P025 - 029 Spatial Ecology and Conservation
P031 - 037 Conservation Area Planning and Management
P038 - 040 Ecosystem Management
P043 - 050 Scientists, Managers and Policy Makers – Bridging the Gaps
P051 - 053 Education and Outreach
P054 - 055 Marine Conservation
P056 - 060 Conservation Issues Concerning the Great Lakes
P061 - 066 Conservation Issues Concerning Fish
P067 - 068 Aquatic Ecology
P069 - 074 Conservation Issues Concerning Amphibians and Reptiles
P075 - 080 Conservation Issues Concerning Mammals
P081 - 098 Conservation Genetics
P099 - 107 Population Dynamics
P108 - 115 Endangered Species
P116 - 119 Conservation Issues Concerning Invertebrates
P120 - 126 Alien and Invasive Species
P127 - 129 Grassland Ecology
P130 - 132 Conservation Issues Concerning Plants
P133 - 140 Disturbance and Restoration Ecology

PL – Plenary Sessions

PL-01 Michael P. Dombeck
PL-02 David Schindler
PL-03 Joy Zedler
PL-04 Jane Lubchenco

S – Invited Symposia

S01 Conservation in a Warmer World: Great Lakes Ecosystems, Climate Change and the Need for New Approaches for Ecosystem Protection
S02 The Interface of Land-Use Planning and Biodiversity Protection
S03 Maintaining Connections for Nature: The Importance of Connectivity for Conservation
S04 Human Interaction with Aquatic Systems: How Knowledge of Aquatic Systems Impacts Individual and Institutional Action
S05 The Future of Conservation Biology in Austral and Neotropical America
S06 Values, Ecology and Management: Integrating Biodiversity and Great Lakes Fisheries Management
S07 Reversing the Paradigm: Science-Based Conservation Planning in the Boreal Forest
S08 Freshwater Biodiversity Conservation: Transitioning from Priorities to Action
S09 Protecting Moving Targets: Integrating Movement Ecology and Conservation Practice
S10 Coastal Wetland Vegetation as a Harbinger of Environmental Change
S11 Community Involvement in Crane and Ecosystem Conservation on Three Continents
S12 Comparing Marine and Terrestrial Ecosystems: Implications for Conservation Theory and Practice
S14 Conservation Planning for Wide-Ranging Species: Challenges and Strategies
S15 Marine Reserves: A Global Perspective

W – Workshops

Note: All other workshops involve informal presentations for which abstracts were not required.
W02 Cybertracker: A Data Collection Tool for Land-Managers, Ecologists and Wildlife Biologists

C23-08 ACEVEDO, MIGUEL A. Department of Biology, University of Puerto Rico, Río Piedras Campus, PO Box 23360, San Juan, Puerto Rico 00931-3360 (miguel_a_acevedo@yahoo.com).
AVIAN SPECIES DISTRIBUTION ALONG A LAND-USE MOSAIC: PUERTO RICO AS A CASE STUDY

Avian distribution responds to the spatial arrangement of landscape attributes, and land-use is one of the determinants of these attributes. I used data from the Puerto Rican Breeding Bird Survey (PRBBS) and from a digital land-use and road map of Puerto Rico to examine how bird assemblages are affected by land-use practices. I drew a 200-m buffer along 42 PRBBS routes distributed along the whole island of Puerto Rico representing data from 1997 to 2001 and in each route a GIS extracted information on percent of land-use types (7 types) for each route. A non-metric multidimensional scaling analysis (NMS) that ordinates bird species based on land-use types showed two main clusters: the first associated with montane forest (lower montane, submontane and coffee) and the second with disturbed habitat conditions (agriculture, urban, dry forest and pasture). In addition all endemic species were part of the cluster associated with montane forest and most of the exotic species were part of the cluster representing bird species that can resist disturbed habitat conditions. Conservation efforts to preserve native, and in particular endemic birds in Puerto Rico, should focus on the preservation and restoration of montane forests.

C48-02 ADAMS, JENNIFER, Buddy Fazio, and Lisette Waits. Department of Fish and Wildlife Resources, University of Idaho, Moscow, ID 83844-1136, USA (adam2483@uidaho.edu) (JA, LW); Red Wolf Recovery Program, PO Box 1969, Manteo, NC 27954, USA (BF).
THE EFFECT OF GENOTYPING ERRORS ON POPULATION SIZE ESTIMATES DERIVED FROM FECAL SAMPLING

Previous research suggests that errors associated with non-invasive genetic sampling can bias population estimates derived from mark-recapture analysis. This study attempts to determine the magnitude of the bias using field data. Genotypes were generated at eight microsatellite loci for red wolf (*Canis rufus*) fecal material (scat) collected in the Alligator River National Wildlife Refuge (ARNWR) in northeastern North Carolina. Scats were collected along refuge roads during three sampling periods. Genotype data were replicated at each locus. Four acceptance criteria for unique genotypes were created to simulate differing levels of genotyping errors and program CAPTURE was used to generate population size estimates. The amplification success rate for eight loci was 56%. Under the least stringent and most error prone criterion for accepting unique genotypes, CAPTURE estimated a population size of 71 individuals. This estimate is almost 6 times larger than the known population size of 12 individuals. Under the most stringent criterion CAPTURE estimated a population size of 17 which is closer to the true population size. Of the 12 known individuals, 11 were detected with the scat sampling. These results suggest that if genotyping errors are accounted for, reasonable population size estimates can be obtained using non-invasive genetic sampling.

C53-06 ADKINS GIESE, COLLETTE, Francesca Cuthbert, and Linda Wires. Joint Degree Program in Law, Health and the Life Sciences, University of Minnesota Law School, 229-19th Avenue South, Minneapolis, MN 55455, USA (adki0020@umn.edu) (CA); Department of Fisheries, Wildlife, and Conservation Biology, University of Minnesota, 1980 Folwell Avenue, St. Paul, MN 55108, USA (FC, LW).
RESOLVING CONFLICTS BETWEEN CORMORANTS AND FISHERIES: IS U.S. FISH AND WILDLIFE SERVICE SIDESTEPPING FEDERAL PROTECTIONS FOR MIGRATORY BIRDS?

Double-crested Cormorants are federally protected migratory birds that have experienced significant population growth. The abundance of these piscivorous birds has led to conflicts with fisheries and allegations of harm to other colonial waterbirds. The U.S. Fish and Wildlife Service (FWS) responded by proposing a Public Resource Depredation Order to allow state and federal agencies to shoot unlimited numbers of cormorants and destroy eggs and nest sites, without migratory bird kill permits, where cormorants are injurious to public resources. Our research assessed the legality of the Public Resource Depredation Order under the Migratory Bird Treaty Act (MBTA). The MBTA authorizes FWS to promulgate regulations permitting the taking of migratory birds consistent with the original conventions. The convention with Canada allows killing birds that "under extraordinary conditions, may become seriously injurious to the agricultural or other interests in any particular community." Review of current biological research provides little evidence that cormorants are having a significant negative impact on open water fisheries or other public resources. In addition, prolonged nationwide lethal management without issuance of depredation permits seems inconsistent with terms and purposes of the conventions. A court of competent jurisdiction would likely find that the Public Resource Depredation Order violates the MBTA.

C18-09 AHMAD, HABIB, and Rashid Ahmad. Department of Botany, Government Jahanzeb Postgraduate College Saidu Sharif, Swat, Pakistan (drhabibnoor@yahoo.com) (HA); Nuclear Chemistry Division PINSTECH, Nilore Islamabad, Pakistan (RA).
ECOLOGY AND BIODIVERSITY OF THE SWAT RIVER CATCHMENT

The study area is a scientifically virgin 643,970 hectares terrain of mountains and valleys within the altitudinal limits of 600-6000m comprising the Hindu Raj series of the great Hindu Kush Mountains. A single watershed, the Swat River, drains it. The

study revealed that it provides habitat to more than 1.7 million people. Seven types of the landforms recognize the geomorphology of the exposed rocks of the area. Depending upon altitudinal variations, the distribution of some indicator species and landuse pattern eight agroecological zones i.e. Sub humid Tropical, Sub Tropical, Humid Temperate, Cool Temperate, Cold Temperate, Sub Alpine, Alpine and Cold Desert zone are broadly differentiated in terrestrial ecosystem of the area. Aquatic ecosystem of the area is represented mainly by Swat River and its tributaries which is broadly divided into the Spating and Sluggish river ecologies, falling within the Monsoon excluded and Monsoon prevailing regions of the study area, respectively. Rainbow Trout and Brown Trout among animals, and *Acer caesium*, *Aesculus indica* and *Prunus Cornuta* among plants indicate the Spating Water Ecology. Among fishes Shizothorax spp and *Garra gotyla*, and trees like *Alnus nitida*, Salix and Populus indicate the Sluggish Water Ecology. Fish fauna of the area is represented by 19 species, whereas 24 resident and 27 migratory birds represent the common avian fauna of the area. Biodiversity of the area is seriously exposed to species erosion pressure which needs immediate and effective conservation measures.

C41-04 AKCAKAYA, H. RESIT, John M. Halley, and Pablo Inchausti. Applied Biomathematics, 100 North Country Road, Setauket, NY 11733, USA (resit@ramas.com) (HRA); Department of Ecology, School of Biology, Aristotle University, U.P. Box 119, 54006, Thessaloniki, Greece (JMH); Laboratoire d'Ecologie, Ecole Normale Supérieure, 46 rue d'Ulm, Paris 75005, France (PI).

EXTINCTION RISK, AUTOCORRELATED ENVIRONMENTS, AND MEASUREMENT ERROR

Many long-term time series of animal population abundances show increased temporal variability with the length of the time series, which is associated with temporal autocorrelation and reddened spectral color. This might suggest that the temporally uncorrelated environmental fluctuations (white noise), used in most PVAs, are inadequate, and that reddened environmental noise needs to be explicitly incorporated in estimating extinction risks. However, population dynamics may become 'reddened' by various means: by inherited redness from variation in the environment (reddened environmental noise), or through trophic, density-dependent, spatially explicit, or age-structured dynamics. We used simulation models to explore the effects of various within-population processes on the spectral color of the simulated time series of abundances. Results show that reddened spectral color could be explained as the effect of a combination of measurement error and natural variability (in the form of white environmental noise). With both measurement error and natural variability, the spectral exponent is around +1, as in observed time series. Thus, it may not be necessary to invoke complex varieties of environmental noise to explain the observed spectral exponents; the typical value of +1 may be caused by white environmental noise affecting a population that is observed with measurement error.

C11-05 ALLENDORF, FRED W. Division of Biological Sciences, University of Montana, Missoula, MT 59812, USA (fred.allendorf@mso.umt.edu).

INTERCROSSES AND THE U.S. ENDANGERED SPECIES ACT: SHOULD HYBRIDIZED POPULATIONS BE INCLUDED AS WESTSLOPE CUTTHROAT TROUT?

There is currently no policy that provides guidelines for how hybrids should be treated under the U.S. Endangered Species Act (ESA). Therefore, the legal status of hybrids under the ESA is unclear. My purpose is to consider the scientific basis for determining if hybridized stocks and stocks of unknown hybridization status should be included as part of the westslope cutthroat trout unit considered for listing under the ESA. Molecular genetic techniques provide a reliable method to detect hybridization if done correctly. Morphological techniques, however, do not reliably estimate hybridization between westslope cutthroat trout and other taxa. Natural hybridization between westslope cutthroat trout and rainbow trout in areas of natural sympatry has been extremely minimal. Listing of populations that morphologically appear to be westslope cutthroat trout but contain admixture from other taxa is likely to result in the loss of the evolutionary lineage and legacy represented by westslope cutthroat trout. Protection of slightly hybridized populations would protect the source of ongoing rapidly spreading hybridization. I recommend that only non-hybridized populations should be included as westslope cutthroat trout in the unit to be considered for listing. Populations of unknown status should be protected until more information about these populations becomes available.

C57-06 ANDELMAN, SANDY, Eric Fegraus, and Mark Burgman. National Center for Ecological Analysis and Synthesis, 735 State Street, Suite 300, Santa Barbara, CA 93101-3351, USA (andelman@nceas.ucsb.edu) (SA, EF, MB); Donald Bren School of Environmental Science and Management, University of California, Santa Barbara, Donald Bren Hall, Room 2400, Santa Barbara, CA 93106-5131, USA (EF); School of Botany, University of Melbourne, Melbourne, VIC 3010, Australia (MB).

USING MODELS TO EVALUATE BIODIVERSITY MONITORING PROTOCOLS

Both assessment and long-term monitoring are essential components of ecological forecasting, and detecting and responding to large-scale changes in biodiversity present significant challenges for both conservation and scientific communities. Unfortunately, many environmental monitoring programs are poorly designed, and the spatial and temporal scales of monitoring activities are

frequently inappropriate to the scales at which inferences are made. Using a combination of models and existing data, we examined the potential ability of alternative monitoring protocols to detect changes in community composition and species diversity in tropical forests over several spatial and temporal scales. Our results provide an example of a cost-effective, adaptive framework allowing for feedback between sampling design, data collection and forecasting components of global or other large-scale biodiversity monitoring programs.

C14-04 ANDERSON, KURT E., Roger M. Nisbet, Sebastian Diehl, and Scott D. Cooper. Department of Ecology, Evolution, and Marine Biology, University of California, Santa Barbara, Santa Barbara, CA 93106, USA (k_anders@lifesci.ucsb.edu) (KEA, RMN, SDC); Department fur Biologie II, Ludwig-Maximilians-Universitat, Karlstr. 23-25, D-80333 Munchen, Germany (SD).
PREDICTING THE DOWNSTREAM PROPAGATION OF DISTURBANCES IN SYSTEMS WITH UNIDIRECTIONAL BIAS IN THE DISPERSAL MEDIA: MODELS AND DATA

In environments with unidirectionally biased dispersal media, such as streams and along coastlines, localized disturbances – for example, increased light input into a stream due to destruction of shoreline vegetation – can propagate rapidly downstream, affecting the dynamics of and interactions between downstream populations. We will present a spatial model of a stream community that consists of an algal producer and an aquatic insect grazer that disperses passively downstream in the water column. We developed a simple technique based on Fourier analysis which allows us to predict the spatial length scale over which localized disturbances – defined in our model as local changes in parameter values – affect downstream algae and grazer distributions. Model parameters were obtained from observations of algae and the mayfly larva *Baetis* in an eastern Californian stream. The model predicted that environments that cause high baetid dispersal, such as in areas with high flow and low algal biomass growth, exhibit longer spatial length scales than those with low baetid dispersal. These predictions matched observed spatial responses of algae and *Baetis* to environmental disturbances that were locally isolated as well as spatially extensive and irregular. We suggest that our model can be altered and applied to many aquatic and marine systems.

C33-02 ANDRIANARIVELO, NORBERT. Institut Halieutique et des Sciences Marines (IH.SM), Université de Toliara B.P : 141, Route du Port, Toliara (601), Madagascar (ihsm@syfed.refer.mg).
LOCAL FISHERIES AND THEIR IMPACT ON DOLPHINS IN THE REGION OF ANAKAO, SOUTHWEST OF MADAGASCAR

Malagasy fishermen exploit many marine species including marine mammals. We initiated the preliminary studies in 1999 in Anakao, a village situated in the southwest of Madagascar in order to obtain more knowledge about small cetaceans of Madagascar. The information concerning dolphin fisheries was gathered through interviews with fishermen, and the data on the dolphin populations – their abundance, distribution and behavior – was collected using boat surveys. Three dolphin species *Tursiops truncatus*, *Stenella longirostris* and *Sousa chinensis* were recorded from the boat. The socio-economic survey enabled us to identify several stresses on the dolphin population: fishing, stranding, and by-catch. Two types of fishing gears (harpoons and gill nets) are used in the region to catch dolphins. At least 4000 small cetaceans were caught between 1974 and 1999 and 1300 dolphins have been stranded. The use of shark nets or "jarifa" can also lead to by-catches of dolphins. The dolphins caught are used for local consumption and are sold locally as well as in other regions. The meat has been sold in the market places and served at restaurants in western Madagascar. Cetaceans are amongst the least studied zoological groups in Madagascar, particularly with regard to research on the conservation of biodiversity.

S07-06 ANGELSTAM, PER, Lars Laestadius, Tommy Ek, Jean-Michel Roberge. Forest Faculty, Department of Conservation Biology, Swedish University of Agricultural Sciences, SE-730 91 Riddarhyttan, Sweden (per.angelstam@nvb.slu.se) (PA, JMR); Örebro University, Department of Natural Sciences, Centre for Landscape Ecology, SE-701 82 Örebro, Sweden (PA); World Resources Institute, 10 G Street NE, Washington, DC 20002, USA (LL); County Administration Board of Östergötland, SE-581 86 Linköping, Sweden (TE).
DATA AND TOOLS FOR CONSERVATION, MANAGEMENT AND RESTORATION OF BOREAL FOREST ECOSYSTEMS AT MULTIPLE SCALES

The transition from the classic forest sustainability concept focusing on wood as renewable resource, to ecological sustainability based on forest ecosystem management requires additional data collection to monitor status and trends, but also an extended and improved toolbox for analytic planning in several steps. In particular, a widening of the range of thematic data and spatially explicit analytic tools are crucial for determining the relative use of protection management but if necessary also restoration by rehabilitation and even re-creation of forests of different types. Our starting point for assessing ecological sustainability is based on the elements of biodiversity at multiple scales as proxies. First we review the appearing needs for data describing the extended forest sustainability concept, and analytic tools for strategic, tactical and operational planning of sustainable forest ecosystem management at spatial scales ranging from trees and stands to landscapes and regions. Second, we discuss the usefulness of the

appearing new data sets and discuss gaps. Finally, due to incomplete availability of relevant proxy data and interpretation techniques, we argue for an adaptive hierarchical approach for the assessment and communication of the environmental sustainability of the boreal forest to different stakeholder groups.

S08-03 ANGERMEIER, PAUL L. Virginia Cooperative Fish and Wildlife Research Unit, Virginia Tech, Blacksburg, VA 24061, USA (biota@vt.edu).
ECOLOGISTS AS CATALYSTS FOR CONSERVING AQUATIC BIODIVERSITY

Aquatic biota worldwide are highly imperiled due to industrialization of ecosystems. This transformation reflects the prevailing views of ecosystem worth, which focus narrowly on short-term egocentric values. From this perspective, the primary role of ecologists is to dispassionately reveal mechanisms of ecosystem operation, especially those that might enhance production of desired goods. Social priorities, not scientific knowledge, limit biological conservation. Broader ethical imperatives open three additional roles for ecologists as conservation catalysts. Their most important role is to reduce ecological illiteracy and complacency among the public. Political support for conservation depends on public recognition of the many values of biota and of the ecological consequences of life-style choices. Such education comprises not only transfer of information but also inculcation of ethical perspectives. Another key role is to help publics formulate ecological questions amenable to scientific inquiry. Finally, ecologists can also develop tools and techniques to ensure that the best available knowledge is applied to those questions. For conservation to become a prominent societal goal, fundamental shifts in how ecologists inform the public are necessary. In particular, ecologists should de-emphasize research on ecosystem operation and redouble efforts to promote public ecological literacy.

C48-07 ARDREN, WILLIAM, and Anne Kapuscinski. U.S. Fish and Wildlife Service, Conservation Genetics Laboratory, Abernathy Fish Technology Center, 1440 Abernathy Creek Road, Longview, WA 98632, USA (William_Ardren@fws.gov) (WA); AquaGen Laboratory, Department of Fisheries, Wildlife, and Conservation Biology, University of Minnesota, St. Paul, MN 55108, USA (AK).
DEMOGRAPHIC AND GENETIC ESTIMATES OF EFFECTIVE POPULATION SIZE REVEALS GENETIC COMPENSATION IN STEELHEAD TROUT

Estimates of effective population size (N_e) are required to predict the impacts of genetic drift and inbreeding on the evolutionary dynamics of populations. We examined the sensitivity of the ratio of N_e to the number of sexually mature adults (N) to fluctuations of N and determined the major variables responsible for changing the ratio over a period of 17 years in a population of steelhead trout (*Oncorhynchus mykiss*) from Washington State. Demographic and genetic methods were used to estimate N_e. Genetic estimates of N_e were gained via temporal and linkage disequilibrium methods using data from eight microsatellite loci. The N_e /N from 1977-1994, estimated using the temporal method, was 0.73 and the comprehensive demographic estimate of N_e /N over the same time period was 0.53. We found increased N_e /N ratios at low N, which we identified as genetic compensation. Combining the information from the demographic and genetic methods of estimating N_e allowed us to determine that a reduction in variance in reproductive success must be responsible for this compensation effect. Understanding genetic compensation in natural populations will be valuable for predicting the effects of changes in N (i.e. high population density and bottlenecks) on the fitness and genetic variation of natural populations.

P037 Asher, Robert, **ROBERT COPPER,** and Marc Ebbin. County of San Diego, Department of Planning and Land Use, Multiple Species Conservation Program Division, 5201 Ruffin Road, Suite B, San Diego, CA 92123, USA (RA); County of San Diego, 1600 Pacific Highway, Room 212, Mail Stop A6, San Diego, CA 92101, USA (robert.copper@sdcounty.ca.gov) (RC); 550 Montgomery Street, Suite 900, San Francisco, CA 94111, USA (ME).
SPECIAL AREA MANAGEMENT PLAN DEVELOPMENT AS INTEGRATED REGULATORY TOOL FOR THE OTAY WATERSHED IN SAN DIEGO COUNTY

Protection of aquatic resources, wetland regulations and watershed planning are three important issues that were not directly addressed in the Multiple Species Conservation Program (MSCP), San Diego County's effort to protect endangered species and enhance biological diversity while streamlining the development permit process. The County is using the Otay River watershed as a pilot project to integrate these issues into the MSCP. The County and the U.S. Army Corps of Engineers, with the local, state, and federal agencies are developing a Special Area Management Plan (SAMP) for the Otay River Watershed. A SAMP is a comprehensive plan that provides for aquatic resource protection and reasonable economic growth within geographic areas of special sensitivity. The general objectives of the study are to: 1) develop a comprehensive aquatic resource preservation, enhancement, and restoration plan; 2) accommodate development activities while meeting goals of the study through issuance of a General Permit under the 404(e) Guidelines; 3) identify potential funding sources and mechanisms for land acquisition and conservation easements; 4) develop initial restoration and long-term management plans; and 5) improve regulatory and resource agency coordination. This effort is in conjunction with the development of a watershed management plan for the Otay River.

C05-08 ASHER, ROBERT, Robert Copper, Thomas Oberbauer, Pat Atchinson, and Maeve Hanley. County of San Diego, Department of Planning and Land Use, Multiple Species Conservation Program Division, 5201 Ruffin Road, Suite B, San Diego, CA 92123, USA (robert.asher@sdcounty.ca.gov) (RA, TO, PA, MH); County of San Diego, 1600 Pacific Highway, Room 212, Mail Stop A6, San Diego, CA 92101, USA (RC).
USE OF RESERVE SELECTION ALGORITHM MODELING IN CREATION OF PRESERVE SYSTEM FOR REGIONAL CONSERVATION

In California, the federal and state wildlife agencies combined the Natural Communities Conservation Planning (NCCP) program with the Habitat Conservation Plan (HCP) process to allow landowners, local governments, and other stakeholders to prepare plans that streamline appropriate development while conserving areas of high biologic value. The first phase of the plan bore some criticism for subjectivity and lack of scientific input. Therefore, in the second phase of the plan, the County used input from Independent Science Advisors that resulted in the utilization of the Reserve Selection Algorithm (RSA) modeling. RSA modeling helps optimize the efficiency (minimum area to accomplish preserve design goals) and 'complementarity' (representation of target conservation elements) of the preserve system based on preserve design criteria and conservation goals. An RSA model named SITES (Andelman, *et al.*, 1999) was selected that allows substantial parameterization and customization to tailor specifically for a given study area. The previous approach had involved a Habitat Evaluation Model (HEM) and gap analysis along with expert opinion of the project team, wildlife agencies, and local biologists to draw preserve area boundaries by hand. The RSA modeling approach is an objective and repeatable method that provides a basis for refinement by the project team.

P051 AXLER, RICHARD, Marion Lonsdale, Cynthia Hagley, George Host, Bruce Munson, and Carl Richards. Natural Resources Research Institute, University of Minnesota Duluth, 5013 Miller Trunk Highway, Duluth, MN 55811, USA (raxler@nrri.umn.edu) (RA, GH); City of Duluth, Stormwater Utility, 600 Garfield Avenue, Duluth, MN 55802, USA (ML); Minnesota Sea Grant College Program, University of Minnesota, 2305 East 5th Street, Duluth, MN 55812-1445, USA (CH, BM, CR).
DULUTH STREAMS: COMMUNITY PARTNERSHIPS FOR UNDERSTANDING URBAN STORMWATER AND WATER QUALITY ISSUES AT THE HEAD OF THE GREAT LAKES

Duluth, Minnesota lies adjacent to western Lake Superior, essentially the source and headwaters of the Laurentian Great Lakes ecosystem. The City has 42 named streams, 12 trout streams, and borders both pristine Lake Superior and the Duluth-Superior-Harbor Area of Concern. Duluth's stormwater infrastructure includes 93 miles of streams and wetlands, and urbanization and rural development impact these waters by increasing temperature, turbidity and sediment, roadsalts, organic matter and nutrients. *DuluthStreams* established a Partnership between the City, university professionals and local resource agencies with the goal of enhancing public understanding of aquatic ecosystems and their connections to watershed land use by illustrating the nature and consequences of degraded stormwater and its real costs to society. The project initiated time-relevant, automated water quality monitoring and a website (*www.duluthstreams.org*) linking the data to GIS landuse and current and historical water quality and biological databases. Data visualization tools, interpretive text and animations are used to visually engage the general public via the Internet and Kiosks at the Duluth Zoo and Great Lakes Aquarium. *DuluthStreams*, working with *RiverWatch*, has also established high school/neighborhood monitoring of trout streams, developed high school/college curricula, and is adapting NEMO (Nonpoint Education for Municipal Officials) to the Duluth Area.

C46-06 BAKER, ANDREW C., Craig J. Starger, Tim R. McClanahan, and Peter W. Glynn. Wildlife Conservation Society, Marine Program, 2300 Southern Boulevard, Bronx, NY 10460, USA (abaker@wcs.org) (ACB, TRM); Center for Environmental Research and Conservation, Columbia University, MC 5557, 1200 Amsterdam Avenue, New York, NY 10027, USA (ACB, CJS); Division of Marine Biology and Fisheries, Rosenstiel School of Marine and Atmospheric Science, University of Miami, 4600 Rickenbacker Causeway, Miami, FL 33149, USA (PWG).
CHANGES IN SYMBIONT COMMUNITIES IN REEF CORALS FOLLOWING A BLEACHING EVENT: WILL RECOVERING REEFS BE MORE RESISTANT TO GLOBAL CLIMATE CHANGE?

Coral bleaching as a result of seawater warming is a major threat to coral reef ecosystems worldwide. The long-term capacity of reef corals to survive warming is influenced by the type(s) of algal symbionts ("zooxanthellae") they contain. Because different algal partners can determine bleaching sensitivity in reef corals, we hypothesized that symbionts from corals that survive a severe bleaching event will more closely resemble those found at higher temperatures. Consequently, affected reefs may have a higher bleaching threshold than before. We tested this hypothesis using molecular techniques to identify the symbionts in corals from Kenya, Panama and Saudi Arabia. We found that a particular symbiont group (*Symbiodinium D*) was: (1) abundant in Kenya and Panama after bleaching; (2) virtually dominant in high-temperature Arabian reefs; and (3) relatively rare in Panama prior to bleaching. These findings suggest this group may have global importance in determining the response of reef corals to future thermal bleaching events and that threshold temperatures for coral bleaching may not be constant over time. Recent bleaching history and the shifting patterns of algal symbionts that result may be important in determining the long-term response of reefs to global climate change.

C20-06 **BALCH, FAITH,** Siobhan Boylan, Hannah Dunevitz, Sharon Pfeifer, and Bart Richardson. Minnesota Department of Natural Resources, Central Region, 1200 Warner Road, St. Paul, MN 55106, USA (faith.balch@dnr.state.mn.us).
ASSESSING ECOLOGICALLY SIGNIFICANT NATURAL RESOURCE AREAS IN THE SEVEN-COUNTY TWIN CITIES METROPOLITAN AREA IN MINNESOTA, USA

Urbanization fragments vegetative communities resulting in a loss of ecological functions. Conservation requires that land use planners have access to replicable, objective methods for identifying and prioritizing natural resource areas for protection and restoration. Using raster land cover data and working in ArcGrid, a series of GIS models were created to identify high quality, ecologically significant natural resource areas in the Twin Cities metropolitan area of Minnesota. Vegetative communities that provide important habitat and are sensitive to human disturbance were identified. The individual GIS models were integrated and all native plant communities mapped by the Minnesota County Biological Survey were incorporated. Conservation biology and landscape ecology concepts were used to assess and rank these vegetative communities. The parameters used to assess the ecological function of the sites were size, shape, species diversity, proximity to other natural areas, and adjacency to incompatible land uses. Wildlife corridors were also mapped. Preliminary findings indicate that about 230,000 acres, or about 23% of the Metro Region, meet our criteria for Regional Significance. Of the 230,000 acres, about 73,000 acres are currently not protected. The models will be available to land use planners and local units of government as a DNR ArcView Extension.

S15-01 Ballantine, Bill, and **TIMOTHY LANGLOIS.** Leigh Marine Laboratory, University of Auckland, Box 349, Warkworth, New Zealand (b.ballantine@auckland.ac.nz).
A REVIEW OF FULLY-PROTECTED MARINE RESERVES: THE LONG ROAD TO PRINCIPLES AND SYSTEMS

Fully-protected marine reserves have been established in most biogeographic provinces, and in most ecosystems and habitats, but such reserves are still rare and their total area is trivial. Many reasons have been used to promote full-protected areas including science, education, conservation, recreation, tourism, and fisheries support or restoration. The key question is why progress on such a simple idea is so slow, despite many known benefits and plenty of successful examples. Most reserves to date have been small, isolated events, generated by special local concerns, but recently interest in systems has developed and two systems have been established (in Victoria, Australia and around the Channel Islands, California). The whole history of marine reserves suggests they can be established anywhere, provided those concerned stop relying on what they know and focus on scientific principles that apply independently of our knowledge. The move to systems makes this easier (both scientifically and politically). The relevant principles required are clear and already accepted. A marine reserve system should be a representative network sufficient to be self-sustaining. A scientific insistence of these principles would encourage elected politicians to act.

C25-03 Bani, Luciano, Luciana Bottoni, Dario Massimino, and **RENATO MASSA.** Department of Landscape and Environmental Sciences, University of Milano Bicocca, Piazza della Scienza 1, I-20126 Milano, Italy (luciano.bani@unimib.it).
THE EFFECTS OF HABITAT MOSAIC AND HABITAT STRUCTURE ON SPECIES ENVIRONMENTAL SUITABILITY

Although remote sensing and spatial statistics may be used to quantify species distribution and abundance and species/habitat relationship at broad scales, when habitat structure information is also needed, mechanisms driving distribution patterns are to be based on large experimental field surveys. Factors affecting species ecological parameters in space and time occur along gradients and are most often modeled by means of linear functions. However, species status in a given area is complicated by their often non-linear response to habitat because (a) linear models for ecotonal species could be ineffective and (b) they may be just partially effective for those species showing a high habitat structure selectivity. Therefore we focused on the role of environmental variables and statistical modeling to develop new quantitative models better predicting bird species distribution and abundance in relation to habitat composition and structure. We first checked the linear model effectiveness by plotting species model determination coefficient either versus tree cover percentage for woodland species or versus woodland species frequency. In this way we identified which species did not satisfactorily fit into a linear model and developed (1) a non-linear model for ecotonal species and (2) a model based on habitat structure for interior woodland species.

C36-03 **BAR-DAVID, SHIRLI,** David Saltz, Tamar Dayan, Amit Dolev, and Amir Perelberg. Department of Zoology, Tel Aviv University, Israel 69978 (SB, TD, AD, AP); Mitrani Department of Desert Ecology, Ben Gurion University, Sde-Boqer, Israel 84990 (DS).
REINTRODUCTION EFFECT ON SURVIVAL RATE AND REPRODUCTION SUCCESS OF REINTRODUCED PERSIAN FALLOW DEER (*DAMA MESOPOTAMICA*)

Understanding the dynamics of reintroduced populations following release is crucial for a successful re-establishment. We assessed the impact of reintroduction on survival and reproductive success (RS) of Persian fallow deer reintroduced in Israel. We monitored 70 radio-collared individuals (53 females, 17 males) released bi-annually between 1996-2001. First-year survival was lower than that of later years (0.90 and 0.82 for female and males, vs. 0.95 and 0.88, respectively). The dominant causes of

mortality were chronic disease, infection, and poaching. We assessed RS by direct observation and video monitoring. The minimum annual RS over the entire period was estimated between 0.23-0.37 fawns/female/year, with lowest levels immediately following release (RS = 0.2, for adult females that were one-two years in the wild) and a gradual recovery over a period of several years to RS = 0.43 for females that were 4 years in the wild (P = 0.047, logistic regression). Similar declines in RS following reintroduction have been documented in other species and can be attributed to stress associated with adjusting to an unfamiliar environment. Population performance following release may be poorer than expected at a time when it is most critical, and should be accounted for when planning reintroductions.

S09-05 BARBER, PAUL H. Boston University Marine Program, 7 MBL Street, Woods Hole, MA 02543, USA (pbarber@bu.edu).
DISPERSAL AND CONSERVATION IN MARINE ENVIRONMENTS: APPLICATION AND LIMITATION OF GENETIC APPROACHES

Many marine organisms are sessile or non-dispersive as adults, yet have populations spanning broad spatial scales. Demographic and genetic exchange among such populations had long been assumed to be facilitated by pelagic larval dispersal. Genetic techniques have been increasingly applied to the question of marine larval dispersal and have been useful in demonstrating the lack of connectivity among populations on both broad and fine spatial scales. Genetically structured populations indicate limited dispersal and genetic exchange among geographic regions over both deep and shallow temporal scales, highlighting the need for regionally focused management strategies. Many studies also show high gene flow among distant marine populations. However, it is often difficult to link the absence of genetic structure and evolutionarily significant levels of gene flow to demographically significant dispersal and recruitment, the latter a prime concern of resource managers. Developing molecular methods that allow the inference of connectivity among marine populations is an active area of study and is likely to remain an important focus of future research. Nonetheless, molecular genetic techniques can provide vitally important information to resource managers and should be drawn upon more heavily in the framing of marine conservation policy.

P054 Barnes, Robin, **REBECCA MCCLATCHEY,** and Charles Acosta. Department of Biological Sciences, Northern Kentucky University, Highland Heights, KY 41099, USA (acostac@nku.edu).
MAXIMIZING PROTECTION OF BIODIVERSITY USING SPATIAL PREDICTIONS OF CORAL REEF COMMUNITY DIVERSITY

Coral reefs are major hotspots of biodiversity, but protection efforts are largely based on cursory biotic surveys or focused on aesthetically-pleasing features. We still lack rigorous analytical methods for predicting biodiversity on coral reefs at appropriate spatial scales to maximize efficacy of marine protected areas. We conducted systematic surveys of fish and benthic communities of different reef physiographic zones on a pristine coral atoll at Glover's Reef, Belize. The density and heterogeneity of biotic communities at Glover's Reef was among the highest reported for any Atlantic coral reef. Diversity varied by reef zone (depth), as well as by exposure (windward versus leeward). Analyses of species richness and evenness indicated that the fish community was most heterogenous on shallow patch reef and forereef habitat. Diversity of corals was highest on the shallow forereef, whereas sponges were dominant on the deep reef. Assessment of the Glover's Reef Marine Reserve, one of the largest reserves in the Caribbean, indicated that, while much of the biodiversity is under protection, leeward areas with the highest densities of reef-building corals were left unprotected. Using GIS, this approach to quantifying the spatial association between reef zonation and the reef builders and users might have utility for assessment, management, and restoration of coral reefs.

C27-06 BARNUM, SARAH, and Willem Van Vliet. Program in Design and Planning, University of Colorado at Denver, Denver, CO 80202, USA (sbarnum@carbon.cudenver.edu).
THE INFLUENCE OF HIGHWAY DESIGN AND LANDSCAPE FEATURES ON WILDLIFE HIGHWAY-CROSSING LOCATIONS

There are many well-documented highway-caused impacts to wildlife. However, little is known about the mechanics of wildlife/highway interactions. Therefore, I examined locations where wild animals cross highways to determine if they are correlated to identifiable characteristics of the surrounding environment and/or the roadway itself. I mapped roadside animal tracks with a GPS devise over a two-year period to determine where wild mammals were most likely to cross the highway at two Southern Rocky Mountain locations. I measured characteristics of crossing zones and random roadside locations for comparison, using digital data layers created from field measurements or from remote photography. My results indicate that crossing zones are related to variables from both the highway itself and the surrounding natural environment. At the landscape scale, the most important features were cover type composition, slope, and slope complexity of landscape surrounding the highway. At the local scale, the most important features were location of and distance to roadside barriers, location of drainages, design of highway features that spanned drainages, and distance from the roadway to cover. My results indicate that appropriate highway design and thoughtful placement of highways within the landscape can reduce wildlife/highway conflicts.

P083 BARTHELMESS, ERIKA L., and Jolaine Roycewicz. Department of Biology, St. Lawrence University, Canton, NY 13617, USA (barthelmess@stlawu.edu).
DO GOLF COURSES SUSTAIN GENETICALLY DIVERSE SMALL MAMMAL POPULATIONS?

In the United States, golf courses constitute a land area larger than that of Rhode Island and Delaware combined. In many urban and suburban areas, golf courses serve as important greenspaces. These greenspaces are usually assumed to be inadequate substitutes for undisturbed natural areas. In this project, we examined the degree to which deer mouse (*Peromyscus maniculatus*) populations occurring on a golf course differ genetically from populations occurring on natural, undisturbed habitat patches. We used microsatellite techniques to examine the degree of genetic variation present in five golf course and five natural populations and studied the level of gene flow between populations. Preliminary results indicate that there is little genetic differentiation between the golf course and undisturbed populations and that gene flow on the golf course is adequate to keep the populations from becoming genetically isolated.

C49-04 BASNET, KHADGA. Biodiversity Research Group, Central Department of Zoology, Tribhuvan University, Kathmandu, Nepal (khadgabasnet@hotmail.com).
EMERGING WILDLIFE ATTACKS ON HUMAN AND LIVESTOCK: A POSSIBLE RESPONSE TO PATCHY APPROACH OF BIODIVERSITY CONSERVATION

Wildlife attack on people and livestock is an emerging issue in protected area (PA) management in Nepal. Its documentation, however, is lacking. The main objective of this paper is to explore spatial and temporal frequency/distribution of such attakcs and their causes and consequences. Specifically, it will assess: a) patterns, frequency, and intensity of incidents in different ecological regions and locations and their proximity from PAs and community forests, b) incidents from historical perspectives (e.g., comparison of three periods – before 1950s, 1950s-1980s, and beyond 1980s), c) relationship between the incidents and PAs and community forests, and d) possible socio-economical impacts and future direction, through literature review and field studies in PAs of Nepal. Preliminary analysis and case studies of large carnivores such as common leopards and tigers show: a) wildlife attacks are common in all ecological regions but the frequency is higher in tarai; b) although they prevailed throughout history, they were recorded most during the 1980s and beyond; and c) small PAs without adequate buffer forests, emerging community forests without prey populations, and burgeoning human population seem to be the major causes of wildlife incidents. These findings provide strong justification for a holistic approach to landscape planning for biodiversity conservation.

C36-05 BATTIN, JAMES. Department of Biological Sciences, Northern Arizona University, Flagstaff, AZ 86011, USA (james.battin@nau.edu).
WHEN GOOD ANIMALS LOVE BAD HABITATS: THEORY AND EVIDENCE FOR ECOLOGICAL TRAPS

There has been a recent upsurge in work on ecological traps, low-quality habitats that animals prefer over superior habitats due to their inability to assess habitat quality correctly in a changing environment. Ecological trap theory provides an important alternative to source-sink theory in understanding how animals respond to heterogeneous landscapes. Here, I review the emerging body of ecological trap theory and assess the empirical support for the existence of traps. Ecological trap models lead to several insights about population dynamics, including: 1) there is a threshold proportion of trap habitat in a landscape above which populations face deterministic extinction, and 2) initial population sizes can determine the fates of populations confronted with ecological traps. These findings contrast sharply with those of source-sink models. Of thirteen studies showing relatively strong evidence of ecological traps, none definitively demonstrates an ecological trap. Taken together, however, these studies strongly suggest the existence of traps in nature. Current approaches to population modeling, and to its application in land management, generally ignore ecological traps. This can be changed by designing monitoring efforts that differentiate between traps and sinks in the field and by creating models that allow habitat selection and habitat quality to be parameterized separately.

P066 BAY, CATHERINE, and Joel W. Snodgrass. Department of Biological Sciences, Towson University, 8000 York Road, Towson, MD 21252, USA (catbay007@aol.com).
EFFECTS OF STREAM NETWORK LANDSCAPE STRUCTURE ON SMALL STREAM FISH COMMUNITIES

Studies have documented relationships between indices of stream network structure and stream fish assemblage properties such as species richness. However, no studies have examined the relationship among different indices of stream network structure or the utility of any index in more than one region. We investigated relationships among several existing and proposed indices of stream network structure, and related them to species richness in third-order dendritic streams of the Piedmont plateau, Maryland. We measured eleven indices of stream network structure using a geographic information system and existing elevation and hydrological data. A Principal Components Analysis indicated three main directions of variation: 1) local habitat size, 2) habitat isolation and contrast, and 3) overall size of the third-order watershed. Habitat size and isolation and contrast were related to species richness, such that larger streams, and small streams adjacent to larger streams, had relatively high species richness.

Our results suggest that models of reference conditions used in biological monitoring programs should incorporate stream network structure, and that preservation of complete networks will be necessary to maintain the natural range of biological interactions in stream ecosystems.

S07-05 **BAYLEY, SUZANNE E.** Department of Biological Sciences, University of Alberta, Edmonton, AB T6G 2E9, Canada (sbayley@ualberta.ca).
EFFECTS OF HUMAN ACTIVITY ON BOREAL WETLANDS

Boreal wetlands make up a large portion of the boreal forest region and include extensive vegetated peatlands and associated wetland ponds, large delta wetlands and riparian forests adjacent to streams and rivers. The biggest threats to wetlands are climate warming, hydroelectric development, oil and gas development, forestry and agriculture. The threats in eastern Canada differ from those in western Canada. In the east, the threats are primarily from hydroelectric development and forestry, while the threats in the western boreal region are mainly associated with climate warming, forestry and resource extraction. Mining of the extensive oil sand areas removes the surface peatlands and replaces them with lakes and fields. Oil and gas extraction and forestry change forested watersheds to unforested and increase road networks, both of which can change run-off and wildlife patterns. However, climate warming may have the largest impact on western boreal wetlands in the future. Recent droughts have increased peatland fires, decreased carbon accumulation, increased shrub invasion, decreased water levels in ponds and lakes, increased nutrient concentrations in ponds and increased the number of dry wetlands; all of which suggest that climate warming in the coming century will have massive impacts on wetlands. Most boreal wetlands are in public lands but there is little management and no legislation that protects them. One new program that may offer hope is Ducks Unlimited Canada's (DUC) new Western Boreal Forest Initiative. This conservation strategy and program targets 7 boreal regions for mapping, research and planning. DUC ranks the western boreal forest second only to the Prairie Pothole region in terms of continental importance to North American waterfowl.

P120 **BEACHY, BRIAN L.,** Justin N. Rosemier, Elizabeth E. Graham, Jordan M. Marshall, and Andrew J. Storer. School of Forest Resources and Environmental Science, Michigan Technological University, 1400 Townsend Drive, Houghton, MI 49931, USA (blbeachy@mtu.edu).
IMPACTS OF AN EXOTIC DISEASE COMPLEX ON NATIVE FOREST ARTHROPODS

The beech bark disease complex, involving an exotic scale insect (*Cryptococcus fagisuga*, Homoptera: Cryptococcidae) and native and exotic pathogenic fungi (*Nectria* spp.), is currently spreading throughout the range of American beech (*Fagus grandifolia*). The impacts of this disease complex on native forest arthropods are not well understood. In the summer of 2002, we sampled arthropods using pitfall and flight intercept traps in three categories of beech forest in Michigan's Upper Peninsula: forests with no scale, low scale, and high scale density. Traps were emptied every two weeks and their contents were sorted into general taxonomic groups. Pitfall trapping results indicated that ground beetles (Coleoptera: Carabidae) and spiders were more abundant in areas with beech bark disease depending upon the time of year. Numbers of bark beetles (Coleoptera: Scolytidae) and horntails and woodwasps (Hymenoptera: Siricidae, Xiphydriidae) caught in flight intercept traps differed significantly among site categories. Bark beetles were more numerous in areas without scale, while horntails and woodwasps were more numerous in areas with high scale density. These differences are likely due to changes in resource availability as beech bark disease progresses. Our results suggest that beech bark disease is altering the community structure of native forest arthropods.

P109 Beck, Benjamin, **JENNIFER MICKELBERG,** Jonathan Ballou, and Andreia Martins. Smithsonian National Zoological Park, 3001 Connecticut Avenue NW, Washington, DC 20008, USA (mickelbergj@nzp.si.edu).
THE GOLDEN LION TAMARIN (*LEONTOPITHECUS ROSALIA*) REINTRODUCTION PROGRAM: PAST, PRESENT, AND FUTURE

Reintroduction of captive-born animals has been a valuable tool in the conservation of the golden lion tamarin (GLT), a small New World primate endemic to the Atlantic Coastal Rainforest of Brazil. The first group of captive-born tamarins was reintroduced in 1983 in what was the only protected area for the species. Almost twenty years later, the reintroduced population has reached over 400 animals and continues to grow. The Reintroduction Program now includes 22 privately owned ranches containing areas of protected habitat for the GLTs. This Program has not only contributed to the conservation of the GLT, but also to the science of reintroduction. Research utilizing the reintroduced and captive populations of GLTs has examined the effectiveness of pre- and post-release conditioning on survival of reintroduced GLTs. The results indicate that captive GLTs that have free ranging experience before being reintroduced do not have a higher survival rate post-reintroduction. Future plans include planting 50,000 native trees on 20 hectares of farmland to create a forestry corridor. This 30 km corridor requires the cooperation of over 20 landowners and once created, will provide additional habitat as well as connect the reintroduced and wild populations of GLTs.

C37-06 BECK, JAMES, and Katrina Brandon. Center for Applied Biodiversity Science, Conservation International, 1919 M Street NW, Suite 600, Washington, DC 20036, USA (j.beck@conservation.org) (JB); Sustainable Development and Conservation Biology Program, University of Maryland, College Park, MD 20742, USA (KB).
THE DEVELOPMENT CONTEXT IN BIODIVERSITY HOTSPOTS: PRIORITIES AND PARTNERSHIPS

Conservation and development must work hand in hand, even when the actions taken differ in their time frame, scale of activities, and delivery of benefits. But what actions are most needed, where, and when? Where should the development community mobilize actions to most strategically support biodiversity conservation? This study builds on the methodology used to identify the hottest of the hotspots (Myers et al. 2000). Development indicators characterizing the socio-economic situation of 25 global biodiversity hotspots are analyzed to reveal the relative human context in hotspots. Results provide a coarse-scale analysis to prioritize where actions urgently need to be pursued by the conservation community, the development community, and the places where strong coordination and agreement on actions needs to be taken by both, if biodiversity in the hotspots is to be maintained. Preliminary results suggest that the situation is particularly urgent for: Eastern Arc Mountains and Coastal Forests of Tanzania and Kenya, Indo-Burma, Western Ghats and Sri Lanka, Philippines, Madagascar and Indian Ocean Islands, and the Caribbean.

C39-06 BECK, MICHAEL, Marci Bortman, Teri Marsh, Shauna Reisewitz, and Katy Doctor. The Nature Conservancy, Marine Initiative, Center for Ocean Health-LML, University of California, Santa Cruz, 100 Shaffer Road, Santa Cruz, CA 95060, USA (mbeck@tnc.org).
APPLYING A NEW STRATEGY FOR MARINE CONSERVATION: THE LEASE, OWNERSHIP, AND RESTORATION OF SUBMERGED LANDS

Traditionally, it has been assumed that strategies for estuarine and marine conservation must be substantially different than those for terrestrial conservation, in part because it is not possible to "buy the bottom" of the publicly owned seas. We have found that this is an unfortunate misconception. An analysis of policy on leasing and ownership of submerged lands was done for all U.S. coastal states and in several other countries. A variety of leasing options were explored, but we focused principally on the leasing of shellfish grounds because: (i) most state leasing programs have specific provisions for shellfish development and harvest. (ii) Shellfish habitats are among the few types of submerged lands readily available for lease that allow conservation and management of native species. (iii) The restoration and conservation of shellfish encourages stakeholders and local communities to take a strong interest in water quality and the link between estuaries and their watersheds. The development of strategies that combine the potential of leasing and shellfish restoration provide powerful new tools for marine conservation and The Nature Conservancy has begun to implement this strategy. We will provide site specific examples from New York and Washington states.

C47-03 BECKMANN, JON P., and Joel Berger. Wildlife Conservation Society, Eastern Idaho Field Office, 528 Marian Street, Rigby, ID 83442, USA (jbeckmann@wcs.org) (JPB); Wildlife Conservation Society, Teton Field Office, Moose, WY 83012, USA (JB).
DEPOPULATION OF WILD AREAS: DISTRIBUTIONAL SHIFTS OF BLACK BEARS (*URSUS AMERICANUS*) THROUGH PROFITABLE FORAGING IN URBAN AREAS

At the interface of the Great Basin Desert and Sierra-Nevada including Lake Tahoe, black bears (*Ursus americanus*) have historically been ecologically restricted. To assess possible effects at contact zones with humans, we tested predictions of resource-based models, first by contrasting biological features of 99 bears between an urban-wildland interface and wildland areas, and second by considering temporal changes in ecology that span 15 years. Among the documented changes were: declines of 90% and 70% in mean home range size for urban-interface males and females (respectively) relative to wildland bears; body mass in which urban-interface bears averaged 30% more for both sexes; alterations of denning chronology with urban-interface bears entering hibernacula later in the winter and emerging earlier than wildland conspecifics; and bear densities which increased 3+fold in urban areas compared to baseline, historical densities. Additionally, since 1990 increases in the frequency of urban-interface bears, collisions with vehicles, and citizen complaints were about 7000%, 1500%, and 1000% respectively despite the fact that estimates of total population size remained constant over the past decade. Our results indicate that expanding, but clumped urban foods facilitated a rapid redistribution of bears across this arid landscape and not an increase in the population per se.

C31-02 BEEHLER, BRUCE, and Gai Kula. Conservation International, 1919 M Street NW, Suite 600, Washington, DC 20036, USA (b.beehler@conservation.org) (BB); Conservation International, PO Box 106, Waigani, NCD, Papua New Guinea (GK).
WHAT MAKES A WILDERNESS? – PLANNING TO CONSERVE NEW GUINEA'S WILDERNESS STATUS

The great tropical island of New Guinea has been designated a "major tropical wilderness" – the third largest tropical wilderness on earth after the Congo and Amazon Basins (Mittermeier et al. 2002). As the smallest of the major tropical wilderness areas, it is probable that New Guinea will face the gravest near-term threat to its wilderness status over the next half-century. A major focus of conservation planners should thus include preservation of New Guinea's wilderness status, not just conservation of representative samples of habitat and biota. We examine New Guinea's biodiversity and natural features to determine what combination of key resources and processes constitute "wilderness" on the island of New Guinea, and what minimum subset of these need to be preserved (and in what combination and pattern) to ensure that New Guinea maintains its wilderness for the foreseeable future. Finally, effective wilderness conservation depends upon fostering a focused and rational development planning process for Papua New Guinea (eastern New Guinea) and Papua province of Indonesia (western New Guinea).

S03-11 BEIER, PAUL, and Kristeen Penrod. School of Forestry, Northern Arizona University, Flagstaff, AZ 86011, USA (paul.beier@nau.edu) (PB); South Coast Wildlands Project, POB 2493, Monrovia, CA 91016, USA (KP).
THE *MISSING LINKAGES PROJECT* AS A TEMPLATE FOR DESIGNING A WILDERNESS NETWORK

In Fall 2001, the ground-breaking *Missing Linkages* report identified 232 wildlife linkages in California (http://www.calwild.org/resources/pubs/linkages/index.htm). South Coast Wildlands Project immediately spearheaded an effort to prioritize, protect, and restore linkages in the South Coast Ecoregion. We first forged a partnership with 15 federal and state agencies, conservation NGOs, universities, and county and transportation planning agencies. By partnering from the start (rather than developing a plan on our own and asking others to *unite under us*), we garnered spectacular support from all sectors and are making rapid progress. With our partners, we (1) prioritized 15 linkages (out of 69 linkages in the ecoregion) on the basis of irreplaceability (size and quality of core areas served) and vulnerability; (2) held a workshop to identify 12 to 20 focal species per linkage; (3) researched the needs of focal species, obtained high-resolution GIS data, and conducted field visits to develop a linkage design; and (4) presented the design at a second workshop (summer 2003) at which our partners volunteer to procure easements, acquire land, change zoning, restore habitat, or mitigate transportation projects. Our collaborative, science-based approach provides a template for creating a green infrastructure in even the most human-dominated landscapes.

S11-02 BEILFUSS, RICHARD, Carlos Bento, Arlindo Chilundo, and Cate Brown. International Crane Foundation, E-11376 Shady Lane Road, PO Box 447, Baraboo, WI 53913, USA (RB); Museu da Historia Natural, Travessia Do Zambeze 104, Maputo, Mozambique (CB); Universidade Eduardo Mondlane, NET, Praca 25 de Junho, CP 257, Maputo, Mozambique (AC); Southern Waters, PO Box 13280, Mowbray 7705, Cape Town, South Africa (CB).
ENVIRONMENTAL FLOWS FOR THE SUSTAINABLE MANAGEMENT OF CAHORA BASSA DAM AND THE LOWER ZAMBEZI VALLEY, MOZAMBIQUE

The Lower Zambezi is home to millions of people and of immense socio-economic and ecological value as one of the most productive and biologically diverse river-floodplain systems in Africa. Over the past forty years, the people and wildlife of this system have been devastated by the construction of large hydropower dams. Flood-recession agriculture and subsistence fisheries have collapsed, commercial prawn harvests have declined by $10 million per annum, and floodplain grasslands have been displaced by upland vegetation. Endangered Wattled Cranes, an indicator and flagship species for other flood-dependent wildlife, have ceased to breed. To rehabilitate the Lower Zambezi, scientists, engineers, and land managers are collaborating with decision-makers, community representatives, and other stakeholders to establish ecologically sustainable methods for managing dam outflows and improving living standards in the basin. The process involves (1) combining data and knowledge from a range of biophysical, social, and economic disciplines to model the effect of specified flow changes on key ecosystem components and produce flow-related scenarios for managers to consider, (2) building consensus with agency, stakeholder, and community representatives to establish a flow management plan, (3) implementing the plan and making water releases, and (4) monitoring and evaluating releases for adaptive management of Zambezi flows.

C28-06 BERES, KARL A. Ripon College, Ripon, WI 54971, USA (beresk@ripon.edu).
USING ROC CURVES TO ASSESS MODELS OF PRESENCE-ABSENCE DATA

Many mathematical and computer models are currently being developed to predict the presence or absence of a given species at a given site. Especially common are habitat suitability indices, which give probabilities that sites will be occupied by the species. In order to assess such models, cutoffs are frequently made on the probability scale, in order to distinguish "good" habitat from "bad." Where to make cutoffs, however, is difficult to determine. Receiver Operating Characteristic curves provide a means of making such assessments, without establishing cutoffs. The method will be illustrated with computer simulations, and applied to presence/absence data for nesting pairs of Northern Spotted Owls in Northern California.

P033 BERGEN, SCOTT, William F. Laurance, Mark A. Cochrane, Phillip M. Fernside, Patricia Delamonica, Christoper Barber, Sammya D'Angelo, and Tito Fernandes. Center for Environmental Literacy, Mt. Holyoke College, 100 Talcott, South Hadley, MA 01075, USA (sbergen@mtholyoke.edu) (SB); Smithsonian Tropical Research Institute, Apartado 2072, Balboa, Panama (WFL); Michigan State University, East Lansing, MI 48824, USA (MAC, CB); National Institute for Amazon Research, Caixa Postal 478, Manaus-Amazonas, 69011-970, Brazil (PMF); Biological Dynamics of Forest Fragments Project, INPA, CP 478, Manaus, AM 69011-970, Brazil (PD, SDA, TF).
FACTORS AFFECTING DEFORESTATION, FRAGMENTATION AND PRISTINE FORESTS WITHIN THE BRAZILIAN AMAZON: EVALUATION OF THE GOOD, THE BAD AND THE UGLY

The future of the Brazilian Amazon is of recent interest and speculation. While road construction is generally accepted as the best predictor of deforestation, this factor alone is insufficient to accurately predict deforestation and fragmentation in a spatially explicit fashion. Other factors such as road improvements, hydroelectric projects, railways, utility corridors, timber exploitation, mining and river channelization have deforestation impacts as well. Conversely, indigenous nations, state reserves and federal ecological reserves protect areas from encroachment. These positive and negative factors effecting deforestation react synergistically with one another making predictions complex. Previous attempts at modeling the future Brazilian Amazon have fallen short of evaluating each of these factors' contribution to deforestation, forest fragmentation, and the preservation of large tracts of undisturbed forests. These factors have been evaluated in a spatially explicit fashion and the results are presented for the factors influence upon deforestation, fragmentation and non-fragmented forest preservation. The factors effecting deforestation were road improvements, hydroelectric, utility corridors, railways, new roads and river channelization (in order of greatest to least). Indigenous nations, state reserves and federal ecological reserves were predicted to prevent 11, 6.5 and 4.25 million hectares of deforestation, respectively. The greatest factors contributing to fragmentation were timber extraction, mining, fire and road construction. The largest threats to large non-fragmented forests were timber extraction, mining, road improvements, fire, new roads, utility corridors, hydroelectric projects and railways (in order of greatest to least). Indigenous nations were seen as the greatest preserving factor for these non-fragmented forests. These results will be evaluated in relevance to ecoregions occurring within the Amazon Basin (WWF 2001).

C53-05 BERGER, JOEL. Wildlife Conservation Society, Teton Field Office, PO Box 340, Moose, WY 83012, USA (jbwcs@earthlink.net).
FLEETING ECOLOGICAL PHENOMENA: CAN WE PROTECT THE LAST OF THE GREAT OVERLAND MAMMAL MIGRATIONS?

Amongst the Earth's most stunning, yet imperiled, ecological processes is Long Distance Migration (LDM), an event already diminished by 99% for terrestrial mammals. Contrasts among 29 mammalian species representing 103 populations from 5 continents indicate that prospects for the future retention of LDMs is poor. However, in areas of low human footprints between Tierra del Fuego and Toronto, 5 social and non-gregarious species, all from the same region of the Rocky Mountains, still experience the most accentuated of remaining New World LDMs. Included among these are annual round-trip treks of North America's sole surviving endemic ungulate, pronghorn, up to 550 kms, extreme movements that (i) necessitate use of historic, exceptionally narrow corridors (0.1 - 0.8 kms in width) that have existed for at least 7800 years, (ii) exceed travel distances of elephants and zebras, and (iii) are on par with those of Asian chiru and African wildebeest. Although conservation planners face uncertainty in situating reserves because landscapes vary in biological value, events beyond protected borders alter the efficacy of reserves, and changing environments impede knowledge about the relative importance of fixed areas on species persistence. Existing biological data on migration adjacent to the Yellowstone system are clear as to where protection is most needed. One creative landscape level solution to protect these remarkable ecological processes is the creation of a National Migration Corridor, an action that would result in de facto protection for a multi-species complex. As in the Yellowstone region, however, conservation measure from other parts of the world will require a good deal of site-specific knowledge.

C09-05 BERGQUIST, JOHN, James Strittholt, and Ruth Norgueron. Conservation Biology Institute, 260 SW Madison Avenue, Suite 106, Corvallis, OR 97333, USA (john@consbio.org) (JB, JS); World Resources Institute, 10G Street NW, Washington, DC 20002, USA (RN).
MAPPING FOREST INTACTNESS IN ALASKA, USA

Assessing and mapping relative forest intactness is an ongoing effort by the Global Forest Watch Program of the World Resources Institute. Intact forests are defined as forest-dominated landscapes of adequate size to support most native species and natural disturbance events unaffected by direct industrial human impacts. As part of a multinational effort, we present results of mapping intact forest landscapes for the boreal forest and temperate rainforest zones of Alaska, USA. Results show numerous large intact forest landscapes remaining in the boreal zone, but far fewer in the temperate rainforest region of the state. Based on detailed satellite imagery and ancillary data such as an extensive clearcut logging and roads databases, the Tongass National Forest region of southeast Alaska and the Kenai peninsula show extensive damage by industrial human activity. Forest landscape change

analysis for southeast Alaska showed rapid and extensive forest impacts and suggests this trend is continuing resulting in significant ecosystem degradation. This paper reviews the forest assessment and mapping methods employed and examines the value of this work for informing forest policy and management.

C10-01 Berkson, Jim, **AUTUMN-LYNN HARRISON,** and Michelle Davis. Department of Fisheries and Wildlife Sciences, Virginia Tech, 114 Cheatham Hall, Blacksburg, VA 24061, USA (aharrison@conbio.org).
WILL TELLING STUDENTS THE TRUTH ABOUT CONSERVATION SCARE THEM AWAY?

Although the science of conservation biology should be objective, the process of conservation in many cases is not. Fresh graduates, armed almost solely with the science and theory of conservation biology are ill prepared to deal with the reality of conservation practice. While many universities have tackled the subjective aspects of this field through the addition of courses in economics, human dimensions, and law, there remains little focus on their integration. Too often, our curricula focus on the role science could ideally play in this process; neglecting the roles science actually does play when integrated with politics, economics, and sociology. In response to this omission, we created a capstone course to integrate relevant subjects and issues into a realistic representation of the process of conservation. We have employed case studies, guest speakers, and lively debates of issues not discussed within the traditional conservation biology curriculum. These issues challenge students' preconceived notions. Inevitably, some students are disheartened and others, inspired when they discover the reality of conservation decision-making. They are not, however, turned away from the field. We have four years of data to suggest that graduates of this course stay within the field of conservation, despite the discouraging reality. Moreover, most change their desired role within the process leading them towards more satisfying and effective conservation careers. Graduates from this capstone course are armed not only with science, but also with realistic expectations – and they are not scared.

C18-05 **BERNATAS, SUSAN.** Vision Air Research, 904 East Washington Street, Boise, ID 83712, USA (wildlife@visionairresearch.com).
FORWARD-LOOKING INFRARED FOR WILDLIFE SURVEYS: A LITERATURE REVIEW AND EVALUATION WITH RECOMMENDATIONS FOR OPTIMAL RESULTS

A reliable population estimate is the cornerstone for studies in population genetics and wildlife management (Novak et al. 1991). Information on size or a population also allows for an understanding of dispersal and competition (Geist 1971, Caughley 1977, Monson and Sumner 1980, Festa-Berger 1990, Hengle et al. 1992). To study population dynamics, set harvest regulations, develop management programs, provide resource protection, conduct research, assess management activities including impact assessment a reliable determination of population characteristics is vital (McCullough and Hirth 1988, Caughley and Sinclair 1994). Cost and reliability are important considerations in evaluating tools to measure population. A literature review was conducted to compare results of the surveys conducted for wildlife surveys using forward-looking infrared and other ground based infrared studies. Equipment specifications, surveys technique, cost, species, habitat, and operator skill, analysis techniques, and results were summarized. Preliminary experiments using forward-looking infrared imagery was first conducted in the 1970-1980. Defining these as standards for infrared capabilities is similar to comparing today's lightweight laptops with 1970s computers. These systems are not comparable to equipment available today and were not included in this review.

C48-03 **BIEK, ROMAN,** and Mary Poss. Fish and Wildlife Biology Program, School of Forestry, University of Montana, Missoula, MT 59812, USA (rbiek@selway.umt.edu) (RB, MP); Division of Biological Sciences, University of Montana, Missoula, MT 59812, USA (MP).
CONNECTIVITY AMONG ROCKY MOUNTAIN COUGAR POPULATIONS: INSIGHTS FROM GENETIC ANALYSIS OF A COMMON COUGAR VIRUS

Conservation strategies for many species rely on sufficient knowledge about patterns of movement and gene flow among populations. Genetic markers are frequently employed to infer such patterns but may reflect processes on much longer time scales than those of interest. We use phylogeographic data from a non-pathogenic virus that is commonly found in cougars (*Puma concolor*) to identify areas within the northern Rocky Mountains (British Columbia, Alberta, Idaho, Montana, Wyoming) that exhibit signs of current population connectivity. Because this virus is measurably evolving in a matter of decades, closely related virus types in different individuals imply contact and transmission events in the recent past. Results so far indicate that virus transmission and thus contact is frequent over short and intermediate distances (< 300 km) in Rocky Mountain cougars. Furthermore, we found evidence for recent long-distance contact (> 300km) and transmission events. Because they reflect contemporary processes, these data will be relevant not only to regional management of cougars but also provide general information about permeability of an increasingly developed landscape to carnivore movements.

C47-07 BIERWAGEN, BRITTA G. Donald Bren School of Environmental Science and Management, University of California, Santa Barbara, Santa Barbara, CA 93106, USA (britta@bren.ucsb.edu).
SELECTIVE PRESSURES OF HABITAT LOSS AND FRAGMENTATION ON BUTTERFLY DISPERSAL

Landscape changes due to habitat loss and fragmentation can exert selective pressures on ecological processes such as dispersal. Evolutionary effects through changes in habitat distribution may be more readily apparent in organisms with short generation times, like insects. In butterflies there is a direct trade-off between resource investment in flight and reproductive structures. My research evaluated how morphology has changed in response to landscape changes during the last century. I measured museum specimens of several California butterfly species collected at sites in Santa Barbara and the San Francisco Bay area. I used an urban growth model parameterized with historical land-use data to analyze landscape changes surrounding collection sites. The model interpolated urban growth between reference years on an annual time step. I measured several landscape metrics such as connectivity, habitat isolation, and patch size, to determine impacts of habitat changes on dispersal success of each species. I used climate data to control for year-to-year variations. I analyzed changes within species at each site over time, as well as cross-site comparisons, using principle components analysis. Results suggest that butterfly morphology differs significantly between collection sites. Several locations also show significant changes over time.

C17-03 BLANCHONG, JULIE A., Kim T. Scribner, Scott R. Winterstein, and Sasha Kravchenko. Department of Fisheries and Wildlife, Ecology, Evolutionary Biology and Behavior Program, Michigan State University, East Lansing, MI 48824, USA (blanchon@msu.edu) (JAB, KTS, SRW); Department of Plant and Soil Sciences, Michigan State University, East Lansing, MI 48824, USA (SK).
SOCIAL STRUCTURE INFLUENCES THE TRANSMISSION OF BOVINE TUBERCULOSIS AMONG FREE-RANGING WHITE-TAILED DEER: A GENETIC PERSPECTIVE

Zoonoses are of increasing importance to wildlife conservation and human health. Understanding the underlying mechanisms of disease transmission is necessary to control and to eradicate wildlife disease. White-tailed deer (*Odocoileus virginianus*) in northeast Michigan represent the only free-ranging cervid population with bovine-tuberculosis (TB) in North America. Management has focused on reducing population density and artificial feeding to minimize probabilities of further infection. Aspects of deer behavior and ecology related to disease transmission have not been considered. We used microsatellite loci to estimate inter-individual relatedness to evaluate the role of genealogical relationships in TB transmission. We compared relatedness among TB-positive deer and non-infected deer over three years prior to, and coincident with current management efforts. Relatedness was significantly higher among TB-positive deer than non-infected deer. Distances over which estimates of relatedness were significantly higher for TB-positive than non-infected deer were consistent with telemetry-based estimates of dispersal and home range sizes. Current management is directed at manipulations of population parameters that will not alone eradicate TB. Social structure and genealogical relationships play key roles in TB transmission among deer. Genetic data suggests that management must also focus on aspects of deer ecology and behavior to facilitate more effective control of disease transmission.

S04-06 BLANN, KRISTEN. Department of Fish, Wildlife, and Conservation Biology, University of Minnesota, 200 Hodson Hall, 1980 Folwell Avenue, St. Paul, MN 55108, USA (klb@fw.umn.edu).
SCIENCE, INSTITUTIONS, AND STAKEHOLDERS: LESSONS FROM IMPLEMENTATION OF ADAPTIVE MANAGEMENT IN RIVER RESTORATION

Although the concept of adaptive management has been around for over two decades, unqualified successes in implementing adaptive management have been few, particularly in aquatic ecosystems where the complexity of interactions and the range of spatial and temporal scales that must be addressed for effective conservation is large. Significant barriers often materialize as part of controversial ecosystem restoration efforts. Agency cultures, narrowly defined missions, fear of lawsuits, legal constraints, and unequally distributed political and personal risk all serve to mitigate against implementation. It may often be infeasible to implement adaptive management without simultaneously attending to the institutional, organizational, and political context of resource management. Lessons are presented from workshops with scholars and practitioners involved in restoration efforts in the Red River, Kissimmee River, Everglades, Colorado River, and the Upper Mississippi. Strategies for overcoming barriers include reorganizing institutional arrangements to support linked decision-making, expanding informal communication, and developing shared understanding among the wider community, both of ecosystem function and social values. Broadening the base of input for identifying uncertainties, problem scoping, evaluation, and decision-making also plays a key role in redefining relationships, building a constituency to weather challenges, and allowing for creative alternatives to be identified and pursued.

P015 BOCCUMINI, KRISTEN, Tedor Whitman, Linda Smith, Laura Thompson, and Rachel Wilson. The Richard Stockton College of New Jersey, Pomona, NJ 08240, USA (KB, LS); The Wetlands Institute, 1075 Stone Harbor Boulevard, Stone Harbor, NJ 08247, USA (TW); Valparaiso University, Valparaiso, IN 46383-6493, USA (LT); Bryn Mawr College, Bryn Mawr, PA 19010, USA (RW).
THE OCCURRENCE OF BREEDING SONGBIRDS: USING DATA FROM THE SURVEY, MONITORING AVIAN POPULATION SUSTAINABILITY (MAPS) TO TEST HYPOTHESES ABOUT VEGETATION AND EDGE EFFECTS

MAPS is a standardized survey of breeding songbirds in the woodlands of North America by capturing birds in mist nets. Belleplain Forest in the coastal pinelands of southern New Jersey is one of many sites in which this annual survey is performed. We used four years of survey data (1999-2002) on the presence of songbird species at this site to examine the influence of vegetation and edge on the occurrence of songbird species. The study area borders a field and has two distinct vegetation types; one with an open canopy and ground cover and another with a closed canopy and little ground cover. We examined where species were captured regarding vegetation type and distance from edge. Our analyses show that certain species were captured significantly more often in one of the two vegetation types as well as certain distances from the forest edge. We suggest that our results can be used for forest management decisions in the NJ pinelands, an area with increased habitat fragmentation due to increasing development. In addition, we propose that our technique of using existing data to test hypotheses about songbird conservation has widespread application.

S14-03 BOERSMA, P. DEE. Department of Zoology, University of Washington, Box 351800, Seattle, WA 98195, USA (boersma@u.washington.edu).
PENGUINS, PEOPLE, POLLUTION, AND POLITICS; WHEN SCIENCE IS NOT ENOUGH

Magellanic penguins are rapidly declining at Punta Tombo, Argentina the largest breeding colony in the world for this species. For twenty years we have intensively studied the breeding biology, reproductive success, and foraging patterns of this colony. In the 1980's the Japanese proposed harvesting the species but fortunately because of public pressure the harvest was delayed to gather scientific information on the species. In the 1980's and 1990's we documented severe mortality on penguins from oil pollution and it's impact on the population. Oil pollution in Argentina was reduced but oiling appears to have increased in Brazil and Uruguay. Magellanic penguins like most seabirds are wide-ranging and cross country borders. Their protection is hampered by human activities including fishing and discharge of oil. Ocean zoning to reduce conflicts with human uses would be useful; however, the scientific data needed is often lacking. We have much of the information needed to recommend zoning for Magellanic penguins. One major obstacle is that penguins and most seabirds use international waters and the EZE of several countries. International conventions are vehicles that may help penguins and other seabirds but the political process needed to list a species under UN Conventions is daunting and protection weak.

C29-04 BORMAN, SUSAN CRAY. Conservation Biology Graduate Program, University of Minnesota, Room 199 McNeal Hall, 1985 Buford Avenue, St. Paul, MN 55108, USA (borm0021@umn.edu).
THE IMPACTS OF SHORELINE DEVELOPMENT ON AQUATIC PLANT COMMUNITIES: WHAT CHANGES HAVE OCCURRED SINCE THE 1930s?

The lakes of northern Minnesota and Wisconsin are being developed at an unprecedented rate. What does this mean for the ecological integrity of the lake ecosystems? The pivotal role of aquatic plant communities in lake ecosystem dynamics makes them valuable bioindicators of change. To assess the impacts of shoreline development, detailed aquatic plant surveys and shoreline assessments have been done on 24 lakes in northern Wisconsin. These results are compared with aquatic plant surveys done in the mid-1930s. Changes in land use are evaluated using Arcview Image Analysis of aerial photographs from the 1930s and present. Preliminary results show a correlation between shoreline development and a shift in aquatic plant community composition. Plant communities composed of low-growing rosette species in the 1930s have shifted to larger stature, weedier species that change the architecture and function of the plant beds. Initial analysis indicates that changes in the aquatic plant community are reduced when shoreline vegetation is left intact, even with a moderate increase in the number of residences per kilometer of shoreline. These findings have implications for shoreline zoning guidelines and land use planning.

P007 BOURDAGHS, MICHAEL. Natural Resources Research Institute, University of Minnesota Duluth, 5013 Miller Trunk Highway, Duluth, MN 55811, USA (mbourdag@nrri.umn.edu).
THE RELATIONSHIP BETWEEN SAMPLING AREA, SPECIES RICHNESS, AND THE FLORISTIC QUALITY ASSESSMENT INDEX

The Floristic Quality Assessment Index (FQAI) has been proposed as a tool that can identify natural areas, compare different sites regardless of plant community type, and assess anthropogenic impacts of an area. FQAI is based on a numerical score, called the coefficient of conservatism (*C*), which ranges from 0-10 and reflects the fidelity of a species to the natural habitats of a region. High *C* values show high fidelity to natural habitats. FQAI is then calculated by multiplying the mean *C* by the square root of the

number of species (*S*) of a site. There has been little critical evaluation of FQAI, even though FQAI has been gaining popularity as an assessment tool. Data were collected from thirteen Great Lakes coastal wetlands to determine how sampling area affects FQAI. Data from a series of nested plots, and a comparison of two sampling methods, show that an increase in sampling area has no effect on mean *C*, but has a postive effect on FQAI, due to an increase in *S*. FQAI is therefore area sensitive. Users of FQAI should be aware of how area affects scores and ultimately any management decisions based upon those scores.

S07-03 BOUTIN, STAN. Department of Biological Sciences, University of Alberta, Edmonton, AB T6H 4L2, Canada (stan.boutin@ualberta.ca).
WOODLAND CARIBOU AS A FOCAL SPECIES FOR CONSERVATION

Woodland caribou have Threatened Status in Alberta, Canada and most populations continue to shown declining trends. I will summarize results of a 10-year study of herds in northeastern Alberta where we have been able to understand some of the dynamics driving this downward trend. Caribou in this region occupy large peatland complexes that overlay rich oil and gas deposits and are surrounded by an active forestry sector. These activities combine to produce some classic cumulative effects issues and I will show how we model these and their effects on caribou to understand the levels of risk associated with various landuse strategies. I will end by outlining how we have produced caribou effective habitat thresholds as a means of managing industrial activity levels.

P097 Bouzat, Juan L., **BRIAN G. WALKER**, Elaine P. Akst, and P. Dee Boersma. Department of Biological Sciences, Bowling Green State University, Bowling Green, OH 43403, USA (JLB); Department of Zoology, University of Washington, Seattle, WA 98195, USA (bwalker@u.washington.edu) (BGW, PDB); University of Maryland and National Zoological Park, Washington, DC 20008, USA (EPA).
LACK OF GENETIC STRUCTURE IN SOUTH ATLANTIC BREEDING COLONIES OF MAGELLANIC PENGUIN

Breeding colonies of Magellanic Penguins (*Spheniscus magellanicus*) are distributed throughout the Patagonian shore of South America and the Falkland/Malvinas Islands. Strong philopatry of penguins to breeding colonies could lead to genetically and demographically independent populations, defining potential units of conservation concern. Using microsatellite markers, we have performed a population genetic analysis of six breeding colonies from Patagonia and the Falklands to evaluate overall levels of genetic diversity and population genetic structure in the Magellanic Penguin. A hierarchical analysis of molecular variance revealed lack of population structure, with no significant genetic differentiation detected among breeding colonies within the two regions as well as between Patagonia and the Falklands (< 1% differentiation). In addition, we found no significant differences in overall levels of genetic diversity among populations in terms of both heterozygosity (H = 0.581) and allelic diversity (A = 7.125). Our results indicate that breeding colonies from the Atlantic coast of Patagonia and the Falklands do not represent demographically independent units, but are part of a large population with continuous gene flow. This suggest that highly productive colonies, with large number of breeding pairs, could play a significant role as *source* populations for maintaining the overall abundance of this species in the Atlantic region.

C02-09 BOUZAT, JUAN L., Marcel Amills, Neus Jiménez, Alessia Riccardi, A. Fernández Arias, J. Guiral, Jose Folch, and Armand Sànchez. Department of Biological Sciences, Bowling Green State University, Bowling Green, OH 43403, USA (jbouzat@bgnet.bgsu.edu) (JLB); Departament de Patologia i Producció Animals, Facultat de Veterinària, Universitat Autònoma de Barcelona, Bellaterra 08193, Spain (MA, NJ, AR, AS); Servicio de Vida Silvestre, Diputación General de Aragón, Zaragoza 50080, Spain (AFA, JG); Unidad de Tecnología en Producción Animal, Servicio de Investigación Agroalimentaria, Diputación General de Aragón, Zaragoza 50080, Spain (JF).
ALLELE LINEAGE EXTINCTION IN THE MAJOR HISTOCOMPATIBILITY COMPLEX CLASS II *DRB1* GENE OF THE SPANISH IBEX

During the last two centuries, the Spanish ibex (*Capra pyrenaica*) has shown a significant demographic recession as a result of the progressive destruction of its natural habitat, disease epidemics, and uncontrolled hunting. Estimates of genetic variation at the MHC *DRB1* gene revealed that the Spanish ibex has remarkably low levels of heterozygosity (Ho = 0.10) and about half the allelic diversity present in domestic goats (A = 5). The low heterozygosity and limited allelic repertoire detected in this species is likely the direct result of its recent history of population bottlenecks and marked demographic recession. DNA sequence analysis of the characterized *DRB1* alleles revealed high levels of amino acid sequence divergence (22.6%), with a ratio of non-synonymous to synonymous substitutions at the antigen-binding sites (dN/dS = 4.56) greater than the unity, suggesting positive selection for variation at this locus. A phylogenetic analysis of the Spanish ibex and a set of domestic goat *DRB1* alleles revealed that the reported sequences represent five major allelic lineages, two of which are currently absent in the Spanish ibex as a result of the recent extinction of subspecies *C. p. pyrenaica*. This study emphasizes the importance of locally adapted populations for the preservation of genetic diversity at MHC loci.

C03-08 BOWNE, DAVID R. Department of Biology, University of Richmond, Richmond, VA 23173, USA and Blandy Experimental Farm, Boyce, VA 22620, USA (dbowne@richmond.edu).
HOW MUCH DRY LAND DOES A SMALL, FRESHWATER TURTLE USE?

Freshwater turtles venture onto dry land to nest, aestivate, and disperse to other aquatic habitat. This behavior has prompted calls for the expansion of protected zones around wetlands to include more upland area. This increased acreage is usually designed to encompass potential nesting sites. Non-nesting terrestrial behavior, however, often includes a significantly greater area than that used in nesting. Yet only in rare circumstances can all of the land potentially used by aquatic turtles be protected. The question then arises as to where to direct conservation efforts, if at all. I contend that this decision be based on detailed understanding of how turtles behave on land. I report on the terrestrial activity of the painted turtle (*Chrysemys picta*) in northern Virginia over a four-year period. *Chrysemys picta* traveled between ponds at distances up to 3 km. In doing so, they exhibited fairly straight movement paths and ignored topographic features. This behavior suggests that *C. picta*, and perhaps aquatic turtles in general, may benefit from linear corridors of protected dispersal habitat that do not necessarily follow drainages. Special consideration needs to be given to locations in which roads and movement corridors intersect.

C31-01 BRANDON, KATRINA, Larry J. Gorenflo, and Ana Rodrigues. Center for Applied Biodiversity Science, Conservation International, 1919 M Street NW, Suite 600, Washington, DC 20036, USA (k.brandon@conservation.org).
PLACING NEW PARKS: MAXIMIZING COMPLEMENTARITY AND MINIMIZING CONFLICTS IN MESOAMERICA

Competition over rural land uses in tropical hotspots is likely to intensify in the 21st century. Mesoamerica is a good place to illustrate the challenges for conservation. High levels of population growth, high forest fragmentation, high demand for agricultural land, and generally good access mean that there are few areas that are really remote. Gap analysis, based on the distribution of mammal and bird species and existing reserves, indicates that new protected areas and corridors to link them need to be established within this context of rapid forest conversion to other uses. This paper describes results from research on the trade-offs in the extent and placement of existing protected areas, agricultural suitability, and remoteness – maximizing complementarity while minimizing conflicts with agriculture productivity and proximity to populated/accessible areas. These results identify, for Mesoamerica, what areas are most important ecologically, and most feasible to establish and maintain based on social and economic data.

C32-01 BRAZNER, JOHN, Steven Campana, and Danny Tanner. U.S. Environmental Protection Agency, National Health and Environmental Effects Research Laboratory, Mid-Continent Ecology Division, 6201 Congdon Boulevard, Duluth, MN 55804, USA (brazner.john@epa.gov) (JB, DT); Bedford Institute of Oceanography, Department of Fisheries and Oceans, PO Box 1006, Dartmouth, NS B2Y 4A2, Canada (SC).
ARE ELEMENTAL FINGERPRINTS OF FISH OTOLITHS DISTINCT AMONG GREAT LAKES COASTAL WETLAND NURSERY AREAS?

Elemental composition of an otolith reflects a fishes rearing environment, so otolith geochemistry can record differences in ambient water conditions specific to habitats used during a fishes life history. Although few studies have been conducted in freshwater, trace element analysis of marine fish otoliths has proven useful in identifying chemical signatures unique to particular spawning and nursery habitats. To examine its utility in freshwater, sagittae were removed from young-of-the-year yellow perch captured from 8 wetlands in western Lake Superior during August, 2001. They were analyzed for 13 elements (Al, Ba, B, Cu, Fe, Pb, Mg, Mn, K, Na, Sr, Zn, and Li) using ICP-MS and ICP-AES. Mean Ba, B, Li, Fe, Mg, Mn, Zn, Na, K, and Sr concentrations differed significantly among sites. Discriminant function analysis revealed relatively distinct habitat fingerprints associated with each site. Site classification accuracy based on jack-knife procedures ranged from 63 to 100 percent and averaged 75 percent. Our results suggest that wetland fingerprints based on otolith elemental analysis may be useful for quantifying relative contributions of different nursery areas to recruitment in adjacent lake populations. *This abstract does not reflect U.S. EPA policy.*

C08-07 BRENEMAN, DAN, Anh Ly, Cathy Johnson, and Lucinda Johnson.
Natural Resources Research Institute, University of Minnesota Duluth, 5013 Miller Trunk Highway, Duluth, MN 55811, USA (dbrenema@nrri.umn.edu).
SPACIAL AND TEMPORAL EFFECTS ON MACROINVERTEBRATE COMMUNITY COMPOSITION IN VERNAL POOLS

The dynamic nature of vernal pool hydrology and resource availability following spring runoff creates a unique habitat for aquatic insects. We examined life history strategies and aquatic insect community structure associated with vernal pools in northern Minnesota. D-frame sweep nets were used to sample macroinvertebrates in 18 fragmented and 20 unfragmented vernal pools during the early spring and summer of 2000-01. Twenty metrics based on aquatic insect behavior, life stages, and functional characteristics were analyzed using a Principle Component Analysis (PCA) and Multivariate Analysis of Variance (MANOVA) to examine seasonal and treatment interactions. A majority of the variance (50%) was explained on the first axis,

providing a clear separation between fragmented and unfragmented treatments. Total number of taxa increased slightly between early and late sampling periods for both treatments, but the fragmented ponds contained significantly more taxa than the unfragmented ponds. Functional attributes like grazers, gatherers, and scrapers responded in a similar fashion as more of those taxa were recorded in the fragmented ponds. Although seasonal alterations in vernal pool communities were observed, aquatic insects showed a greater response to landscape characteristics.

S10-01 BRINSON, MARK, and Richard Rheinhardt. Biology Department, East Carolina University, Greenville, NC 27858, USA (brinsonM@mail.ecu.edu).
BIOMASS AND SPECIES COMPOSITION AS INDICATORS OF ECOSYSTEM CONDITION OF TWO CONTRASTING COASTAL PLAIN WETLAND TYPES

Riparian areas and wet interstream divides are two important landscape features of the southeastern coastal plain, USA. We use data from riparian forests along headwater streams and wet pine savannas to illustrate how vegetation can be used in different ways as indicators of environmental quality. Riparian forests were ranked by the maturity of forest buffer and corresponding biomass. The assumption is that living components have the capacity to store and recycle nutrients, non-living components contribute to detrital food webs, and both are important for habitat structure. Biomass estimated for five cover types, ranging from mature forest (> 50 years) to annual row crops, spanned two orders of magnitude. Woody vegetation dominated the live biomass component while litter and soil organic matter dominated the detrital component. Species composition of the woody vegetation is a mesic to hydrophytic assemblage of hardwoods common also in wet hardwood flats. Wet savannas have comparatively less biomass and detritus than riparian forests as suggested by low tree densities and the nutrient and organic poor, sandy soils. In contrast, ecosystem condition is indicated by species composition, with fire-dependent bunchgrasses and annual forbs signaling the lack of alteration by humans. The strikingly different approaches toward estimating ecosystem condition in these two wetland types are a consequence of their differing functions and landscape settings. Riparian forests are imbedded in a landscape of intense agricultural practices, and contain few species to distinguish them from unaltered sites. Wet savannas, where they occur, dominate the landscape and provide refuges for high species richness.

S06-03 BRISTER, DEBORAH. Institute for Social, Economic and Ecological Sustainability, University of Minnesota, 186 McNeal Hall, 1985 Buford Avenue, St. Paul, MN 55108-6142, USA (djb@fw.umn.edu).
AQUACULTURE IN THE GREAT LAKES: CONSERVING BIODIVERSITY USING THE ENVIRONMENTAL ASSESSMENT TOOL FOR AQUACULTURE IN THE GREAT LAKES BASIN

An increasing interest in aquaculture development in the Great Lakes region has inspired the development of an aquaculture environmental assessment tool for aquaculture facilities in the Great Lakes. There are approximately 560 aquaculture facilities in the Great Lakes basin all under varying degrees of jurisdictional regulation. Because the Great Lakes are interconnected water bodies, organisms may move freely from one body of water to another, making aquaculture management a possible contentious issue between jurisdictions. To best address the multitude of issues that need to be considered when determining the suitability and environmental effects of an aquaculture facility at a particular site, we have assembled an environmental assessment tool that methodically takes the user through these issues, identifies potential hazards and, when possible, makes risk management recommendations. It is comprised of three distinct components: the pathway flowcharts that guide users through assessment of potential environmental effects, the supporting text that provides scientific background, and the summary documentation that traces the user's path through the assessment pathway and prompts the user to describe the rationale for any selected risk management measures. This tool aims to assist decision-makers and other interested parties by providing a systematic and consistent process for assessing aquaculture facilities.

P082 BRITTEN, HUGH, Kristie Trudeau, and Marco Restani. Department of Biology, University of South Dakota, Vermillion, SD 57069, USA (hbritten@usd.edu) (HB, KT); Department of Biological Sciences, St. Cloud State University, St. Cloud, MN 56301, USA (MR).
SYLVATIC PLAGUE REDUCES GENETIC VARIABILITY IN CENTRAL MONTANA BLACK-TAILED PRAIRIE DOG COLONIES

Black-tailed prairie dogs (*Cynomys ludovicianus*) are a "keystone species" in North American short- and mixed-grass prairies. An outbreak of sylvatic plague (*Yersinia pestis*) in the late 1980s caused declines and extirpations of many prairie dog colonies in north-central Montana. Plague-induced population bottlenecks may contribute to significant reductions in genetic variability. In contrast, gene flow maintains genetic variability within colonies. We investigated the impacts of the plague epizootic and distance to nearest colony on levels of genetic variability in six prairie dog colonies using 24 variable randomly amplified polymorphic DNA (RAPD) markers. Gene diversity (h) was significantly decreased in the three plagued colonies that were recovering from the resulting bottlenecks (h = 0.266 | 0.177) compared to the three colonies that were not plagued (h = 0.356 | 0.137) (Wilcoxon paired-sample test; T = 40, p < 0.001). Gene diversity was not affected by geographic distance between

colonies. An analysis of molecular variance (AMOVA) revealed that the majority of variance in gene frequencies (77.7%) was found within prairie dog colonies. Conservation of genetic variability in black-tailed prairie dogs will require the preservation of both large and small colony complexes, and of the gene flow among them.

C26-06 Brooks, Margaret, and **HEATHER GERMAINE.** National Park Service, 1415 North Sixth Avenue, Tucson, AZ 85705, USA (MB); George Washington Memorial Parkway, c/o Turkey Run Park, McLean, VA 22101, USA (heather_germaine@nps.gov) (HG).

REACHING BEYOND BOUNDARIES TOWARD WATER RESOURCES PROTECTION

Natural resource managers have discovered that interagency coordination of projects and management activities can be essential to ensure conservation of regional water resources. The National Park Service (NPS), through its National Natural Landmarks Program (NNLP), provides staff dedicated to working across agency lines to monitor and protect natural resources at nearly 600 sites across the nation. Ninety-seven percent of these sites are outside of NPS unit boundaries, but lie within areas designated as National Natural Landmarks. This designation is given by the Secretary of the Interior after detailed comparative studies determine that a site's condition and illustrative character make it an outstanding example of a biological or geological resource. Program coordinators routinely work with a wide variety of state and federal agencies to protect nationally significant water resources within designated landmarks. Recent successes include removal of a planned highway from the watershed of Big Run Bog in West Virginia, construction of a boardwalk to protect the Orono Bog in Maine, removal of hazardous materials from the Ocean shore in Washington, and revegetation of denuded land along Catfish Creek in Texas.

C15-03 **BROOKS, THOMAS,** Mike Parr, John Lamoreux, Eric Dinerstein, Tom Allnutt, and Ana Rodrigues. Center for Applied Biodiversity Science, Conservation International, 1919 M Street NW, Suite 600, Washington, DC 20036, USA (t.brooks@conservation.org) (TB, AR); American Bird Conservancy, 1834 Jefferson Place NW, Washington, DC 20036, USA (MP); Department of Environmental Sciences, University of Virginia, Charlottesville, VA 22903, USA (JL); World Wildlife Fund US, 1250 24th Street NW, Washington, DC 20037, USA (ED, TA).

THE ALLIANCE FOR ZERO EXTINCTION: ACTUAL PROTECTION AND SURROGACY VALUE OF THE TIP OF THE ICEBERG

The Alliance for Zero Extinction is a multi-institutional partnership with the aim of identifying and stimulating the conservation of all sites holding the entire global population of one or more species listed as Critically Endangered or Endangered on the IUCN Red List. As an initial focus, the alliance has assessed such sites across Latin America for terrestrial vertebrate species. We identified a total of 140 sites across the continent, which if successfully conserved would prevent the extinction of all narrow-ranged Latin American terrestrial vertebrate species. How close are we to achieving this conservation, and how well would this conserve species generally? To address these questions, we overlaid two data coverages: protected areas; and the distributions of all bird and mammal species. Overall, the Alliance for Zero Extinction sites are poorly conserved to date: less than a quarter are covered by the existing protected areas system. However, together these sites represent not just their target species but also the bulk of Latin American bird and mammal species. Our initial analyses suggest that this is significantly more than would be represented by random selection of the same number of sites, and than are currently represented in protected areas. We conclude that the incorporation of all of these 140 sites into the protected areas system would not only dramatically reduce terrestrial vertebrate extinction rates in Latin America, but also increase the species representation generally to near total coverage.

S14-04 **BROWER, LINCOLN P.** Department of Biology, Sweet Briar College, Sweet Briar, VA 24595, USA (brower@sbc.edu).

HISTORY AND PROSPECTS OF CONSERVATION EFFORTS TO PRESERVE THE OVERWINTERING SITES OF THE MONARCH BUTTERFLY IN MEXICO

It was evident upon discovering the overwintering sites of the monarch butterfly in Mexico that the migration of the eastern North American migratory population was an endangered biological phenomenon. Field research established that all overwintering habitats occur on 12 isolated mountain massifs, occupying less than 100 by 100 km in the Transverse Neovolcanic Range, west of Mexico City. Efforts by the scientific community, the World Wildlife Fund and a local NGO in Mexico resulted in a Presidential Decree in 1986 that partially protected 16,110 hectares of forest. WWF, in cooperation with the Mexican Government, documented that the geographic area protected by the 1986 decree was inadequate, that forest degradation was accelerating, and that more detailed biological parameters needed to be taken into account to provide better long term protection. This resulted in a new, revised Presidential Decree in November 2000 that increased the protected area to 56,259 hectares and wedded implementation of the plan with economic compensation, made possible by the Packard Foundation. All is not well, however, because illegal tree harvesting is rampant. The biological reasons why large areas of intact forest are critical to the long term survival of the migratory phenomenon will be presented, as will recent collaborative GIS studies with the University of Mexico and NASA.

C59-02 **BROWN, JENNIFER,** Gretel Kiefer, and Brian Winter. The Nature Conservancy, 1313 5th Street SE, Suite 320, Minneapolis, MN 55414, USA (jbrown@tnc.org) (JB); The Nature Conservancy, 15337 28th Avenue South, Glyndon, MN 56547, USA (GK, BW).
ESTABLISHING SPECIES COMPOSITION OBJECTIVES FOR PRAIRIE RESTORATIONS AND EVALUATING THE CAPABILITIES OF CURRENT TECHNIQUES

Due to enormous losses of prairie habitat in the Great Plains, many conservation efforts focus on restoring the vegetative component of these ecosystems. This study identified objectives for a 24,000 restoration project and evaluated whether these can be achieved using current prairie restoration methods. We used the results of releve surveys in native prairie remnants to identify a set of species essential to each of 11 plant communities at the site. At five nearby restorations of mesic, wet, and dry prairies, the composition of the source seed and established vegetation was measured. 50% of the essential dry and wet prairie species established in these projects; only 16% of mesic prairie species established. The presence and abundance of essential species in the source seed was not reflective of results within the restoration area. Fifteen mesic prairie species absent from the source seed established successfully in the restorations, and almost 25% of the dry and wet prairie species present in the seed mixes were not detected in the restorations. While detection of essential species improved with prairie age, techniques such as adding seeds harvested at different times of the year and herbicide use after seeding also increase abundances of essential species.

P003 **BRYCE, SANDRA,** and Michael Bollman. Dynamac Corporation, 200 Southwest 35th Street, Corvallis, OR 97333, USA (bryce.sandy@epa.gov).
DEVELOPMENT OF A DISTURBANCE INDEX TO ASSESS THE CONDITION OF AQUATIC ECOSYSTEMS

An objective of aquatic monitoring is to assess the condition of aquatic habitats and biota. To rationally interpret aquatic condition, we must identify the range of human activities and the risks they pose to aquatic ecosystems. Placing stream reaches and their watersheds on a human disturbance gradient is a prerequisite for distinguishing human disturbance from natural controls in aquatic systems and for interpreting biological response to disturbance. We describe a process that uses readily available sources, such as topographic maps, aerial photographs, and field information, as well as several metrics generated by a Geographic Information System (GIS) to identify and prioritize stream reach and watershed stressors for 31 streams in the Blue Mountains of Oregon, USA. All perceptible human alterations to riparian and upland areas were recorded and ranked, and a scoring system was developed that gave each watershed a discrete score. The resulting disturbance index provides a cost-effective method to directly compare the relative condition of watersheds in similar size classes and ecological regions. It can be used as a measure of condition in multivariate analyses or as an explanatory variable to evaluate the responsiveness of candidate metrics in indices of biotic integrity.

P036 Bryer, Mark, Kristine Ciruna, Tracy Horsman, and **PETER SKIDMORE.** The Nature Conservancy, 4245 North Fairfax Drive, Suite 100, Arlington, VA 22203, USA (mbryer@tnc.org) (MB); The Nature Conservancy of Canada, 202-26 Bastion Square, Victoria, BC V8W 1H9, Canada (KC); The Nature Conservancy of Washington, 217 Pine Street #1100, Seattle, WA 98101, USA (TH, PS).
INTERNATIONAL BIODIVERSITY CONSERVATION: USING A FRESHWATER ECOLOGICAL CLASSIFICATION TO GUIDE ACTION IN CANADA AND THE USA

In conjunction with governmental, academic, and non-governmental partners, The Nature Conservancy has developed an approach to describe freshwater biodiversity for use in conservation and resource management. Four hierarchical levels are classified using principles of conservation biology, aquatic ecology, and multivariate statistics, and are mapped in a Geographic Information System (GIS). The Nature Conservancy and The Nature Conservancy of Canada are working together to implement this hierarchy across the Canadian province of British Columbia and the U.S. states of Alaska, Washington, Oregon, Idaho, and Montana. We will discuss the results of this effort, its implications for integrated biodiversity conservation across the region, as well as other applications of the classification that include developing species habitat models (e.g., for salmon management), informing land use planning, and identifying reference conditions for biological integrity assessments.

C27-04 **BURDETT, CHRISTOPHER L.,** Gerald J. Niemi, Ronald Moen, L. David Mech, and Ed Lindquist. Natural Resources Research Institute, University of Minnesota Duluth, 5013 Miller Trunk Highway, Duluth, MN 55811-1442, USA (cburdett@nrri.umn.edu) (CLB, GJN, RM); Department of Fisheries and Wildlife, U.S. Geological Survey, 1920 Fitch Avenue, St. Paul, MN 55108, USA (LDM); USDA Forest Service, Superior National Forest, 8901 Grand Avenue Place, Duluth, MN 55808, USA (EL).
PAST AND PRESENT STATUS OF THE CANADA LYNX IN MINNESOTA

The Canada lynx was listed under the U.S. Endangered Species Act in April 2000. Minnesota, along with New Hampshire, Montana, and Washington, historically supported the greatest number of Canada lynx in the contiguous states. Little ecological

information exists on the species in Minnesota, even though several hundred Canada lynx were trapped during peaks in hare and lynx populations from the 1940s to the 1970s before harvest of lynx in Minnesota was stopped in the early 1980s. After several sightings, tracks, and pictures of Canada lynx in 2001-2002, a snow-tracking study was initiated in Minnesota. DNA amplification of scat and hair samples confirmed the presence of between 13 and 22 individual Canada lynx in northeastern Minnesota. We will review the status of the Canada lynx with regard to habitat and landscape features of northeastern Minnesota. Telemetry collars have been deployed on 2 Canada lynx and the animals are being regularly relocated from both the air and the ground. In the winter of 2002-2003, we expanded the genetic based snow-tracking protocol to determine distribution of lynx. The combination of radiotelemetry, track surveys, and genetic analysis of tissue samples will help determine the distribution, persistence, and habitat use of the Canada lynx population inhabiting Minnesota.

C32-04 BURNETT, KELLY, Dan Miller, Gordon Reeves, Sharon Clarke, Ken Vance-Borland, and Kelly Christiansen. Pacific Northwest Research Station, 3200 Jefferson Way, Corvallis, OR 97331, USA (kmburnett@fs.fed.us) (KB, GR, KC); Earth Systems Institute, 3040 NW 57th Street, Seattle, WA 98107, USA (DM); Department of Forest Science, Oregon State University, Corvallis, OR 97331, USA (SC, KVB).

IDENTIFYING STREAM REACHES WITH POTENTIAL TO SUPPORT HIGH QUALITY HABITAT FOR IMPERILED ANADROMOUS SALMONIDS

Decision makers concerned with imperiled populations of steelhead *Oncorhynchus mykiss* or coho salmon *O. kisutch* must often select freshwater areas to protect or restore based on limited site-scale information. To foster conservation of these wide-ranging fish, we developed models that can relatively quickly characterize the potential of streams in a region to support high quality habitat. The modeled attribute, termed intrinsic potential, was expressed for each species as the geometric mean of classified channel gradient, valley constraint, and mean annual discharge. These components were derived for all streams in the Coastal Province of Oregon, USA, using 10-m digital topographic data. Because the topographic features most associated with steelhead and coho salmon differ, stream reaches with high intrinsic potential (values ≥ 0.8) for these two species generally did not overlap. High intrinsic potential reaches typically occurred on publicly owned forestlands for steelhead but on privately owned lands with various uses for coho salmon. Results are relevant in describing the likelihood of locating unimpaired habitat in high intrinsic potential reaches for these species and in assessing the feasibility of conservation options. The approach and models can be adapted to any lotic species for which links to topographic features are known.

C27-01 BURNS, CATHERINE. Department of Ecology and Evolutionary Biology, Yale University, 370 Prospect Street, New Haven, CT 06511, USA (catherine.burns@yale.edu).

IS ABUNDANCE DATA REALLY ENOUGH? THE UTILITY OF LIFE-HISTORY DATA FOR ASSESSING HABITAT QUALITY

To facilitate wildlife management within heterogeneous landscapes, it is generally necessary to establish the relative quality of each habitat type. We often assume that higher population densities indicate higher quality habitat. This positive relationship between abundance and habitat quality may not always exist. In cases where dominant individuals are able to monopolize high quality habitat and force newcomers or subordinate individuals into lower quality habitat, we may expect the relationship to be less clear, and in some instances counter-intuitive. We contrast abundance versus life-history (measures of reproduction and survival) based assessments of habitat quality for the white-footed mouse, *Peromyscus leucopus*, in the mosaic landscape of southern New England's temperate forests and old-fields. Our analyses incorporate three years of live-trapping data and nest-box surveys. In several cases abundance and life-history data yielded comparable habitat rankings. In other cases, however, especially at high-density sites, animals residing in more highly populated habitats were found to exhibit lower reproductive output and persistence times than those living in less densely populated habitats. We assert that it is dangerous to assume a positive relationship between abundance and habitat quality, and that this assumption may lead to costly errors and inefficient management strategies.

P020 BURTON, JULIA, Lee E. Frelich, Eric Zenner, and Meredith Cornett. Department of Forest Resources, University of Minnesota, 115 Green Hall, 1530 Cleveland Avenue North, St. Paul, MN 55108, USA (burt0148@umn.edu) (JB, LEF, EZ); The Nature Conservancy of Minnesota, 394 Lake Avenue South, Duluth, MN 55802, USA (MC).

PREDICTING AND MAPPING FUTURE PLANT ASSEMBLAGES IN FORESTED LANDSCAPES

Forests in the Manitou Landscape on the North Shore of Lake Superior in Minnesota, USA do not currently reflect their potential in terms of late-successional, old-growth forests. The current forests are composed of early-successional species such as aspen (*Populus tremuloides*) and paper birch (*Betula papyrifera*), which may succeed along alternate pathways to potential communities of spruce and fir (*Picea glauca* and *Abies balsamea*), white pine (*Pinus strobus*) or northern hardwoods dominated by sugar maple (*Acer saccharum*) and yellow birch (*Betula alleghaniensis*). We predicted and mapped potential plant communities at the stand scale for the ~ 40,000 ha landscape by comparing current vegetation to the range of natural variation as predicted by vegetation at the time of the pre-European settlement land survey in Minnesota (late 1800's), land type association and the

natural disturbance regime. Since all factors that affect plant assemblages could not be accounted for in the mapping process, the predictions are of questionable accuracy or absent in a few portions of the map. However, our map of potential vegetation will assist land managers by predicting locations of future old growth forests, although it is not intended to serve as a management prescription.

S15-04 BUSTAMANTE, RODRIGO, Andrew Tyre, and Alan Butler. Northern Fisheries and Torres Strait Ecosystems, CSIRO Marine Research, PO Box 120, Cleveland, QLD 4163, Australia (rodrigo.bustamante@csiro.au) (RHB, AB); School of Natural Resource Sciences, University of Nebraska–Lincoln, Lincoln, NE 68583-0819, USA (AT).
PROCESSES FOR IDENTIFYING AND CHOOSING MARINE RESERVES: A COMPARISON OF CONSERVATION TRATEGIES IN THE GALÁPAGOS ISLANDS AND AUSTRALIA

We compare the experience of two cases of marine conservation that differed in their procedures, targets and spatial scales. Zoning of the Galapagos Marine Reserve (~ 133,000 km^2) was implemented considering the interests and needs of different user groups. Delphic approaches were used for biodiversity and biogeographic information, as well as complementarity-like criteria achieving protection of nearly 20% of coasts. A-posteriori assessment revealed that zoning has to be modified to achieve representative conservation. By contrast, in the south-east of Australia (~ 2.1 million km^2) the establishment of a representative system of MPAs in deep water began with an analytical approach, using biophysical data as surrogates for biodiversity to represent each bioregional unit in a system of MPAs; the selection procedure was repeated many times and a Delphic consideration of the resultant selection frequencies was used to identify broad geographical areas of interest for further consideration. A multi stakeholder Delphic and decision-support process is currently identifying and selecting specific MPAs within the broad areas. The problems encountered were: limited consideration of nature and extent of the spatial and temporal variability of marine biodiversity, lack of fine-scale habitat and species data, and inability to articulate ecosystem processes into the conservation schemes.

C16-01 BYRD, KIMBERLY. Conservation Biology Graduate Program, University of Minnesota, 1743 Goodrich Avenue, St. Paul, MN 55105, USA (byrd0023@umn.edu).
OF WOLVES AND WORLDVIEWS: NAVIGATING THE SOCIAL LANDSCAPE OF WOLF MANAGEMENT IN MINNESOTA

Large carnivore conservation is a complex and challenging endeavor that is often situated in a social landscape that seems neither logical nor predictable. Conservation biologists need maps to help them navigate the deep seated beliefs and values that contribute to management conflicts, which frequently appear intractable. A Q-methodology study was conducted to examine the different knowledge systems, authority structures, and human-nature relationships that shape the unique and distinct worldviews of participants in the Minnesota, USA wolf debate. The study revealed three primary factors, or shared belief systems, about wolf management in the state. The factors included the Idealist Perspective, the Institutional Perspective, and the Localist Perspective. The intricacies and unique logic of each of the three factors are discussed, and themes of consensus and disagreement are highlighted. The recommendation of policy goals, which are derived from areas of consensus among the three factors, include the establishment of a democratic process for citizen participation, the realization of dignity for all participants, and increased focus on depredation compensation programs. This case study demonstrates how Q-methodology can be used as an innovative tool to produce accessible, comprehensive guides for assessing the complex social realities of large carnivore conservation.

C26-03 CAMPBELL, PATRICK, Francisco Dallmeier, Alfonso Alonso, and Michelle Lee. Smithsonian Institution Monitoring and Assessment of Biodiversity Program, PO Box 37012, Washington, DC 20013-7012, USA (pcampbell@ic.si.edu).
INTEGRATING CONSERVATION OF BIODIVERSITY AND NATURAL RESOURCE DEVELOPMENT IN THE GUINEO-CONGOLIAN RAINFORESTS OF GABON

Conservation of biodiversity presents a challenge in the shadow of continued development and extraction of natural resources. Biodiversity is showing signs of stress from resource extraction to meet human demands for food, fuel and shelter. The 11,000 km^2 Gamba Complex, located along the Atlantic coast of Gabon, is one such example of this challenge. It is valued for its high biodiversity, yet it is threatened by over 40 years of oil exploration and development. In 2002, the government of Gabon established two national parks in the Complex thereby creating a matrix of national parks, critical conservation areas and industrial operations. Since 2000, we have been working to develop relationships among industry, governments and scientists that foster a more environmentally friendly approach to resource development and extraction while promoting the conservation of biodiversity. We have developed a framework for biodiversity inventory and monitoring that includes research and in country capacity building. The project strategy includes biological inventories and studies of multiple ecological systems (vegetation, aquatic systems, amphibians and reptiles, arthropods, birds and mammals). The information gathered promotes informed decision making by managers, thus integrating the science of conservation biology, national park planning, design and management, and oil development.

S12-01 CARR, MARK H., and James A. Estes. Department of Ecology and Evolutionary Biology and Institute of Marine Sciences, University of California, Santa Cruz, Santa Cruz, CA 95064, USA (carr@biology.ucsc.edu) (MHC); U.S. Geological Survey, University of California, Santa Cruz, Santa Cruz, CA 95064, USA (JAE).
COMPARING MARINE AND TERRESTRIAL ECOSYSTEMS: IMPLICATIONS FOR THE DESIGN OF COASTAL MARINE RESERVES

Concepts and theory for the design and application of terrestrial reserves is based on our understanding of environmental, ecological and evolutionary processes responsible for biological diversity, sustainability of terrestrial ecosystems and how humans have influenced these processes. How well this terrestrial-based theory can be applied toward the design and application of reserves in the coastal marine environment depends, in part, on the degree of similarity between these systems. Several marked differences in ecological and evolutionary processes exist between marine and terrestrial ecosystems as ramifications of fundamental differences in their physical environments (i.e. the relative prevalence of air and water) and contemporary patterns of human impacts. Most notable, the great extent and rate of dispersal of nutrients, materials, holoplanktonic organisms and reproductive propagules of benthic organisms, expand scales of connectivity among nearshore communities and ecosystems. Consequently, the "openness" of marine populations, communities and ecosystems probably has marked influences on their spatial, genetic and trophic structures and dynamics in ways experienced by only some terrestrial species. Such differences appear to be particularly significant for the kinds of organisms most exploited and targeted for protection in coastal marine ecosystems (fishes and macroinvertebrates). These and other differences imply some unique design criteria and application of reserves in the marine environment.

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WHEN DOES CONNECTIVITY MATTER: INSIGHTS FROM SPATIALLY-EXPLICIT POPULATION MODELS

Conservation groups and agencies increasingly attempt to create regional reserve designs that move beyond a simple aggregation of important sites to produce a biologically functional network. However, conservation biologists have long debated whether resources devoted to corridors might be better spent on other goals. Because assessing the tradeoff between connectivity and other design goals is difficult without long-term field data on dispersal and demographics, this may be where mechanistic models are most useful. Spatially-explicit population models can help planners decide when to allocate resources towards protecting relatively secure core areas, to stemming the degradation of threatened buffer zones, or to restoring linkages that are already degraded but might contribute to long-term persistence of metapopulations. However, in some regions model results are too sensitive to uncertainty about processes such as dispersal to provide reliable insights. Examples from regional population viability analyses for carnivores in the Rocky Mountains, northern Mexico, and eastern Canada demonstrate that guidelines for the importance of connectivity, as well as the amount of protected area necessary to insure species viability, may be strongly context-specific. However, spatially-explicit population models often provide non-intuitive yet informative results that can help ensure the survival of wide-ranging species in increasingly human-dominated landscapes.

S15-03 CASTILLA, JUAN CARLOS. Center for Advanced Studies in Ecology and Biodiversity, Facultad de Ciencias Biológicas, Pontificia Universidad Católica de Chile, Casilla 114-D, Santiago, CP 6513667, Chile (jcastill@genes.bio.puc.cl).
CHILEAN "CALETAS" AND ASSOCIATED MANAGEMENT AND EXPLOITATION AREAS FOR BENTHIC RESOURCES AS TOOLS TO EVALUATE THE BENEFIT OF MARINE RESERVES

Definition of Marine Protected Areas (MPA) vary widely. "The Marine Reserve Task Group", SANCOR, South Africa (1997) recognized 4 types: Sanctuary (full protection), Marine Reserve (protection for majority of species, allowing certain species to be harvested), Fishery Reserve (protection of single species) and Marine Park (any zoning allowing a mixture of the three). In Chile there is 20-year experience with the implementation of Marine Reserves linked to the rational management of benthic resources. They are known as "Management and Exploitation Areas" (MEAs) for benthic resources. MEAs are co-management units where Territorial Users Rights in Fisheries are allocated exclusively to fisher communities, known as "Caletas." Fishery and ecosystem regulations, based on species sustainable management plans and restrictions to alter/modify the biota/environment, exist. Pilot studies have demonstrated MEAs' benefits in the enhancement of fishery yields and export of larvae. MEAs' have been selected based on social acceptance, urgency and socio-economical aspects. They have proven effective in the implementation of sustainable co-management plans and positive changes in resource/ecosystem user's perceptions. In Chile MEAs may be seen as the first step leading to the transformation of people-reserve (parks) conflicts into mutual beneficial relationships and bridging conservation and management issues.

C17-05 CHAMBERS, MELINDA D., Carolyn Friedman, Lorenz Hauser, and Glenn R. VanBlaricom. School of Aquatic and Fisheries Sciences, University of Washington, Seattle, WA 98105, USA (mdc2@u.washington.edu) (MDC, CF, LH); Washington Cooperative Fish and Wildlife Research Unit, School of Aquatic and Fisheries Sciences, University of Washington, Seattle, WA 98105, USA (GRVB).
THE EFFECTS OF LARVAL DISPERSAL ON GENETIC STRUCTURE OF BLACK ABALONES (*HALIOTIS CRACHERODII*)

Populations of black abalone have experienced declines of 85-99% since the emergence of the disease abalone Withering Syndrome (WS) in 1985, infecting animals throughout the species range that once extended from northern California to Mexico and the California Islands. Black abalone populations in the California Channel Islands formerly harbored unprecedented densities. Recent data from population census analyses at San Nicolas Island suggest a recovery trend indicated by an increase in the proportion of recruit sized (< 50 mm) individuals. A drift card study conducted in August 2002 from San Nicolas Island implies that the dispersal of free-floating particles representing abalone larvae is strongly localized. Larval dispersal significantly influences the sustainability for populations in which recruitment is limiting. Genetic analyses are being used to test hypotheses developed from the drift card study that the existing populations of black abalones are spatially fragmented, by identifying population structure within and between islands in the California Channel Island system in comparison to the California mainland. Such genetic data will be applied to the identification of management units, to the generation of conservation plans, and to predictions for the recovery of the population throughout its geographic range.

C39-05 CHASE, GIB. U.S. Fish and Wildlife Service, 6 Kimball Lane, Northboro, MA 01532, USA (gib_chase@fws.gov).
STELLWAGEN BANK NATIONAL MARINE SANCTUARY: A QUESTION OF COMPATIBILITY
A comparison is made between our national wildlife refuge system and the Stellwagen Bank NMS. The Refuge Administration Act of 1966 requires the U.S. Fish and Wildlife Service (Service) to "facilitate" high-quality and safe opportunities for wildlife-dependent recreation. The National Marine Sanctuaries Act stipulates the facilitation of "all uses" or "multiple uses" of the natural resources of a marine sanctuary. The legislation also, clearly requires managers and superintendents to ensure that all recreation and economic uses are "compatible" with the respective purposes and missions. The term "facilitate" was deliberately used to represent a strong sense of encouragement, but not a requirement, that ways be sought to permit uses to occur if they are compatible. A refuge is closed until opened for public use. Conversely marine sanctuaries are essentially opened to all uses unless specifically prohibited by the enabling legislation. The Service has a formally approved compatibility determination process and policy; NOAA's marine sanctuary program does not. While the authority to determine compatibility within the National Marine Sanctuaries program is not explicit, neither is it defined; therefore the opportunity exists to develop both a policy and process for compatibility.

C08-04 CHAUDHARI, LALIT P. Institute for Sustainable Development and Research, N-1-8, Narayan Pujari Nagar, Worli, Bombay, 400018, India (clkp123@yahoo.com).
MANAGING WETLANDS FOR SMALL SCALE AGRICULTURAL PRODUCTION ALONG COASTAL ZONES IN DROUGHT PRONE AREAS: INDIAN EXPERIENCES

Wetlands are the key to development of the agricultural as well as social and economic development of the coastal areas. Considering the shortage of water, cost involved in water storage and conveyance to the users end, it is necessary to adopt innovative methods of conjunctive use of coastal wetlands and water for agricultural production using water effectively and efficiently in the draught-prone areas along the coast. Aquaculture is such an innovative tool for wetland utilization in both urban and also in rural agriculture to use and reuse the coastal wetland, mangrove, tidal water as well as waste water reducing adverse environmental impacts. Aquafarming has a multidimensional context in perspective agricultural growth. It is a tool for utilizing wetlands and water more economically and optimally for increasing productivity of both wetland and water, through sustainable agriculture. The countries in the Asia-Pacific region have vast and varied aquafarming resources. Often these are the main sources for socio-economic development in this region. The overuse of water causes salinity and water logging problems in many countries, reducing the cultivatable area due to formation of coastal wetlands resulting reduction in aquacultural production. An attempt has been made in this paper to develop the plan for coastal wetland management for agriculture, aquaculture and horticulture using innovative technologies from Indian experience. The paper also evaluates the wastewater quality criteria for increasing the agricultural productivity in coastal wetlands. The paper also discusses the innovative small scale methods and technologies for food production using non-conventional sources of water for increasing the productivity of coastal wetlands, especially in drought-prone areas.

P029 CHEKUIMO, GEORGES HERBERT, William E. Kunin, Michael Pocock, and Rebecca Aston. PO Box 8047, Yaounde, Cameroon (chekuimo@hotmail.com) (CGH); Faculty of Biological Sciences, School of Biology, University of Leeds, Leeds, West Yorkshire, LS1 9JT, UK (WEK, MP, RA).
FRACTAL PATTERNS IN SPECIES DISTRIBUTIONS OF SOME BRITISH SCARCE PLANTS

The analysis, measurement, and management of species abundance is central to ecology and conservation biology, but it has proved difficult to find a single index that adequately reflects the commonness or rarity of species across a range of spatial scales. The spatial distribution and fractal structure of two British scarce plants, *Lobelia urens* (heath lobelia) and *Phyteuma orbiculare* (round-headed rampion), have been examined at several different scales. The two species have similar degrees of local patchiness at scale coarser than 50 km, and have contrasting coarse-scale between 50 km and 1 km scale, but differed consistently in the slopes of their scale-occupancy curve distributions at scale finer than 1 km. The slope of the log-log plot of *L. urens* is not constant, but varies systematically with spatial scale, and from habitat to habitat at the same spatial scale. Abundance estimates suggest that the species *P. orbiculare* is found to be clumped at all scales, whereas *L. urens* is dispersed at intermediate scale. Fractal dimension analysis suggests that this changes through scale. The distribution varied in their pattern from highly clumped to randomly dispersed. Fair predictions of *L. urens* can be made from 50 m and 200 m.

C19-06 CHELGREN, NATHAN, Selina Heppell, and Daniel Rosenberg. Department of Fisheries and Wildlife, Oregon State University, 104 Nash Hall, Corvallis, OR 97331, USA (chelgren@onid.orst.edu) (NC, SH); Department of Forestry, Range, and Wildlife Sciences, Utah State University, Logan, UT 84322, USA (DR).
AQUATIC AND TERRESTRIAL DYNAMICS OF EMIGRATION FOR NEWLY METAMORPHOSED NORTHERN RED-LEGGED FROGS

Effects of aquatic and terrestrial habitat on behavior and survival are important for understanding global amphibian declines. We studied emigration of newly metamorphosed *Rana aurora* aurora from two contrasting ephemeral ponds. We manipulated body size at metamorphosis by varying food availability to tadpoles. We individually marked 1046 animals during metamorphosis and subsequently recaptured 34% in forest pitfall traps. Larger body size increased the probability of surviving and emigrating. Time elapsed from metamorphosis to emigration varied by pond: 5.5 days (range = 1 to 23) versus 13.2 days (range = 1 to 101) for the disturbed site and natural site respectively. In addition to pond differences, animals with larger body size at metamorphosis waited significantly longer to emigrate than smaller animals. Our study emphasizes continued impacts of aquatic conditions on demographics and behavior in the terrestrial stage.

C02-05 CHEN, XIAO-YONG, Yuan-yuan Li, Xin Zhang, Tian-yi Wu, Hui-ping Lu, and Yue-wei Cai. Department of Environmental Sciences, East China Normal University, Zhongshan Road (N.) 3663, Shanghai 200062, P.R. China (xychen@des.ecnu.edu.cn) (XC, YL, XZ, TW, HL, YC); Key Laboratory of Geographic Information Science, The Ministry of Education, Zhongshan Road (N.) 3663, Shanghai 200062, P.R. China (XC).
GENETIC DIFFERENCES BETWEEN WILD AND ARTIFICIAL POPULATIONS OF *METASEQUOIA GLYPTOSTROBOIDES*: IMPLICATIONS FOR SPECIES RECOVERY

*Metasequoia glyptostroboide*s, a living fossil endemic to China, might be the most successfully recovered threatened species. Lower genetic variation than gymnosperms was found in wild populations, indicating the effects of glaciations and recent habitat loss and fragmentation led by human activities. Genetic variation in artificial populations is comparable to wild populations. However, UPGMA revealed two distinct groups: the wild and the artificial populations. Artificial populations have much higher similarity to each other than to wild populations. This might be the result of (1) sole seedling or seed source, (2) biased seed collection, (3) mixture of seeds from different populations, or (4) unsexual propagation. The present study suggests that, although the quantity and distribution range has been successfully restored, genetic structure of *M. glyptostroboide*s has not recovered appropriately. We put forward the following suggestions for the recovery of threatened plant species: (1) population genetics should be considered in recovery plans of threatened species; (2) appropriate recovery approaches other than traditional methods in forestry breeding should be used in the recovery of genetic structure; and (3) among-population variation is as important as within-population variation and genetic differentiation should also considered in the recovered populations.

P139 CHIKOSKI, JENNIFER, and Arthur R. Rodgers. Lakehead University, 955 Oliver Road, Thunder Bay, ON P7B 5E1, Canada (jmchikos@mail.lakeheadu.ca) (JC); Ontario Ministry of Natural Resources, Centre for Northern Forest Ecosystem Research, Lakehead University Campus, 955 Oliver Road, Thunder Bay, ON P7B 5E1, Canada (ARR).
THE EFFECTS OF TIMBER HARVEST ON MOOSE USE OF AQUATIC FEEDING AREAS IN THE GREAT LAKES ST. LAWRENCE AND BOREAL TRANSITION FOREST OF CENTRAL ONTARIO

The effects of different timber harvesting systems on moose use of aquatic feeding areas was studied in the Great Lakes-St. Lawrence and boreal transition forests of central Ontario. We compared use of aquatic feeding sites by moose among selection, shelterwood and clearcut silvicultural systems. At >50 sites within each harvesting system we studied the relationships between moose use and age of forest stands adjacent to aquatic feeding areas, proximity of timber harvest, and amount of shoreline affected. Sites were surveyed for moose use by recording the characteristics of trails, tracks, pellets, and browsing. Physiographic and vegetative attributes of the aquatic and terrestrial landscape were also measured. Overall, moose use of aquatic feeding areas was greatest in areas harvested by selection cutting, followed by shelterwood and cleacutting, respectively. In areas harvested by

selection cutting, moose use was greatest adjacent to older cuts (> 20 years) and was not related to reserve width. The shelterwood and clearcut areas showed more moose use of sites adjacent to recent cuts (< 5 years) with 0-60m reserves than at older sites with wider reserves. Statistical models have been developed to help define functional relationships for evaluation and refinement of current habitat protection guidelines.

C54-06 CHOW, JEFFREY, Thomas E. Dowling, and Gerald R. Smith. Nicholas School of the Environment and Earth Sciences, Duke University, Box 90328, Durham, NC 27708-0328, USA (jeffrey.chow@duke.edu) (JC); Department of Biology, Arizona State University, Tempe, AZ 85287-1501, USA (TED); Museum of Zoology, University of Michigan, Ann Arbor, MI 48109, USA (GRS).
MITOCHONDRIAL DNA VARIATION WITHIN AND AMONG POPULATIONS OF *RHINICHTHYS OSCULUS* (TELEOSTEI: CYPRINIDAE) AS DETERMINED BY MITOCHONDRIAL DNA SEQUENCES

Complex patterns of morphological variation in speckled dace (*Rhinichthys osculus*) have made reconstruction of phylogenetic relationships difficult and have led to considerable debate over distinctiveness of many local and regional populations. Such variation, with many distinctive forms represented by small, isolated populations threatened with extinction, has complicated the formulation of management policies for this species. Levels of genetic divergence and phylogenetic relationships within and among populations of speckled dace were assessed by analysis of cytochrome *b* (cyt*b*) and ND4L sequences. Phylogenetic and population genetic analyses indicated that alleles from within drainages were generally similar to each other but distinctive from those of other geographically isolated drainages. There were two major exceptions. Samples from the mainstem Virgin River exhibited variants most similar to the recently isolated Pluvial White River and neighboring Bonneville Basin, identifying a recent connection of these two drainage systems. The sample from the Bonneville Basin exhibited two divergent haplotypes (> 8% sequence divergence) found in different lineages. Divergence times estimated from phylogenetic analysis of cyt*b* largely corresponded with known geologic history. The levels of genetic divergence among population lineages aided in identifying evolutionarily significant units and management units that should be the focus of conservation.

P094 CIAMPI, ANA YAMAGUISHI, Christina Cleo Vinson, Andrielle Câmara Amaral, Milton Kanashiro, and Iracilda Sampaio. Laboratório de Genética Vegetal, Embrapa Recursos Genéticos e Biotecnologia C.P.02372, 70 770-900 Brasília-DF, Brazil (AYC, ACA); Laboratório de Genética e Biologia Molecular Campus de Bragança – UFPA, Rua Leandro Ribeiro s/n. 68 600-000, Bragança-PA, Brazil (CCV, IS); Embrapa Amazonia Oriental, Trav. Dr. Eneas Pinheiro s/n. 66 095-100 Belem-PA, Brazil (MK).
DEVELOPMENT OF MICROSATELLITE MARKERS FOR TROPICAL TIMBER SPECIES

Molecular markers based on simple sequence repeats (SSRs or microsatellites) provide an ideal tool for genetic studies, because of their high degree of polymorphism. They are codominant, multiallelic markers with high powers of discrimination. Microsatellites have been used in agricultural breeding studies, and in analyses of natural populations. We are applying SSR to studies of genetic conservation in tropical forests which are being managed for timber extraction. We have developed a large series of microsatellite for Tatajuba *Bagassa guianensis* Aubl. (Moraceae) and Ananí *Symphonia globulífera* L.f. (Clusiacea), which will allow genetic characterization of variation in natural populations, as well as precise estimates of parentage coefficients. DNA fragments of 300-800bp were separated, then were ligated to adaptors and hybridized to biotinylated (AG)13 and (TC)13, and the fragments were separated using magnetic beads. Positive clones for SSRs were done by hybridization with a poly AG/TC probe. These will then be sequenced in order to design primers. A battery of SSR will be to analyse two species, each with a minimum of 4 alleles. Loci will be characterized using 12 initial individuals. These SSRs will then be used to evaluate genetic diversity, breeding systems, and gene flow in managed forests (Dendrogene Project).

C05-03 CLAGGETT, PETER R., Stephanie Painton-Orndorff, Ward S. Hastings, Menchu Martinez , Claire A. Jantz, and Scott J. Goetz. U.S. Geological Survey, Chesapeake Bay Program, 410 Severn Avenue, Annapolis, MD 21403, USA (pclagget@chesapeakebay.net) (PRC); Center for Environmental Science, University of Maryland, Chesapeake Bay Program, 410 Severn Avenue, Annapolis, MD 21403, USA (SPO); National Park Service, Rivers, Trails and Conservation Assistance, Chesapeake Bay Program, 410 Severn Avenue, Annapolis, MD 21403, USA (WSH); U.S. Environmental Protection Agency, Chesapeake Bay Program, 410 Severn Avenue, Annapolis, MD 21403, USA (MM); Department of Geography, University of Maryland, College Park, MD 20742, USA (CAJ, SJG).
ASSESSING THE VULNERABILITY OF RESOURCE LANDS IN THE CHESAPEAKE BAY WATERSHED

The Chesapeake Bay Program is near completion of its assessment of resource lands in the Bay watershed. Resource lands are areas that are valued for their water quality, wildlife habitat, and cultural and/or economic functions. Resource lands will be prioritized for protection based on their resource value and vulnerability. Vulnerable lands are areas that are both exposed and susceptible to sources of impairment. The initial phase of the vulnerability assessment will focus on measuring the threat from development to resource lands in the Baltimore-Washington corridor. Development threats will be evaluated using a modified

version of a supply-demand-allocation model developed by Theobald (2001) that forecasts the spread of residential housing units. The model results will be generalized to create a threat surface map for the region overlaid on the inventory of resource lands. Both the original and generalized model results will be compared to original and generalized results from the SLEUTH (Slope, Land Use, Excluded land, Urban extent, Transportation networks, Hillshade) model that has been run for the same region by the University of Maryland. The challenges of assessing the vulnerability of a variety of resource lands and differentiating between the threats from land cover vs. land use conversion will be discussed. Further discussion will examine some of the factors that may affect the susceptibility of resource lands to impairment such as slope, vegetation type, soils, land value, etc.

C53-01 CLARK, J. ALAN, and Robert M. May. Department of Zoology, University of Washington, Box 351800, Seattle, WA 98195-1800, USA (alanc@u.washington.edu) (JAC); Department of Zoology, University of Oxford, South Parks Road, Oxford OX1 3PS, UK (RMM).

TAXONOMIC BIAS IN CONSERVATION RESEARCH

Taxonomic bias is pervasive in organismal research; i.e., research is not proportional to organisms' frequency in nature. We wondered if conservation research would show less taxonomic bias. To evaluate taxonomic bias in conservation research, we reviewed 15 years (1987-2001) of issues from the two leading conservation research journals: *Conservation Biology* (United States) and *Biological Conservation* (United Kingdom). Quantifying research bias is difficult, but a reasonable proxy measure is to evaluate subject organisms in the research literature. Overall, we analyzed and cataloged more than 2700 articles with a primary focus on one or more organismal groups. Unfortunately, we found that taxonomic bias also pervades the conservation literature and is even more severe than in the taxonomic community's literature or in the general scientific literature. Given the maturation of conservation biology as a discipline and the increasing attention to the issue of taxonomic bias, we hoped that such bias in conservation research would have decreased over time. However, we found that taxonomic bias in the conservation literature has not improved over the past 15 years. We recommend that conservation journals and organizations take a more proactive role in addressing this taxonomic bias.

C09-01 CLARKE, SHARON, Kelly Burnett, Kelly Christiansen, and Ken Vance-Borland. Department of Forest Science, Oregon State University, Corvallis, OR 97331, USA (sharon.clarke@orst.edu) (SC, KVB); USDA Forest Service, Pacific Northwest Research Station, Corvallis, OR 97331, USA (KB, KC).

ARE YOUR SPATIAL DATA ADEQUATE FOR YOUR CONSERVATION BIOLOGY PROJECT? WHAT YOUR GIS ANALYST SHOULD TELL YOU

Spatial data are widely used in conservation biology. Although these data are invaluable for discerning and understanding spatial patterns, assessing their accuracy and limitations is essential. An accurate portrayal of the stream network, assessed in terms of spatial location and extent of the drainage network, is crucial for aquatic analyses. In the Coastal Province of Oregon we found that 1:100,000-scale streams represented 17% and 1:24,000-scale streams represented 35% of the streams mapped by the local national forest. Additionally, the location of the 1:100,000-scale streams were sometimes offset by as much as 150 m from known locations. The slope of hillsides and channels often strongly affects stream conditions and processes. We found that USGS 30m DEMs generally underrepresented steep slopes and low gradient areas when compared to USGS 10m Drainage-Enforced (DE)-DEMs. The average coincidence was least in the > 65% slope class (31%). Roads influence a variety of aquatic processes and values. We found significant and inconsistent differences in road density among three sources of road data. As a result of these analyses, we opted to have 10m DE-DEMs created for the study area, model streams from these DEMS, and adjust road metrics to compensate for the inconsistencies.

C58-02 COCHRANE, JEAN FITTS, and Monica Tomosy. U.S. Fish and Wildlife Service, PO Box 1326, Grand Marais, MN 55604, USA (jean_cochrane@fws.gov) (JFC); U.S. Fish and Wildlife Service, Endangered Species Program, 4401 North Fairfax Drive, Room 420, Arlington, VA 22203, USA (MT).

DEVELOPING A NEW PROCESS FOR PRIORITIZING LISTING ACTIONS UNDER THE U.S. ENDANGERED SPECIES ACT

The U.S. Fish and Wildlife Service is developing a new prioritization process for allocating a limited endangered species listing program budget each year, given a backlog of nearly 500 pending actions related to listing species and designating critical habitat. The purpose is to conserve species more effectively while progressively reducing this backlog. The current Listing Priority Number system is inadequate because it does not address critical habitat designation or petition findings, which presently consume most of the budget through court ordered actions, and the ranking criteria are too subjective and lack transparency. Further, the number of candidate species currently assigned top ranking for listing proposals exceeds the available budget. The goal is to develop more objective and transparent prioritization criteria in a feasible system encompassing all types of listing actions. The proposed process concentrates on ranking species' relative extinction risks and may consider species' taxonomic

distinctiveness, the geographical overlap among at-risk species and among conservation actions, and the relative conservation benefits to species from different types of listing actions. Scientific and public review, understanding, and support for the new prioritization process are essential.

C32-06 COLLYER, MICHAEL, and Craig Stockwell. Department of Biological Sciences, North Dakota State University, Stevens Hall, Fargo, ND 58105, USA (michael.collyer@ndsu.nodak.edu).
CONSERVATION IMPLICATIONS FOR POPULATIONS OF A THREATENED FISH SPECIES THAT ARE MORPHOLOGICALLY ADAPTED TO LOCAL ENVIRONMENTS

Conservation of protected fish species often involves efforts to understand local adaptation of populations to different aquatic environments. Here, we use landmark-based geometric morphometrics methods to consider morphological adaptation of populations of White Sands pupfish (*Cyprinodon tularosa*) to local environments. The White Sands pupfish are comprised of two ESUs: Salt Creek and Malpais Spring. Morphometric analyses revealed that the average body shape of Salt Creek pupfish was more streamlined, and the average shape of Malpais Spring pupfish was comparatively deeper-bodied. The Salt Creek ESU was historically replicated by the unauthorized transfer of fish to habitats at Lost River (ecologically similar to Salt Creek) and to Mound Spring (ecologically dissimilar to Salt Creek). Morphometric analyses revealed that the Lost River population has not diverged morphologically. By contrast, the Mound Spring population has undergone rapid phenotypic divergence in terms of body shape. Experimental evidence suggests that phenotypic plasticity is not responsible for shape divergence. We conclude that body shape is adaptive to local environments for White Sands pupfish populations. The association of body shapes and local environments is consistent with the ESU designation of White Sands pupfish populations, and our results should have bearing on conservation strategies for the two pupfish ESUs.

P078 COLON, CHRISTINA. New York Botanical Garden, 200th Street and Kazimiroff Boulevard, Bronx, NY 10458, USA (ccolon@nybg.org).
THE VALUE OF A SELECTIVELY LOGGED FOREST AS A VIABLE HABITAT FOR THE MALAY CIVET (*VIVERRA TANGALUNGA*)

The value of logged forests may be high for some species, and can be maximized through proximity to undisturbed areas that may serve as a biological reservoir. To examine the impact of selective logging on civets, a radiotelemetry study of the Malay civet was carried out from 1995 to 1997, in Sabah, East Malaysia. Data on home range, movement and activity were collected on animals in a selectively logged and unlogged dipterocarp rain forest. Mean home range size was 110 ha and did not differ between sites. In areas of range overlap, study animals avoided one another. Day-beds were located on the ground and were associated with dense cover. Activity levels averaged 55% and were similar between forest types. In a single day, males traveled further and covered a larger portion of their home range than females. Roads and trails were used by both sexes, and were the only observed source of mortality. While density was higher in the unlogged forest, this species survived well in both areas. This may be due to its ecological plasticity as well as the proximity of undisturbed habitat that served as a biological reservoir, or source of individuals to immigrate into the disturbed habitat.

C19-08 COMPTON, BRADLEY W., and Paul R. Sievert. Department of Natural Resources Conservation, University of Massachusetts, Amherst, MA 01003, USA (bcompton@forwild.umass.edu) (BWC); U.S. Geological Survey, Massachusetts Cooperative Fish and Wildlife Research Unit, University of Massachusetts, Amherst, MA 01003, USA (PRS).
A LANDSCAPE MODEL OF BLANDING'S TURTLE HABITAT IN EASTERN MASSACHUSETTS

Blanding's turtles (*Emydoidea blandingii*) are threatened throughout their disjunct eastern range. Massachusetts has the most extensive eastern populations, but they are threatened by a dense road network and ongoing suburban development. Blanding's turtles make long overland treks between wetlands, often crossing roads in the process. As a long-lived iteroparous species, populations are sensitive to anthropogenic adult mortality, such as roadkills. A conservation strategy for Blanding's turtles must include identification and protection of habitat where animals can move normally without crossing roads. We obtained 2776 radiotelemetry locations of 48 Blanding's turtles at eight sites in northeastern Massachusetts over two years. Home range lengths (the longest distance between locations) ranged from 256 m to 3203 m (median = 909 m, $\log_{10}$ mean = 2.96, $\log_{10}$ s.d. = 0.23). We used photo-interpreted wetlands (including vernal pools) and roads across the 7000 km^2 range of Blanding's turtles in Massachusetts in a GIS to model the percentage of turtles with a home range centered in each wetland that would never cross a road, thereby identifying wetland complexes with a low risk of roadkill. Results across the landscape identify Blanding's 'hot spots' where viable populations may exist, helping to focus conservation efforts and target surveys.

P001 Cook, Terry, Mark Goering, Zach Ferdana, **JOHN FLOBERG,** Tracy Horsman, and Marcy Summers. The Nature Conservancy, 217 Pine Street, Suite 1100, Seattle, WA 98101, USA (jfloberg@tnc.org) (MG, ZF, JF, TH, MS); The Nature Conservancy, 490 Westfield Road, Charlottesville, VA 22901, USA (TC).
AN ECOLOGICAL ASSESSMENT OF THE WILLAMETTE VALLEY-PUGET TROUGH-GEORGIA BASIN ECOREGION: AN ANALYSIS TO IDENTIFY, INTEGRATE AND PRIORITIZE AREAS OF FRESHWATER, TERRESTRIAL AND MARINE BIODIVERSITY SIGNIFICANCE

The Nature Conservancy, along with a variety of state, provincial, and federal partners, conducted an ecological assessment of the Willamette Valley-Puget Trough-Georgia Basin (WPG) ecoregion for the purpose of identifying and prioritizing biologically significant areas. This group of conservation areas represents our best attempt, given current knowledge, to depict a set of locations that, if properly managed, would conserve all biodiversity representative of this ecoregion. The assessment used a combination of coarse filter targets (ecological systems) and fine filter targets (species and natural communities) to identify terrestrial, freshwater, and marine areas of biological significance. The total number of targets used in the assessment was 867. Number and area goals for all targets were developed and used to identify the conservation areas using the SITES computer model. Separate model runs for terrestrial, freshwater, and marine targets were performed using three separate 'cost' or suitability indices. These indices, based upon such factors as road density, dam density, land ownership, zoning, landcover, etc. are used to help determine the most efficient selection of sites. Terrestrial, freshwater and marine sites were then integrated through GIS overlay and refined through expert review. Three hundred and forty-three areas of biological significance were identified during the assessment representing 24% of the total land and 9% of the total marine area of the ecoregion.

C48-06 **COOPER, ANNE M.,** Loren M. Miller, and Anne R. Kapuscinski. Department of Fisheries, Wildlife and Conservation Biology, University of Minnesota, 1980 Folwell Avenue, St. Paul, MN 55108, USA (amcoop@fw.umn.edu).
MICROSATELLITE MARKER EVALUATION OF COASTER BROOK TROUT (*SALVELINUS FONTINALIS*) BROODSTOCK DEVELOPMENT FOR LAKE SUPERIOR

Coaster brook trout (*Salvelinus fontinalis*), a migratory life-history variant of brook trout, have decreased dramatically in abundance in Lake Superior. In response, the USFWS developed captive broodstocks using Isle Royale wild brook trout from two locations to restore extirpated populations within the lake. Our objective was to evaluate genetic changes occurring during broodstock development and, specifically, to determine if equalizing family size at an early life stage led to equal family sizes at older ages. Wild founder adults and source populations were genotyped at microsatellite DNA loci. The two source populations were highly differentiated (Fst = 0.15). Subsequent hatchery generations maintained the genetic variation and allelic diversity of the founders. Using parentage assignment we determined that manually equalizing family size at eyed egg-take resulted in equal family representation at later life stages with one possible exception. This supports the USFWS practice of equalizing family size as a method to maintain effective population size and reduce domestication selection within the hatchery. Genetic data added to known differences in life history traits implies that the two source populations exhibit low straying levels and are not one homogenous population, supporting the USFWS's practice of keeping separate strains to maintain local adaptations.

C06-06 **CORDEIRO, NORBERT J.,** and David A.G. Patrick. Department of Biological Sciences, University of Illinois-Chicago, m/c 066, 845 West Taylor Street, Chicago, IL 60607, USA (NJC); Durrell Institute for Conservation and Ecology, University of Kent, Canterbury, Kent CT2 7NZ, UK (DAGP).
SEED DISPERSAL AND INVASION OF AN EXOTIC TREE IN AN AFRICAN FOREST RICH IN ENDEMIC BIOTA

Few studies quantify how seed dispersers may influence the invasion process of exotic trees in tropical forests. We evaluated the seed dispersal ecology of *Maesopsis eminii* (Rhamnaceae), an early successional exotic tree species originally from central to western Africa that has extensively invaded forests in the East Usambara Mountains, Tanzania. Through focal watches at eight trees, we determined the primary dispersal agents and various aspects of their dispersal effectiveness. Three of 13 frugivores that consumed *Maeospsis* fruits functioned as primary seed dispersers: Silvery-cheeked hornbill *Ceratogymna brevis*, Fischer's turaco *Tauraco fischeri* and Blue monkey *Cercopithecus mitis*. Hornbills dispersed > 26 and > 3 times more seeds on average than monkeys and turacos, respectively. Germination experiments revealed that gut passage through hornbills did not hinder seed viability. Furthermore, seed germination in four microhabitats demonstrated that large gaps and forest edges had significantly higher germination rates than understory and small gap locations. Given the extensive movements of hornbills throughout this fragmented forest archipelago, coupled with dispersal of high quantities of viable seeds, we suggest that the expansive *Maesopsis* invasion of East Usambara forests was, in part, facilitated by the presence of this very effective dispersal agent.

C08-06 COSYLEON, GABRIEL B., and Steven S. Schwartz. Department of Zoology, Oklahoma State University, Stillwater, OK 74078, USA (Cosyleo@okstate.edu).
MICROCRUSTACEAN SPECIES RICHNESS IN EPHEMERAL WETLANDS AMONG THE ECOREGIONS OF OKLAHOMA

Isolated ephemeral wetlands are ubiquitous in all but the most arid landscapes. Although they provide habitat for many unique invertebrates, our knowledge of local and regional patterns of species distribution and richness is weak. These habitats are highly fragmented in space and time, without connection across the landscape. Given the intimacy of the terrestrial landscape of these shallow (< 1 m) habitats, we tested the hypothesis that terrestrial ecoregions can predict aquatic microcrustacean community assemblages. We intend to determine quantitative criteria with which to formulate protocols for protecting ephemeral aquatic ecosystems. In spring, 2001 and fall, 2002, we sampled 146 ephemeral wetlands across the 11 ecoregions of Oklahoma. Microcrustacean species richness was determined for each habitat and compared within and between ecoregions. Although invertebrate assemblages of ecoregions were distinctive, each ecoregion could not be clearly discriminated. We believe that this can be explained by the island-like nature of these habitats. The use of species-area relationships on a subset of wetlands reveals that ephemeral pond fauna increase similarly to real islands. Such data demonstrate protecting areas containing several wetlands may be effective for conservation. However the importance of individual isolated wetlands must not go unappreciated.

P091 COURTER, LINDA K., and Shanna E. Carney. Department of Biology, Colorado State University, E411 Anatomy/Zoology Building, Fort Collins, CO 80523, USA (lcourter@lamar.colostate.edu).
POPULATION GENETIC STRUCTURE OF A RARE COLORADO ENDEMIC, *PHYSARIA BELLII*, USING PCR-RFLP MARKERS

Physaria bellii (Bell's Twinpod) is a self-incompatible member of the Brassicaceae (Mustard family) whose range is restricted to three counties in north-central Colorado. This Front Range endemic has probably never been common, due to its particular habitat preferences; it occurs on open shale and, less commonly, sandstone washes. As many of the populations are found on lands protected by county and city open space programs, there was a need to assess the relative health of this species for future management plans. Leaf tissue samples were collected from populations throughout *P. bellii's* range and DNA was extracted for the purposes of analyzing the genetic variation found between and within populations. Codominant molecular markers were sought for this study because they are more informative than dominant markers and because the relatively narrow distribution of *P. bellii* suggests the possibility of low amounts of variation. PCR-RFLP (Polymerase Chain Reaction – Restriction Fragment Length Polymorphism) markers were screened from universal primers to find informative markers for *P. bellii*. Several informative markers were found that were polymorphic. The data suggest that *P. bellii* populations are presently stable. Future studies will address whether that stability is threatened by hybridization with a congener.

S03-01 CROOKS, KEVIN, Muttulingam Sanjayan, and Autumn-Lynn Harrison. Department of Wildlife Ecology, University of Wisconsin–Madison, Madison, WI 53706, USA (kcrooks@wisc.edu) (KC); The Nature Conservancy, 4245 North Fairfax Drive, Suite 100, Arlington, VA 22203 (MS, ALH).
THE IMPORTANCE OF CONNECTIVITY FOR CONSERVATION: INTRODUCTION TO THE SYMPOSIUM

Fragmentation of the natural world is occurring at increasingly rapid rates, and with more permanence. Thus, it is not surprising that conservationists have long promoted the value of maintaining connectivity between natural areas. While the vision of a connected natural world is indeed compelling, implementation strategies for maintaining connections are challenging. Despite the many pitfalls and arguments for and against corridors, the fact remains that connecting landscapes is a major and growing part of conservation worldwide. This growing prominence is reflected in the diversity of talks within this symposium. The field of connectivity includes experimental approaches, modeling, and implementation while also covering terrestrial and aquatic systems at many scales. For an emerging field fast amassing a body of results, there has not previously been a useful framework to organize, evaluate and examine trade-offs for each of these efforts. Here, we will outline and propose such a framework while examining the major areas of conceptualization, research, and implementation relevant to connectivity. We will highlight the trade-offs and new areas of investigation that are yet to be tackled. As such, this symposium will guide but also challenge practitioners as to how best to apply existing knowledge to the task of maintaining connections for nature.

C21-02 CROUSE, DEBORAH T., Mary Parkin, Susan Pultz, Karene Motivans, Barry Thom, Carlita Payne, Judy Jacobs, Linda Walker, and Patty Worthing. U.S. Fish and Wildlife Service, 4401 North Fairfax Drive, Room 420, Arlington, VA 22203, USA (Debby_Crouse@fws.gov).
RECOVERY PLANNING FOR ENDANGERED AND THREATENED SPECIES IN THE U.S.: THE FUTURE

A key step to recovering endangered and threatened species is the development of a scientifically sound, strategically effective, and realistically implementable recovery plan to guide responsible agencies and their partners in effecting the recovery of any particular species. The U.S. Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS), the responsible agencies under the U.S. Endangered Species Act of 1973, as amended, promulgated guidelines in 1990 and 1992 respectively

for the development of recovery plans for listed species under their authorities. In 1998, the Society for Conservation Biology and the FWS began collaboration on an analysis of the science in FWS endangered species recovery plans, with a mind to strengthening future planning. The findings and recommendations from that study were completed and published in 2002. Concurrently, the FWS and NMFS began development of joint revised recovery planning guidelines based on statutory requirements, on-the-ground experience from the two agencies, and the SCB study. The authors will review the status of the revised guidance and ways in which the SCB study has influenced endangered species recovery planning in the U.S.

S06-01 CROWDER, LARRY B. Duke University Marine Laboratory, Nicholas School of the Environment and Earth Sciences, 135 Duke Marine Lab Road, Beaufort, NC 28516-9721, USA (lcrowder@duke.edu).
IMPLICATIONS OF BIODIVERSITY LOSS IN AQUATIC ECOSYSTEMS: A SOMEWHAT SALTY PERSPECTIVE ON THREATS TO BIODIVERSITY AND FISHERIES IN THE GREAT LAKES

The Great Lakes have experienced increasing threats to biodiversity including altered hydrography, pollution, habitat alteration, invasive species, local extinction, and effects of global change. Here I place the Great Lakes in context from small freshwater systems to oceans regarding these threats and implications for fisheries. Species losses and invasions are much more common in small "insular" freshwater systems that in open "continenta" oceanic systems. Many freshwater stream fishes are extinct. But fewer extinctions of marine vertebrates have been documented than of fishes alone in the Great Lakes. Species losses and gains in the Great Lakes make some fisheries food webs vulnerable to invasion or rapid change relative to more diverse marine systems. Habitat loss and alteration is most extreme in freshwater systems and relative to open oceans. In marine systems, commercial fishing capacity far exceeds possible yields and many fisheries have destructive habitat or bycatch effects. By contrast commercial fisheries in the Great Lakes are a remnant of their former size – recreational fisheries dominate. Approaches to protecting biodiversity in marine systems increasingly focuses upon spatial reserves or zoning to meet the variety of goals society places upon these systems and to keep our options open for the future.

C23-06 CUERVO, ANDRES, and Carla Restrepo. Department of Biology, University of Puerto Rico, PO Box 23360, San Juan, Puerto Rico 00931-3360 (acmaya@hotmail.com).
HABITAT FRAGMENTATION INCREASES FLUCTUATING ASYMMETRY IN NEOTROPICAL MONTANE BIRDS

Organisms subject to strong environmental or genetic stresses such as those resulting from habitat fragmentation may exhibit high levels of fluctuating asymmetry (FA) in traits otherwise symmetrical. We assessed the effect of habitat fragmentation on tarsus FA in assemblages of neotropical birds mistnetted in highly fragmented (fragments averaging 20ha), moderately fragmented (~ 100ha), and continuous (> 1,000ha) forests of the Central Andes of Colombia. We found that bird assemblages from highly and moderately fragmented forests had significantly higher levels of tarsus FA than those from continuous forests. Our results suggest that fragmentation of tropical montane ecosystems can disrupt developmental processes and ultimately impact bird fitness. In addition, our results suggest that FA can be used to predict bird populations that are threatened, and eventually species that are prone to extinction in highly fragmented montane landscapes.

C35-05 CULVER, DAVID, Horton H. Hobbs III, and Irena Sereg. Environmental Studies Program, American University, 4400 Massachusetts Avenue NW, Washington, DC 20016, USA (DC, IS); Department of Biology, Wittenberg University, PO Box 720, Springfield, OH 45501, USA (HHH).
ENDEMISM, SPECIES RICHNESS, AND PROTECTION PRIORITIES FOR THE EASTERN NORTH AMERICAN SUBTERRANEAN FAUNA

An extraordinarily high percentage of obligate subterranean species found east of the Mississippi River are known from a single cave – 33 percent of the 166 aquatic species and 43 percent of the 428 terrestrial species. All 239 single-cave endemics are ranked as critically imperiled (G1) by NatureServe but only three are listed under the Endangered Species Act. An additional 6 percent of the aquatic species and 12 percent of the terrestrial species are endemic to a single 1000 km^2 hexagon. The number of endemics is so large that for many states or ecoregions, it overwhelms the list of surface-dwelling endemic species. The coincidence of centers of endemism and centers of species richness can aid in establishing protection priorities. For terrestrial species, hexagons of high endemism correspond to hexagons of high species richness 80 percent of the time. For individual caves the corresponding figure was 32 percent. The coincident centers are clustered in northeast Alabama and southwest Virginia. For aquatic species, hexagons of high endemism correspond to hexagons of high species richness 50 percent of the time, and for caves 57 per cent of the time. The coincident centers are clustered in southern West Virginia and southern Indiana.

C34-08 CUTTER, PETER G., and J.L. David Smith. Conservation Biology Graduate Program, University of Minnesota, 180 McNeal Hall, 1985 Buford Avenue, St. Paul, MN 55108, USA (pcutter@fw.umn.edu).
DISTRIBUTION AND MONITORING OF TIGERS IN THAILAND'S WESTERN FOREST COMPLEX

Patterns of tiger and tiger prey distribution and their habitat associations were assessed over a large, forested area (~ 10,000 km^2) in the northern part of the Western Forest Complex in Thailand. Tigers were disproportionately found in gentle terrain with little human disturbance. The data suggest that there is a population of at least 34 adult tigers in the area surveyed. A preliminary evaluation of satellite images from neighboring unsurveyed areas of Thailand and Myanmar indicates that contiguous potential tiger habitat extends far beyond the bounds of area considered in this analysis. Compared with current estimates of tiger populations throughout their range, this study provides evidence that the Southern Tenasserim region is home to the world's second largest tiger population. A practical monitoring strategy based on tiger residency within explicit 100-300 km^2 watershed survey units is developed that would effectively detect declines of 10% in tiger residency over a 3 year period.

C49-08 CZECH, BRIAN. U.S. Fish and Wildlife Service, National Wildlife Refuge System, 4401 North Fairfax Drive, MS 670, Arlington, VA 22203, USA (brian_Czech@fws.gov).
ECONOMIC GROWTH, TECHNOLOGICAL PROGRESS, AND BIODIVERSITY CONSERVATION

Economic growth is an increase in the production and consumption of goods and services and is a function of increasing population and per capita consumption. Economic growth generally proceeds at the competitive exclusion of non-human species in the aggregate and threatens other levels of biodiversity. Technological progress is an increase in material output per unit input and has been proffered to reconcile the conflict between economic growth and biodiversity conservation. Skeptics argue that technological progress is typically used in the pursuit of growth rather than conservation. This argument leaves open the possibility of reconciliation. However, a new analysis of the sources and institutions of technological progress casts doubt on the possibility of technological progress to reconcile growth with conservation. The primary source of technological progress is research and development, 95.2% of which is corporately or federally funded. Research and development funding is a function of pre-progress per capita economic growth and results from economies of scale. This suggests: 1) a positive feedback loop of technological progress and economic growth; 2) the fundamental conflict between economic growth and biodiversity conservation entails a fundamental conflict between technological progress and wildlife conservation, at least given current institutional arrangements for research and development.

C33-06 D'AGROSA, CATERINA, K. David Hyrenbach, Larry B. Crowder, and Gil Rilov. Nicholas School of the Environment and Earth Sciences, Duke University Marine Laboratory, 135 Duke Marine Lab Road, Beaufort, NC 28516, USA (ced@duke.edu) (CD, KDH, LBC, GR); Department of Zoology, University of Canterbury, Private Bag 4800, Christchurch, New Zealand (GR).
IS SEA TURTLE BYCATCH INEVITABLE IN SWORDFISH LONGLINE FISHERIES?

Pelagic longlines take many non-target taxa, including endangered leatherback *Dermochelys coriacea* and threatened loggerhead sea turtles *Caretta caretta*. To determine whether the distribution of turtle bycatch and fishing effort are predictably associated with specific oceanic habitats, we examined the spatio-temporal patterns of fishing effort and sea turtle bycatch in the U.S. North Atlantic (1992-1999) and Hawaiian-based (1994-2000) swordfish fisheries using a GIS and multivariate spatial statistics. In the Atlantic, the number of hooks set is positively related to swordfish catch ($p = 0.001$) and significantly linked to depth ($p = 0.03$). Loggerhead bycatch was positively correlated to swordfish catch ($p = 0.016$) and was higher at particular sea surface temperatures (SST, $p = 0.01$). Leatherback bycatch was also positively correlated to swordfish catch ($p = 0.001$) and tended to be higher where depths changed slowly ($p = 0.049$). As in the Atlantic, more hooks set correlates positively to swordfish catch in the Pacific ($p = 0.001$). Loggerhead catches were higher when swordfish catches were higher ($p = 0.001$) and related to particular ranges of SST ($p = 0.084$). Because marine turtles do not concentrate exclusively along restricted bathymetric habitats and turtle bycatch is strongly positively correlated with swordfish catch, our results suggest that traditional "site-specific" management approaches may only provide limited protection for these broadly-distributed species.

C42-02 DADASER, FILIZ, and Uygar Ozesmi. Water Resources Science Program, University of Minnesota, 173 McNeal Hall, 1985 Buford Avenue, St. Paul, MN 55108, USA (dada0004@tc.umn.edu) (FD); Department of Environmental Engineering, Erciyes University, 38039, Kayseri, Turkey (UO).
THE USE OF FUZZY COGNITIVE MAPPING FOR STAKEHOLDER INVOLVEMENT IN ENVIRONMENTAL POLICY-MAKING AT SULTAN MARSHES – TURKEY

Stakeholder involvement in environmental policy-making necessitates a strong method to obtain stakeholders' views and perceptions. We used fuzzy cognitive mapping to develop management policies for Sultan Marshes ecosystem, a Ramsar site in Turkey. Five stakeholder groups were identified and 56 cognitive maps were prepared with the stakeholders. Cognitive maps

were analyzed using graph theory indices, statistical methods and artificial neural networks. According to the statistical analysis, local people (group consisting of local decision makers, villagers, reed exporters, park wardens) and government officials were the most dissimilar groups. While government officials have a broader view of the ecosystem, local people are more focused on the issues related to their life and the marshes. The most mentioned and the most central variable for local people are "livelihood," whereas they are "birds" for government official. Both of the groups agree that water policies and projects increase agriculture. However they also indicate that water policies and projects increase water problems and decrease ecosystem integrity. "What-if" scenarios were determined based on stakeholder recommendations. The results indicate that conservation strategies developed for Sultan Marshes should also focus on livelihoods of local people and consider villagers' welfare while conserving ecosystem.

P087 DANIELS, AMY, Marcie Baer, and Timothy Maret. Department of Biology, Shippensburg University, 1871 Old Main Drive, Shippensburg, PA 17257, USA (ad7446@ship.edu).
GENETIC ANALYSIS OF POPULATION STRUCTURE OF VERNAL POOL AMBYSTOMATID SALAMANDERS

Vernal pool communities are being threatened by development and currently receive little protection in Pennsylvania. Since ambystomatid salamander populations are an important component of these communities, understanding the population structure and migration patterns will aid in the development of conservation strategies of vernal pool communities. Larval tissue samples (tail snips) of *Ambystoma opacum*, *Ambystoma maculatum*, and *Ambystoma jeffersonianum* were collected in the summer of 2002 from different areas in south central Pennsylvania. RAPD analysis of genomic DNA utilizing two different primer sets (GGGAATTCGG, GGCTGCAGAA) displayed unique species patterns. Within species, results demonstrated that between pond genetic variation was greater than within pond variation. Results suggest that most individuals return to their natal pools to breed although some migration appears to occur between close ponds. Unrooted trees based on Nei's genetic distances indicate that genetic diversity increases with geographic distance.

C23-03 DANZ, NICHOLAS, Gerald Niemi, Jim Lind, JoAnn Hanowski, and Malcolm Jones. Natural Resources Research Institute, University of Minnesota Duluth, 5013 Miller Trunk Highway, Duluth, MN 55811, USA (ndanz@nrri.umn.edu).
FOREST COVER AFFINITIES FOR GREAT LAKES BIRDS: DO THEY SEE THE FOREST OR THE TREES?

Associations between bird species occurrence and forest cover are important in conservation efforts ranging from predictive modeling to forest planning. Forest cover classification is often based upon mapping features not explicitly related to habitat of individual bird species, such as forest stand boundaries or pixels. Our objective was to describe how bird species affinity for forest cover varied according to how the forest was classified. Our forest cover classifications ranged from coarse to fine resolution (2 to 15 cover types), and were based upon tree species, stand age, and physiography individually and together. Occurrences for 77 bird species were compiled from a long-term regional monitoring program, and Indicator Value was used to describe species affinity to forest cover. Strong affinities were noted in all classifications, demonstrating how species perceive forest cover differently. Most species had strongest affinities in classifications with coarse resolution, especially the classification based on stand age alone. Uncommon species tended to have strongest affinities in classifications with fine resolution. This work suggests that a variety of forest cover types are needed to maintain bird populations and that modeling exercises may be improved by matching forest cover classifications to species being modeled.

P031 DARNELL, TRACI, and Kathryn Sieving. Department of Wildlife Ecology and Conservation, 303 Newins-Ziegler Hall, University of Florida, Gainesville, FL 32611, USA (tracidarnell@hotmail.com).
MATRIX PERMEABILITY AND USE OF VEGETATED CORRIDORS BY ENDEMIC SOUTH-TEMPERATE RAINFOREST BIRDS: A TRANSLOCATION EXPERIMENT

Translocation experiments are underway to test the permeability of forest corridors relative to two matrix types (pasture and shrub fields) to movement by the Chucao Tapaculo (*Scelorchilus rubecula*), a forest understory bird endemic to South American temperate rainforest. These data will be used to parameterize a spatially explicit metapopulation model that will predict patch occupancies within real and hypothetically modified landscapes. Preliminary analysis of existing data (41 birds tested to date) show significant effects of matrix type on movement decisions that outweigh the importance of other landscape variables (e.g. patch area and nearest-patch distance). The number of days birds remained in release patches prior to dispersal (a measure habitat resistance) was significantly different among treatments, with dispersal occurring sooner for patches surrounded by dense shrubs, or adjoining corridors, than for patches surrounded by pasture. Our results support the hypothesis that matrix types differ in their resistance to animal movement, and that explicit consideration of matrix permeability is important for realism of metapopulation models.

C31-05 Davenport, Tim R.B., and **GRAEME PATTERSON.** Wildlife Conservation Society, PO Box 1475, Mbeya, Tanzania (trbd@twiga.com) (TRBD); Wildlife Conservation Society, 2300 Southern Boulevard, Bronx, NY 10460, USA (gpatterson@wcs.org) (GP).
BURNING, GRAZING AND TRADE: TOWARDS CONSERVATION OF PLATEAU GRASSLANDS IN SOUTHERN TANZANIA

The montane grasslands of southern Tanzania are amongst the most important areas for floral conservation in Africa. Add to that a range of endemic fauna, and the biodiversity value of this neglected region is clear. The past decade has witnessed a sharp rise in demand in Zambia for Kinaka or Chikanda, the edible root tubers of terrestrial orchids (principally *Disa*, *Habenaria* and *Satyrium* spp.). This has prompted increased numbers of traders to collect tubers from Tanzania's Southern Highlands. We have studied the resulting cross-border trade and showed that between 2.2 and 3 million tubers a year, from 85 species, are being harvested and exported despite a CITES 2 classification. A combined conservation effort was thus set in motion leading to the announcement of Kitulo Plateau as Tanzania's next National Park and the first in the continent designated primarily for plants. In order to manage this unique grassland it may be necessary to implement innovative management systems such as rotational burning, and sustained grazing by cattle or reintroduced herbivores. Meanwhile, the unsustainable trade in orchids is spreading unchecked across the south of Tanzania demanding the introduction of licenses, quotas or border controls if many endemic orchids are not to go extinct.

C32-02 **DAVIES, JEREMY,** Beth Sanderson, Kerry Lagueux, Tim Beechie, and Mary Ruckelshaus. NOAA Fisheries, Northwest Fisheries Science Center, 2725 Montlake Boulevard East, Seattle, WA 98112, USA (jeremy.davies@noaa.gov).
IS THERE ENOUGH QUALITY HABITAT REMAINING TO SUPPORT VIABLE POPULATIONS OF CHINOOK? A SPATIAL ASSESSMENT OF SALMON SPAWNING HABITAT IN PUGET SOUND

The ability of freshwater habitat to support and sustain healthy populations of salmon has changed markedly from historical conditions. In Puget Sound, where chinook are threatened, we have developed methods for quantifying habitats used by adult and juvenile life stages for both current and historical conditions. Our approach for deriving coarse-scale estimates of existing chinook spawning habitat utilizes existing geospatial data coupled with empirical data from previous studies to develop a spawning suitability index for individual stream reaches. This index is derived using stream gradient, estimated bank full width, and riparian condition. The validity of this approach is being assessed using information from ongoing fine-scale analyses and local watershed groups. Preliminary results indicate that anthropogenic barriers exclude adult chinook from large areas of formerly accessible spawning habitat, and that changes in riparian conditions have reduced the spawning potential of many reaches. For example, the potential capacity of chinook spawners has declined 35% in the Snohomish Basin. Ultimately our results will be used to compare the current and historical potential of Puget Sound watersheds to support chinook salmon, and to assist local watershed groups in setting protection and restoration goals.

C15-01 **DAVIS, FRANK,** Chris Costello, David Stoms, Sandy Andelman, Helen Regan, Elia Machado, and Josh Metz. Donald Bren School of Environmental Science and Management, University of California, Santa Barbara, Santa Barbara, CA 93106-5131, USA (fd@bren.ucsb.edu) (FD, CC, DS, EM, JM); National Center for Ecological Analysis and Synthesis, University of California, Santa Barbara, 735 State Street, Suite 300, Santa Barbara, CA 93101-3351, USA (SA, HR).
A NEW SYNTHETIC APPROACH TO CONSERVATION PLANNING

Much of the research in systematic conservation planning has focused on techniques for identifying the minimal land allocations needed to reach specified conservation targets or for maximizing the amount of conservation accomplished under an area or budget constraint. In this talk we present a new conservation-planning framework. We define a hierarchy of conservation objectives and associated criteria and assess the current conservation system, as well as the marginal conservation value of candidate conservation areas, based on resource quality and threat. We allocate available conservation funds to maximize the overall utility of the conservation system based on assessed value relative to cost. The planning approach is designed to support collaborative processes and negotiation among competing interest groups. I demonstrate these ideas with a case study for conserving biodiversity of the Sierra Nevada Bioregion. The framework was designed, however, to accommodate other conservation values such as working landscapes and urban open space. We submit that, compared to traditional reserve selection approaches, the proposed framework accounts for a broader range of conservation objectives, deals more appropriately with threats, provides substantial flexibility to explore different stakeholder values, and is more consistent with economic theory.

P101 **de GOUVENAIN, ROLAND,** and John Silander, Jr. Department of Ecology and Evolutionary Biology, University of Connecticut, U-42, 75 North Eagleville Road, Storrs, CT 06269, USA (roland.degouvenain@uconn.edu).
CAN TROPICAL FOREST HARVESTING BE SUSTAINABLE?

Can tree harvesting by local residents be sustainable and compatible with the long-term conservation of coastal rainforests in eastern Madagascar? To answer this question, we determined what harvesting regimes were sustainable (or not) for a set of native

tree "target species" using empirical, field calibrated population dynamics models. We conducted tree demographic inventories in 50 x 50 m replicated plots in stands subjected to different levels of harvesting, and in two distinct forests. We calculated effective reproductive output as a function of tree diameter for each target species, and we estimated species-specific growth from prior data. We estimated population viability for the target species using two types of structured population models: Lefkovitch matrix models and Integral Projection models. Population-level response to harvesting varied among species depending on their life history strategies. Within a shade tolerant guild, some species benefited from moderate harvesting (< 50% of largest diameters removed) while others were negatively affected. At the community level, a stand-level rotation system of light to moderate harvesting (20-50% of largest diameters per rotation) could be both sustainable and promote native biodiversity conservation. Light harvesting applied uniformly would not maintain biodiversity since some shade tolerant canopy species would be lost.

C28-05 DE LIMA, MARCELO GONÇALVES, Mario Barroso Ramos-Neto, Ricardo Bonfim Machado, and Roberto Brandão Cavalcanti. Pós Graduação em Ecologia, Departamento de Ecologia, IB, Universidade de Brasília, Brasília, 70910-900, Brazil (mglima@unb.br) (MGdeL); Conservation International do Brasil, SLCN 212 Bloco D Sala 103, Brasília, 70864-540, Brazil (MBRN, RBM); Conservation International, 1919 M Street NW, Suite 600, Washington, DC 20036, USA (RBC).
CERRADO FRAGMENTATION: DO BIRDS PERCEIVE IT?

The Cerrado is the most diverse savanna in the world and is considered a biodiversity hotspot. Of its original cover of 1,783,200 km^2 though, only 20% remains. As human occupation is so intense and recent, little is known about the fragmentation effects upon the Cerrado's biodiversity. We studied the fragmentation effect on the Cerrado bird community in the region of Emas National Park (132,000 ha), which is surrounded by a matrix of both agriculture and cattle ranching. Bird species were investigated in twelve study sites (six inside the preserve and six in the neighboring landscape). Each site was visited five times along a fixed transect of 500m x 50m, and all birds observed inside the transect were recorded during a one hour period after dawn. A total of 626 observations were recorded of 58 bird species. A DCA analysis was unable to separate groupings and a co-occurrence analysis showed no "check board" community pattern. A two-way Anova analysis of density data showed that only eight species had significant differences between sites. Our data suggests that some Cerrado bird species may be less sensitive to fragmentation due to the fact that the natural landscape is a mosaic of formations including open ones.

C46-05 DEBINSKI, DIANE M., Mark E. Jakubauskas, and Kelly Kindscher. Ecology, Evolution and Organismal Biology, Iowa State University, Ames, IA 50011, USA (debinski@iastate.edu) (DD); Kansas Applied Remote Sensing Program, University of Kansas, Lawrence, KS 66045, USA (MJ); Kansas Biological Survey, 2041 Constant Avenue, University of Kansas, Lawrence, KS 66047, USA (KK).
MONTANE MEADOWS AS INDICATORS OF GLOBAL ENVIRONMENTAL CHANGE

We used a time series of satellite multispectral imagery for mapping and monitoring six classes of montane meadows arrayed along a moisture gradient (from hydric to mesic to xeric). We hypothesized that mesic meadows would support the highest species diversity of plants, birds, and butterflies because they are more moderate environments. We also hypothesized that mesic meadows would exhibit the greatest seasonal and interannual variability in spectral response. Field sampling in each of the meadow types was conducted for plants, birds, and butterflies. Mesic meadows supported the highest plant species diversity, but there was no significant difference in bird or butterfly species diversity among meadow types. These data show that it may be easier to detect significant community differences in more species rich taxa (e.g., plants) than taxa that are represented by fewer species (e.g., butterflies and birds). However, at the species level, there are significant relationships between many of the bird and butterfly species and specific meadow types. Mesic meadows showed the greatest seasonal and interannual variability in spectral response. Given the rich biodiversity of mesic montane meadows and their sensitivity to variations in temperature and moisture, they may be important to monitor in the context of environmental change.

C25-01 DEHGAN, ALEX. Committee on Evolutionary Biology, University of Chicago, 1025 East 57th Street, CH402, Chicago, IL 60637, USA and Division of Mammals, Field Museum of Natural History, 1400 South Lake Shore Drive, Chicago, IL 60605, USA (adehgan@midway.uchicago.edu).
PLASTICITY-DEPENDENT CHANGES IN DEMOGRAPHY, BEHAVIOR, AND PHYSIOLOGY IN RESPONSE TO FRAGMENTATION FOR RAINFOREST LEMURS IN S.E. MADAGASCAR

Conservation Biology has long searched for predictive framework for policy. This study examines one novel approach – behavioral plasticity – and compares it to other predictive methods. The degree of phylogenetic constraint on an organism's behavior (behavioral plasticity) is important in determining that individual's response to environmental changes, such as forest fragmentation. To adjust to heterogeneous distribution of resources, those species with a high degree of behavioral plasticity were predicted to modify their behavior to increase their foraging effort. Conversely, those species estimated to be more behaviorally constrained were predicted to have no change in their foraging effort, but consequently to suffer physiological and demographic

declines. These predictions were tested in Madagascar for two lemur species, *Eulemur fulvus rufus*, and *Propithecus diadema edwardsi*, which exhibited greater and lesser degrees of plasticity, respectively. Fragment and park populations for each species were compared. In fragmented habitats, Propithecus populations did not modify their foraging effort, and consequently significantly declined in abundance and body mass. Eulemur populations, in contrast, increased their home-range by 400%, increased in abundance, and maintained their body mass. Estimates of plasticity also correlated with foraging party size and abundance in the fragments for all 12 lemur species in the park. Traditional biogeographic and local level approaches to extinction failed to predict these findings.

S06-07 DEPHILIP, MICHELE M. The Nature Conservancy, Great Lakes Program, 8 South Michigan Avenue, Suite 2301, Chicago, IL 60603, USA (mdephilip@tnc.org).
DEVELOPMENT AND IMPLEMENTATION OF A FRESHWATER CONSERVATION BLUEPRINT FOR THE GREAT LAKES REGION

In 1996, The Nature Conservancy's Great Lakes Program launched a collaborative initiative to identify areas of biodiversity significance in the Great Lakes region. At that time, despite wide recognition that the habitats of the Great Lakes region support tremendous biological diversity, there was no comprehensive vision for conservation of these resources. The Nature Conservancy and its partners recognized the need to characterize the natural diversity of the region and to develop a conservation blueprint that includes areas that need to be protected to conserve the regions native biodiversity. The ecoregional planning initiative is a systematic approach that considers elements of biodiversity species, natural communities, and ecosystems across their range, and determines how much of and where these elements need to be protected over the long term. The initiative explicitly addresses freshwater ecosystems, including rivers, inland lakes, and coastal habitats. We completed a significant portion of the conservation blueprint in 2000, and the blueprint has already begun to direct where The Nature Conservancy and its conservation partners will focus limited time and resources.

C23-04 DEVELEY, PEDRO FERREIRA. Department of Ecology, University of São Paulo, CP:11461, 05422-970, São Paulo SP, Brazil (pdeveley@uol.com.br).
EFFECT OF FOREST FRAGMENTATION ON THE DIVERSITY OF ATLANTIC FOREST BIRDS

Bird diversity in forest fragments is known to be influenced by the nature of the landscape matrix and the forest successional phase. The Brazilian Atlantic Forest is highly fragmented with a few remnants of primary forest and thus a suitable site for fragmentation studies. Even so, there are few systematic studies that have evaluated bird diversity from a landscape ecology approach. This study aims to help fill this gap by systematically studying the influence of landscape structure and forest regeneration on the diversity of Atlantic Forest birds. To do that, birds were sampled by point counts in a continuous primary forest, a secondary forest, and three fragmented landscapes with different degrees of connectivity (3x8 fragments: 4 small, 4 large). The study concludes that: (i) large forest areas (> 10,000ha) are essential for maintaining bird diversity; (ii) high connectivity associated with large forest fragments (60-260ha) is not sufficient for maintaining bird diversity; (iii) proximity to mature forest increases bird diversity in fragments; and (iv) isolation determines species depauperation, even in large forest fragments (i.e. 450ha). For bird conservation to succeed, continuous forests must be protected and connectivity restored between forest fragments and large tracts.

C11-02 DICKENS, SARA JO, Fritz Gerhardt, and Sharon Collinge. Department of Environmental, Population, and Organismic Biology, Environmental Studies Program, University of Colorado, Boulder, CO 80309-0143, USA (sarajo12@excite.com).
HUMAN DISTURBANCE AND NON-NATIVE PLANT INVASION OF THE BOUNDARY WATERS CANOE AREA WILDERNESS (BWCAW)

Invasion of non-native species is known to alter ecosystems and negatively impact native species. Disturbances, which are thought to facilitate invasions, create open spaces for establishment that initially provide increased resource availability. This study examined the role that human disturbances along trails play in the introduction and establishment of non-native plant species into the BWCAW of Northern Minnesota. On twenty portages, I sampled at four distances (0m, 10m, 25m, and 50m) perpendicular from trails (portages) connecting lakes. Distance from the trail strongly affected non-native species richness. Non-native species richness was only moderately affected by slope and trail distance from the last entry point. Non-native species richness decreased as slope increased and as distance from last vehicle accessible entry point increased. I observed six non-native species, all of which were either directly on the trail or within 1 meter of the trail. These results suggest that non-native plant invasions are strongly related to the presence of human disturbance along trails. However it is unclear whether these effects are caused by the creation of bare ground, changes in resource availability or dispersal of seeds via hikers along the trail.

C26-02 DIETZ, JAMES M., Natalie Bailey, Gary Dodge, Heather Eves, and Michael Hutchins. Graduate Program in Sustainable Development and Conservation Biology, University of Maryland, College Park, MD 20742, USA (jmdietz@umd.edu) (JMD, GD); Bushmeat Crisis Task Force, 8403 Colesville Road, Suite 710, Silver Spring, MD 20910, USA (NB, HE, MH).
ACADEMIC AND PROFESSIONAL COLLABORATION TO IDENTIFY SOLUTIONS FOR COMPLEX CONSERVATION PROBLEMS: EVALUATING COSTS AND BENEFITS OF STUDENT INTERNS AT THE BUSHMEAT CRISIS TASK FORCE

Educators of graduate students have recognized the heuristic importance of placing students in professional settings as consultants or interns. Benefits to busy employers will increase if the students are adequately prepared with protocols for addressing complex conservation problems. We developed a training procedure to improve the success of student interns, including workshops in communication, teamwork, interviewing, oral presentation, time management and peer evaluation. In this presentation we detail this procedure and evaluate costs and benefits from the perspective of a "client organization", the Bushmeat Crisis Task Force (BCTF), established to identify appropriate solutions to the unsustainable commercial trade in bushmeat. Seventeen interns from U. Maryland spent a semester working on projects identified as priorities by BCTF: an external review of BCTF; review of bushmeat public awareness campaigns in the US and Africa; a review of the concept of sustainable use; an analysis of potential economic and protein alternatives; and an analysis of the potential for developing wildlife management programs within logging concessions in Central Africa. Relative to costs and benefits that might have been obtained by hiring a consulting firm, BCTF invested more time in providing direction to the student problem solving team at the onset but received deliverables of equal quality for a fraction of the cost.

C15-02 DINERSTEIN, ERIC, Robin A. Abell, Thomas F. Allnutt, Thomas M. Brooks, Neil D. Burgess, Jennifer A. D'Amico, John F. Lamoreux, Colby J. Loucks, John C. Morrison, Mike Parr, Taylor H. Ricketts, Wesley W. Wettengel, and Eric D. Wikramanayake. World Wildlife Fund US, 1250 24th Street NW, Washington, DC 20037, USA (Eric.Dinerstein@wwfus.org) (ED, RAA, TFA, NDB, JAD, CJL, JCM, THR, WWW, EDW); Center for Applied Biodiversity Science, Conservation International, 1919 M Street NW, Suite 600, Washington, DC 20036, USA (TMB); American Bird Conservancy, PO Box 249, The Plains, VA 20198, USA (MP); Department of Environmental Sciences, University of Virginia, Charlottesville, VA 22903, USA (JFL).
IMPROVING THE BIOLOGICAL TREASURE MAP: THE ALLIANCE FOR ZERO EXTINCTIONS

A key target of ecoregion or other large-scale conservation planning is to identify irreplaceable sites containing populations of highly endangered species and rare habitats. Outside the United States and a few other areas, detailed information on rare species is quite limited. To address this gap in information, the Alliance for Zero Extinction highlights the rarest of the rare: terrestrial vertebrate species listed as Critically Endangered or Endangered on the IUCN Red List, and whose global population is limited to a single site. Our preliminary list contains over 300 sites globally, including 45% in tropical moist forest ecoregions, 10% in tropical dry forest ecoregions, and 10% in desert ecoregions. Roughly half are on islands. Among the 867 terrestrial ecoregions of the world, 8 ecoregions contained over five sites each: Sulawesi lowland forests, Hawaiian Islands, Bahia coastal forests, Serra Do Mar coastal forests, Bahamian-Antillean mangroves, Peruvian Yungas, Comoros forests, and Mascarene forests. Including AZE sites in investment portfolios and ameliorating overarching threats to these locales will increase the probability that ecoregion scale planning can achieve its goal of conserving the full expression of biodiversity and prevent extinctions.

C52-04 DOERINGSFELD, MATTHEW, Paul Meysembourg, Carol Johnston, and Isaac Schlosser. Department of Biology, University of North Dakota, Grand Forks, ND 58202-9019, USA (matthew_doeringsfeld@und.nodak.edu) (MD, IS); Natural Resources Research Institute, University of Minnesota Duluth, 5013 Miller Trunk Highway, Duluth, MN 55811, USA (PM, CJ).
GENETIC DIVERSITY AND ENVIRONMENTAL HETEROGENEITY: LESSONS FROM AN UNUSUAL COMPLEX OF CLONAL AND SEXUAL FISH IN A DIVERSE SUCCESSIONAL LANDSCAPE

Conservation of species and genetic diversity often requires implementing strategies at relatively large spatial scales. Unfortunately our understanding of how interactions between genetic variation and spatial pattern influence ecological success, dispersal, and the evolution of species interactions is very limited. Our research goals are to integrate conceptual levels of organization from genes to communities and landscapes in an effort to increase this understanding. We have been studying the ecology of a complex of clonal hybrid fish and their two sexual parental species across a spatially and temporally heterogeneous landscape in northern Minnesota. Despite its genetic uniformity, the clone is widely distributed among multiple beaver-modified drainages and successional environments. Variation in clonal abundance and relative frequencies, however, indicate that its success is mediated by both local and landscape positional effects. Relative to its sexual progenitors, the clone appears to thrive in habitats frequented by disturbance through greater hydrologic fluxes and successional processes. These environments are predominantly situated lower in the watershed of our largest study drainages. Movement studies indicate that more permeable habitat boundaries associated with successional environments promote greater dispersal, suggesting that success of the clonal genotype is ultimately tied to the availability of a diverse range of habitat conditions.

P005 DOLLAR, LUKE, Julie Pomerantz, Martel Jaonina, Leon Pierrot Rahajanirina, and Anna Kopitov. Nicholas School of the Environment and Earth Sciences, Duke University, A322 Levine Science and Research Center, Durham, NC 27708, USA (luke@duke.edu).
BIODIVERSITY AND HABITAT CONSERVATION STATUS OF A DRY DECIDUOUS FOREST IN WESTERN MADAGASCAR

The dry, deciduous forests of Madagascar have experienced a disproportionate amount of habitat destruction over the last fifty years. The Kirindy Mitea protected area is ranked among the highest priorities for research and management development. We conducted biodiversity and habitat groundtruthing surveys in November and December, 2001. We present new information on the carnivores, primates, and birds of Kirindy Mitea. Based on these surveys, we provide information on the possibility of a new subspecies of the Narrow-Striped Mongoose and range extensions for two bird species. Using remote sensing analysis of Landsat images from 1990 and 2000, we demonstrate that the Kirindy Mitea forest is undergoing a process of regeneration and likely recolonization from the surrounding forest corridor following pre-1990 deforestation events. Forest regeneration is an unfortunately rare occurrence in Madagascar. These results provide promise for the possibility of current and future conservation management initiatives in Kirindy Mitea.

PL-01 DOMBECK, MICHAEL P. Global Environmental Management Education Center, University of Wisconsin–Stevens Point, 1900 Franklin Street, Stevens Point, WI 54481, USA (mdombeck@uwsp.edu).
CONSERVATION CHALLENGES FOR A NEW CENTURY

During an illustrious quarter-century career that included stints as Acting Director of the Bureau of Land Management and Chief of the Forest Service, Mike Dombeck faced some of the nation's most daunting resource management issues. In his new role as educator and ambassador of global conservation, he offers a thought-provoking peek into the future. Guided by the wisdom of his science training and considerable first-hand experience, Dr. Dombeck presents his "Conservation Challenges for a New Century." In his refreshingly clear style and non-technical, common sense presentation, he outlines critical natural resource issues that warrant significant attention in the coming decades. Ranging from mining law, to loss of biodiversity, to wildfire, to off-road vehicle use, to the incalculable value of water, Dr. Dombeck's list will surprise some and enlighten others. Clearly, he provides a serious challenge to all, but with an air of optimism and hope. We have the ability and opportunity now to find sustainable solutions to these problems: ones that forego short-term fixes, and make sense economically and socially to the human species, for the long haul.

C33-01 DOUKAKIS, PHAEDRA, Mananjo Jonahson, Bemahafaly Jean de Dieu Randriamanantsoa, Andrew C. Cooke, and Ellen Pikitch. Marine Conservation Program, Wildlife Conservation Society, 2300 Southern Boulevard, Bronx, NY 10460, USA (pdoukakis@wcs.org) (PD, EP); Wildlife Conservation Society Madagascar, Villa Ifanomezantsoa, Face II A 78 D Soavimbahoaka, BP 8500, Antananarivo 101, Madagascar (MJ, BJdDR, ACC).
FISHERIES OF ANTONGIL BAY, MADAGASCAR: APPROACHES TO MARINE CONSERVATION

Historically, biodiversity conservation efforts in Madagascar have been largely terrestrial and freshwater focused, with marine systems only recently emerging as a conservation priority. Antongil Bay, located in northeastern Madagascar, is one of the few marine systems currently under study. Adjacent to the largest protected tract of eastern rainforest in the country, Parc National Masoala (PNM), the Bay supports coral reef marine protected areas, populations of sea turtles, dolphins, humpback whales and dugongs, and a substantial, economically important local and commercial fishery. Our work has emphasized establishing resource monitoring programs to obtain baseline information on marine resource composition and seasonal and spatial variation, and to quantify effort and use. A DNA-based monitoring program has been introduced to characterize the shark fishery and to understand the importance of Antongil Bay as a nursery and breeding area. Based on the information collected, fisheries management is being accomplished through a combination of community management, coastal zone conservation, and strategies aimed at alleviating conflict between local and commercial fishers. Lessons learned in Antongil Bay are considered within the context of marine conservation in Madagascar.

C26-01 DOVIE, DELALI B.K. Restoration and Conservation Biology Research Group, School of Animal, Plant and Environmental Sciences, University of the Witwatersrand, Wits 2050, Johannesburg, South Africa (delali@biology.wits.ac.za).
'SCIENCE' NOT 'SCIENTISM': INTERFACING DIVERSITY IN WETLAND MANAGEMENT

The ideals, rules and perception that it is only exclusive science that can provide solutions for conserving biodiversity, herein referred to as 'scientism' is questioned. More often than not 'scientism' has resulted in the complete alienation of people from biodiversity rich areas. Merging the active participation of indigenous people and their knowledge system with the role of scientists and managers is crucial for conserving biodiversity. The decision making process of conserving biodiversity in the context of sustainable livelihoods and development is one of the greatest dilemmas facing the conservation community because it is multifaceted. The conservation of coastal wetlands in Ghana has been utilised to develop a 'community conservation interface'

(CCI) model for active participation of local communities, social and natural scientists to manage wetland biodiversity. The model seeks to promote accountability, transparency and responsibility throughout a project's planning and implementation process. Additionally, it seeks to provide a forum for resolving conflicts, developing partnership and building capacity. It is applicable to community based conservation (CBC), and partnerships in protected area (PA) management and beyond. As an adaptive management initiative, the CCI is vital for decision making forums at broader scales, providing institutional interfaces for setting of common goals and indicators.

P081 DRATCH, PETER, Mathew Cronin, Michael Nelson, L. David Mech, and Timothy Miller. National Park Service, Biological Resources Management Division, 1201 Oakridge Drive, Fort Collins, CO 80525, USA (Peter_Dratch@nps.gov) (PD); LGL Alaska Research Associates, 1011 East 76th Avenue, Suite B, Anchorage, AK 99518, USA (MC); U.S. Geological Survey, Biological Resources Division, Northern Prairie Wildlife Research Center, Jamestown, ND 58401-7317, USA (MN, LDM); 4232 SW Condor Avenue, Portland, OR 97201, USA (TM).

DO MINNESOTA DEER THAT DIE BY HUMAN OR WOLF PREDATION SHOW DIFFERENCES IN PROTEIN MARKERS?

For decades, protein variation in white-tail deer (*Odocoileus virginianus*) has been used to demonstrate genetic differences between populations. An important question that these data stimulated was whether the differences of alleles and genotypes are due to selection or simply different breeding patterns in particular localities. Some studies with wild deer and sheep have shown associations of molecular genetic markers and fitness traits. Because wolf (*Canis lupus*) predation and human hunting require fundamentally different hunting behaviors, vulnerability to each predator is probably related to different fitness traits. We hypothesized that such selection could result in differences in genetic markers in wolf-killed and hunter-killed deer. To test this, we examined five protein (isozyme) loci in 360 white-tailed deer from northern Minnesota that were killed by wolves and human hunters. The age structure of the two classes differed, and we found no significant allele frequency differences, or differences in genetic variability measures in the two mortality classes. This suggests that variation at the five loci we analyzed is not associated with fitness traits that affect vulnerability to these causes of mortality.

C28-02 DRISCOLL, MELISSA A., John P. Loegering, and Vernon B. Cardwell. Conservation Biology Graduate Program, University of Minnesota, 180 McNeal Hall, 1985 Buford Avenue, St. Paul, MN 55108, USA (MAD, JPL, VBC); Department of Agronomy and Plant Genetics, University of Minnesota, 411 Borlaug Hall, 1991 Upper Buford Circle, St. Paul, MN 55108-6026, USA (VBC); Department of Fisheries, Wildlife and Conservation Biology, University of Minnesota, Twin Cities and Department of Natural Resources, University of Minnesota, Crookston, 2900 University Avenue, Crookston, MN 56716-5001, USA (JPL).

REPRODUCTIVE SUCCESS OF GRASSLAND PASSERINES IN AN AGRICULTURAL LANDSCAPE: THE CONTRIBUTION OF ALTERNATE GRAZING SYSTEMS TO BIRD POPULATION VIABILITY

Grassland bird populations in the Midwestern United States have experienced steep declines that correlate with a reduction of pasturage and hay fields on Midwestern farms. Rotational grazing systems where cattle infrequently but intensely graze small plots of pasture are becoming popular with farmers as an inexpensive method of feeding beef cattle and milk cows, and may be more ecosystem-friendly as grassland paddocks remain undisturbed for long periods. We compare reproductive success of grassland birds on three rotationally-grazed, and three continuously-grazed pastures on family farms in southeast Minnesota to ascertain which grazing method allows for greater bird production. We located and monitored 30 nests in 2001; 13 at continuously grazed sites and 17 at rotationally grazed sites. Bird species were Savannah Sparrows (24 nests), Bobolinks (5), and Eastern Meadowlarks (1). Mayfield daily nest survival was 0.9354 (0.0071 SE) for the continuously grazed pastures and 0.9065 (0.0072 SE) for the rotationally grazed pastures ($P > 0.9998$). Vegetation analysis, survival rates, and breeding bird counts suggest that bird density differences have more to do with pasture-specific vegetation characteristics than the specific grazing method. Grazing strategies that foster a mosaic of different vegetation and litter densities offer habitat for declining grassland birds.

S08-07 DUDGEON, DAVID. Department of Ecology and Biodiversity, University of Hong Kong, Hong Kong SAR, P.R. China (ddudgeon@hkucc.hku.hk).

CONSERVATION OF RIVERINE BIODIVERSITY IN ASIA: THREATS, INFORMATION, PRIORITIES AND ACTION

Asia is the most densely populated and degraded continent on Earth with the highest deforestation rates in the tropics. Aggressive water extraction and flow regulation are significant threats to riverine biodiversity in the region, and act in combination with overharvesting, pollution, and other sources of habitat degradation. Current inventories and knowledge of riverine biodiversity are generally lacking in Asia. In part, this reflects a limited representation of Asian science in the international limnological and conservation literature, but even the data that are available are not effectively deployed toward conservation ends. Exceptionally, China has produced 'Red Data Books' for endangered freshwater vertebrates, but strategies for their protection are underdeveloped. Where legislation to protect water resources have been put in place in Asia, they are directed towards enhancing human use of water – not biodiversity conservation – and enforcement remains weak. Steps are being taken to deal

with species specific harvesting, but huge obstacles remain in the management of rivers crossing international boundaries. Even within national borders, local interests override drainage-basin perspectives. In many places, preservation of near-pristine riverine environments is no longer an option, and minimizing further biodiversity loss in degraded ecosystems may be the most achievable goal.

C17-01 DUDLEY, JOSEPH. U.S. Army Environmental Programs Directorate / Versar, Inc.; Institute of Arctic Biology, University of Alaska Fairbanks; Department of Earth Sciences, University of Alaska Museum; 702 Fletcher Place, Rockville, MD 20851, USA (fnjpd@uaf.edu).
BIOWEAPONS AND BIODIVERSITY: PATHOGENS, PESTILENCE, AND ECOCIDE

Microorganisms cultured and tested for use as biological weapons include numerous broad-spectrum diseases of animals or plants. Current bioweapons arsenals include diseases of both humans and animals (zoonoses) that are highly infectious and contagious, able to cause severe morbidity or mortality in humans and other animals, and may be relatively easy to produce and deploy. Genetic engineering techniques have reportedly been used to create vaccine-subverting and/or antibiotic-resistant strains of at least three broad spectrum zoonotic diseases (anthrax, bubonic plague, tularemia). Bioweapon attacks against agriculture and livestock may result in the erosion of genetic diversity in domesticated plant and animal species, and generate spillover impacts on non-target species of wild plants and animals. The destruction of biodiversity by biological weapons could result from accidental as well as deliberate releases of bioweapon disease organisms. Failures in the prevention, early detection, and containment of bioweapon diseases within and among populations of humans, animals or plants could result in the erosion of genetic diversity, the extinction of endangered species populations, the disruption of biotic communities, the destruction of traditional human societies, and the extirpation of indigenous peoples.

C53-02 DUKER, LAURIE. LakeNet, 300 State Street, Annapolis, MD 21403, USA (lduker@worldlakes.org).
IDENTIFICATION OF 250 LAKE BIODIVERSITY CONSERVATION PRIORITIES AND A TOOL FOR STAKEHOLDER ASSESSMENT OF ESSENTIAL BIOLOGICAL AND POLICY PROGRAM COMPONENTS

Land-water interactions in lake watersheds are severely threatened globally; focused and effective conservation approaches are needed. The author identifies 250 lake watersheds in 73 countries as high priorities for conservation by combining previous global biodiversity assessments that focused solely on fish, mollusc, crab and shrimp data or on rarity of lake type with waterfowl data. A new lake biodiversity conservation assessment tool for stakeholders facilitates effective land-water interaction conservation in these 250 watersheds by evaluating the strengths and weaknesses of essential biological and policy components of lake conservation programs. The survey assesses current information available on lake and watershed biodiversity, monitoring, threats, policy and reserve protections in place in the watershed, and the status of work toward a watershed-wide management plan. Initial results from a survey of 18 programs on five continents suggest that although many programs are trying to control already-present invasive species, very few programs have monitoring programs in place able to detect the presence of new invasives before they gain footholds. Important policy underpinnings of effective lake conservation such as bans on phosphate detergents appear to be uncommon. Many programs do have basic tools such as watershed maps that identify political jurisdictions.

C34-05 DUNN, JAMES P., Matthew Johnson, Holly Hereau, and Casie J. Summerfield. Department of Biology, Grand Valley State University, Allendale, MI 49401, USA (dunnj@gvsu.edu).
RARE OR ELUSIVE: DISTRIBUTION AND SITE QUALITY OF A MICHIGAN THREATENED SPECIE, THE HILLTOP SPITTLEBUG, *LEPYRONIA GIBBOSA* (HOMOPTERA: CERCOPIDAE)

Distribution of a state threatened specie, *Lepyronia gibbosa*, within the dry sand prairies of West Michigan was determined. Sixty-one survey sites in nine counties were selected from among historical collection sites and prairie/oak savannah remnants within the Manistee National Forest and state game areas. In 1999-2002 adult spittlebug populations were estimated by sweep netting. Surprisingly, *L. gibbosa* were found in 51 of 61 sites surveyed (84%). Site areas ranged from 0.4 to 30 ha with many of the smaller sites supporting as large per-area populations of *L. gibbosa* as some of the larger sites. Moreover, nymphs were highly polyphagous (many families), and adults monophagous by feeding only upon little bluestem, *Schizachyrium scoparium*, and occasionally big bluestem, *Andropogon gerardi*. Site quality was estimated by qualifying the occurrence of alien and offsite plants. Plant species richness of all sites are being greatly reduced by invading "weeds" (esp., Pennsylvania sedge) and the bluestem component is declining. Our results indicate that *L. gibbosa* is more common in the sand prairies of Michigan than previously estimated. However, if this insect is to recover, immediate habitat management including fire to suppress invading weeds is needed.

P113 DUNWIDDIE, PETER, and Wendy Wayne. The Nature Conservancy, 217 Pine Street, Suite 1100, Seattle, WA 98101, USA (pdunwiddie@tnc.org) (PD); Center for Urban Horticulture, College of Forest Resources, Box 354115, Seattle, WA 98195, USA (WW).
LESSONS FROM RECOVERY EFFORTS ON *CASTILLEJA LEVISECTA* (SCROPHULARIACEAE) IN A COASTAL GRASSLAND IN WASHINGTON, USA

Castilleja levisecta, the Golden Paintbrush, is a federally threatened plant that occurs in fewer than 12 grassland sites in Washington and southern British Columbia. To meet a federal recovery goal of at least 20 viable populations, studies are being conducted to investigate and develop strategies for augmenting existing populations and establishing new, self-sustaining populations. We report the current status of efforts to establish a population at one site. Initial survival of outplanted plugs is high, but no plants have become established from experimental sowing of seed. Successes and failures at this site are being used to guide similar efforts elsewhere. Major issues that have influenced the pace and success of this recovery project include: 1) Deciding whether a population should be established using seed or out-plantings of nursery-grown plants, 2) Anticipating and supplying adequate quantities of seed needed for recovery efforts, 3) Including redundancy in propagation and out-planting efforts to accommodate occasional failures, and 4) Establishing mechanisms for ensuring long-term continuity of recovery efforts despite short-duration academic and funding commitments.

C22-01 DYCK, MARKUS. Department of Sustainable Development, Government of Nunavut, Iqaluit, Nunavut, X0A 0H0, Canada (mdyck@gov.nu.ca).
FEASIBILITY ASSESSMENT OF A POLAR BEAR RECOVERY PLAN FOR THE M'CLINTOCK POLAR BEAR POPULATION

Polar bears (*Ursus maritimus*) have late sexual maturity and low reproductive rates (i.e., small litter sizes and long birth intervals). Their only major threat therefore is over-harvest that could deplete populations severely. The "M'Clintock Channel" polar bear population in Canada's north is such a population: uncertainty in population estimates has led to over-harvest and depletion, resulting in a possible 30-year moratorium. An alternative to such a moratorium would be a recovery effort that can decrease the moratorium time, increase productivity of this polar bear population, and allow Inuit people to exercise their traditional rights. Polar bear movement patterns, fidelity to specific areas, sex and age, number of individuals to be trans-located, originating area for trans-located bears, and reproductive potential need to be examined closely. Socio-economic aspects, such as compensation for trans-located bears and community support are essential to get such an undertaking off the ground. Other research results of this work, such as movement patterns, orientation, reproduction, behaviour, population boundaries, and harvest theory could greatly contribute to the current understanding of polar bears and their management.

P110 EARNHARDT, JOANNE M., Dennis Rentsch, Eric VanderWerf, Lisa Faust, Amy Wolf, and Steven D. Thompson. Department of Conservation and Science, Lincoln Park Zoo, 2001 North Clark Street, Chicago, IL 60614, USA (joanne@lpzoo.org) (JME, DR, LF, AW, SDT); U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, 300 Ala Moana Boulevard, Room 3-122, Honolulu, HI 96850, USA (EV).
THE SCIENCE OF REINTRODUCTION: A SURVEY OF AVIAN RELEASE PROGRAMS

Reintroduction is a powerful conservation tool in the restoration of endangered species. However, program design and implementation is critical to the success and value of this tool.We have developed a database on avian reintroduction programs that can help guide the design of future reintroductions, characterize past reintroduction practices, and compare/contrast procedures across programs. The database includes 80 parameters pertinent to the species, release location, individuals released (e.g., number, sex, age, origin), and release techniques (e.g., supplementation, intervention). Database information is collected from peer-reviewed journals, gray literature, websites, and personal interviews. Data collection is ongoing with 54 species and 350 releases currently incorporated. Our summary statistics for the database indicate high variability within and between reintroduction programs. The biggest impediment to locating data is that quantitative information is lacking from many publications. For example, for 30-day survivorship, we could find data for only 54% of 183 release events. For reintroduction theory and practice to progress, it is essential that the design of future reintroductions be based on rigorous review of methods, results and lessons from the past.

S06-02 EBY, LISA, Karen Mumford, Larry Crowder, J. Baird Callicott, E.J. Crossman, and Becky Cudmore. Wildlife Biology Program, University of Montana, Missoula, MT 59812, USA (leby@forestry.umt.edu) (LE); Environmental Policy Program, Carl Vinson Institute of Government, University of Georgia, 201 North Milledge Avenue, Athens, GA 30602, USA (KM); Duke University Marine Laboratory, Nicholas School of the Environment and Earth Sciences, 135 Duke Marine Lab Road, Beaufort, NC 28516-9721, USA (LC); Department of Philosophy, Institute of Applied Sciences, University of North Texas, PO BOX 310920, Denton, TX 76205-0920, USA (JBC); Royal Ontario Museum, Centre for Biodiversity and Conservation Biology and University of Toronto, 100 Queens's Park, Toronto, ON M5S 2C6, Canada (EJC, BC).
INCORPORATING BIODIVERSITY OBJECTIVES INTO FISHERIES MANAGEMENT: LESSONS FROM WORKSHOPS

Concurrent with an increasing commitment to maintaining biological diversity in natural systems, several management agencies within the Great Lakes basin have adopted new discourse to include biodiversity and other conservation concepts explicitly within their management objectives. As part of a larger project sponsored by the Great Lakes Fishery Commission, workshops were convened to gain insight from both U.S. and Canadian citizens representing various governmental and nongovernmental organizations on the current perception of major changes in Great Lakes fish species diversity and its affects on their use or value of the lakes, how the range of values can be represented in current fisheries management, their views on conservation concepts for management, and more specifically potential opportunities and hurdles associated with the integration of biodiversity and other conservation concepts into fisheries management policy and actions to preserve current and future uses of the Great Lakes fishery. There were many overlapping issues of concern for citizens associated with the introduction of unintentional exotic species, habitat degradation, pollution, and inequalities in resource allocation and regulation between user groups. The largest sources of disagreement were associated with role for naturalized species and ways in which diverse and conflicting uses of the system can be accommodated.

C49-06 ELLIS, CHRISTINA, Izabella Koziel, Brian McQuinn, and Julie Stein. The Jane Goodall Institute, 8700 Georgia Avenue, Suite 500, Silver Spring, MD 20910, USA (cellis@janegoodall.org).
APPROACHING THE TABLE: A FRAMEWORK FOR TRANSFORMING CONSERVATION-COMMUNITY CONFLICTS INTO OPPORTUNITIES

With a goal of protecting and conserving natural resources, the approach of conservationists in communities often creates conflict. External conservation forces often expect communities living near key species or spaces of conservation interest, to participate in programs which garner little benefits for their own identified livelihood and development needs. As a one-year analysis, semi-structured interviews and focal observations were conducted with six conservation projects in Sub-Saharan Africa. Analysis of the data elicited lessons learned and key factors affecting conservation activities, as well as relationships with government institutions and the country's citizens. Four themes, enabling environment, role of NGO, food security and identity exhibited important influence in the success of conservation initiatives and in shaping the outlook of affected communities. By coupling these results with key concepts from community reconciliation, this study presents a Conservation Conflict Transformation Framework (CCT), which focuses on transforming the conflict relationship between conservation and communities into opportunity. By presenting three basic areas of inquiry and action, conservationists are given methods and models for comprehension and analysis of their project's situation, to create a new vision for the future, to develop a strategy for creating new principles and approaches for a more effective relationship with communities.

C54-02 ELPHICK, CHRIS S., Ted Floyd, Graham Chisholm, and Robert G. Elston, Jr. Department of Ecology and Evolutionary Biology, University of Connecticut, 75 North Eagleville Road, Storrs, CT 06268-3043, USA (elphick@uconn.edu) (CSE); American Birding Association, PO Box 7974, Boulder, CO 80306-7974, USA (TF); The Nature Conservancy, California Chapter, 201 Mission Street, 4th Floor, San Francisco, CA 94105-1832, USA (GC); Biological Resources Research Center/314, University of Nevada, Reno, NV 89557-0015, USA (RGE).
HOW ACCURATELY CAN SPECIES DISTRIBUTIONS BE PREDICTED USING SIMPLE MODELS AND SPARSE DATA?

The ability to predict species distributions is an important component of land conservation planning, especially when resources to accurately map distributions are limited and existing data lack high resolution. Biologists and statisticians have responded by developing increasingly sophisticated and complex models for predicting distributions. The widespread use of these methods, however, may be hampered by the paucity of information for many species. With this in mind, we investigated the ability of extremely simple models using relatively sparse data to predict bird distributions accurately. Using breeding bird data collected throughout Nevada, we developed a model that uses only information on latitude, longitude, elevation, and broad habitat types to predict the occurrence of over 200 species. We tested predictions for 19 randomly selected species using independent data from 78 additional sites in Clark County, NV. Our ability to accurately predict occurrence varied considerably among species, ranging from only 9% to 88% accuracy (average 43%). Compared to a null model, our analysis improved the proportion of occupied sites that were identified by as little as 0% and as much as 65% (average 24%). Our next step is to determine why simple models work so well for some species, but so poorly for others.

P126 EMRY, JASON. Department of Ecology and Evolutionary Biology, University of Kansas, 1200 Sunnyside Avenue, Lawrence, KS 66045, USA (jemry@ku.edu).
THE EFFECT OF SEED DENSITY AND CANOPY REMOVAL ON THE FATE OF *LESPEDEZA CUNEATA* SEEDS IN TWO HABITATS

The existence and/or persistence of seed banks can greatly affect population persistence. *Lespedeza cuneata* is an introduced perennial from East Asia that has invaded a wide range of habitats. Studies have recognized the existence of a seed bank of *L. cuneata*, but the seed bank's effect on persistence or invasion success could not be easily quantified because the studies were

conducted in areas with established populations. In order to determine germination and establishment of *L. cuneata* under field conditions, I crossed three seed densities and two disturbance levels in brome pasture and reseeded prairie. Seed density influenced seedling emergence in the reseeded prairie but not in the brome pasture. Canopy removal did not affect seedling emergence in either the reseeded prairie or the brome pasture. Percent germination was higher in the pasture than in the prairie. Twice as many seedlings emerged in the low-density pasture plots as in the low-density prairie plots. Similarly, more than 3.5 times more seedlings emerged in the high-density pasture plots than in the high-density prairie plots. This study shows that seed-limitation could be the primary constraint of *L. cuneata* invasion success in the two habitats.

C46-08 EPPS, CLINTON, Dale McCullough, John Wehausen, Vernon Bleich, and Jennifer Rechel. Department of Environmental Science, Policy and Management, University of California, Berkeley, 151 Hilgard Hall #3110, Berkeley, CA 94720-3110, USA (buzzard@nature.berkeley.edu) (CE, DM); White Mountain Research Station, 3000 East Line Street, Bishop, CA 93514, USA (JW); California Department of Fish and Game, 407 West Line Street, Bishop, CA 93514, USA (VB); USDA Forest Service, 4955 Canyon Crest Drive, Riverside, CA 92507, USA (JR).
EFFECTS OF CLIMATE CHANGE ON POPULATION PERSISTENCE OF DESERT-DWELLING MOUNTAIN SHEEP IN CALIFORNIA

Metapopulations may be very sensitive to global climate change, particularly if temperature and precipitation change rapidly. We present an analysis of the role of climate and other factors in determining metapopulation structure using presence and absence data. Existing and historical population distributions of desert bighorn sheep *Ovis canadensis* were compared to test whether regional climate patterns were correlated with local extinction. All mountain ranges known to hold or have held desert bighorn populations in California were scored for variables describing climate, metapopulation dynamics, human impacts, and other environmental factors. Logistic regression and hierarchical partitioning were used to assess the relationship between these variables and presence or absence of each population. Parameters related to climate (elevation, precipitation, and presence of dependable springs) were strongly correlated with population persistence in the twentieth century: populations inhabiting lower, drier mountain ranges were more likely to go extinct. Historic presence of domestic sheep grazing allotments was negatively correlated with population persistence. Using conditional extinction probabilities generated by the logistic regression model, remaining populations were assessed for vulnerability to extinction under several climate change scenarios. Thus, different global climate change scenarios can be evaluated for probable impacts on metapopulations even when few demographic data are available.

P086 ERB, LORI, and Brian Masters. Department of Biological Sciences, Towson University, Towson, MD 21252, USA (lerb1@tiger.towson.edu).
PRE-METAMORPHIC SURVIVORSHIP OF THE SPOTTED SALAMANDER (*AMBYSTOMA MACULATUM*) IS POSITIVELY ASSOCIATED WITH MICROSATELLITE ALLELIC DISTANCE (D^2), BUT NOT HETEROZYGOSITY

Habitat fragmentation can create pockets of small, isolated animal populations. Isolated populations are likely to become inbred, increasing their risk for local extinction. Molecular biology offers one potential way of managing isolated populations. Recently, investigators have begun testing a new diversity measure, mean d^2, the average microsatellite inter-allelic distance. This estimator may offer a refined or additional means of measuring genetic diversity for detecting inbreeding depression and/or heterosis (hybrid vigor). We evaluated both mean d^2 and individual heterozygosity diversity estimators and looked for associations with pre-metamorphic survivorship using a large population of spotted salamanders (*Ambystoma maculatum*). Eighty egg samples and eighty pre-metamorphic larval tissue samples were collected from the same cohort. The average mean d^2 and average heterozygosity values were compared for egg and larval samples. We found a significant, positive association between mean d^2 and pre-metamorphic survivorship, but not with the individual heterozygosity values. In addition, the distribution of mean d^2 values for the egg samples differed significantly from the larvae samples, while the two heterozygosity distributions did not differ. Our results suggest that mean d^2 can be a useful tool for detecting heterosis. However, heterozygosity may still be a better measure for detecting inbreeding depression.

C07-03 ETTERSON, JULIE R., and Laura F. Galloway. Department of Biology, University of Minnesota Duluth, 221 Life Science Building, 1110 Kirby Drive, Duluth, MN 55812-2496, USA (jetterso@d.umn.edu) (JRE); Department of Biology, University of Virginia, Gilmer Hall, PO Box 400328, Charlottesville, VA 22904-4328, USA (LFG).
THE GENETICS OF POPULATION DIVERGENCE STUDIED THROUGH HYBRIDIZATION

Informed decisions should be made concerning the source of seeds used for restoration of native plant communities. Gene flow from restored communities founded by nonlocal genotypes may result in reduced fitness of other nearby natural populations. Such outbreeding depression may occur as a result of intrinsic genetic differences among the populations generated by local adaptation or random genetic changes. The degree of genetic divergence among populations can be studied through artificial hybridization. We present greenhouse data on hybrids of six populations of herbaceous forest species *Campanula americana* that

differ in proximity (2 km - 600 km apart) some of which also differ significantly in genome size (up to 7%) as measured by flow cytometry. For early life traits, we found that hybrids between geographically close populations express hybrid vigor while those between more distant populations exhibit outbreeding depression suggesting that populations have diverged primarily as a result of natural selection. Furthermore, we found no relationship between genome size and hybrid performance. Hybrids from populations with similar genome sizes but from distant locations exhibited outbreeding depression, whereas hybrids with different genome sizes that were closely located did not. The severity of outbreeding depression diminished substantially in later life traits.

C23-01 ETTERSON, MATTHEW, Julie Etterson, and Francesca Cuthbert. U.S. Environmental Protection Agency, Mid-Continent Ecology Division, 6201 Congdon Boulevard, Duluth, MN 55804, USA (etterson.matthew@epa.gov) (ME); Department of Biology, University of Minnesota Duluth, 211 Life Science, 1110 Kirby Drive, Duluth, MN 55812, USA (JE); Department of Fisheries, Wildlife, and Conservation Biology, 1980 Folwell Avenue, St. Paul, MN 55108, USA (FC).
CHANGES IN NEOTROPICAL MIGRANT LANDBIRDS WITH FOREST SUCCESSION AT THE UNIVERSITY OF MICHIGAN BIOLOGICAL STATION: A META-ANALYSIS SPANNING 84 YEARS

Declines in neotropical migrant landbirds (NML) of the eastern deciduous forest, USA, have been reported from long-term studies and the North American Breeding Bird Survey. Forest succession may confound the interpretation of such changes. However, time-series for avian abundance and forest succession are rare. We developed a meta-analytical technique to analyze a time-series derived from independent studies of avian abundance over 82 years (1914-1996) at the University of Michigan Biological Station (UMBS), Pellston, MI. We validated the method by applying it to data from long-term vegetation plots (1938-2000) at the same location. Both bird and vegetation community composition changed significantly ($p < 0.0001$). Increased relative abundance for tree and shrub species correlated with decreased tolerance for dry conditions ($p = 0.021$) and increased tolerance for low light ($p = 0.039$) based on synecological values. This agrees with previously published analyses of the same data. NML showed correlated changes (with each other, $p = 0.0152$). However these changes were not consistent across time intervals ($p > 0.550$). Our results support efforts to manage NML collectively. More importantly, the method we describe provides a powerful quantitative tool for retrospective community analysis from independent studies.

S03-06 FAGAN, WILLIAM. Department of Biology, University of Maryland, College Park, MD 20742, USA (bfagan@glue.umd.edu).
QUANTIFYING CONNECTIVITY: EXPLORING THE RELATIONSHIPS OF LANDSCAPE FRAGMENTATION TO EXTINCTION RISK, BIODIVERSITY, AND SPATIAL SCALE

Understanding the influences of habitat fragmentation on conservation efforts requires a concerted effort to clarify what we actually mean by "connectivity." Over the last few years, ecologists have begun using a variety of mathematical techniques to characterize how severely human activities have fragmented different landscapes. These include techniques from spatial statistics, graph theory, and biogeography. I will review these recent developments in our quantitative understanding of connectivity, and discuss the emerging relationships between connectivity metrics and key conservation topics such as extinction risk and biodiversity. The issue of spatial scale merits special attention in the context of connectivity conservation, and I will review the need for complementing scale-specific measures of connectivity with metrics that are scale-independent, especially when dealing with multispecies problems where species face different challenges within the same fragmented landscape. To keep the discussion firmly grounded in reality, biodiversity databases featuring aquatic and terrestrial species of significant conservation interest will be used to highlight these dependencies.

P105 FAUST, LISA J., Joanne M. Earnhardt, and Steven D. Thompson. Department of Conservation and Science, Lincoln Park Zoo, 2001 North Clark Street, Chicago, IL 60614, USA, (lisa@lpzoo.org) (LJF, JME, SDT); Ecology and Evolution Group, University of Illinois at Chicago, 845 West Taylor, Chicago, IL 60607, USA (LJF).
IS REVERSING THE DECLINE OF ASIAN ELEPHANTS (*ELAPHUS MAXIMUS*) IN CAPTIVITY POSSIBLE? A MODELING APPROACH

Demographic models are important tools in quantitatively diagnosing population declines and assessing the management strategies that might reverse them. We used models to scientifically evaluate the observed decline in the North American Species Survival Plan (SSP) population of Asian elephants, which acts as an important ambassador for its highly endangered wild counterparts. The captive population is declining due to low birth rates and high mortality in younger age classes. Given the current population structure and vital rates, a preliminary model indicated that the decline would continue at a rate of 2% per year; to achieve an annual population growth rate of 1, a minimum of three additional births per year would be needed. We then constructed a more complex model that allowed exploration of the population's ability to reach that goal. We assessed the

impact of female reproductive status (cycling vs. non-cycling) and space limitations on population dynamics; we then evaluated and prioritized the different management options available for reversing the population decline, including importation, changes in mortality, and increasing reproduction through artificial insemination or increased natural reproduction.

C57-05 FEGRAUS, ERIC, Sandy Andelman, and Mark Burgman. National Center for Ecological Analysis and Synthesis, 735 State Street, Suite 300, Santa Barbara, CA 93101-3351, USA (EF); Donald Bren School of Environmental Science and Management, University of California, Santa Barbara, Donald Bren Hall, Room 2400, Santa Barbara, CA 93106-5131, USA (SA, MB).
USING MODELS TO EVALUATE FOREST BIOMASS MONITORING PROTOCOLS

If survey techniques are to be useful for monitoring the status of biodiversity and detecting the effects of climate and environmental change on components of biodiversity, both the effectiveness and the statistical power of those techniques must be documented. For example, there is concern about the potential impacts of climate change and other anthropogenic impacts on tropical forest biomass and the future role of tropical forests in the global C cycle. Using models and existing long-term data sets for tropical forests, we developed simulations of scenarios of potential environmental change. This involved analyzing empirical data, using the characteristics of these datasets to create simulated tropical forests, and subjecting the simulated forests to various levels of biomass change. We then evaluated the effectiveness of various sampling designs and protocols at detecting specified types and levels of changes in the simulated forests. This approach provides a quick, strategic and cost-effective means for designing large-scale biodiversity monitoring programs. Our results indicate the level of monitoring effort a number of sampling designs require to detect various amounts of change in biomass over time and space.

S15-06 FERNANDEZ, MIRIAM. Estación Costera de Investigaciones Marinas and Center for Advanced Studies in Ecology and Biodiversity, Departamento de Ecología, Facultad de Ciencias Biológicas, Pontificia Universidad Católica de Chile, Casilla 114-D, Santiago, CP 6513667, Chile (mfernand@genes.bio.puc.cl).
MARINE RESERVES IN CHILE: THE EXPERIENCE OF LAS CRUCES AND NEW CHALLENGES

Empirical evidence of the benefits of marine protected areas in Chile comes mainly from the Marine Reserve of Las Cruces and Mehuin, two initiatives supported for more than 20 years by Chilean Universities and scientists. The increase in abundance and size of several exploited benthic invertebrate species and the concurrent changes in the communities have not only served to show the benefit of protected areas for conservation purposes, but also to implement novel management strategies. More recently, a few more areas have been protected through government, universities, and private initiatives. However, national efforts to create marine protected areas do not keep pace with the increasing use of the marine environment. Socioeconomic and political pressure have not helped to revert this trend. Substantial social, political and scientific efforts are needed to improve existing information and establish a network of marine protected areas along the 4000 kilometers of coastline of Chile. Further studies focusing on patterns of biodiversity and the effect of different kinds of human impact on marine diversity are urgently needed. More efforts need also to be directed to the understanding of the potential for dispersal of marine organisms along the coast of Chile, to assure connectivity among protected areas.

C51-02 FERNÁNDEZ-JURICIC, ESTEBAN, Raul Vaca, and Natalia Schroeder. Department of Ecology, Evolution and Behavior, University of Minnesota, 100 Ecology Building, 1987 Upper Buford Circle, St. Paul, MN 55108, USA (estebanfj@yahoo.com) (EFJ); Museo de Zoología, Facultad de Ciencias Exactas, Físicas y Naturales, Universidad Nacional de Córdoba, Av. Velez Sarsfield 299, 5000 Córdoba, Argentina (RV, NS).
SPATIAL AND TEMPORAL RESPONSES OF FOREST BIRDS TO HUMAN DISTURBANCE AND MANAGEMENT IMPLICATIONS FOR COEXISTENCE

Relatively little is known about the effects of visitors to protected areas on small forest birds. We analyzed the spatial and temporal responses of five species to human approaches in a reserve in central Argentina. We considered three components of flight distances: horizontal, vertical, and diagonal. We found that (a) the relationships between horizontal and vertical components of flight distance were negative (*Zonotrichia capensis*, *Saltator aurantiirostris*, *Turdus chiguanco*), positive (*Columba maculosa*), and neutral (*Molothrus badius*), and (b) the probabilities of fleeing increased when individuals were in the upper and outer portion of trees. These findings suggest that differential exposure of the perching site could greatly modify bird tolerance to visitors. Interspecific comparisons showed that (c) all flight distance components increased linearly with body size, and (d) species differed in landing distances but not in response duration: large-bodied species tended to land farther than smaller-bodied ones. We recommend two management scenarios for differently sized species to promote coexistence between visitors and wildlife: to reduce the amount of a protected area accessible to visitors for large-bodied species, and to manage the rate of human visitation (redistributing the number of visitors in pathways) for small-bodied species.

P106 **FERRAZ, KATIA,** and Luciano M. Verdade. Laboratório de Ecologia Animal, Universidade de São Paulo, Cx. P. 09, 13418-900, Piracicaba, São Paulo, Brazil (kferraz@esalq.usp.br).
SUSTAINABLE MANAGEMENT PROGRAM OF CAPYBARAS: POPULATION FLUCTUATION AND RATE OF INCREASE IN ANTHROPOGENIC WETLAND, SOUTHEASTERN BRAZIL

Capybaras (*Hydrochoerus hydrochaeris*, Rodentia: caviomorpha) have been reported as a plague in the Southeastern Brazil due to the extinction of large predators and the great offer of food resources from agricultural fields such as corn, rice, and sugar cane. As a part of a management program, capybaras have been monitored weekly by direct counts in anthropogenic wetland from July 1998 to June 2002, in order to assess population fluctuation and the rate of increase. There was a consistent seasonal and annual fluctuation in capybaras population along the years at the study site. Juveniles and young presented similar seasonal fluctuation, but both differed from adults. Adults and juveniles, as well as adults and young presented a consistently different monthly fluctuation along the years, whereas juveniles and young presented similar monthly fluctuation. Monitoring frequency for capybaras can be monthly or bimonthly, not necessarily weekly, in order to perceive seasonal fluctuation in a certain study site. At the present study the rate of increase varied from 1.098 (9.8%) to 1.597 (59.7%) along the study period. It can be described by the following regression model: Yt = 2.617 - 1.2805t + 0.2605t2. The population rate of increase slightly rose after the first harvest.

P021 **FERRAZ, SILVIO,** and David Theobald. Natural Resource Ecology Laboratory, Colorado State University, Fort Collins, CO 80523-1499, USA (sfbferra@cnr.colostate.edu).
SPATIAL AND TEMPORAL CHANGES IN LANDSCAPE STRUCTURE IN CENTRAL RONDÔNIA (BRAZILIAN AMAZON) – IMPLICATIONS FOR SPECIES CONSERVATION

The Tropical Forest has been deforested in Rondônia state (western Brazilian Amazon) due to land conversion to pasture and agriculture since the 1970s. The fragmentation process has reduced over 58000 km^2 of the original habitat in the whole state (24%). We analyzed temporal changes in landscape structure in a typical disturbed watershed located at Ariquemes, central Rondônia. Annual Landsat TM/ETM+ images were analyzed to produce historic land use maps for the past 18 years, and landscape structure changes were evaluated at class level for Mature Forest. We measured the dynamics of landscape structure using fragmentation, core area and permeability indices at different spatial scales over 18 past years at annual intervals. We found different temporal patterns of fragmentation process that varied with spatial scale. These spatio-temporal patterns have varied consequences for species of conservation concern.

C18-04 Field, Scott, **ANDREW TYRE,** and Hugh Possingham. The Ecology Centre, University of Queensland, St. Lucia, QLD 4072, Australia (SF, AT, HP); School of Natural Resource Sciences, University of Nebraska–Lincoln, Lincoln, NE 68583-0758, USA (drew_tyre@yahoo.com) (AT).
OPTIMIZING LANDSCAPE-SCALE SURVEY EFFORT UNDER ECONOMIC AND OBSERVATIONAL CONSTRAINTS

Designing monitoring regimes capable of demonstrating landscape-scale population trends is a task of increasing importance for conservation managers. However, such efforts can be thwarted by serious observational and economic constraints inherent in most biological surveys. Consideration of the statistical power of alternative survey designs is therefore critical to ensuring that limited resources are allocated efficiently. In this paper we consider a manager attempting to detect occupancy trends across a landscape and search for survey designs that yield maximum statistical power for minimum cost. We simulate the process of data collection by a 'virtual ecologist' on a landscape where we initiate declines in species of varying prevalence and observability. The virtual ecologist estimates the changing occupancy levels using a technique that accounts for the effects of false negative errors on survey data and her ability to correctly identify significant declines yields a measure of statistical power. 'Significance' is defined in the frequentist sense, but is set using decision theory, thus eliminating the fallacious use of an arbitrary and fixed significance threshold. By varying the number of sites sampled and repeat visits made, we show how managers can design an optimal monitoring regime that maximizes statistical power within the constraints of a fixed budget. We present a worked example based on woodland bird monitoring in the Mt. Lofty Ranges, South Australia, and suggest several general rules of thumb for managers undertaking biological surveys. We discuss the potential of this technique for application to more sophisticated monitoring problems.

S12-04 **FIGUEIRA, WILL F.,** and Larry B. Crowder. Duke University Marine Laboratory, Nicholas School of the Environment and Earth Sciences, 135 Duke Marine Lab Road, Beaufort, NC 28516-9721, USA (wff@duke.edu).
METAPOPULATION DYNAMICS IN MARINE VS. TERRESTRIAL SYSTEMS

Spatial structure often plays an important role in the population dynamics of both terrestrial and aquatic organisms, so metapopulation theory has been applied to an ever broadening range of taxa. While the application of metapopulation theory is, in most cases, certainly justified, there are key differences in both the physical worlds of these two systems as well as in the life

histories of the organisms which inhabit them that require special consideration. A brief review of the theory of metapopulations as formulated for terrestrial systems along with a summary of its use to date in marine systems makes it clear that the theory is applied differently to the two systems. In terrestrial systems, the emphasis is on habitat-level effects. By contrast most marine researchers focus on dispersal-level effects. These biases can lead to incorrect assumptions about both the transient and long-term dynamics of these systems and especially about the relative impacts that different habitat patches may have. We have developed conceptual and analytical models that serve to eliminate these biases and allow for a more integrated assessment of the contribution of particular patches to overall population dynamics. Our models allow us to understand and account for the differences in the physical and biological forces in these systems, so enabling the larger goal of understanding the role of spatial processes in the dynamics of these populations. Only with such knowledge can we expect to pursue the larger aim of successfully conserving and managing these valuable systems.

C02-07 FIRESTONE, KAREN. Evolutionary Biology Unit, Australian Musuem, 6 College Street, Sydney, NSW 2010, Australia (karenf@austmus.gov.au).
PHYLOGEOGRAPHICAL POPULATION STRUCTURE OF NORTHERN QUOLLS (*DASYURUS HALLUCATUS*), A SPECIES IN DECLINE

Northern quolls were once widespread across the northern third of Australia; the species is now fragmented into six highly disjunct population centers and is in rapid decline. In addition, four subspecies were once described based on morphological differences and geographical location, yet no current management plan recognizes these trinomials. Samples of northern quolls were collected from all major population centers and specimens of each purported subspecies. Data from mitochondrial DNA sequencing has shown that there is wide divergence between disjunct populations (which is, incidentally, even greater than that found between two separate species) and that there are reciprocally monophyletic clades among populations from Queensland and the Northern Territory. These results are supported by genotyping from microsatellite loci which indicate that there is significant genetic subdivision among the same populations (Fst = 0.223). The results of this work suggest that there has been a long divergence between populations and that these populations should be conserved separately. Conservation strategies for northern quolls will have to be developed with this information in mind.

S04-07 FISH, THOMAS, and Karen Mumford. Coastal Services Center, National Oceanic and Atmospheric Administration, 2234 South Hobson Avenue, Charleston, SC 29405, USA (tom.fish@noaa.gov) (TF); Environmental Policy Program, Carl Vinson Institute of Government, 201 North Milledge Avenue, Athens, GA 30602, USA (KM).
INTERSECTIONS OF TECHNOLOGY, VALUES, AND KNOWLEDGE IN MANAGING AQUATIC SPECIES IN THE LAURENTIAN GREAT LAKES

Loss of aquatic native species and the introduction and proliferation of non-native aquatic species have had widespread ecological and economic impacts throughout the Laurentian Great Lakes. Projected increases in ship-borne commerce, residential development, and aquatic recreation over the next 20 years may increase the likelihood of declines in native populations and invasions by non-native species. We conducted a qualitative content analysis of management documents from a sample of state, provincial, tribal, federal, and bi-national management entities as well as stakeholder groups within the Lake Superior basin to assess the technological and non-technological approaches supported or employed by these groups to protect native species and to control non-native species. After developing an inventory of strategies, we examined the relationship of the approaches adopted by these groups with the goals, values, and knowledge statements expressed within their documents. We then assessed the ways values and knowledge systems correlated with the selection of measures to control non-natives or sustain native species. Despite a web of individual and coordinated efforts, we identify institutional and management gaps and present insights for strengthening the capacity of agencies and stakeholders to implement broad approaches for managing aquatic species in the Great Lakes.

C07-04 Fitzgerald, Thomas, and **SHAWN MEAGHER.** Biological Sciences, Western Illinois University, Macomb, IL 61455, USA (sa-meagher1@wiu.edu).
MUSCLE PATHOLOGY CAUSED BY *TRICHINELLA SPIRALIS* INFECTION IN INBRED AND OUTBRED OLDFIELD MICE (*PEROMYSCUS POLIONOTUS*)

Inbreeding produces offspring with increased levels of homozygosity. These offspring often display reduced evolutionary fitness, known as inbreeding depression. One potential consequence of inbreeding depression is decreased resistance to parasites, but this has received little research attention. We tested whether inbred individuals display an increased risk of harm from parasites by infecting 63 male oldfield mice (*Peromyscus polionotus*) with *Trichinella spiralis*, a parasitic nematode. We evaluated the effects of inbreeding on parasite susceptibility, suppression of parasite growth, and immune responsiveness. In cross sections of diaphragm muscle, we measured the infection intensity (number of parasites), maximum nurse cell area, worm diameter, and the number of inflammatory cells. Using a series of two-way ANOVAs, we found that inbreeding has a significant effect on parasite

intensity: inbred mice had significantly more worms. Neither nurse cell area, worm diameter, nor inflammatory cell count were effected by inbreeding. This is the first experimental study of a mammal designed to test the hypothesis that inbreeding decreases parasite resistance. If increased homozygosity leads generally to increased parasite susceptibility, then these results have important implications for the management of endangered, inbred populations.

C27-03 FLASPOHLER, DAVID, Audra Bassett, Peter Hurley, Justin Rosemier, and Brian Beachy. School of Forest Resources and Environmental Science, Michigan Technological University, 1400 Townsend Drive, Houghton, MI 49931, USA (djflaspo@mtu.edu).
THE ECOLOGICAL LEGACY OF HISTORICALLY HIGH WHITE-TAILED DEER DENSITIES AT SLEEPING BEAR DUNES NATIONAL LAKESHORE

White-tailed deer have been shown to influence forest and understory plant community structure, particularly when they are maintained at high densities for a long period to time. However, the duration of browse-related forest disturbance has not been well studied. Within Sleeping Bear Dunes National Lakeshore, the beech-maple forests of North Manitou Island (NMI) and nearby South Manitou Island (SMI) have experienced dramatically different exposure to deer during the last 75 years; deer were introduced to NMI prior to Federal ownership and maintained at high densities for several decades while SMI has been a historically deer-free system. We examined several features of the two islands and the mainland likely to be influenced by current and historic levels of deer browse. On NMI, American beech was far more dominant relative to the co-dominant sugar maple, Canada yew has apparently been extirpated, and several other tree species varied in their relative abundance. Predation rates by small mammals on artificial nests were higher on NMI than SMI, as were densities of eastern chipmunks. Several understory bird species also showed differences in relative abundance. These preliminary data suggest that long-term exposure to intense deer browsing may alter forest and vertebrate community structure for many years.

C18-01 FLEISHMAN, ERICA, and Ralph Mac Nally. Center for Conservation Biology, Department of Biological Sciences, Stanford University, Stanford, CA 94305-5020, USA (efleish@stanford.edu) (EF); Australian Centre for Biodiversity: Analysis, Policy and Management, School of Biological Sciences, Monash University, Clayton, VIC 3800, Australia (RM).
A SUCCESSFUL PREDICTIVE MODEL OF SPECIES RICHNESS USING INDICATOR SPECIES

Because complete species inventories are expensive and time-consuming, scientists and land managers seek techniques to alleviate logistic constraints on measuring species richness. We developed a method to identify indicators of species richness that is applicable to any taxonomic group and ecosystem. In an initial case study, a model based on the occurrence of five indicator species explained 88% of the deviance of species richness of 56 butterflies in a mountain range in western North America. We validated model predictions and spatial transferability of the model using independent, newly collected data from another, nearby mountain range. Predicted and observed values of butterfly species richness were highly correlated, with 93% of the observed values falling within the 95% credible intervals of the predictions. We used a Bayesian approach to update the initial model using both the model-building and model-validation data sets. In the updated model, the effectiveness of three of the five indicator species was similar, while the effectiveness of two species was reduced. The latter species had more erratic distributions in the validation data set than in the model-building data set. This objective method for identifing indicators of species richness could substantially enhance our ability to conduct large-scale ecological assessments.

S03-10 Fonseca, Gustavo A.B., **JAMES SANDERSON,** Carlos Galindo-Leal, Keith Alger, Victor Hugo Inchausty, Karl Morrison, Thomas Brooks, Jose Maria Cardoso da Silva, Roberto B. Cavalcanti, Russell A. Mittermeier, and Anthony B. Rylands. Center for Applied Biodiversity Science, Conservation International, 1919 M Street NW, Suite 600, Washington, DC 20036, USA (j.sanderson@conservation.org) (GABF, JS, CGL, TB, ABR); Departamento de Zoologia, Universidade Federal de Minas Gerais, Belo Horizonte, MG Brazil (GABF, ABR); Conservation International, 1919 M Street NW, Suite 600, Washington, DC 20036, USA (KA, KM, RAM); Conservation International – Bolivia, Calle Pinilla # 291, Esq. Av 6 de Agosto, La Paz, Bolivia (VHI); Conservation International – Brazil, Av. Getúlio Vargas, no. 1300, 7.o Andar – Belo Horizonte, MG Brazil (JMCS, RBC).
ESCAPING THE MINIMALIST TRAP: DESIGN AND IMPLEMENTATION OF LARGE-SCALE BIODIVERSITY CORRIDORS

The still young discipline of conservation biology was founded based largely on questions about the minimum critical size of populations. The first generation science of conservation biology was thus minimalist in its approach to a widespread problem of biodiversity loss. However, global climate change and a rapidly evolving globalized economy have exposed added complexity to the conservation conundrum, leading to the realization that existing blueprints to avoid extinction are vastly insufficient. There needs to be a shift in the scale of action to ensure that all species are provided with sufficient habitat, functioning ecological processes, and protection from human pressures. A regional approach that reinforces the vital role of protected sites in avoiding foreseeable extinctions, while at the same time expands the scale of analysis and action beyond the boundaries of parks and reserves, will be vital for the long-term maintenance of biodiversity. Here we describe the general principles that define large-

scale biodiversity corridors, and discuss challenges associated with their implementation. Biodiversity corridors should be based fundamentally on the presence of species and site scale conservation targets within them, overlaid with the connectivity and land-use patterns necessary to ensure not just the representation but also the persistence of biodiversity.

S03-12 FOREMAN, DAVE, Leanne Klyza Linck, and Robert E. Howard. The Wildlands Project, POB 13768, Albuquerque, NM 87192, USA (eltigredave@comcast.net) (DF); The Wildlands Project, POB 455, Richmond, VT 05477, USA (LKL); The Wildlands Project, 14 Reno Place, Santa Fe, NM 87508, USA (REH).
REWILDING NORTH AMERICA TO PRESERVE AN ENDURING RESOURCE OF WILDERNESS

The Wildlands Project proposes to preserve an enduring resource of wilderness through rewilding North America. Without the top-down regulatory role of large carnivores, ecological integrity degrades. Wilderness needs wolves, big cats, and other large carnivores. Large carnivores need secure wilderness core habitats tied together by wildlife movement linkages. Four MegaLinkages are proposed to reconnect Wilderness Areas in North America for the free movement of wide-ranging species: Pacific, from Baja California to Alaska; Spine of Continent from Central America to Alaska through the Rocky Mountains; Appalachian, from the Everglades to New Brunswick; and Boreal-Arctic, from Alaska to Labrador.

P011 FORYS, ELIZABETH, Elizabeth DeVries, Alisa Mazzhocchi, and Mark Mueller. Biology Discipline, Eckerd College, 4200 54th Avenue South, St. Petersburg, FL 33711, USA (forysea@eckerd.edu).
ESTIMATING THE NUMBER OF ROOF-NESTING LEAST TERNS FROM GROUND COUNTS

The Least Tern nests on open beaches throughout North America. Due in part to habitat destruction, increased predation and disturbance, Least Tern numbers have decreased, and the species has begun nesting on flat gravel roofs. In Florida, > 80% of Least Tern colonies occur on roof-tops, but the number of Least Terns in these colonies is difficult to estimate. The purpose of this research was to census Least Terns from the ground. During the summer of 2002, three attempts were made to count Least Terns from the ground on 10 roofs by counting birds flying off the roof during 1, 3 and 5 minute intervals. These counts were compared using linear regression to roof top counts made from a bucket lift placed next to the buildings. All of the regressions were significant, but the earliest survey that was conducted at the beginning of the nesting season (late May), and the 3 minute counts produced the strongest regressions ($r^2 = 0.89$, $F = 31.4$, $d.f. = 9$, $p > 0.005$). These results indicate that ground counts might be an efficient method of monitoring Least Tern and other roof-nesting species.

C46-04 FOUFOPOULOS, JOHANNES, Marmaduke Kilpatrick, and Anthony R. Ives. School of Natural Resources and Environment, University of Michigan, Dana Hall, 430 East University Avnue, Ann Arbor, MI 48109-1115, USA (jfoufop@umich.edu) (JF); Department of Zoology, University of Wisconsin–Madison, Madison, WI 53706, USA (MK, ARI).
EXTINCTIONS OF ISLAND REPTILES UNDER THE COMBINED EFFECTS OF HABITAT FRAGMENTATION AND A WARMING CLIMATE

We examine the effects of a natural fragmentation process caused by rising sea levels on the reptile communities of the Aegean Sea islands (Greece). Following the formation of the islands since the end of the last ice age, reptile populations have been disappearing in a predictable manner dependent on island size and age of isolation. We calculated extinction rates for each species taking historical, geographical and phylogenetic non-independecies into account. Taxa with lower population densities and habitat specialists have higher extinction rates. Furthermore, species with more northern current distributions have higher extinction rates even after correcting for confounding factors. This appears to be in part explained by the particular life history characteristics of each species and in part by the combined effects of habitat fragmentation and increased temperature regimes. The results can help us understand species responses to currently observed global climate change trends.

C33-08 FOX, HELEN, Jos Pet, and Roy Caldwell. Hawaii Institute of Marine Biology, PO Box 1346, Kane'ohe, HI 96744, USA (helenfox@alum.swarthmore.edu) (HF); The Nature Conservancy, Coastal and Marine Program, Jl. Pengembak No. 2, Sanur, Bali, Indonesia (JP); Department of Integrative Biology, University of California, Berkeley, Berkeley, CA 94720-3140, USA (RC).
THINGS THAT GO 'BANG' ON THE REEF: LOW CORAL RECOVERY FROM DYNAMITE FISHING IN INDONESIA

Dynamite or 'blast' fishing with homemade bombs is an immediate and destructive threat that has brought many reef ecosystems to near collapse. Little is known about the long-term ecosystem effects of such blasts or the process of recovery. Here, we examine the impact and recovery from acute single blasts of known age and from chronic blasting. Our data show that although acute blast craters fill in slowly with surrounding coral, overall scleractinian (hard coral) regrowth and recruitment is low. In chronically bombed areas, no significant recovery was detected over the 3 years of this study despite adequate supply of coral propagules. After extensive blasting, coral rubble shifts in ocean currents, effectively forming 'killing fields' for new recruits. Our results show that natural recruitment processes may be insufficient to ensure recovery of these disturbed coral reefs without active

rehabilitation. We conducted pilot rehabilitation studies starting in 1998, installed 3 or 4 larger rock piles within a 100 m^2 area in nine blast sites in 2000, and initiated large-scale substrate stabilization over ~ 2 ha in 2002. By testing four rock pile designs, the configuration that best resists rubble encroachment and gives the best ecosystem recovery for the same cost will be determined.

C53-08 FRANCO, ALDINA M.A., Joao T. Marques, Jorge M. Palmeirim, and William J. Sutherland. Centre for Ecology, Evolution and Conservation, University of East Anglia, Norwich NR4 7TJ, UK (a.franco@uea.ac.uk) (AMAF, JTM, WJS); Centro de Biologia Ambiental, Fac. Ciências de Lisboa, Campo Grande, 1700 Lisboa, Portugal (JMP).
WHY IS THE LESSER KESTREL DECLINING?

The Lesser Kestrel (*Falco naumanni*) has rapidly declined and is one of the most threatened species in Europe. Nest and foraging habitat selection was studied using transects and radio telemetry. All Portuguese colonies were visited and all buildings in the study area characterised. In Spain 50 colonies were visited and 50 random points characterised. A model to predict the presence of colonies of lesser kestrel was built using habitat variables and nest hole availability in churches and old buildings. Independent analysis using telemetry data and transects provided similar results: the traditional rotation system (cereal followed by fallow in a rotation of 4/5 years) is positively selected, with cereals being more selected after harvesting, while pine plantations and tall vegetation habitats are avoided. The most utilised foraging areas are located close to the colony, have livestock and no forest. However, the subsidies of the European Union Common Agriculture Policy favour afforestation over traditional agriculture. Lesser kestrel colony size is reduced or extirpated where buildings have experienced maintenance that has destroyed cavities. The species has disappeared from areas with persecution. Maintenance of traditional agriculture and sensitive building restoration are of great importance for the conservation of lesser kestrels.

C51-01 FRASER, JAMES, P.A. Buckley, Jon Cohen, Larry Houghton, Shannon Keane, and John Loegering. Department of Fisheries and Wildlife Sciences, Virginia Tech, Blacksburg, VA 24060, USA (Fraser@vt.edu) (JF, JC, LH, SK); U.S. Geological Survey, Patuxent Wildlife Research Center, Graduate School of Oceanography, University of Rhode Island, Box 8, Narragansett, RI 02882, USA (PAB); Center for Agriculture and Natural Resources, University of Minnesota, Crookston, Crookston, MN 56716, USA (JL).
BARRIER ISLAND TIDAL FLATS AND DELTAS: ENDANGERED KEYSTONE RESOURCES FOR PIPING PLOVERS AND OTHER SHOREBIRDS?

Intertidal flats and deltas associated with barrier islands may limit some shorebird populations. Piping plovers in Maryland and Virginia nested almost exclusively adjacent to tidal flats and a brackish, flat-like impoundment. Plover chicks with access to bay-side tidal flats in Maryland were exposed to more prey, foraged at higher rates, weighed more and were more likely to survive than were chicks in other habitats. Piping plovers forage on tidal flats and deltas in the winter and before, after, and during breeding. In the 1980's no plovers nested at West Hampton Dunes, NY. After winter storms breached the island and created a 39 ha flat, piping plovers colonized the area. The population grew to 39 pairs by 2000. Surveys from 1997 to 2000 accounted for thousands of shorebirds using this small tidal flat and many fewer using associated beach habitats. Since 1900, we have spent billions of dollars building artificial dunes, nourishing beaches and stabilizing inlets to protect property and navigation. These activities prevent the formation of intertidal flats and deltas used by resident and migratory shorebirds. Shorebird conservation efforts should include provisions to maintain a sustained yield of these habitats.

P055 FREEMAN, KATE S., and K. David Hyrenbach. Duke University Marine Laboratory, Nicholas School of the Environment and Earth Sciences, 135 Pivers Island Road, Beaufort, NC 28516, USA (ksf3@duke.edu).
LONG-TERM HABITAT ASSESSMENT OF SEABIRDS AND CETACEANS IN THE NORTHEASTERN PACIFIC TOWARDS THE DEVELOPMENT OF PELAGIC MARINE PROTECTED AREAS

To date, only five marine protected areas have been established along the West Coast of the United States, none of which extend more than 18 nautical miles from shore. These areas do not afford habitat protection for a number of highly migratory and often endangered pelagic seabird and cetacean species found in the Northeastern Pacific Ocean. In order to design pelagic marine protected areas we need to better understand both the ephemeral and plastic forces which drive habitat preferences for pelagic species. We use a combination of both sightings data from the Minerals Management Service Computer Database Analysis System and remotely sensed environmental data (bathymetry, sea-surface temperature, chlorophyll) to describe the spatial and seasonal distributions of four cetacean and eight seabird species from 1996-1997. We then compared these distributions to sightings data from the past 22 years to determine how effectively these environmental features describe habitat preferences over longer time periods. Results point to the necessity of using plastic parameters in concert with static features in developing pelagic marine protected areas.

C46-07 FRIEDLAENDER, ARI, David Johnston, Leigh Torres, and David Lavigne. Duke University Marine Laboratory, Nicholas School of the Environment and Earth Sciences, 135 Duke Marine Lab Road, Beaufort, NC 28516, USA (asf7@duke.edu) (AF, DJ, LT); International Fund for Animal Welfare, 1474 Gordon Street, Guelph, ON N1L 1C8, Canada (DL).
VARIATION IN SEA ICE COVER ON THE EAST COAST OF CANADA, 1969 TO 2002: IMPLICATIONS FOR PAGOPHILIC SEALS

There is growing evidence that climate change may be affecting the quality, quantity and distribution of sea ice in northern Canada. Recent qualitative observations suggest that seasonal ice coverage on the east coast of Canada may be in decline. Such changes could have serious consequences for harp (*Pagophilus groenlandicus*) and hooded seals (*Cystophora cristata*) which congregate on ice every February and March in the Gulf of St. Lawrence and off Newfoundland to reproduce and nurse their pups. We combined a numerical statistical analysis of weekly averages of ice data with a spatial analysis of the same data to examine the spatio-temporal variability of ice cover during February and March, 1969 to 2002. Our results indicate that ice cover on the east coast has varied significantly during the study period, culminating with an extended decline. In six of the past seven years, ice cover was significantly below the seasonal average. In recent poor ice years, ice cover in some regions was up to 60% less than the yearly average for the same period. Such reductions in ice cover may have deleterious effects on the reproductive success of pagophilic seals and should be accounted for in management plans for commercially exploited species.

S10-04 FRIESWYK, CHRISTIN B., and Joy B. Zedler. Department of Botany, University of Wisconsin–Madison, Birge Hall, 430 Lincoln Drive, Madison, WI 53703, USA (cbfrieswyk@students.wisc.edu).
TYPES OF DOMINANCE BY WETLAND PLANTS INDICATE ENVIRONMENTAL STRESS

Dominance is a plant community attribute and a component of vegetation diversity, but it comes in many types (as does rarity; Rabinowitz 1982), and one type of dominance might be a better indicator of environmental stress than another. We characterized patterns of dominance in the vegetation of 25 Lake Michigan coastal wetlands, chosen randomly across stressor gradients, using randomly placed 1-m^2 quadrats and visual estimations of cover. Four patterns emerged: Four species achieved high cover ($>25\%$) in at least one quadrat in many wetlands. Twelve achieved high cover in many quadrats within a wetland. Five had high cover ($>50\%$) in most quadrats of occurrence when all quadrats were considered. Eight had high cover in most quadrats of occurrence in individual wetlands. Different types of dominance based on these patterns are likely related to environmental stress; the most disturbed landscapes likely support species that have (a) widespread dominance, (b) large areas of dominance within each wetland, and (c) high cover in most quadrats of occurrence. Changes in the type of dominance by an abundant species or expansion of a subdominant species could also indicate stress. "Dominance type" could be a useful indicator of wetland plant species responses to environmental stress.

C30-02 FULLER, STEVEN, and Neil Gifford. Department of Environmental and Forest Biology, SUNY College of Environmental Science and Forestry, Syracuse, NY 13210, USA (sfuller@wildlife.state.nh.us) (SF); Albany Pine Bush Preserve Commission, 108 Wade Road, Latham, NY 12110, USA (NG).
ALLEE EFFECTS IN A FRAGMENTED KARNER BLUE BUTTERFLY POPULATION

The Karner blue butterfly (*Lycaeides melissa samuelis* Nabokov) and its obligate hostplant, blue lupine (*Lupinus perennis*), have persisted in some areas because anthropogenic activities mimic beneficial ecological disturbances. However, extensive development in the eastern portion of the Karner blue's range may fragment populations beyond minimum metapopulation viability requirements. We conducted a study to investigate whether patterns of human development influence migration. Mark-release-recapture was used to observe migrations of butterflies among subpopulations in a fragmented suburban landscape. Limited dispersal across roads occurred. Low density populations and poor quality habitat patches had high rates of emigration. Higher density populations had lower rates of emigration. Landscape boundaries, nectar plant availability, and sex ratio were related to migration rates and population density. We conclude that in highly fragmented Karner blue metapopulations, small habitat patches have a low probability of lasting colonization, and therefore are unlikely to buffer metapopulation declines. These findings suggest that Allee effects operate in declining Karner blue populations. Recovery plans should minimize the number of roads between habitat patches, enhance the quality and size of buffering habitat patches, and facilitate colonizations via augmentation or other population management strategies.

S04-01 FULTON, DAVID, and Leigh Currie. Minnesota Cooperative Fish and Wildlife Research Unit, Department of Fisheries, Wildlife, and Conservation Biology, University of Minnesota, 1980 Folwell Avenue, St. Paul, MN 55108, USA (dcf@fw.umn.edu).
UNDERSTANDING INDIVIDUAL ANGLER KNOWLEDGE AND ETHICS: PROMOTING USER ETHICS IN FISHERIES

During the past century, angling effort in the USA has dramatically increased as the human population has grown. Concurrent advances in technology have further increased the human pressure on recreational fisheries. As pressure on the resource has increased, some have advocated using an appeal to ethics to dissuade anglers from harming the resource or engaging in

behaviors that disrupt others. In this study, a social psychological approach was used to identify beliefs about what defines ethical angling behaviors and who has responsibility for encouraging such behaviors. Among resident, non-resident, and resort owner populations in Minnesota, beliefs about appropriate angling ethics are quite similar. A core set of ethical behaviors was shared by > 90% of respondents, including actions such as maintaining a clean environment, not wasting fishing, respecting the resource, respecting private property and other anglers, and following rules and regulations. Less crystallization on ethical appropriateness was apparent for actions such as catch-and-release fishing, sharing the resource among anglers, and the use of new technology. Beliefs about ethics varied by respondents' motivations for fishing. Most believed responsibility for promoting ethics was more the responsibility of individuals and sporting groups than the Minnesota Department of Natural Resources or the state legislature.

C54-04 GAGNON, JENNIFER, Peter Leimgruber, and Peter Yaukey. Smithsonian Conservation and Research Center, 1500 Remount Road, Front Royal, VA 22630, USA (gagnonj@crc.si.edu) (JG, PL); University of New Orleans, 2000 Lakeshore Drive, New Orleans, LA 70148, USA (JG, PY).
GLOBAL CONSERVATION ASSESSMENT OF TEMPERATE FORESTS: ELEVATION AND GEOGRAPHIC BIASES IN PROTECTION

Temperate forests are more threatened and less protected than many tropical forests, probably because they are located in areas with high human population densities. However, the ecological services and resources temperate forests provide are increasingly needed as human populations grow. Protected forest areas should serve to safeguard these services and resources along with the naturally occurring biodiversity of these ecosystems. Thus, protected forest areas need to be distributed to represent the geographic and genetic variation in biodiversity within each ecosystem type. We assessed the degree of protection for temperate forests across naturally occurring geographic and elevation ranges. We used landcover and elevation data at 1-kilometer resolution to compare elevation and slope for protected and unprotected forest areas. We also determined geographic biases of protected areas by comparing the latitude and longitude of forest patch centroids between protected and unprotected areas. We analyzed each continent separately, and then combined the results for a global analysis. Our findings demonstrate that protected temperate forests are biased towards higher elevations and steeper slopes. In addition, protected temperate forest areas tend to be clumped and not distributed across the entire geographic range of a continent. Biases in location and/or elevation of protected temperate forests are present at both the regional and global scale and likely reduce our ability to preserve the full range of biodiversity of temperate forests.

C14-02 GAHL, MEGAN K., Terry R. Morley, and Aram J.K. Calhoun. Department of Ecology and Environmental Science, University of Maine, Orono, ME 04469, USA (megan_gahl@umit.maine.edu) (MKG, TRM); Department of Plant, Soil, and Environmental Sciences, University of Maine, 5722 Deering Hall, Orono, ME 04469-5722, USA (MKG, TRM, AJKC).
ASSESSING CUMULATIVE WETLAND CONVERSION ON A WATERSHED SCALE: A TOOL FOR WETLAND CONSERVATION PLANNING AND POLICY

Resource regulation is effectual only within the political boundaries of property owners, towns, states or regulatory regions. We completed a spatial and temporal review of wetland permitting trends within the biological boundaries of the Casco Bay Watershed to address landscape scale patterns in wetland alteration. Wetland permits approved by the Maine Department of Environmental Protection from 1995-2001 were reviewed and impact sites located on a watershed map using GIS and National Wetlands Inventory. Major changes in development type, wetland type, mitigation, and acreage were tracked. Commercial and residential development were the primary determinants of wetland loss. GIS mapping revealed that both occur more densely in coastal areas of the watershed than interior portions. Forested wetlands were most affected by development pressures, especially residential growth. Such land-use change and mapping information can be used to prioritize and design conservation efforts and management activities for many levels of resource planning. It also enables political borders to be viewed in the context of biological boundaries and provides a visual depiction of cumulative habitat change. The goal of this research is to produce a practical tool for regulatory agencies to track the collective effects of allowed permitting on individual wetlands and watersheds.

C03-09 GAMBLE, LLOYD, Kevin McGarigal, and Christopher L. Jenkins. Department of Natural Resources Conservation, University of Massachusetts, Amherst, MA 01003, USA (lgamble@forwild.umass.edu) (LG, KM); Department of Biological Sciences, Idaho State University, Pocatello, ID 83209-8007, USA (CLJ).
POPULATIONS OR METAPOPULATIONS? A MULTI-YEAR LOOK AT DEMOGRAPHICS ACROSS 14 BREEDING SITES OF THE MARBLED SALAMANDER

Though principles of metapopulation theory have been broadly applied to spatially-structured populations, there remains a shortage of real-world examples from which we can examine the usefulness of this theory. Here, we present early findings from a landscape-level field investigation into the population dynamics of the marbled salamander (*Ambystoma opacum*), a pond-breeding amphibian native to eastern North America. From 1998 to 2002, 14 pond basins in a 1 km-radius study area were continuously monitored using drift fence arrays and pitfall traps. Marbled salamanders were detected at 13 of 14 pond basins;

however, significant numbers of breeding adults ($3 \leq n \leq 294$) were detected at only 6 of 14 basins. Breeding effort varied widely among ponds and among years, reflecting moderate asynchrony among "pond-populations." Only one breeding season was substantially productive with estimated reproductive success ranging from 0 to 14.7 emerging metamorphs per breeding female across sites. While pending analyses will quantify pond fidelity and dispersal frequencies, early results suggest that breeding populations are largely discrete and respond uniquely to local conditions. If confirmed, these findings suggest that metapopulation-level processes (specifically, the probability of local extinctions and recolonizations) must be accommodated by landscape-level planning strategies to ensure long-term conservation success.

C48-08 GARNER, ALISSE, Janet L. Rachlow, and Jason F. Hicks. Department of Fish and Wildlife Resources, University of Idaho, Moscow, ID 83844-1136, USA (garn9434@uidaho.edu).
PATTERNS OF GENETIC DIVERSITY AND ITS LOSS ACROSS MAMMALIAN TAXA: IMPLICATIONS FOR THE CONSERVATION OF THE THREATENED IDAHO GROUND SQUIRREL

Biological theory suggests that we should aim to conserve not only biodiversity at multiple levels, but also the full range of variability within levels. Understanding current patterns of genetic diversity in healthy populations is necessary for evaluating loss of genetic diversity in populations of concern. We reviewed studies of microsatellite variability in mammals to assess patterns of genetic diversity across taxa and body sizes, and to evaluate loss of diversity in threatened populations. We noted significant differences between placental and marsupial mammals and significant variation among families, but no variation across body masses. Populations of conservation concern exhibited significantly lower levels of heterozygosity than did healthy populations, indicating that we are not currently succeeding at conserving the range of genetic variability within species. In this context, we examined patterns of genetic diversity in populations of the threatened Idaho ground squirrel, which have become isolated due to habitat loss and fragmentation. Our research provides genetic information critical to conservation planning for Idaho ground squirrels and develops genetic tools for use in evaluation of future conservation efforts (habitat restoration, translocation, or captive breeding) aimed at maintaining the full range of genetic variability in this species.

C44-03 GEORGE, ANNA L. Department of Biology, Saint Louis University, 3507 Laclede Avenue, St. Louis, MO 63103-2010, USA (georgeal@slu.edu).
CONSERVATION GENETICS OF THE IMPERILED LOGPERCHES *PERCINA BURTONI*, *PERCINA JENKINSI*, AND *PERCINA REX* (TELEOSTEI: PERCIDAE)

Of the nine recognized species of logperch, large darters in the subgenus *Percina*, two are Federally Endangered (*Percina rex*, *Percina jenkinsi*) and one is critically imperiled (*Percina burtoni*). These species are resolved as basal members of the subgenus, in contrast to the widespread terminal species (e.g. *Percina caprodes*, *Percina macrolepida*, and *Percina carbonaria*). *Percina jenkinsi* is found in only 18 contiguous river kilometers of the Conasauga River, and occurs at low population densities. *Percina rex* is restricted to the Roanoke and Chowan river drainages and has a distribution fragmented by impoundments, but is often relatively abundant at occupied localities. *Percina burtoni* occupies a large geographic area in the Tennessee River drainage, but has a highly fragmented distribution and occurs at very low densities. Genetic variation in each of these taxa was examined using sequence data from the mitochondrial cytochrome *b* gene. Population size provided a better predictor of the level of genetic variation than the level of fragmentation or current conservation status. While *P. jenkinsi* displayed low levels of variation, *P. burtoni* had lower levels of infrapopulation variation than did *P. rex*, suggesting that the conservation status of both *P. burtoni* and *P. rex* be reevaluated.

S14-06 GERBER, LEAH R., and Sascha K. Hooker. Department of Biology, Arizona State University, Tempe, AZ 85287, USA (leah.gerber@asu.edu) (LRG); Sea Mammal Research Unit, University of St. Andrews, St. Andrews, Fife, KY16 9LB, UK (SKH).
THE ROLE OF MARINE PROTECTED AREAS IN CONSERVING WIDE-RANGING SPECIES: IMPLICATIONS FOR DESIGN AND EFFICACY

Recently there has been significant attention given to the establishment of marine reserves, with most of the focus of research directed at economically-valuable (i.e. mid-trophic level) species. Some of the lessons learned from these reserves have now been widely accepted (e.g., bigger is better, dispersal matters). However, one of the most interesting questions to emerge from the initial exploration of marine reserve design theory is the significance of life history characteristics. We review issues concerning the ecology of higher predators and their relevance for marine zoning and reserve design and selection. Marine predators are tempting political figureheads for ocean conservation planning, and are often used to promote reserve designation. We examine whether their ecology and life history can help provide a rigorous ecological foundation for marine reserve design. In general we find both that reserves can benefit marine megafauna, and that marine megafauna can help establish target areas and boundaries for ecosystem reserves. Modeling tools such as demographic sensitivity analysis will aid in establishment of protection for

different life-stages and distributional ranges. The need for pelagic marine reserves is becoming increasingly apparent, and it is in this venue that marine predators are likely to be most effectively used as indicator species of underlying prey distribution and ecosystem processes.

P058 GERDES, D. LAWSON, Meredith W. Cornett, and Carmen Converse. Minnesota Department of Natural Resources, Minnesota County Biological Survey, 500 Lafayette Road, PO Box 25, St. Paul, MN 55155, USA (lawson.gerdes@dnr.state.mn.us) (DLG, CC); The Nature Conservancy, 394 Lake Avenue South, Duluth, MN 55802 USA (MC).
SYNTHESIZING AQUATIC, WETLAND AND TERRESTRIAL BIODIVERSITY ASSESSMENTS FOR CONSERVATION ACTION IN THE NORTH SHORE (LAKE SUPERIOR) HIGHLANDS

Conservation of biological diversity often requires an understanding of processes and interrelationships at the species, community and landscape level, and across both spatial and temporal scales. Managers are frequently required to translate the results of surveys and scientific investigations that address widely varying objectives, without a holistic interpretation of the significance of these findings to the conservation of biodiversity. The results of a statewide biological inventory in Minnesota and the findings of a Great Lakes ecoregional planning effort have resulted in the collection of species, community and landscape data in the North Shore (Lake Superior) Highlands ecological subsection. We collected data on the distribution, abundance and ecology of rare species, composition and structure of native plant communities, and biological and physical characteristics of aquatic, terrestrial and wetland systems. These data were integrated with ecosystem models based on historical landscape patterns and processes, a statewide classification of Native Plant Communities, and existing forest inventories to identify sites of statewide and regional biodiversity significance requiring conservation action in this landscape. Results also provided ecological interpretations, classification and mapping for collaborative, landscape level management of several large areas of conservation priority in the North Shore (Lake Superior) Highlands.

P085 GERLACH, NICOLE M., Joanne M. Earnhardt, and Steven D. Thompson. Department of Conservation and Science, Lincoln Park Zoo, 2001 North Clark Street, Chicago, IL 60614, USA (ngerlach@lpzoo.org).
LINEAGE LOSS, HERITABILITY OF FITNESS, AND EFFECTIVE POPULATION SIZE IN THE NORTH AMERICAN CAPTIVE CHEETAH POPULATION

Lineage loss has been used in recent studies to estimate the loss of genetic diversity from small populations. We calculated lineage loss, heritable variance in fitness, and effective population size from studbook data for the captive North American population of cheetahs (*Acinonyx jubatus*). We also used this data to calculate loss of genetic diversity in this population. We found that 85% of matrilines and patrilines were lost over the course of 33.7 years; however, when only considering multi-generational lineages, less than half of matrilines and patrilines were lost. Although variance in reproductive success was high for both males and females, this variation was not significantly heritable, which may be due to the effects of captive population management. Effective population size was strongly affected by high variance in reproductive success, being only 18% of the adult female population and 13% of the adult male population. However, neither this measure nor the high rates of lineage loss are indicative of the loss of genetic diversity in this population. Lineages were lost from the population at a higher rate than heterozygosity or founder representation. Lineage loss should therefore be interpreted cautiously when being used to approximate loss of genetic diversity.

C03-03 GIBBS, JAMES P., Kris Whiteleather, and Fred Scheuler. Department of Environmental and Forest Biology, College of Environmental Science and Forestry, State University of New York, 350 Illick Hall, 1 Forestry Drive, Syracuse, NY 13210, USA (jpgibbs@syr.edu) (JPG, KW); Eastern Ontario Biodiversity Museum, PO Box 1860, Kemptville, ON K0G 1J0, Canada (FS).
PATTERNS AND CAUSES OF FROG POPULATION CHANGE OVER 30 YEARS IN THE EASTERN GREAT LAKES REGION

We re-surveyed in 2001-2002 frog and toad populations at 300 sites first surveyed 20-27 years ago in northern New York state. Our goal was to estimate population changes and correlate them with measurements of environmental change at those same sites. Analyses are ongoing and indicate that 10% of the original sites have been destroyed, mainly by ditching and filling. At sites remaining, population changes were not evident in *Bufo americanus*, increases were evident in *Hyla versicolor*, and decreases were evident in *Rana sylavatica*, *R. pipiens*, *Psuedacris crucifer* and, in particular, *P. triseriata*. Correlations between population change and environmental conditions (rates of acid deposition, elevation, land cover, etc.) at each site are ongoing and will be reported. Our study represents one of the few well-replicated, long-term assessments of frog population change in North America.

P014 GIBSON, JULIE. Center for Biodiversity, University of Wisconsin–Green Bay, 2420 Nicolet Drive, Green Bay, WI 54311, USA (gibsjm24@uwgb.edu).
MICRO/MACROHABITAT ANALYSIS, PRODUCTIVITY, AND PREDATION OF NESTING WOODLAND RAPTORS IN THE UPPER PENINSULA OF MICHIGAN, USA

The Northern Goshawk *Accipiter gentilis* and Red-Shouldered Hawk *Buteo lineatus* are both listed as "Regional Forester Sensitive Species" on the Hiawatha National Forest (HNF) in the Upper Peninsula of Michigan. Political and legal issues associated with the status of these birds have demanded research on the specific habitat requirements of these species on National Forest lands. Nesting woodland raptors, particularly Northern Goshawk, Red-Shouldered Hawk and Red-Tailed Hawk *Buteo jamaicensis* have been monitored on the HNF with varying levels of intensity since the 1980's. I have identified 81 nest sites presently and/or previously used by these species within the last eight years (1995-2002). In this investigation I collected microhabitat variables in the field and macrohabitat characteristics through GIS. Using logistic regression comparing variables for each species to 49 random sites of similar habitat, I have created models identifying the best predictors of nesting species occurrence. This study also evaluates productivity and predation rates from 1996-2002. Results of this study will enable biologists to more accurately predict nesting success of woodland raptors in a managed forest context, will aid in evaluating species viability, and will assist in the development/refinement of management standards and guidelines for nesting woodland raptors.

C02-10 GIOVAMBATTISTA, GUILLERMO M., M. Verónica Ripoli, J. Pedro Lirón, Pilar Peral-García, and Juan L. Bouzat. Centro de Investigaciones en Genética Básica y Aplicada, Facultad de Ciencias Veterinarias, Universidad Nacional de La Plata, La Plata B1900 AVW, Argentina (ggiovam@fcv.medvet.unlp.edu.ar) (GMG, MVR, JPL, PP); Department of Biological Sciences, Bowling Green State University, Bowling Green, OH 43403, USA (JLB).
GENETIC DIVERSITY IN SOUTH AMERICAN INDIGENOUS CATTLE REFLECTS DEMOGRAPHIC HISTORY, GENETIC DRIFT AND NATURAL SELECTION

Since its introduction into the Americas by Spanish conquerors, the South American Creole cattle (SAC) have spread throughout the continent becoming locally adapted to a wide range of environments, from rainforest to prairies and Patagonian steppe. Genetic analyses of milk protein markers, microsatellites, and the MHC BoLA-DRB3 gene in 11 Creole cattle breeds from Argentina and Bolivia revealed high levels of genetic diversity. High genetic variability within populations is likely the result of low levels of artificial selection. Significant genetic differentiation among breeds suggests that stochastic processes such as founder events and genetic drift may have resulted in genetic structuring. Higher rates of non-synonymous versus synonymous substitutions at the MHC marker and the presence of population-specific alleles suggest that natural selection is operating at this particular gene. Two characterized DRB3 alleles were previously reported in African indigenous breeds, tracing the history of the SAC founding population to Iberian breeds of African origin. This study emphasizes the importance of history, genetic drift and natural selection in shaping the genetic structure of feral populations over short time periods.

C30-01 GIRVETZ, EVAN H., and Steven E. Greco. Department of Environmental Design, University of California, Davis, One Shields Avenue, Davis, CA 95616, USA (ehgirvetz@ucdavis.edu).
A PREDICTIVE SPATIAL MODEL OF YELLOW-BILLED CUCKOO OCCUPANCY IN RIPARIAN FOREST PATCHES ON THE MEANDERING SECTOR OF THE SACRAMENTO RIVER, CALIFORNIA

The once common western subspecies of the yellow-billed cuckoo (*Coccyzus americanus occidentalis*) is now a state-listed endangered species in California. One of the largest remaining populations inhabits riparian forests along 115 km of the Sacramento River and consists of less than 50 breeding pairs. In this river reach, a geographic information system dataset of land cover was digitized from aerial photographs. Land cover variables included vegetation type, height, and age. Discrete and contiguous habitat patches were derived from the vegetation data using a spatial algorithm that split patches narrower than 100 meters and combined patches closer than 300 meters. A multiple stepwise logistic regression to predict cuckoo presence in patches during 1999-2000 found that area of young vegetation, thickness, and spatial location are the significant explanatory variables. This model was validated on cuckoo occupancy data from 1987-1990 and correctly predicted the occupancy of 87 of patches, with 6 commission and 7 omission errors. Young vegetation tends to have a higher proportion of willow and cottonwood trees, which has been found as necessary for cuckoo presence. These findings suggest that the hydrogeomorphic processes that drive willow and cottonwood recruitment may be an important factor affecting the future population viability of cuckoos.

C49-01 GLENN, MARIAN. Biology Department and Whitehead School of Diplomacy and International Relations, Seton Hall University, South Orange, NJ 07079, USA (glennmar@shu.edu).
ALIGNING PROTECTED AREAS MANAGEMENT WITH SUSTAINABILITY PRINCIPLES. I. CENTRAL AMERICA AND THE CARIBBEAN

The global consensus to honor biodiversity alongside economic development in land use, exemplified in Agenda 21, is manifested in the World Bank's $2.6B post-Rio biodiversity portfolio and in management discourse concerning UNESCO's Biosphere Reserves. One-third of Mexico and the entire rest of Central America and the Caribbean are designated biodiversity hotspots by Conservation International, and the region encompasses 8 terrestrial and 8 aquatic eco-regions on the World Wildlife Fund's Global 200 conservation priorities. The World Bank's 15 biodiversity projects in Central America and the Caribbean invested $500M in the post-Rio decade, aimed at protected areas, buffer zone activities, and sustainable use of biodiversity and other natural resources in the production landscape. The region has 28 UNESCO Biosphere Reserves, demonstration areas for balancing conservation and economic development. This study examines the goals and implementation of selected World Bank projects and Biosphere Reserve management plans to assess the extent of their alignment with four principles of sustainability outlined by David Orr [Conservation Biology (2002) 16 (6): 1459-1460]. Review of published material suggests that park and project management goals address those sustainability issues: economic-environment interdependencies, civic participation, environmental education, and spiritual growth. Interviews with park and project managers and community leaders provide a nuanced perspective of the actualities of implementation and identify areas where these sustainability principles can guide adaptive management to further effective stewardship of biodiversity.

C14-05 GOFORTH, REUBEN R., David Stagliano, Joshua Cohen, Yu Man Lee, and Michael Penskar. Michigan Natural Features Inventory, Michigan State University Extension, Lansing, MI 48909, USA (Goforthr@Michigan.Gov).
BIODIVERSITY PATTERNS ASSOCIATED WITH VARIED RIPARIAN PROPERTIES OF SOUTHERN MICHIGAN'S FRAGMENTED LANDSCAPE

Extensive landscape modifications have dramatically changed the character of terrestrial and aquatic ecosystems in southern Michigan, where riparian ecosystems are among the only remaining contiguously forested areas within highly fragmented landscapes. This study sought a better understanding of the biodiversity refuge potential of riparian corridors within such fragmented landscapes. Our approach comprised terrestrial and aquatic biodiversity elements, including plant, breeding bird, amphibian and aquatic communities. Overall, the results of this study provided some support for the idea that biodiversity refuge potential of riparian corridors within fragmented landscapes can be predicted based solely on corridor width and contiguity, primarily with respect to terrestrial flora and some vertebrate groups. However, aquatic community elements were much more responsive to varied channel conditions in streams rather than riparian corridor width and connectivity. Spatial analyses of local and upstream riparian buffer land covers provided an additional level of correlation analysis for riparian biodiversity elements. These analyses identified some strong associations between terrestrial and aquatic community measures and upstream properties, suggesting that effective riparian biodiversity modeling and management must be conducted within the context of environmental properties quantified over multiple spatial scales.

C47-02 GONZALEZ-ABRAHAM, CHARLOTTE E., Volker C. Radeloff, Roger B. Hammer, Todd J. Hawbaker, and Susan I. Stewart. Department of Forest Ecology and Management, University of Wisconsin–Madison, 1630 Linden Drive, Madison, WI 53706, USA (cegonzalezab@students.wisc.edu) (CEG, VCR, TJH); Department of Rural Sociology, University of Wisconsin–Madison, 1180 Observatory Drive, Madison, WI 53706, USA (RBH); USDA Forest Service, North Central Research Station, 1033 University Avenue, Suite 360, Evanston, IL 60201, USA (SIS).
CHANGES IN FOREST FRAGMENTATION BY HOUSING IN NORTHERN WISCONSIN 1938-1998

Houses that are scattered in forested landscapes can cause habitat loss and fragmentation as well as decreased biodiversity due to local extinctions. These effects may exhibit substantial time lags, e.g. current biodiversity may reflect past fragmentation levels. Unfortunately, little is known about change in fragmentation by housing. Our objective was to estimate the change in forest fragmentation by housing in northern Wisconsin from 1938 to 1998. We digitized housing units in 15 townships of northern Wisconsin at multiple dates between 1938 and 1998 using aerial photographs and topographic maps. Forest fragmentation was quantified using landscape metrics (e.g. landscape connectivity). Overall housing growth was 250% in north-central and 150% in northwestern Wisconsin. As expected, forest fragmentation increases in areas with higher housing density. Landscapes exhibited critical thresholds of housing density beyond which forest connectivity was lost. However, fragmentation was not linearly correlated with the number of housing units. Detecting the change over time in forest fragmentation allows us to anticipate future trends in landscape structure and biodiversity, and aid in the development of conservation policies.

S14-01 GOOD, THOMAS P., Paul McElhany, and Mary H. Ruckelshaus. Conservation Biology, Northwest Fisheries Science Center, National Marine Fisheries Service, 2725 Montlake Boulevard East, Seattle, WA 98112, USA (Tom.Good@noaa.gov).
CONSERVATION PLANNING FOR PACIFIC SALMONIDS: CROSSING ECOSYSTEM AND MANAGEMENT BOUNDARIES

The 25 ESUs (Evolutionary Significant Units) of Pacific salmon and steelhead listed as endangered or threatened under the Endangered Species Act span most of the major fresh-water ecosystems along the west coast of the United States. As a result of their well-known anadromous life history, individuals inhabit multiple ecosystems – the open ocean, coastal estuaries, major

rivers, and montane and desert tributaries – exposing them to suites of physical and biological factors that affect their survival. Their wide-ranging habits also expose them to a variety of anthropogenic risk factors during their peregrinations, most notably from hydropower operations, ocean and freshwater harvest, habitat degradation, and the release of millions of hatchery-reared salmonids. Consequently, conservation and recovery efforts must be broad-based and require oversight and cooperation from federal, state, tribal, and private entities, which have different and often competing mandates. Technical Recovery Teams (TRT) comprised of agency scientists have been convened in several distinct geographic domains. We present results of TRT analyses that define essential populations, propose de-listing criteria, and evaluate catastrophic risk for listed salmonids. The results of these analyses will ultimately provide a scientific basis for recovery plans for Pacific salmonids, few of which have contended with impacts over such spatial scales.

P073 GOODSTINE, AMY. Graduate Program in Sustainable Development and Conservation Biology, University of Maryland, College Park, MD 20742, USA (goodstine@nwf.org).
AMPHIBIANS AND ATRAZINE: THE IMPACT OF ENVIRONMENTAL CONTAMINANTS ON AMPHIBIAN DECLINE AND POLICY ALTERNATIVES TO MINIMIZE THE RISK OF EXPOSURE

While amphibians have long managed to prosper despite extensive changes to their environment, it is well recognized that populations are declining around the globe. One of the suspected culprits is the widespread use of chemical pesticides. Recent studies indicate that there is a link between the agricultural herbicide known as atrazine and anomalies in amphibian development. Atrazine is one of the most widely used pesticides in the United States, and amphibians have a high potential for exposure during spring application when runoff takes place into adjacent farm ponds and vernal pools where amphibians may breed. A review of the current literature on amphibian decline and an examination of the impact of environmental contaminants, specifically atrazine, on amphibians in the U.S. reveal that this herbicide has potential broad-ranging negative effects on amphibian species, and that this line of research warrants further consideration in the atrazine re-registration process currently underway by the EPA. Policy alternatives for improving water quality, including alternative farming practices and water treatment options, are explored in terms of economic impact, human and environmental health, and implications for amphibian conservation.

P026 GORMAN, THOMAS A., John D. Erb, Brock R. McMillan, and Daniel J. Martin. Department of Biological Sciences, Minnesota State University, Mankato, Mankato, MN 56001, USA (tom.gorman@dnr.state.mn.us) (TAG, BRM, DJM); Minnesota Department of Natural Resources, Grand Rapids, MN 55744, USA (JDE).
HOME RANGE CHARACTERISTICS OF RIVER OTTERS IN SOUTHEASTERN MINNESOTA

The geographic range of the river otter *Lontra canadensis* has been increasing in North America for more than 25 years due to extensive reintroduction programs, increased water quality, and wetland restoration. In southern Minnesota, there are both native and reintroduced populations of river otters that are currently undergoing range expansion. However, little information on population size, geographic range, or dynamics of these populations is available. We examined home range characteristics of a naturally expanding population in an area that has received wetland restoration, but no reintroduction efforts. We monitored 20 river otters (11 male; 9 female) that were equipped with radio transmitter implants during fall 2001 - fall 2002 along portions of the Mississippi River, the Whitewater River, and the Zumbro River, all of which have been altered by human development. We estimated annual and seasonal home ranges for individual otters and compared home range characteristics between sexes and among age classes. Annual and seasonal home ranges were smaller for females than for males. In addition, home range size differed among seasons for both males and females. Knowledge of spatial requirements and resource use will enable the management and continued conservation of this recovering species.

P016 GORRESEN, P. MARCOS, Richard J. Camp, Bethany L. Woodworth, and Thane K. Pratt. U.S. Geological Survey – BRD, Pacific Island Ecosystem Research Center, Hawaii Forest Bird Interagency Database Project, PO Box 44, Hawaii National Park, HI 96718, USA (marcos_gorresen@usgs.gov).
MODELING HAWAIIAN FOREST BIRDS: HABITAT ASSOCIATIONS, SPECIES DISTRIBUTIONS AND POPULATION ESTIMATES

Accurate information on population size is fundamental for conservation biology. To these ends, the Hawaii Forest Bird Interagency Database Project has developed a GIS-intensive revision and update of population estimates and distribution maps for the Hawaiian forest avifauna. We used GIS to integrate information on species densities at surveyed locations with habitat data derived from remote sensing and field sampling, and to develop predictive models at the landscape level. The models used an autoregressive method that incorporates a spatially autocorrelated error structure, thereby accounting for fine-scale autocorrelation in density and habitat variables. Coarse-scale autocorrelation was controlled with trend surface terms. Densities were predicted for all 1-hectare cells within a study area, and totaled to estimate population size. We analyzed data from 65 variable circular plot surveys within a 64,843-hectare study area on the northeastern slopes of the Island of Hawaii that encompasses the Hakalau Forest National Wildlife Refuge. Results are presented for 3 native (Hawaii Amakihi [*Hemignathus*

virens], Hawaii Creeper [*Oreomystis mana*], and Akepa [*Loxops coccineus*]) and 1 alien (Japanese White-Eye [*Zosterops japonicus*]) bird species. Density surface maps based on models that incorporate habitat characteristics more accurately depict the relationships of bird density and habitat than inter- and extrapolation of survey site data alone. Species-habitat models provide an effective method for determining distribution and population size information essential for monitoring programs and conservation efforts.

C22-02 GRANEK, ELISE F., and Brent J. Sewall. Department of Zoology, Oregon State University, 5008 Cordley Hall, Corvallis, OR 97331, USA (graneke@science.oregonstate.edu) (EFG); Graduate Group in Ecology, Department of Wildlife, Fish, and Conservation Biology, University of California, Davis, Davis, CA 95616, USA (BJS).
CONSERVATION ACTION FOR AN AFRICAN INDICATOR SPECIES: DEVELOPING A FRAMEWORK FOR PROTECTING THE CRITICALLY ENDANGERED LIVINGSTONE'S FLYING FOX (*PTEROPUS LIVINGSTONII*)

Livingstone's flying fox (*Pteropus livingstonii*), a giant fruit bat endemic to Anjouan and Moheli, Comoros Islands, is listed as Critically Endangered on the IUCN Red List. This species inhabits, and is an indicator species for, Comorian rainforests, a western Indian Ocean biodiversity hotspot. Rapid human population growth, accompanied by increased land transformation for subsistence agriculture and fuelwood, has resulted in an annual deforestation rate of 5.8%, one of the world's highest. Degradation of roost and foraging habitat threatens the *P. livingstonii* population and its critical seed dispersal and pollination roles. Recent surveys have identified only 1500 individuals in the wild. In response, international and local NGOs, researchers, and educators have engaged in ten years of *P. livingstonii* education, research, and conservation, culminating in a comprehensive and applied Conservation Action Plan (CAP). The CAP utilizes a multi-faceted approach addressing economic, social, and political realities of the developing Comoros Islands. The CAP focuses on *P. livingstonii* conservation while also benefiting the rainforest ecosystem, other endemic species, and the Comorian people. More broadly, the CAP offers a conservation template for endangered tropical species in countries with unstable economic and political conditions, and for other situations requiring integrated multi-dimensional approaches.

P049 GRANILLO, KATHY. U.S. Fish and Wildlife Service, PO Box 1306, Albuquerque, NM 87103, USA (Kathy_Granillo@fws.gov).
COMING SOON TO A NATIONAL WILDLIFE REFUGE NEAR YOU! LAND MANAGEMENT RESEARCH AND DEMONSTRATION AREAS

After a nationwide competition, the Service designated 13 national wildlife refuges as Land Management Research and Demonstration Areas. These sites will showcase successful management techniques and develop and validate new techniques through applied research. They will serve as learning centers and training grounds for land managers. Each refuge will hire a senior level biologist to oversee implementation of the project and to coordinate and conduct research, as well as to provide training and technical assistance. This poster provides information on each refuge, and solicits participation in both research and technical assistance from conference attendees.

C24-04 Gray, Timothy J., **ANNA M. BAGGIO,** Justina C. Ray, and Julee Boan. Wildlands League, Chapter of the Canadian Parks and Wilderness Society, 401 Richmond Street West, Suite 380, Toronto, ON M5V 3A8, Canada (anna@wildlandsleague.org) (TJG, AMB); Wildlife Conservation Society, Faculty of Forestry, University of Toronto, 33 Willcocks Street, Toronto, ON M5S 3B3, Canada (JCR); Federation of Ontario Naturalists, 355 Lesmill Road, Don Mills, ON M3B 2W8, Canada (JB).
CONSERVATION FIRST: BIODIVERSITY-CENTERED PLANNING IN INTACT NORTHERN BOREAL FORESTS OF ONTARIO

Ontario's boreal forest north of 51 degrees N. Lat. comprises 37 million ha of wilderness forests, lakes and rivers inhabited by 28 First Nation communities. It is roadless, free of major industrial development, and represents the last stronghold for species at risk such as woodland caribou (*Rangifer tarandus*) and wolverine (*Gulo gulo*). Led by First Nations and the federal and provincial governments, development planning is currently underway for this region. We present an analysis of conservation planning for the region, which contrasts sharply to planning that has taken place in many other boreal regions, particularly the southern boreal forests of the province. Unlike previous planning processes, First Nations communities will play a key role in decision-making, in that any management plan must meet with their final approval. Equally unique in the industrialized world, conservation planners are faced with a nearly pristine landscape, and in order to be effective, planning must envision the nature of future conservation threats, both in terms of scope and severity. Finally, because of its remoteness, the biological resources of the region are poorly known to Western Science. As such, a new paradigm for the design and management of protected areas and industrial use zones will be necessary.

C03-02 GREEN, DAVID M., and Leslie Bol. Redpath Museum, McGill University, 859 Sherbrooke Street West, Montreal, PQ H3A 2K6, Canada (david.m.green@mcgill.ca).
AMPHIBIAN POPULATION FLUCTUATIONS AND DECLINES

The probability of a population's extinction correlates both with variance in its size and the extent of its isolation. Variation in species' abundance, however, is a matter of landscape as well as the variance of individual populations. To address how variation in demographic characteristics and habitat requirements of amphibians may reflect on their comparative risk of decline, 617 time series of population census data were analysed. Census declines outnumbered increases yet the average magnitudes for both declines and increases were not demonstrably different, substantiating findings of general amphibian decline even among widespread species. Species living in large streams or breeding in ponds had significantly higher variance per population size than did completely terrestrial or other stream-dwelling amphibians. This is largely related to environmental variance. Estimated local extinction rates averaged higher among pond-breeding frogs and salamanders than either stream-breeding or terrestrial-developing species. Less common species had greater negative disparities between extinctions and recoveries. Species with highly fluctuating populations and high frequencies of local extinctions living in changeable environments may be especially susceptible to curtailment of dispersal and restriction of habitat. However, landscape heterogenity may damp overall population fluctuations whereas low inter-site variance within years may exacerbate fluctuations in abundance.

C58-01 GREENWALD, D. NOAH, Kieran Suckling, and Martin Taylor. Center for Biological Diversity, PO Box 5101, Bozeman, MT 59717, USA (ngreenwald@biologicaldiversity.org) (DNG); Center for Biological Diversity, PO Box 710, Tucson, AZ 85702, USA (KS, MT).
THE ROLE OF CITIZENS IN PROTECTING SPECIES UNDER THE ENDANGERED SPECIES ACT

The citizen suit provision of the Endangered Species Act (ESA), in combination with a provision permitting citizens to petition to list species as threatened or endangered, allows citizens to be directly involved in protecting species under the ESA. To quantify the role of citizens in obtaining protection for species under the ESA, we obtained data on the listing history of all species listed as threatened or endangered since the ESA was passed in late 1973. Fifty seven percent of threatened and endangered species were listed following citizen petitions or lawsuits. Citizens contributed to an increase in the mean number of species listed per year from 29 from 1974-1990 to 59 from 1991-2002. Eighty percent of all species listed since 1991 followed citizen petitions or suits. Plants and invertebrates comprised a majority (78.6%) of the species that were the focus of citizen suits or petitions, helping to correct a historic imbalance in the composition of the threatened and endangered species list towards vertebrate animals. On average, the U.S. Fish and Wildlife and National Marine Fisheries Services took considerably longer to list species than mandated by congressionally designated timelines. These findings highlight the importance of citizens in protecting species under the ESA.

C15-06 GROSSMAN, DENNIS, Kristin Barker, Richard Bernknopf, Ruiwu Chen, Patrick Comer, Patrick Crist, Frank Davis, Linda Evers, Larry Master, Mark Schaefer, David Stoms, Larry Sugarbaker, and Alicia Torregrosa. NatureServe, 1101 Wilson Boulevard, 15th Floor, Arlington, VA 22209, USA (denny_grossman@natureserve.org).
A BIODIVERSITY DECISION SUPPORT SYSTEM FOR MULTISCALE LAND-USE PLANNING

Conservation planning remains a highly complex endeavor limited to experts and conducted by a handful of organizations. To address the most substantial loss of biodiversity – habitat loss from development – a methodology and technological tools are required to extend conservation planning to the thousands of institutions that either impact or are capable of conserving biodiversity through their routine planning and management activities. NatureServe, in cooperation with several partners, has created a conservation planning system that couples conservation biology expertise with technological tools that can facilitate the conversion of data to knowledge and knowledge to planning decisions. The result is an overlapping continuum among scientists, planners, and others that allows for iterative planning and evaluation using best-available data and conservation planning theory. This system has been piloted in Napa County, California for the Land Trust of Napa County. This project has resulted in development of a standard conservation data model, a scaleable conservation planning process, and initial software tools serving both experts in development of relevant knowledge and clients in querying and investigating data and conservation strategies.

C24-01 GROVES, CRAIG. Wildlife Conservation Society, 2023 Stadium Drive, Suite 1-A, Bozeman, MT 59715, USA (cgroves@wcs.org).
PRIORITY-SETTING FOR BIODIVERSITY: PROGRESS, PROGNOSTICATIONS, AND GUIDEPOSTS FOR CONSERVATION PLANNING

Over the past decade, we have witnessed a proliferation of plans aimed at identifying high-priority areas for conserving biodiversity. There are several technical and practical aspects of these planning processes that need to be improved to make them more effective. First, there is a real need for empirical field studies to evaluate the effectiveness of various biodiversity surrogates or coarse filters. Second, more attention needs to be given to the underlying ecological processes that sustain biodiversity through

analyses of ecological integrity and population viability. Third, assessments of threats to biodiversity need to move from the realm of expert opinion to more quantitative predictions on the vulnerability of various landscapes to biodiversity losses. Fourth, assessing and reporting the accuracy of digital data needs to become a standard practice. On the implementation side, the results of these planning exercises need to be made available in user-friendly formats to those constituencies that will put them to the most effective use – often local governments and citizen's groups. Finally, planners need to recognize that the scale and resolution of data necessary to take effective conservation action at a local level is far greater than that required to identify the area as being a priority for conservation.

C50-03 **GRUNDEL, RALPH,** Noel Pavlovic, and Gary Glowacki. U.S. Geological Survey, 1100 North Mineral Springs Road, Porter, IN 46304, USA (Ralph_Grundel@usgs.gov).
COMPARISON OF DIVERSE ANIMAL TAXA AS INDICATORS OF OAK SAVANNA

Oak savanna was historically an abundant terrestrial ecosystem within the western Great Lakes' basin but is rare today. Restoration of degraded savanna remnants is an important pathway for conservation of this ecosystem. Establishment of restoration goals might be facilitated if we better understood the degree of obligation of different species to the savanna landscape. Toward that goal, we examined animal species' distributions in 25 historic oak savanna sites in northwest Indiana. Due to different management regimes, these 25 sites today represent a gradient of habitat types ranging from open fields to closed forests. We surveyed amphibians (n = 14 species), birds (n = 137), butterflies (n = 53), and reptiles (n = 16) at these sites and performed indicator species analyses to assess which species, if any, were significantly obligated to the more savanna-like habitats along the grassland-forest continuum represented by these 25 sites. In most cases, species that were significantly obligated to a habitat type exhibited preferences for the continuum extremes, preferring sites with canopies that were more open or more closed than occur in savannas.

C33-04 **GUERREIRO, JOSÉ,** and Paula Afonso. Instituto de Ciência Aplicada e Tecnologia, Campus da Faculdade de Ciências da Universidade de Lisboa, Campo Grande – Edíficio ICAT, 1749-016 Lisboa, Portugal (jose.guerreiro@icat.fc.ul.pt) (JG); Universidade Eduardo Mondlane, Departamento de Biologia, Maputo, Mozambique (PA).
IMPACTS OF THE EXPLOITATION OF THE BIVALVE *MODIOLUS PHILIPPINANARUM* FOR HUMAN DIET AT THE MARINE PROTECTED AREA OF INHACA ISLAND (MOZAMBIQUE)

Exploitation of natural resources often crucial for survival in many places of Africa are nevertheless a factor for habitat degradation and resources depletion. Ecological assessment of impacts is needed in order to establish sustainable management plans, mainly in critical ecosystems like mangroves or seagrass beds. Inhaca Island (26ºS; 33ºE) near Maputo bay (Mozambique) is one of the oldest (1965) Marine Protected Areas of Africa. The local population of 5000 people depend on natural resources. Artisanal fisheries, together with tourism, maintain the local economy, while oysters, mussels, crabs and gastropods are crucial to human diet. Four main marine ecosystems were identified and characterised: mangroves, sandy beaches, coral reefs and seagrass beds (namely Sangala bank, 6Km large). Attached to the roots of seagrass, the bivalve *Modiolus philippinarum* is one of the major sources of protein for the local population. Fishery of this resource is made only by women and children; nevertheless it is highly destructive for seagrass. Estimates of catch were based on direct assessment during one year and showed that 29 people were involved in this activity with a daily mean of catch of 7.9Kg, during 12 days each month accounting for 2826Kg/mth. Results are the basis for management plan proposals.

P118 Gunnarsson, Bengt, **KAROLINA NITTÉRUS,** Åsa Gunnarsson, and Peter Wirdenäs. Department of Applied Environmental Science, University of Gothenburg, Box 464, SE-405 30 Göteborg, Sweden (karolina.nitterus@miljo.gu.se).
SLASH REMOVAL AND DIVERSITY OF BEETLES

Arthropod diversity is often affected by structural habitat complexity. Removal of logging residue, "slash" from clearcuts may alter the micro-habitat complexity, and thereby indirectly affect the numbers of beetles (Coleoptera) and species richness. Short-term effects on ground living Coleoptera after slash removal were studied in south and central Sweden. Coleoptera were collected by pitfall trapping in 16 clearcuts (< 1 yr old). In eight of the areas, slash was removed after cutting and in eight areas slash was left. Micro-habitat structure was measured by the height of the slash piles on ground. Slash height was positively correlated with two complexity measures; i.e. the number of sticks and fractal dimension. The investigated clearcuts were situated in areas with coniferous and mixed forests in three regions (North, West and East) and were analysed separately since we found regional differences in the number of species found per trap. In the North region, slash height was significantly lower on areas with slash removal. In West and North regions no such differences were found. However, on areas with slash removal in West and East regions there was a positive relationship between slash height and number of individuals per trap. Rarefaction plots for 4 of the 16 clearcuts shows that number of species increases with number of specimens collected. A laboratory experiment on micro-habitat choice showed that two ground-living beetle species (*Carabus hortensis* and *Pterostichus oblongopunctatus*) generally

spent more time under slash heaps than on open ground. Slash piles might serve as important refuges for ground-living beetles on clearcuts, and extensive slash removal may lead to impoverished species richness of Coleoptera on a local scale. Further studies about distribution and volumes of slash piles remaining on clearcuts are needed.

C34-07 GURUNG, BHIM, and J.L. David Smith. Department of Fisheries, Wildlife and Conservation Biology, University of Minnesota, 1980 Folwell Avenue, St. Paul, MN 55108, USA (bbg@fw.umn.edu).
MAPPING AND ASSESSING SPATIAL DISTRIBUTION OF TIGERS IN THE EXTENDED AREA OF ROYAL BARDIA NATIONAL PARK, NEPAL

We assessed the distribution of tigers (*Panthera tigris*) in the extended area of Royal Bardia National Park, Nepal to develop an effective monitoring scheme for tigers and contribute to overall planning for the park. We surveyed stream beds and trails for tiger tracks, scats and kills. We expanded the use of GPS technology to record tiger sign and survey routes traveled. We trained 4 local people as "Village Ranger" to survey the area intensively. Our results show that tigers are widely distributed throughout the park and breeding occurs within the park. The "Village Ranger" approach provides greater information on tiger status than the survey method alone.

C11-01 GUTIERREZ, ALEXIS. Global Invasive Species Programme, U.S. Office of the Secretariat, c/o Smithsonian Institution, PO Box 37012, NHB MRC 105, Washington, DC 20013-7012, USA (gutierrez.alexis@nmnh.si.edu).
INTERNATIONAL ASSISTANCE AS A PATHWAY OF BIOLOGICAL INVASION IN FRESH WATER SYSTEMS IN SOUTHEAST ASIA

Invasive alien species (IAS) are among the top drivers of environmental change globally, and pose a threat to food security, health, and economic development. Due to limits on financial, technological, and informational resources, developing countries are often least able to address the threats posed by IAS to agriculture and natural systems. This can and does create barriers to sustainable development. In recent years, there has been increasing evidence that development projects have been the source of IAS introductions. For example, international famine relief and military assistance programs have also been associated with the unintentional introduction of the larger grain borer (*Prostephanus truncatus*) and parthenium weed (*Parthenium hysterophorum*) into Africa and recently the corn rootworm (*Diabrotica virgifera*) into Eastern Europe. Intentional introductions of non-native species that became invasive include water hyacinth (*Eichhornia crassipes*) in Africa, which was introduced as potential inexpensive source of biomass for various products. The Global Invasive Species Programme has been contracted by the US Agency for International Development to conduct an assessment on the role of international assistance as a pathway for biological invasion in fresh water systems in Southeast Asia. The assessment examines the biological and socioeconomic impacts of these introductions. For the purposes of this study the Southeast Asia region includes Cambodia, Indonesia, Laos, Malaysia, Philippines, Singapore, Thailand and Vietnam. The assessment draws on case studies from the areas of aquaculture, dam building and removal, and aquatic plant introductions.

C39-02 GUZMAN, HECTOR M., and Carlos A. Guevara. Smithsonian Tropical Research Institute, PO Box 2072, Balboa, Ancon, Republic of Panama (guzmanh@naos.si.edi).
TRADITIONAL CORAL REEF MINING BY KUNA INDIANS: CULTURAL AND CONSERVATION IMPLICATIONS

Kuna people of Panama have protected their vast territory for over five centuries and it is said, "They still struggle to preserve a measure of autonomy and cultural integrity." While this might be partially true, Kuna Indians have traditionally mined coral reefs and overfished few marine resources. Here, we made a comprehensive survey across the entire Reserve; described for the first time the structure, diversity and conservation status of 56 reef sites, measured the volume of coral mined at 21 inhabited islands, and used aerial photographs to compare changes in the size of 15 of those islands between 1966 and 2001. Overall, live coral cover was 23% (8-38%) with estimated species diversity of 69 scleractinian corals, 82 sponges and 35 octocorals. Volume mined was estimated at 16215 m^3, while 93% of island's size increased due to landfilling, in some cases 190% greater than before. Consequently, Kuna have systematically damaged reefs, and even though reefs are resilient to human disturbances, cultural traditions should change to protect their coastal habitats. We propose "hot spots" to create marine protected areas within the Reserve. We speculate that local trends in sea-level rise, already eroding some islands, presents a short-term threat to coastal populations.

P045 HACKEL, JEFFREY. Department of Geography, California State University, San Bernardino, San Bernardino, CA 92407, USA (jhackel@csusb.edu).
HISTORY OF THE HLANE ROAD: A CASE STUDY OF WILDLIFE CONSERVATION AND ECONOMIC DEVELOPMENT IN AFRICA

Conservationists in Swaziland are presently trying to develop strategies that will ensure survival of the nature reserves. Their ability to achieve this goal in large part depends on two factors: 1) the commitment of Swaziland's government officials to nature conservation; and 2) the effectiveness with which conservationists present their arguments to Swazi decision-makers. Examination of a resolved issue as a case study offers insights into the present status of both factors. The issue selected involved the decision in the late 1970s to upgrade northeastern Swaziland's main road, which bisects the country's major conservation area and a commercial farming region, or to build a new route west of the protected areas. The debate was significant because for the first time conservationists were full participants in the decision-making process. However, in the end, the established alignment was upgraded to a high volume road. The outcome reflects that economic development was given a higher priority than conservation, as economic interests won out in the end. There may be a lesson for the future as integrated conservation and development projects become more popular. Swaziland shows that it is likely that economic development will be given priority over wildlife conservation when conflict between them develops.

C50-06 HADJ-CHIKH, LEILA, Kerri Frangioso, and Keyt Fischer. Wildlife Conservation Society, 2377 #B Virginia Street, Berkeley, CA 94709, USA (lzh@sbcglobal.net) (LH); Wildlife Conservation Society, 248 Swanton Boulevard, Santa Cruz, CA 95060, USA (KF, KF).
MEASURING THE ECOLOGICAL IMPACT OF SUDDEN OAK DEATH: QUANTIFYING MAST ABUNDANCE IN FORESTS SUSCEPTIBLE TO *PHYTOPHTHORA RAMORUM*

One effect of *Phytophthora ramorum* is a decline in acorn production by affected oak (*Quercus*) and tanoak (*Lithocarpus*) species. This study quantified acorn availability in a forest infected with the disease, relative to a comparable uninfected forest. We measured acorn availability to terrestrial predators using seed traps in Pfieffer Big Sur State Park, CA, where *P. ramorum* has infected many oaks and tanoaks, and in Big Creek Reserve, CA, where *P. ramorum* has not yet been found. Terrestrial acorn availability at the Big Sur site was estimated as 4 kg of acorns/ha, compared to 389 kg/ha at Big Creek. To determine acorn availability to arboreal predators at Big Creek, we used a spotting scope to visually survey the canopies of 25 tanoak trees. Visual estimates of acorn production were approximately 2.6 times greater than trap-based estimates, suggesting that 62% of the acorns produced by survey trees were removed by arboreal predators prior to seed fall. Declines in mast production from Sudden Oak Death may therefore affect terrestrial predators before arboreal predators, due to their delayed access to crops. These data show the importance of combining visual surveys with seed traps to provide a complete picture of acorn availability to wildlife.

C10-05 HAGLEY, CYNTHIA, Richard Axler, George Host, Glenn Merrick, Bruce Munson, and Carl Richards. Minnesota Sea Grant College Program, University of Minnesota, 2305 East 5th Street, Duluth, MN 55812-1445, USA (chagley@umn.edu) (CH, CR); Natural Resources Research Institute, University of Minnesota Duluth, 5013 Miller Trunk Highway, Duluth, MN 55811, USA (RA, GH); Lake Superior College, 2101 Trinity Road, Duluth, MN 55811, USA (GM); Department of Education, University of Minnesota Duluth, 120 Montague Hall, 1211 Ordean Court, Duluth, MN 55812, USA (BM).
WATER ON THE WEB: TRAINING WATER SCIENCE TECHNICIANS WITH AN ONLINE, DATA-RICH CURRICULUM

Water quality and quantity problems continue to mount worldwide, threatening US and global ecology and economies. At the same time, training in water resource management becomes ever more complex, requiring knowledge of diverse subject matter, including aquatic and terrestrial ecology; data acquisition, analysis, and interpretation; resource management, regulation, and restoration; communication; and use of advanced technology. Water on the Web (wow.nrri.umn.edu) contains an integrative two-semester, online course targeted toward second year technical students or undergraduates in water resource programs. This modular, lab and field based course provides training with an emphasis on conservation and restoration of aquatic systems. It consists of 6 major units, each of which contains from one to six modules (lecture slides and labs/case studies). Instructors can adopt the course in its entirety or select individual modules or units for inclusion into their courses. The cornerstones of Water on the Web are its reliance on real-world, real-time data from lakes and rivers nationwide; innovative data visualization tools that animate sequences of data, making the aquatic systems come alive for students; regional case studies that weave throughout the course to provide practical applications of complex environmental problems; and a comprehensive, resource-filled website to augment the curriculum.

C07-05 HAIG, SUSAN, Liv Wennerberg, Thomas Mullins, Eric Forsman, and Pepper Trail. U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center, 3200 SW Jefferson Way, Corvallis, OR 97331, USA (susan_haig@usgs.gov) (SH, TM); Zoological Museum, University of Oslo, Sars' gate 1, NO-0562 Oslo, Norway (LW); USDA Forest Service, Pacific Northwest Forest Experiment Station, 3200 SW Jefferson Way, Corvallis, OR 97331, USA (EF); U.S. Fish and Wildlife Service, National Wildlife Forensic Laboratory, 1490 East Main Street, Ashland, OR 97520, USA (PT).
GENETIC IDENTIFICATION OF HYBRID SPOTTED AND BARRED OWLS AND IMPLICATIONS UNDER THE U.S. ENDANGERED SPECIES ACT

Recent population expansion of Barred Owls into western North America has lead to concern that Barred Owls may compete with and further threaten the Northern Spotted Owl. Species ranges now overlap and birds hybridize. However, consequences and extent of hybridization are largely unknown. Further, there is a need under the U.S. Endangered Species Act (ESA) for identification of both species and their hybrids using forensic samples. We used sequences from the mitochondrial control region (mtDNA) and Amplified Fragment Length Polymorphism (AFLP) analyses to portray maternal and paternal gene flow in the hybridization process. MtDNA indicated large divergence between Barred and Spotted Owls (13.9%). Two distinct clades showed no overlap between species and revealed no signs of previous introgression. AFLPs also indicated divergence between species, including markers with substantial frequency differences between species and clear differentiation in principal coordinate analyses and assignments tests. Hybrids had unique genetic combinations, including AFLP markers from both parental species. Analyses further indicated that most hybrids resulted from crosses between female Barred Owls and male Spotted Owls. Within areas of range overlap, we suggest that Barred Owls and hybrids between Spotted and Barred Owls be listed under the "similarity of appearance" clause (section 4E) of the ESA.

C01-08 HALE, CINDY M., Lee E. Frelich, and Peter B. Reich. Natural Resources Research Institute, University of Minnesota Duluth, 5013 Miller Trunk Highway, Duluth, MN 55811, USA (halex004@tc.umn.edu) (CH); Department of Forest Resources, University of Minnesota, 115 Green Hall, 1530 Cleveland Avenue North, St. Paul, MN 55108, USA (LF, PR).
A MESOCOSM EXPERIMENT: SPECIES SPECIFIC AFFECTS OF EARTHWORMS ON FOREST FLOOR REMOVAL, SOIL CHARACTERISTICS AND UNDERSTORY PLANT MORTALITY

During recent decades, European earthworms have been invading previously worm-free hardwood forest ecosystems in Minnesota. When earthworms invade the forest floor is rapidly consumed and the abundance and diversity of native plant species and tree seedlings often decline steeply following earthworm invasion. Up to seven different earthworm species in four ecological groups have been identified at or near leading edges of invasion. The different feeding and habitat preferences of these ecological groups suggest that different earthworm species may have dramatically different affects on the forest floor, soil and understory plants. A 14 week greenhouse microcosm study was designed to quantify the magnitude of impacts resulting from the different earthworm species and to investigate potential mechanisms of impact on the understory plant community. Microcosms, 30 cm in diameter and 40 cm deep, replicated worm-free conditions by using intact layers of forest floor and upper soil horizons. A factorial design including 4 plant species and 5 earthworm treatments was used. Different earthworms species had significantly different affects on the rate of loss of the forest floor, development of an A horizon and plant mortality. Three of the four plant species responded negatively to earthworm treatments and one plant species responded positively.

C37-05 HALL, JENNIFER. The Nature Conservancy, Great Plains Division, 1402 Culver Road, Ann Arbor, MI 48103, USA (jhall@tnc.org).
INCORPORATING U.S. FARM BILL SUBSIDY AND CENSUS DATA INTO BIODIVERSITY CONSERVATION PLANS FOR NEBRASKA

Recent population declines across the Great Plains combined with a vigorous reauthorization of the U.S. Farm Bill bring into question the opportunities and challenges facing the conservation work of organizations such as The Nature Conservancy. Recent census and agricultural subsidy data for Nebraska were combined with biodiversity data to begin to understand the relationships between subsidies, land prices, population trends, and other socio-economic variables. Despite declining populations across Nebraska, land prices continue to rise. The value of land seems to be positively related to the amount of production subsidies paid out under the U.S. Farm Bill. From 1987-2001, the total amount of cropland decreased in Nebraska. However, production payments increased and conservation payments decreased. Mapping these trends against biological hotspots in Nebraska can focus conservation efforts to areas more sympathetic to conservation (where conservation subsidies are greater) and predict areas with higher threats to biodiversity (areas where production subsidies are the greatest). Being aware of these relationships are helping conservation planners to design more effective strategies for conservation.

C56-01 HANOWSKI, JOANN, Terry Brown, George Host, and Mark White. Natural Resources Research Institute, University of Minnesota Duluth, 5013 Miller Trunk Highway, Duluth, MN 55811, USA (jhanowsk@nrri.umn.edu).
SETTING REGIONAL BIRD CONSERVATION PRIORITIES BASED ON SPECIES HISTORIC POPULATION RANGES

Most prioritization schemes developed for bird species include an assessment of the current population trend. Species with declining trends are usually given higher conservation priority than species with increasing trends. Often the only population trend available for conservation assessments is from Breeding Bird Surveys (BBS) conducted across North America over the past 35 years. Although population trends from these surveys are statistically reliable, the reference time used to calculate trends may not be appropriate for developing conservation priorities. We calculated historic ranges of bird populations for 40 breeding species in northern Minnesota. We compared these values to a calculated current population, BBS trends, and trends from a regional monitoring program. We found that current populations of species that prefer early-successional forests are above the

maximum number that occurred in the region historically, including species that are declining in population based on BBS. In contrast, current populations of species that occur in late-successional, conifer dominated forests are lower than their minimum historic populations. Some of these species have increasing BBS trends. Our examples show that regional conservation priorities for birds should consider historic ranges of species populations as a benchmark rather than trends calculated from any one point in time.

S15-07 HARRIS, JEAN M., Sandile Sibiya, George Branch, Scotty Kyle, Ronnie Brereton-Stiles, and Gugu Zama. Ezemvelo KwaZulu-Natal Wildlife, Private Bag X3, Congella, Durban, KwaZulu-Natal 4013, South Africa (jmharris@iafrica.com) (JMH, SS, SK); University of Cape Town, Rondebosch 7701, South Africa (GB, RBS, GZ).
INTEGRATING TRADITIONAL FISHERIES IN MARINE PROTECTED AREA MANAGEMENT: CO-MANAGEMENT CASES STUDIES IN SOUTH AFRICA

Traditional fisher perceptions of, and relationships with, marine protected areas in South Africa are complex and are tainted by a past of politically driven unequal access to natural resources. This history is overlain on strong cultural practices and indigenous knowledge around resource use. High poverty levels and a dependence on natural resources for basic food security in areas adjacent to marine protected areas (MPAs), has led to increasing demand on resources inside the MPAs and conflict between communities and authorities. This paper briefly outlines the shift in South Africa to legally recognise and formalise traditional fisheries, and to develop management systems and sustainable harvesting strategies for these previously outlawed activities. It highlights a number of case-studies on the east coast of South Africa that attempt to engage the authorities of MPAs and traditional fishers in joint management and decision-making processes. Successes and failures, are reported and the associated factors explored. The model of co-management as an option for dealing with conflict and unsustainable resource use, and improving the biodiversity integrity, and value to communities, of MPAs is critically evaluated.

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COSTS OF PARASITISM (DIPLOSTOMATIDAE) TO MALE WHITE SANDS PUPFISH (*CYPRINODON TULAROSA*)

The costs of novel parasitism are especially important for species that have altered parasite communities due to historical translocations. This is the case for two populations of White Sands pupfish (*Cyprinodon tularosa*) that lost parasites as a result of one translocation and acquired novel parasites through another. In a laboratory study, I examined the costs of parasitism by white grubs (Diplostomatidae), a novel parasite of one pupfish population, on the life history traits of male White Sands pupfish. Pupfish were exposed to parasites at three treatment levels; acute exposure (500 cercariae at once, $n = 42$), trickle exposure (50 cercariae a day for 10 days, $n = 42$), and sham exposure (0 cercariae, $n = 42$). We found that there was no significant difference in pupfish survival, growth, fat storage, or edema between the three treatment levels. These findings are in contrast to a previous study conducted on female White Sands pupfish which found that exposure to white grub parasites significantly affected survivorship, total mass and somatic mass gain, and fat storage. White grub infection caused swollen eyes and darker coloration, which could increase predation risk. The potential affects novel parasites have on their host should be considered before future translocations.

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MITIGATING DIAMONDBACK TERRAPIN BYCATCH AND MORTALITY IN ACTIVELY-FISHED COMMERCIAL CRAB POTS: AN EXERCISE IN COMPROMISE?

Diamondback terrapins (*Malaclemys terrapin*) and blue crabs (*Callinectes sapidus*) occupy similar estuarine habitats, so gear designed to trap crabs also frequently captures and drowns air-breathing terrapins. We performed a study in Jarrett Bay, NC during 2000-2001 to assess the extent of terrapin bycatch and mortality in actively-fished commercial hard crab pots and to evaluate the effect of different crab pot designs and bycatch reduction device (BRD) sizes on both crab and turtle catch rates. Although our overall catch rate of terrapins was low ($N = 12$), 58% of turtles captured were dead and all turtle captures occurred in May in shallow water. Analysis of crab catch statistics revealed that the differences in mean values among the different types of pots was greater than would be expected by chance only in the spring of 2001 when we tested 4.5 cm BRDs ($P < 0.001$). During spring 2001, the mean catch of control pots was greater than the mean catch of pots with BRDs by a factor of only 1.064. Seasonal (spring) use of pots outfitted with 4.5 cm BRDs on all funnel entrances seems to be the best way to reduce terrapin bycatch and only slightly compromise hard crab catch.

C55-04 HARVEY, CELIA, and Jorge Gonzalez. Department of Agroforestry, Centro Agronómico Tropical de Investigación y Enseñanza (CATIE), AP 7170 Turrialba, Costa Rica (charvey@catie.ac.cr).
BIODIVERSITY, COCOA AND INDIGENOUS PEOPLE: PARTICIPATORY MONITORING OF BIODIVERSITY IN TALAMANCA, COSTA RICA

In the indigenous reserves of Talamanca, Costa Rica, cocoa is typically grown under a dense canopy of fruit trees, timber trees and relicts of the original forest. These agroforestry systems produce an important cash crop (cocoa) for the indigenous people, while also providing habitats and resources for wildlife. In order to determine the importance of cocoa agroforestry systems for conserving biodiversity and to interest local people in the biodiversity present on their cocoa farms, we conducted surveys of dung beetles, birds and terrestrial mammals in four types of cocoa agroforestry systems, banana plantations and adjacent forest patches. All monitoring was conducted monthly by local farmers (n = 60) over a one-year period, using simple methods (pitfall traps, observations and searching of animal tracks in pre-established transects). Preliminary results indicate that cocoa agroforestry systems harbor a significant proportion of the fauna present within the forests, whereas banana plantations typically have reduced species richness. Multi-strata cocoa plantations appear to host more dung beetle species than monoculture cocoa plantations. Our experience also suggests that the inclusion of local people in biodiversity monitoring creates a considerable awareness and interest in conservation issues, and could be a key element in conservation strategies.

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EXPLORING THE SMALL POPULATION PARADIGM: DATA FROM ISOLATED CUTTHROAT TROUT POPULATIONS IN SOUTHEASTERN ALASKA

Threats to the persistence of small populations are generally organized into three categories: genetic, demographic, and environmental. Rare is the opportunity, however, to examine how these factors interact across ecological time to impact natural small populations. To explore this interaction, we studied coastal cutthroat trout populations isolated above waterfalls by isostatic rebound for about the last 8,000 years. We found a strong relationship between watershed size (length of available stream habitat) and population persistence. All above-barrier populations exhibited dramatically lower amounts of genetic variation at eight microsatellite loci than below-barrier populations from the same streams. We estimated effective population sizes from both genetic and environmental data. Estimates of effective population size by all methods were relatively small, on the order of just a few thousand adults. Correlations between genetic and environmentally-based population size estimates were weak, suggesting that the relationship is not a strictly linear one.

P023 HAWBAKER, TODD, Charlotte E. Gonzalez-Abraham, Volker C. Radeloff, Roger B. Hammer, and Susan I. Stewart. Department of Forest Ecology and Management, University of Wisconsin–Madison, 1630 Linden Drive, Madison, WI 53706, USA (tjhawbaker@wisc.edu) (TH, CEG, VCR); Department of Rural Sociology, University of Wisconsin–Madison, 1180 Observatory Drive, Madison, WI 53706, USA (RBH); USDA Forest Service, North Central Research Station, 1033 University Avenue, Suite 360, Evanston, IL 60201, USA (SIS).
RELATIVE AND CUMMULATIVE EFFECTS OF ROADS AND HOUSES ON FOREST FRAGMENTATION IN NORTHERN WISCONSIN

Both roads and houses impose structure on landscapes by directly removing habitat and by fragmenting remaining habitat. The objective of this study was to explore the relative and cumulative effects of houses and roads on landscape fragmentation in northern Wisconsin. We compared the response of landscape metrics as we varied the road-effect zone between 30 and 500 meters and the house-effect zone between 50 and 1000 meters. Current road and housing data were derived from air photos from 1997 to 1999. We analyzed terrestrial patches greater than 1 hectare remaining after removing the road-effect zone and house-effect zone from the surrounding landscape. Both roads and houses remove and subdivide habitat; however, the character and magnitude of the response depends on the respective zones widths. In northern Wisconsin, landscape structure is more sensitive to changes in the road-effect zone than the house-effect zone. When the road-effect zone is large, increasing the house-effect zone has little additional impact on landscape structure. Houses and roads have different effects on ecosystems. The results of this study provide insights into the range of scales over which the different effects of houses and roads are most important and their implications for land management and planning.

C03-04 HECNAR, STEPHEN, Gary Casper, Ronald Russell, Darlene Hecnar, and Jeffrey Robinson. Department of Biology, Lakehead University, 955 Oliver Road, Thunder Bay, ON P7B 5E1, Canada (Stephen.Hecnar@lakeheadu.ca) (SH, DH, JR); Section of Vertebrate Zoology, Milwaukee Public Museum, Milwaukee, WI 53233, USA (GC); Department of Biology, Saint Mary's University, 923 Robie Street, Halifax, NS B3H 3C3, Canada (RR).
NESTED HERPETOFAUNAL ASSEMBLAGES ON ISLANDS IN THE GREAT LAKES: LESSONS FOR CONSERVATION

Nestedness in insular systems has important implications for conservation. A diverse herpetofauna of widely distributed species occurs in the Laurentian Great Lakes. Great Lakes islands differ in many abiotic characteristics, but they share a common post-glacial history. Our goal was to investigate nestedness across a variety of spatial and taxonomic scales. We studied 47 species occurring on 107 landbridge islands among four archipelagoes (Lake Erie, St. Lawrence, Georgian Bay, Apostle). We constructed presence-absence matrices from recent surveys and quantified nestedness using several methods. Island assemblages were significantly nested across the entire basin, all archipelagoes, and all taxa, but did not differ among archipelagoes. Degree of nestedness differed (most to least) among classes (reptiles, amphibians), orders (snakes, turtles, frogs, salamanders) and species. Nestedness was strongly associated with area but not isolation. The similarity of insular and mainland faunas indicate that the entire basin shares virtually the same species pool. Differences in nestedness among taxa appear to be related to differences in basic biology, natural history, and ecology. Our results suggest that preserving large islands instead of equivalent areas of small islands is a more effective conservation strategy and results of island studies may be applicable elsewhere in the Great Lakes basin.

C30-04 HEDIN, JONAS. Department of Ecology, Animal Ecology, Lund University, Ecology Building, SE-223 62, Lund, Sweden (jonas.hedin@zooekol.lu.se).
POPULATION SIZE OF THE THREATENED SCARABAEID BEETLE *OSMODERMA EREMITA* IN RELATION TO HABITAT QUALITY AND ISOLATION

Habitat quality is sometimes described as the missing third parameter in metapopulation ecology, a parameter equally or sometimes even more important than site area and isolation. I have studied the threatened scarabaeid beetle *Osmoderma eremita* inhabiting hollow deciduous trees in Sweden. Previous studies of this beetle have shown that it has a population structure that conforms to that of a metapopulation. It has a relatively low dispersal rate (studied by both mark-recapture and telemetry) and a dispersal range biased towards short distances. Spatial variability in population size is much greater than the temporal variability between years. Each populated tree can thus be seen as a local population and a stand of hollow trees as the metapopulation. In this study I have found that the incidence and population size in *Osmoderma eremita* is strongly positively correlated with volume of wood mould inside the trees. The wood mould constitutes the food source for the larvae. This gives us a more detailed knowledge of which trees are most important in the conservation of *Osmoderma eremita*. Since the species previously has been shown to be dispersal restricted I am just now studying the effect of habitat isolation on population size.

C20-01 HEINEMEYER, KIMBERLY, Julian Griggs, Bryan Evans, and Dennis Sizemore. Round River Conservation Studies, 4301 Emigration Canyon Road, Salt Lake City, UT 84108, USA (KH, DS); Dovetail Consulting, Inc., 105-2590 Granville Street, Vancouver, BC V6H 3H1, Canada (JG, BE).
DEVELOPMENT AND IMPLEMENTATION OF A CONSERVATION AREA DESIGN THROUGH FIRST NATION PARTNERSHIPS

There is increasing scientific interest in the development of robust ecological network or conservation area designs (CAD), yet implementation strategies have received significantly less attention. We partnered with the Taku River Tlingit First Nation (TRTFN) to develop and implement a CAD incorporating Traditional and Indigenous Ecological Knowledge (TIEK) for their 3.9 million ha territory in British Columbia. The CAD was integrated with the results of extensive TRTFN community-values interviews (25% of adult TRTFN population, n = 51) to produce a Land Plan for their territory. Throughout the interviews, community members consistently placed environmental conservation above short-term, environmentally-damaging economic development, even though they contend with severe economic depression. Two potential avenues for implementation of the CAD and Land Plan were considered. Initially, implementation via joint planning with the BC government was pursued, but this avenue was abandoned due to complex issues surrounding consultation and aboriginal rights. The TRTFN have chosen to proceed independently to approve and implement their Land Plan, emphasizing sustainable economic development opportunities such as commercial recreational, wildlife-viewing and small-scale forestry. The community has wrestled with balancing conservation values with immediate economic opportunities. This process illuminates the challenges and opportunities of developing and implementing conservation plans through local community partnerships.

S02-03 HELTNE, PAUL. Center for Humans and Nature, 2430 North Cannon Drive, Chicago, IL 60614, USA (heltne@chias.org).
AN URBAN WILDERNESS: LAND-USE PLANNING AND BIODIVERSITY PROTECTION

Large metropolitan areas contain surprising amounts of biodiversity. The Chicago experience shows that the interstices between industrial enterprises and transportation corridors may provide large areas of relatively native floral communities. The Chicago Wilderness project is concerned with understanding, cataloguing, connecting, and protecting these patches. Restoration of interstitial landscape and forest preserves provides new challenges technically and politically. The history of Chicago's open space plans creates opportunity and limitations for conservation of biodiversity. Currently, three major planning efforts and several minor projects are underway; the volume of activity presents challenges to the citizen and to the professional in terms of participation and coordination. Yet the urban-wildlands interface provides crucial settings for the preservation of life other than human and deserves to be much more fully understood.

C02-02 HENDRICKSON, SHER L. Department of Zoology, University of Wisconsin–Madison, 438 Birge Hall, 430 Lincoln Drive, Madison, WI 53706, USA (sher.hendrickson@earthlink.net).
LOW MITOCHONDRIAL VIABILITY IN NEW WORLD VULTURES: THE NEED FOR UNDERSTANDING UNDERLYING GENETIC AND LIFE HISTORY PHENOMENA INFLUENCING GENETIC MARKERS

The Andean condor (*Vultur gryphus*) is the world's largest flying avian species. Unfortunately, as is the case for many large-bodied animals, the Andean condor is now endangered from persecution and habitat destruction (listed as CITES I, 1975). To date, conservation efforts on behalf of the species have focused on captive breeding and reintroduction. I compared sequences from Domains II and III of the mitochondrial control-region of Andean condors in an effort to elucidate population structure and biogeographic patterns relevant to their management and conservation. Sequences from the control region were selected for study based on their generally rapid evolution and accessibility from both modern and museum specimens. However, genetic analysis of 38 Andean condors from throughout the species' range yielded only 2 variable nucleotide sites. Follow-up analysis of mitochondrial variability in other New World vultures (black vultures, turkey vultures and in a small number of California condors) demonstrated the same pattern of low population-level variability. Mitochondrial genes often are examined in genetic studies involving rare and endangered species; however, the results for vultures demonstrate that for some large-bodied species, interpretation of genetic data based on standard mitochondrial markers may be difficult until more is known about their underlying genetic and life history phenomena.

S14-02 HEPPELL, SELINA S. Department of Fisheries and Wildlife, Oregon State University, 104 Nash Hall, Corvallis, OR 97331, USA (Selina.Heppell@oregonstate.edu).
LIFE HISTORY ANALYSIS FOR CONSERVATION AND RECOVERY PLANNING: LESSONS FROM THE SEA TURTLE 'SUCCESS' STORY

Nearly all sea turtles cross international boundaries, either through migration corridors or ontogenetic shifts. The continued recovery of many sea turtle populations in the southeastern U.S. is thought to be due to regulations that require Turtle Excluder Devices (TEDs) on shrimp trawls that reduce incidental mortality. Policy decisions by the National Marine Fisheries Service were greatly influenced by the results of relatively simple population models that suggested a need to focus management on large turtles, rather than eggs and hatchlings. Because we rarely have the luxury of fine scale demographic data to make management decisions for threatened species, it is important to develop general guidelines that account for differences in species' life history and population dynamics. But because these are general guidelines, they should not serve as quantitative predictors of population response, nor should they release agencies from their obligation to monitor and research populations to parameterize better models. To illustrate, I will discuss the uses and abuses of elasticity analysis, a method used to examine the effects of perturbations on populations.

C45-01 HERBERT, MATTHEW, and Timothy Tear. The Nature Conservancy, Illinois Chapter, 301 SW Adams Street, Suite 1007, Peoria, IL 61602, USA (mherbert@tnc.org) (MH); The Nature Conservancy, Eastern New York Chapter, 200 Broadway, 3rd Floor, Troy, NY 12180, USA (TT).
TEMPORAL TRENDS IN THE HYDROLOGIC REGIME OF THE MAJOR TRIBUTARIES OF THE ILLINOIS RIVER: IMPLICATIONS FOR ECOLOGICAL RESTORATION

Streamflow is a predominant feature of riverine ecosystems. Alteration of the hydrologic regime can substantially alter stream ecosystems and aquatic communities. The Illinois River is one of three large floodplain river ecosystems in the United States with sufficient ecological integrity for recovery. However, alterations to its hydrologic regime are substantial and require restoration in order to restore the structure and function of the ecosystem. Hydrologic stresses include increased annual water-level fluctuations, extreme unnatural water-level fluctuations during critical low-flow periods, and loss of low-water conditions.

Sources of these alterations include lock and dam operation, loss of floodplain habitat, altered hydrologic conditions within tributaries, and influences due to water delivered from Chicago and Lake Michigan. We assessed the altered hydrologic conditions in the major Illinois River tributaries during the 20th century in order to assess the relative contributions from the tributaries. The assessment was conducted for changes in annual and summer low-flow hydrographs separately. The Index of Hydrologic Alteration was used to derive hydrologic variables from discharge data from multiple USGS gauging stations from each drainage. Analysis of covariance was used for assessments with tributary river as a blocking variable and drainage area as a covariable. The tributaries experienced substantial hydrologic alteration during the 20th century, including increases in annual streamflow variability (reversals) and increases in harsh low-flow conditions. Tributary trends match many of the trends within the Illinois River. However, trends in the tributaries indicate that they have not contributed to the extreme unnatural low-flow fluctuations that appear periodically in the Illinois River. This study documents hydrologic alterations in Illinois River tributaries and clarifies the role of the tributaries in contributing to the altered hydrologic conditions within the Illinois River.

C28-01 HERKERT, JAMES, and Scott Robinson. The Nature Conservancy, 301 SW Adams Street, Peoria, IL 61602, USA (jherkert@tnc.org) (JH); University of Illinois, 606 East Healey, Champaign, IL 61820, USA (SR).
EFFECTS OF ROADS ON BREEDING GRASSLAND BIRDS

Fragmentation is a major factor influencing grassland bird populations. Although it is generally believed that roads 'fragment' grassland systems, data addressing this issue are scarce. We studied the effects of roads on the abundance and nesting success of grassland birds in Illinois. We found that 7 of the 16 most common species showed a significant ($P < 0.05$) tendency to avoid high volume roads (> 30,000 vehicles/day), including 6 of 8 grassland obligate species. Fewer species ($N = 2$) showed signs of avoiding lower volume roads. Nesting success for 7 species of grassland birds breeding close to low volume roads (< 50 m), was not significantly different than success for birds breeding at greater distances (> 50 m). Our data suggest that road effects vary depending on traffic volume, and support the idea that factors associated with high traffic volume (e.g., loud/continuous traffic noise) and not the road itself (e.g., the physical structure) are largely responsible for reduced densities of grassland birds along particular roads.

P123 HERRICK, BRADLEY. Department of Natural and Applied Sciences, University of Wisconsin–Green Bay, Green Bay, WI 54311, USA (herrbm11@uwgb.edu).
THE EFFECTS OF DIKES ON THE SEED BANKS AND STANDING VEGETATION OF GREAT LAKES COASTAL WETLANDS

A significant number of Great Lakes coastal wetlands have been diked to provide protection from flooding and to manipulate water levels for vegetation management. Dikes change the hydrological regime by isolating the coastal wetland from natural lake processes. I evaluated the seed banks of seven pairs of diked and undiked coastal wetlands in Green Bay (Lake Michigan) and Saginaw Bay (Lake Huron) in order to assess the effects of dikes on long term vegetation dynamics. I also estimated cover of dominant plant species in the extant vegetation. Seed banks in diked wetlands yielded a significantly greater density of invasive species compared with undiked wetlands. *Lythrum salicaria* (purple loosestrife) and *Chenopodium rubrum* (red groosefoot) were the two most abundant invasive species present in all seed banks. Two other common invasive species, *Phragmites australis* (giant reed grass) and *Phalaris arundinacea* (reed canary grass), were abundant in the extant vegetation but were not present in either the diked or undiked wetland seed banks. My results demonstrate that diking of coastal wetlands significantly alters the seed bank and existing vegetation by promoting a greater biomass, largely composed of undesirable exotic species.

C38-04 HEWITT, JENNIFER, Michele Webber, and Albert Meier. Center for Biodiversity Studies, Western Kentucky University, 1 Big Red Way, Bowling Green, KY 42101, USA (hewitje@wku.edu) (JH, AM); Division of Science and Resource Management, Mammoth Cave National Park, PO Box 7, Mammoth Cave, KY 42259, USA (MW).
THE RESPONSE OF EGGERT'S SUNFLOWER (*HELIANTHUS EGGERTII*) TO RELOCATION AT MAMMOTH CAVE NATIONAL PARK

Eggert's sunflower (*Helianthus eggertii*) is a federally threatened plant that is known to occur from central Kentucky and Tennessee to northern Georgia. Twenty-two of these occurrences are in and around Mammoth Cave National Park, Kentucky. Although efforts are currently in place to protect known populations and to increase the total number of individuals throughout the park, road construction plans have been approved which threaten the park's largest group. Since the plants needed to be moved, this situation presented an opportunity to examine the effects of substrate disturbance on this threatened species and to determine whether or not relocation is a viable conservation method. In November of 2001 seeds were collected from the plants at this roadside location, and the population was transplanted to two similar sites within the park. We surveyed the disturbed population, 5 natural undisturbed populations, and 5 groups of transplanted individuals during the 2002 growing season. We found that the original roadside group increased from 1505 stems before the relocation event to 2480 stems in the following season, representing an increase in stem density from 12.5 to 20.7 stems/m^2. There was a significant difference in mean stem height between natural, disturbed, and transplanted groups ($p < 0.01$ for each comparison, with means of 77.4, 65.5, and 26.5

cm). We also found a significant difference in the number of flowers produced per plant between natural and transplanted ($p < 0.01$ for means of 0.75 and 0.00) and between disturbed (mean = 0.71) and transplanted populations ($p < 0.01$) with no significant difference between natural and disturbed ($p > 0.05$). These results show that in this case severe substrate disturbance resulted in increased stem height and density over one growing season.

C02-04 HICKS, JASON, Janet Rachlow, Olin Rhodes, Jr., and Lisette Waits. Department of Fish and Wildlife Resources, University of Idaho, Moscow, ID 83844, USA (hick0136@uidaho.edu) (JH, JR, LW); Department of Forestry and Natural Resources, Purdue University, West Lafayette, IN 47907, USA (OR).

MICROSATELLITE ANALYSIS OF GENETIC VARIATION AND STRUCTURE AMONG SOURCE AND REINTRODUCED ELK POPULATIONS IN THE WESTERN STATES

Reintroduction programs are a common conservation strategy in reestablishing wildlife populations. Maintaining genetic variability in these populations is a fundamental component of successful reintroduction efforts. Low levels of genetic diversity resulting from reintroductions may negatively impact individual fitness characteristics and future population viability. We explore the impact of translocations on genetic diversity and structure of reintroduced elk populations. Tissue samples from 30-40 individuals per population were collected from five reintroduced and two source populations of elk (Yellowstone northern range and Teton/Jackson Hole herds), and samples were analyzed using 12-15 microsatellite markers. No significant differences in expected heterozygosity and mean number of alleles per locus were detected among populations. Additionally, low to intermediate levels of genetic differentiation were observed among reintroduced populations and between each reintroduced population and its respective source population. Our results indicate that augmentation is not currently necessary to bolster genetic variation in the reintroduced populations examined. Presently, we are exploring the correlation between individual measures of genetic diversity and antler abnormalities in the reintroduced elk population on the Hualapai Indian Reservation in northern Arizona.

S08-01 HIGGINS, JONATHAN, and Robin Abell. The Nature Conservancy, 8 South Michigan Avenue, Suite 2301, Chicago, IL 60603-3318, USA (jhiggins@tnc.org) (JH); World Wildlife Fund, 1250 24th Street NW, Washington, DC 20037, USA (robin.abell@wwfus.org) (RA).

MAKING THE TRANSITION FROM FRESHWATER CONSERVATION PLANNING TO CONSERVATION ACTION: GOING FROM WHERE TO HOW

The World Wildlife Fund and The Nature Conservancy have each worked to incorporate freshwater biodiversity targets into their ecoregional planning. Both organizations are now focused on translating those plans into action. This process largely involves analyzing the extent and magnitude of threats to biologically important areas and then defining mitigation strategies. Dominant threats to freshwater targets typically constitute a different set from threats to terrestrial targets. Addressing these threats requires strategies that go beyond the creation of traditionally-defined protected areas. For instance, mitigating disturbances to natural flow and sediment regimes are priorities and can require interventions in both the terrestrial and aquatic realms; designing these interventions necessitates greater use of innovative tools. Important strategies for conserving freshwater biodiversity include ecologically sustainable water management, improving agricultural practices, re-establishing connectivity, and avoiding species invasions. We present examples of how ecoregional plans can inform strategies, focusing on joint work in the Southeast US and on projects conducted separately elsewhere. We describe threat assessments based on spatial data, expert assessment, and sampling, and offer results of a comparative analysis of data types for the Southeast. We discuss approaches for strategy development, including integrating freshwater and terrestrial priorities, and recommend avenues for future research.

S08-05 HILDERBRAND, ROBERT, Jeffrey Kershner, and Warren Colyer. Center for Environmental Science, University of Maryland, Appalachian Laboratory, Frostburg, MD 21532, USA (hilderbrand@al.umces.edu) (RH); USDA Forest Service, Fish and Aquatic Ecology Unit, Department of Aquatic, Watershed, and Earth Resources, Utah State University, Logan, UT 84322, USA (JK); Trout Unlimited, 230 West 100 North, Logan, UT 84321, USA (WC).

MAINTAINING AND RESTORING CONSERVATION POTENTIAL FOR INTERIOR CUTTHROAT TROUT: PARADIGMS AND POSSIBILITIES

Distributions of cutthroat trout in many areas are disjunct as a result of isolation due to human made physical barriers, habitat degradation, and interactions with non-native species. Even for well distributed populations, the one-dimensional character of streams on the landscape makes loss of connectivity and isolation by fragmentation a persistent threat. In highly fragmented systems, the conservation focus has been on headwater and tributary streams and has often evolved into a conservation by isolation paradigm. Many of these populations have increased extinction risk due to small populations and restricted fragment size, and the fluvial (larger body size and migratory) life history component that probably linked and maintained populations as a metapopulation has largely disappeared. Simulation models indicate that small amounts of immigration from a larger source population or through managers moving fish can maintain persistence in even the most extinction-prone fragments. Recent work

indicates the fluvial component can be re-expressed and seemingly marginal habitats may be extremely important to their existence. We view the restoration of a fluvial component as important to long-term persistence of populations and genetic diversity and propose multiple approaches to restore metapopulations yet protect existing populations from non-native invasions as population connectivity is restored.

C14-03 HILTY, JODI A., and Adina M. Merenlender. Wildlife Conservation Society, 2023 Stadium Drive, Suite 1A, Bozeman, MT 59715, USA (jhilty@wcs.org) (JAH); Department of Environmental Science, Policy, and Management, University of California, Berkeley, Hilgard #3110, Berkeley, CA 94720-3110, USA (AMM).
USE OF RIPARIAN CORRIDORS AND VINEYARDS BY MAMMALIAN PREDATORS IN NORTHERN CALIFORNIA

Valley bottom streams and adjacent riparian vegetation often provide the only remaining natural linkages among isolated upland habitat patches. Conservation of wildlife habitat is often used as part of the justification for riparian corridor protection, but wildlife use of riparian corridors compared to surrounding modified landscapes is not well-documented. In Sonoma County, California we examined mammalian predator use of 21 riparian corridors classified as denuded, narrow, or wide according to the width of the remaining natural vegetation adjacent to the creek. In addition, we monitored predator activity in six vineyards, three close to core habitat and three far from core habitat. Unbaited remotely triggered cameras were used to determine presence-absence of predators. Mammalian predator detection rates were 11-fold higher in riparian study areas than in vineyards. More native predator species were found in wide corridors than in narrow or denuded creek corridors. The number and activity level of native predators was higher in vineyards adjacent to core habitat as compared to vineyards farther away, where the number and activity level of non-native predators was higher. Maintaining wide and well vegetated riparian corridors may be important in maintaining connectivity of native predator populations to ensure their long-term survival.

P092 Hipkins, Valerie, and **JENNIFER DEWOODY.** USDA Forest Service, Pacific Southwest Research Station, National Forest Genetic Laboratory (NFGEL), 2480 Carson Road, Placerville, CA 95667, USA (jdewoody@fs.fed.us).
INTEGRATING GENETIC INFORMATION INTO CONSERVATION STRATEGIES FOR TAHOE YELLOW CRESS, *RORIPPA SUBUMBELLATA* (BRASSICACEAE)

Rorippa subumbellata (Roll.), Tahoe yellow cress, is endemic to sandy beaches on the shores of Lake Tahoe in California and Nevada, and is a candidate for listing under the U.S. Endangered Species Act. A conservation strategy has been developed through a coalition of a dozen local, state, and federal agencies, including the U.S. Forest Service. In order to determine the amount of genetic variation present in extant populations of *R. subumbellata*, and estimate the genetic relationship among populations, we assayed 31 populations for 23 isozyme loci. Results reveal low levels of genetic variation within and among populations. Twenty-seven of the 31 populations were monomorphic at the 23 loci examined, and three of the genetically variable populations displayed a single alternate allele at one locus. One population displayed variation at two loci. If DNA-based markers that are being developed for this species reveal a similar paucity of variation, the genetic data will support anatomical studies indicating that vegetative reproduction is probably in this species. If this lack of genetic variation reflects historical levels and not recent decreases due to artificial events, current management theory aimed at maximizing and maintaining genetic variation may not apply to the conservation of this species.

C32-05 HOAGSTROM, CHRISTOPHER, and James Brooks. Department of Wildlife and Fisheries Sciences, South Dakota State University, Box 2140B, NPBL 138, Brookings, SD 57007, USA (hoagstrom@brookings.net) (CH); U.S. Fish and Wildlife Service, New Mexico Fishery Resources Office, 2105 Osuna Road NE, Albuquerque, NM 87113, USA (JB).
PECOS BLUNTNOSE SHINER CONSERVATION STATUS

The Pecos bluntnose shiner (*Notropis simus pecosensis*) occupies the Pecos River between Fort Sumner Irrigation District Diversion Dam and Brantley Reservoir. The population was monitored multiple times per year from February 1992 through October 2002. Abundance was very low in 1992, presumably due to surface flow intermittence that occurred in 1989 and 1990. Above average precipitation, beginning in 1991, corresponded with a population increase. The Pecos bluntnose shiner population was divisible into upstream (150 km) and downstream (145 km) sub-populations. The upstream population had stable relative abundance, stable density, and multiple year classes. The downstream population exhibited less stable relative abundance and density, and was dominated by young-of-the-year. Population instability, low growth, and low survival downstream were attributable to low habitat complexity caused by channel incision and narrowing. Channel narrowing in the upstream stretch (observed during the study period) suggests that poor habitat conditions are extending upstream. Thus, a short-term threat to Pecos bluntnose shiner conservation is surface-flow intermittence, but a long-term threat is channel narrowing. Base-flow supplementation, reduced groundwater pumping, and improved rangeland and riparian conditions could reduce the short-term threat. River channel restoration, transport of sediment through dams, and restoration of flood flows could address the long-term threat.

C36-04 HOEKSTRA, JONATHAN M. Northwest Fisheries Science Center, National Marine Fisheries Service, 2725 Montlake Boulevard East, Seattle, WA 98112, USA (Jonathan.Hoekstra@noaa.gov).
HABITAT HETEROGENEITY CAN REDUCE POPULATION VARIABILITY AND SUGGESTS AN ADDITIONAL STRATEGY FOR MITIGATING EXTINCTION RISK

Innumerable conservation strategies seek to minimize risk of stochastic extinction by maximizing population size, or at least exceeding a theoretical minimum (e.g., minimum viable population size). Population biology theory also predicts that extinction risk can be reduced by attenuating demographic variability. Surely, all finite populations will exhibit some inherent stochasticity, but could additional variability driven by external forces – such as climate – be mitigated to reduce extinction risk? Habitat heterogeneity may afford such mitigation by providing micro-environmental refuges that buffer populations against climate-induced variability. To experimentally test this hypothesis, I established 36 replicate populations of *Drosophila melanogaster* in large field cages that enclosed homogeneous and heterogeneous "landscapes" of sun-exposed and shaded fruit, and measured subsequent population growth rates during summer and autumn. Seasonal climate change induced substantial variability such that population growth rates in homogeneously shaded and sun-exposed treatments switched relative ranks. Meanwhile, population growth rates in heterogeneous cages with both shaded and sun-exposed fruit were intermediate to the homogeneous treatments, but consistent between seasons. These results demonstrate that habitat heterogeneity can indeed attenuate temporal variability in population dynamics, and suggest that maintaining appropriate levels of habitat heterogeneity may offer an additional conservation strategy for hedging against stochastic extinction risks.

S08-06 HOGAN, ZEB. Department of Wildlife, Fisheries, and Conservation Biology, One Shields Avenue, University of California, Davis, Davis, CA 95616, USA (zebhogan@hotmail.com).
FROM PRIORITIES TO ACTION: THE MEKONG FISH CONSERVATION PROJECT (CAMBODIA)

The Mekong Fish Conservation Project focuses on three species of threatened Mekong fish, the giant catfish, *Pangasianodon gigas*, the giant carp, *Catlocarpio siamensis*, and the river catfish, *Pangasianodon hypophthalmus*. The objectives of the project are to purchase endangered species for release, tag fishes to examine their migratory behavior and habitat use, collect non-invasive tissue samples for genetic analysis, and educate the public about fish ecology and conservation. Significant numbers of fish have been purchased and released. Acoustic tagging has indicated substantial migration among catfish species. Genetic analysis shows an extreme lack of genetic diversity in Thai captive-bred stock, raising questions as to the suitability of Thai stock for reintroduction efforts. In the short term, the purchase and subsequent release of captured wild fish decreases the probability of extinction of these species, and generates an appreciation for endangered species conservation. In the longer term, tagging and genetics research will help to determine the migratory patterns, habitat use, and exploitation rates of *P. gigas* and *P. hypophthalmus*. This knowledge is critical to the development of a long-term conservation strategy for these, and other, important Mekong fish species.

C20-10 HOGLE, INGRID. California Department of Fish and Game, Habitat Conservation Planning Branch, 1416 Ninth Street, Room 1207, Sacramento, CA 95814, USA (ibhogle@mindspring.com).
ROLES AND RESPONSIBILITIES OF CONSULTANTS IN DEVELOPING NCCP/HCP CONSERVATION PLANS

The California Natural Community Conservation Planning (NCCP) Act provides an opportunity for applicants to develop biologically-based, landscape-level conservation plans in conjunction with federal Habitat Conservation Plans (HCPs). These multi-stakeholder conservation planning efforts require expertise, collaboration and dedication among plan participants. All applicants to date have hired consultants to assist in NCCP/HCP planning efforts. The relationship between applicant and consultant can vary from plan to plan, as can the responsibilities granted to consultants. Information on the roles and responsibilities conferred to consultants in past and present NCCP/HCP development efforts was obtained through personal interviews with 55 individuals representing private consultants, applicant jurisdictions, wildlife agencies, developers, environmentalists, attorneys and elected officials involved in conservation planning in California. This report uses case studies to describe three different consultant-applicant relationship models: landowner-driven, jurisdiction-driven and team-driven. Challenges faced by consultants working on NCCP/HCP planning efforts, and effective techniques and strategies used by consultants to meet these challenges, are discussed. Characteristics of successful technical, administrative and organizational, outreach and facilitative consultants are described. The information provided in this report can provide guidance to future plan participants on the effective roles and responsibilities of consultants in NCCP/HCP development.

P022 HOLCOMB, SHERRY S., Volker C. Radeloff, Roger B. Hammer, and Susan I. Stewart. Department of Forest Ecology and Management, University of Wisconsin–Madison, 1630 Linden Drive, Madison, WI 53706, USA (ssholcomb@facstaff.wisc.edu) (SSH, VCR); Department of Rural Sociology, University of Wisconsin–Madison, 1180 Observatory Drive, Madison, WI 53706, USA (RBH); USDA Forest Service, North Central Research Station, 1033 University Avenue, Suite 360, Evanston, IL 60201, USA (SIS).

HOUSING GROWTH 1940-2000 IN THE WESTERN U.S. AND ITS RELATIONSHIP TO FOREST FRAGMENTATION

Human development is a major conservation challenge, yet spatially detailed studies of housing growth across large regions are lacking. Our objective was to assess changes in housing density in the Western United States between 1940 and 2000, and to relate the observed changes to forest cover. The analysis was based on 2000 U.S. Census data and the NLCD satellite classification for the 1990s. Historic housing densities were estimated based on the 'year housing unit built' question from the Census long form and assessed for every decade since 1940. Our results demonstrate a strong increase in housing density over the 60-year time span. Housing growth in rural areas was particularly pronounced in the 1970s and 1990s. Mid-level housing densities exhibited the largest increase in extent. Housing density exhibits little effect on forest abundance up to a threshold of about 1000 housing units per square kilometers, above which forest cover declines rapidly. However, even low levels of housing are positively correlated with higher forest fragmentation and negatively with the abundance of interior forests. A summary of housing growth by ecoregion identifies areas that have been particularly affected, thus potentially warranting special conservation efforts.

C06-05 HOLDSWORTH, ANDREW, Lee Frelich, and Peter Reich. Conservation Biology Graduate Program and Department of Forest Resources, University of Minnesota, 1530 Cleveland Avenue North, St. Paul, MN 55108, USA (hold0094@umn.edu).

PATTERNS OF EARTHWORM INVASION AND UNDERSTORY PLANT COMPOSITION IN LAKESIDE NORTHERN HARDWOOD FORESTS

Current studies show that exotic earthworm invasion can significantly affect the understory plant communities and nutrient cycling of northern hardwood forests. However, little is known about the extent of earthworm invasion. We conducted a survey of understory plant communities, earthworms, soils, and tree composition in 314 plots located in 40 mature hardwood stands in the Chippewa and Chequamegon National Forests (Minnesota and Wisconsin, respectively). In both forests we found a significant correlation between the presence of exotic earthworms and the presence of cabins, resorts, boat landings, roads, and campsites. The earthworm species most associated with duff loss (*Lumbricus rubellus*) was found in over two-thirds of the Chippewa and Chequamegon plots. The nightcrawler, *L. terrestris*, inhabited nearly half of the Chequamegon plots while only occupying 16% of Chippewa plots. However, earthworm-free plots were much more common in the Chequamegon, 19% vs. only 3% in the Chippewa. Plots with all three earthworm ecological groups had an average of 50% less sugar maple seedling cover and between 10 and 20% less plant species richness than plots with few or no earthworms. Efforts should be made to prevent additional exotic earthworm introductions, especially in large earthworm-free areas.

C14-06 HOLLENHORST, THOMAS, Lucinda B. Johnson, George Host, Jeff Schuldt, and Carl Richards. Natural Resources Research Institute, University of Minnesota Duluth, 5013 Miller Trunk Highway, Duluth, MN 55811, USA (thollenh@nrri.umn.edu) (TH, LJ, GH); University of Wisconsin–Superior, PO Box 2000, Superior, WI 54880-4500, USA (JS); Minnesota Sea Grant College Program, University of Minnesota, 2305 East 5th Street, Duluth, MN 55812-1445, USA (CR).

SCALE EFFECTS IN MAPPING RIPARIAN ZONES IN AGRICULTURAL LANDSCAPES: PREDICTING IN-STREAM CONDITIONS FROM LAND USE AT VARYING DISTANCES FROM THE CHANNEL

Riparian zones play an important role in mediating water quality and enhancing local biodiversity, yet are among the most difficult landscape features to characterize and map. In non-forested landscapes the riparian zone is frequently smaller than the minimum resolution of traditional satellite imagery, with the result that some land cover classes are either missed altogether or misclassified. We mapped land cover in 12 watersheds in Southeastern Minnesota using aerial photography (0.5 meter) and satellite imagery (30 meter resolution). Our objectives were to quantify the bias for each data source and to determine how land cover at varying distances from a stream influences in-stream properties. Satellite imagery underestimated the proportion of forest and wetland classes and overestimated the proportion of agricultural land within 30, 60 and 120m of the channel compared to the high resolution imagery. We developed regression models predicting nutrient concentrations, percent fines, maximum temperature, number of fish species, scrapers, and predators from land cover in buffer widths varying from 2 to 500m. Percent predators was best predicted by land cover within 10m of the channel, while % fines and TN were best predicted by land cover within 120m of the channel. Potential conservation implications will be discussed.

C19-09 HOLMAN, HEIDI, Jaime Edwards, and Barb Perry. Conservation Biology Graduate Program, University of Minesota, Ecology Building, St. Paul, MN 55108, USA (holm0512@umn.edu) (HH); Minnesota Department of Natural Resources, 2300 Silver Creek Road, Rochester, MN 55906, USA (JE, BP).
COMPARISON OF SIZE, WEIGHT AND HOME RANGE OF WOOD TURTLES (*CLEMMYS INSCULPTA*) AT COMPARABLE LATITUDES WITHIN ITS GEOGRAPHIC RANGE

Past research on the wood turtle (*Clemmys insculpta*) has shown that turtle size, weight and home range increase with increasing latitude. Initial results from a telemetry study conducted from April 2002 - November 2002 show that a population of adult wood turtles in Southeastern Minnesota does have increased weight and carapace length, but a smaller home range size per individual than other populations of equal or lesser latitude. Since home range size is important for determining critical habitat necessary for protecting a population, it is important to know the variation in home range needs of that population, especially in a highly disturbed and/or fragmented habitat and if that population is in jeopardy of decline. The study population of wood turtles in southeast Minnesota resides in a privately-owned inactive quarry situated along the riparian corridor of a mid-sized stream. This quarry, although highly disturbed and fragmented, has a varied landscape which may provide adequate resources for all parts of the adult life cycle including foraging, nesting, thermoregulation and hibernation, in a smaller area than suggested by past research.

C47-05 HOLTGRIEVE, GORDON W., Scott R. Loarie, and Alan E. Launer. Department of Geological and Environmental Sciences, Stanford University, Stanford, CA 94305, USA (gwh@pangea.stanford.edu) (GWH); Center for Conservation Biology, Stanford University, Stanford, CA 94305, USA (SRL, AEL).
INFLUENCE OF INVASIVE SPECIES AND CUMULATIVE WATERSHED EFFECTS ON THREATENED CALIFORNIA RED-LEGGED FROG (*RANA AURORA DRAYTONII*) DISTRIBUTION IN A SUBURBAN STREAM

Suburban landscapes are conservation focal points in that native species are typically subjected to multiple pressures, including modified/degraded habitat, invasive exotic species, and human encroachment. During 1997-2002, threatened California red-legged frogs (CRLF) and other important aquatic species were monitored in San Francisquito Creek, California. This creek is characterized by rapid change from preserved open-space and low-density development in upper reaches to moderate agriculture and suburban developments in downstream areas. Data on abundance and distribution of fishes, frogs, and non-native crustaceans were compiled and analyzed in 250-meter stream segments. Land-use and faunal data were placed into a spatially explicit framework using GIS (geographic information system). Results indicate year-to-year distribution of CRLF is consistent but suggest a trend of decreasing abundance. For all years, CRLF populations within San Francisquito Creek were concentrated in segments immediately downstream of high non-native fish abundance and upstream from segments with higher proportions of developed land and high non-native crustacean abundance. These data suggest that CRLF are limited to areas within San Francisquito Creek with a minimum of multiple pressures typical of the suburban landscape, and as development continues within the watershed their range may become increasingly restricted.

C19-04 Homan, Rebecca Newcomb, Bryan S. Windmiller, and **J. MICHAEL REED**. Department of Biology, Tufts University, Medford, MA 02155, USA (michael.reed@tufts.edu) (RNH, JMR); Hyla Ecological Services, 1150 Main Street #7, Concord, MA 01742, USA (BSW).
CRITICAL THRESHOLDS ASSOCIATED WITH HABITAT LOSS FOR TWO VERNAL POOL-BREEDING AMPHIBIANS

A critical threshold exists when the relationship between the amount of suitable habitat and population density or probability of occurrence exhibits a sudden, disproportionate decline as habitat is lost. Critical thresholds are predicted by a variety of modeling exercises, but empirical support has been ambiguous. We looked for critical thresholds in two pool-breeding amphibians, the spotted salamander (*Ambystoma maculatum*) and the wood frog (*Rana sylvatica*). These species were selected because of their reported poor dispersal capacities and their dependency on forest habitat when not breeding. We looked for a relationship between the probability of occupancy of a site and forest cover at five radial distances from edges of suitable breeding ponds: 30m, 100m, 300m, 500m, and 1000m. Our results suggested that both species exhibited significant critical thresholds at some of the spatial scales examined. The thresholds for spotted salamanders occurred with 40-50% remaining forest cover within 100m, and with 20-30% remaining forest cover within 300m. Wood frogs showed a critical threshold at 20-30% forest cover only within 300m. Knowing if a species has a critical threshold, at what level of cover it exists, and at what spatial scale it exists would be essential for conservation of habitat-sensitive species.

C20-08 HORWICH, ROBERT H. Community Conservation, Inc., 50542 One Quiet Lane, Gays Mills, WI 54631, USA (ccc@mwt.net).
EVALUATING COMMUNITY CONSERVATION PROJECTS – 5 CASE STUDIES

Although in their infancy, community-based conservation projects, in recent years, have begun receiving criticism from both biologists and sociologists – researchers without hands-on experience in the complex problems inherent in such projects. Yet, since community conservation projects may represent the only alternative solution to complex social/ecological situations, conservationists need a more objective evaluation system for critiquing projects to answer the growing criticisms. Having helped to catalyze 18 community conservation projects in 7 countries in the past 17 years, I evaluate five of these projects (3 in Belize, 2 in Wisconsin) which have been in existence from 8 to 18 years, based on "products" that have been achieved. Ten products are conservation-based and ten are community-based. I give a very brief history of each project. I then elaborate a list of the products which have been evolved as measures of project success. Four of the projects have been deemed successful based on attaining over 80% of the products, while one was considered currently unsuccessful with a much lower percentage of products. Finally, each project is rated and critiqued relative to the product criteria.

C09-06 HOST, GEORGE E., and Mark A. White. Natural Resources Research Institute, University of Minnesota Duluth, 5013 Miller Trunk Highway, Duluth, MN 55811, USA (ghost@nrri.umn.edu).
HISTORIC CHANGES IN LANDSCAPE SPATIAL PATTERNS OF NORTHERN MINNESOTA FORESTS: INTERPRETATIONS FROM DIGITIZED SURVEYOR NOTES AND AIR PHOTO SEQUENCES

The spatial arrangement, age structure, and species composition of forest patches has significant implications for conservation biology. We assessed historical trends in landscape pattern in 42 plots stratified across ecological subsections of northern Minnesota. Presettlement patterns were assessed using public land survey notes digitized within 12 x 12 mi plots. Aerial photographs from the 1930s, 1970s, and 1990s were used to assess post-settlement spatial patterns. Forest patches were classified according to composition, growth stage, and originating disturbance. Disturbance patches from the presettlement plots ranged from 10s to 15,000+ ha. Fire was the predominant large disturbance; windthrow formed small to moderate-sized patches. Ecological subsections varied in total amount and size of presettlement disturbance, ranging from 2% of the North Shore Highlands to 8% of the Border Lakes. We observed a two-fold decrease in mean patch size from the 1930s (~20 ha) and the 1970s (10-12 ha). Understanding presettlement disturbance patterns and postsettlement changes in landscape pattern provides land managers with information on the potential of the forest to provide coarse and fine-grained spatial structures. Since these patterns vary by ecological subsection, there is an opportunity to tailor forest management plans to best reflect the varying potentials of the landscape.

C05-07 HOWE, ROBERT, Malcom Jones, Nick Danz, JoAnn Hanowski, Gerald Niemi, David Ewert, and Jennifer Davis. Department of Natural and Applied Sciences, University of Wisconsin–Green Bay, Green Bay, WI 54311-7001, USA (hower@uwgb.edu) (RH, JD); Natural Resources Research Institute, University of Minnesota Duluth, 5013 Miller Trunk Highway, Duluth, MN 55811, USA (MJ, ND, JH, GN); The Nature Conservancy, Great Lakes Program, 8 South Michigan Avenue, Suite 2302, Chicago, IL 60603, USA (DE).
A GIS FRAMEWORK FOR BIRD CONSERVATION AND MONITORING IN WESTERN GREAT LAKES FORESTS

Geographic information systems have created unprecedented opportunities for conservation planning. Computerized maps enable policy makers to visualize spatial information from population monitoring programs and to extrapolate findings at scales that are directly relevant to regional conservation efforts. We present an application of GIS analysis for the conservation of forest bird populations in the western Great Lakes Basin of Minnesota and Wisconsin. Multi-year breeding bird censuses (point counts) from 883 unique localities were used as a basis for models of bird-habitat relationships; classification trees (CART) were used to relate the bird data and 661 independent variables, including climate data and GIS land cover variables. Indices of landscape pattern and coverages of 20 land classes were calculated for each bird census point at radii of 100 m, 500 m, 1000 m, 2000 m, and 5000 m. Results for 82 bird species were mapped to 8525 contiguous 4 km x 4 km geographic cells. The spatially explicit predictions were subsequently tested with field surveys at 484 new points. Maps for individual species and combinations of priority species, together with reliability estimates, are now available for targeting areas of high conservation value and for identifying gaps in existing monitoring programs (http://www.uwgb.edu/birds/greatlakes/species/results.htm).

C37-09 HOYT, REGINALD A. Conservation and Science, Philadelphia Zoo, 3400 West Girard Avenue, Philadelphia, PA 19104-1196, USA (hoyt.reg@phillyzoo.org).
EVALUATING LIBERIA, WEST AFRICA'S BUSHMEAT TRADE

Liberia is a priority biodiversity "hotspot" in the Upper Guinea Forest block of West Africa. Civil war has left Liberia in economic ruin, resulting in over-dependency on natural resources and reduced management capacity. This paper will discuss the initiatives

undertaken since 2000 to evaluate the impact of the bushmeat trade in Liberia. Hunter surveys and data collection have demonstrated that differential vulnerability of mammal species to hunting pressure, for example the zebra duiker (*Cephalophus zebra*), should be taken into consideration when evaluating the sustainability of harvest rates. Village off-take surveys highlight the changing nature of the bushmeat trade, showing a shift from subsistence hunting to commercial ventures. Further, the results of a recent urban public opinion and bushmeat survey demonstrate that urban centers are not only consumers of bushmeat, but also that unemployment is fostering the growth of the bushmeat trade. This survey also points out opportunities related to the core beliefs of Liberians, and challenges that include economic, enforcement, nutritional and awareness components that may impede the implementation of any strategy to control wildlife harvesting. Finally, gaps that remain in our understanding of the bushmeat trade in Liberia will be outlined, and priorities for future research will be suggested.

S11-04 HUFFAKER, WELLINGTON, Steve Swenson, Jeff Knetter, and Jeb Barzen. Aldo Leopold Foundation, PO Box 77, Baraboo, WI 53913, USA (buddy@aldoleopold.org) (WH, SS, JK); International Crane Foundation, E-11376 Shady Lane Road, PO Box 447, Baraboo, WI 53913, USA (JB).
BRINGING COMMUNITY INTO COMMUNITY-BASED CONSERVATION: TWO CONTRASTING CASE STUDIES

Over 50 years ago, Aldo Leopold eloquently defined the 'Land Ethic.' In the Midwest, where the majority of the land is held in private ownership, it is critical to foster this ethic in private landowners to maintain the integrity of our native ecosystems. We will discuss two contrasting community conservation initiatives. The Blufflands Project, with a history of actually implementing conservation practices (in particular, prescribed burning) for over 10 years, and the Farming And Conservation Together (F.A.C.T.) conservation initiative, which has recently begun implementation after several years of planning. While these two projects were initiated under very different circumstances and presented substantially different challenges, we have found that landowner empowerment ensures certain outcomes. These include an increased appreciation for their responsibilities as stewards, a greater confidence to take on stewardship activities, and an overall improvement of their understanding of ecological processes.

S02-02 HUNTSINGER, LYNN. Department of Environmental Science, Policy, and Management, University of California, Berkeley, 147 Hilgard Hall, MC#3110, Berkeley, CA 94720, USA (buckaroo@nature.berkeley.edu).
CONSERVATION EASEMENTS: UNIVERSAL AND UNIQUE

Conservation easements, perpetual deed restrictions on land, are becoming a widely used conservation tool for groups and individuals who believe that traditional governmental acquisition and planning programs do not adequately protect extensive ranch, farm, and forest land. Easements commonly prohibit activities like development or conversion, and are purchased by or donated to a Land Trust. They are the financial recognition of public values in private lands. Because their sale or donation by the landowner is voluntary, they are relatively acceptable to ranch, farm, and forest communities. Each is unique, as can be expressed in a state-factor equation: CE (conservation easement characteristics) = f [TC (trust characteristics and interest), WL (landowner willingness and characteristics), LT (land characteristics, context, and value), F (available funds)]. The pattern of conservation easements on the landscape, and the character of each easement contract, is the result of these complex interactions. Meeting landscape-scale conservation goals is a challenging and creative process, and one whose outcome, to a certain extent, defies prediction. The more we know about each factor in the equation, and the associated uncertainties, the more we will be able to know about the outcome of conservation easement-based land conservation initiatives.

C25-05 HUSTON, MICHAEL, Enrique Gomezdelcampo, Rachel Sewell Nesteruk, and Sidey Timmins. Interdisciplinary Solutions for Environmental Sustainability, Inc., 808 West Outer Drive, Oak Ridge, TN 37830, USA (mahustonor@comcast.net).
USE OF TOPOGRAPHY-CLIMATE INTERACTIONS TO PREDICT BETA-DIVERSITY AND EROSION POTENTIAL

The concept of "effective heterogeneity" integrates the effects of topography and climate on the biotic landscape. Effective heterogeneity refers to the actual spatial variation in soil moisture conditions that is produced by the interaction of climate and topography. For example, in a region with relatively high rainfall distributed evenly throughout the year, the soil moisture difference between a valley bottom and a ridgetop will be much less than in an area with the same topography, but lower and/or more seasonal precipitation. The soil moisture distribution in turn influences the productivity and structure of the vegetation that covers the landscape and determines the spatial scale at which patterns are replicated on the landscape. The scale of pattern replication determines the scale of habitat heterogeneity, beta-diversity, and the proportion of the landscape that is susceptible to different types of disturbance. Our analysis of topography-climate interactions using digital elevation models and climate data from different regions of the country reproduces complex climate-dependent vegetation patterns and allows prediction of landscape susceptibility to erosion as a function of the amount of plant cover.

C45-03 INFANTE, DANA, and David Allan. School of Natural Resources and Environment, University of Michigan, Dana Building, 430 East University, Ann Arbor, MI 48109, USA (macile@umich.edu).
DOES LANDSCAPE VARIABILITY INFLUENCE STREAM HABITAT?

It is widely assumed that, by influencing stream habitat, landscape affects aquatic biota. However, few studies directly examine this relationship. We evaluated the ability of three suites of landscape measures to explain habitat variability across 46 southeast Michigan streams. We derived surficial geology measures for catchments; land cover/use for catchments and 200 m-wide buffers, and pattern metrics for catchments. Approximately 80 habitat variables grouped into 4 categories were measured at stream sites: channel shape, substrate, channel units, and visual habitat metrics; redundant habitat variables were eliminated by correlation analysis. Using multiple linear regression, we sequentially examined geology, then land cover/use, then pattern as predictors of remaining habitat measures. Channel shape was best predicted by catchment geology and drainage area, while substrate measures were best predicted by urban land use in the buffer. Visual habitat metrics were described by catchment geology and buffer land use, the most important of which were urban and agricultural land. Some landscape pattern metrics, particularly the patch density of agriculture and urban within a catchment, explained variance in some habitat variables. Overall, however, stream habitat was weakly predicted by landscape data, suggesting that other factors, including flow variability or past disturbance, may be more important.

P053 JACOBSON, SUSAN, Lynn Gape, and Monique Sweeting. Department of Wildlife Ecology and Conservation, PO Box 110430, University of Florida, Gainesville, FL 32611-0430, USA (jacobsons@wec.ufl.edu) (SJ); Bahamas National Trust, PO Box N-4105, Nassau, Bahamas (LG, MS).
PEOPLE AND PARROTS: INTEGRATED RESEARCH AND STAKEHOLDER OUTREACH FOR ABACO NATIONAL PARK, BAHAMAS

This study engaged key stakeholders in developing environmental outreach materials to support the management of Abaco National Park. The goal is to protect the endangered Bahama parrot (Amazona leucocephala bahamensis) and the rare pineland habitat and endemic avifauna on Abaco. We conducted a comprehensive needs assessment for an outreach program using the nominal group technique to collect data from six stakeholder groups: neighboring residents, community leaders, teachers, recreational users, hunters, and tourism industry representatives. Discussion groups were designed to interview a homogeneous group of 12-14 individuals who shared similar resource use interests in Abaco Park. Each meeting explored issues related to opportunities and threats to the park and parrots, and consisted of six stages: 1) presentation of the issue, 2) individual reflection and brainstorming, 3) documentation of individual ideas in round-robin style, 4) consolidation and review of all ideas listed, 5) ranking of ideas, and 6) compilation of results. Our results were combined with ecological data to develop an integrated conservation education program to foster appropriate behaviors and improve knowledge and attitudes for sustainable management of the park. The results demonstrate the efficiency of the nominal group technique as a tool for educators and managers to incorporate stakeholders' opinions into the decision-making process.

C08-02 JACOBUS, JENNIFER. School of Natural Resources and Environment, University of Michigan, 430 East University Avenue, Ann Arbor, MI 48109, USA (mackayj@umich.edu).
AN APPLICATION OF THE SPECIES-AREA RELATIONSHIP TO THE CONSERVATION OF MARSH HABITAT FOR FISHES

Coastal wetland ecosystems are threatened by numerous human activities. As a result, resource managers need practical information about the local effects of wetland loss on resident species, such as fishes. Addressing this issue, I determined the species-area relationship (SAR) for coastal marsh fishes in Mismer Bay (1.87 km^2) in northern Lake Huron. The fish SAR in three adjacent marsh habitats was best described by the power function ($S = cA^z$). The slope, z, ranged between 0.42 and 0.56 and did not vary across habitats. Such functions did not reach an asymptote, however, which would have indicated the minimum area requirements for protecting fish assemblages. Information derived from the SARs was further confounded by an overlap in species composition amongst habitats, an artifact of modeling vagile species such as fishes. An approach to estimating declines in fish species richness due to wetland loss was developed using a multi-habitat SAR that maximized species richness for a patchwork of habitats in a limited area.

C52-07 JOHANSSON, PER, and Johan Ehrlén. Department of Conservation Biology, Swedish University of Agricultural Sciences, SE-750 07 Uppsala, Sweden (per.johansson@nvb.slu.se) (PJ); Department of Botany, Stockholm University, SE-106 91 Stockholm, Sweden (JE).
INFLUENCE OF HABITAT QUANTITY, QUALITY AND ISOLATION ON THE DISTRIBUTION AND ABUNDANCE OF TWO EPIPHYTIC LICHENS

We assessed the relative importance of patch size, quality and isolation for the distribution and local abundance of two epiphytic lichens, *Parmelina tiliacea* and *Pleurosticta acetabulum*, similar in their natural histories but different in their dispersal attributes. We mapped 94 patches containing suitable host trees for the lichens (3237 trees) from aerial, infra-red photographs. Patch identity had strong influence on lichen species presence on individual trees. Within patches, presence was positively correlated with tree size and influenced by tree species. At patch-level, species presence was positively correlated with tree number and negatively correlated with the proportion of adjacent coniferous forest at the expense of open farmland. Isolation also affected patch occupancy, but the effect of isolation differed between three different isolation/connectivity measures used. Lichen abundance was mostly correlated with tree size and the number of large trees at tree- and patch-level respectively. There was no clear evidence that the mainly vegetatively dispersed *P. tiliacea* was more constrained by isolation than the sexually dispersed *P. acetabulum*. Whilst this study emphasizes the importance of habitat quantity for species occupancy and local abundance, it shows that explanations of species occurrence in fragmented landscapes must also involve variables describing patch quality and spatial configuration.

C55-01 JOHNSON, ARLYNE, and Malaykam Dongdala. Wildlife Conservation Society, Box 6712, Vientiane, Lao P.D.R (ajohnson@wcs.org).
WILDLIFE USE AND FOOD SECURITY IN ETHNIC MINORITY VILLAGES IN THE NAM HA NATIONAL PROTECTED AREA IN NORTHERN LAO P.D.R.

One of world's least developed nations, Lao P.D.R. is struggling to reduce unsustainable rates of wildlife hunting and trade while increasing rural food security. We conducted household surveys in 24 villages made up of four ethnic minorities within the Nam Ha National Protected Area to evaluate the harvest, consumption, and trade of 56 species of commonly used mammals, birds and reptiles. We compared results with national policy for achieving sustainable harvest rates of managed species as well as food security. Findings indicate that small mammals and gallinaceous birds were consumed weekly in the majority of households, that the abundance of reptiles as well as large mammals and birds available for harvest is declining, and that most families maintained a preference for wild versus domestic meat. Results suggest that wildlife is an important component of the diet in most households but that the rate of harvest of most species is likely unsustainable.

C19-07 JOHNSON, CATHERINE M., Lucinda B. Johnson, Jennifer H. Milan, and Anh Ly. Natural Resources Research Institute, University of Minnesota Duluth, 5013 Miller Trunk Highway, Duluth, MN 55811, USA (cjohnson@nrri.umn.edu).
MOVEMENT PATTERNS OF WOOD FROGS (*RANA SYLVATICA*) AMONG VERNAL POOLS IN NORTHERN MINNESOTA

Vernal pools provide essential breeding habitat for many woodland amphibians, including the wood frog (*Rana sylvatica*). As part of a mark-recapture study, we uniquely marked over 14,000 wood frogs from 1999-2002 in eight vernal pools in northern Minnesota. We also collected data regarding physical attributes of those wetlands and summarized landscape data within a 1 km radius of each vernal pool based on aerial photo-interpretation. Sixty-five percent of wood frogs captured were metamorphs. In two sites that had both habitats along their perimeters, a disproportionately high percentage of metamorphs dispersed toward woodlands, regardless of where egg masses had been laid. Of the individual wood frogs that were recaptured, 21% traveled between two or more sites within or between years, with the majority of that movement taking place within a forested corridor. While egg masses were observed at most sites during all years of our study, several of those sites failed to produce metamorphs; furthermore, this failure was not consistent among sites between years. Given the inconsistency in breeding success and the apparent importance of forested areas to dispersing metamorphs, our data emphasize the importance of preserving groups of vernal pools connected by wooded corridors for long-term viability of populations.

C51-03 JOHNSON, DOUGLAS H., Jill A. Shaffer, and Lawrence D. Igl. Northern Prairie Wildlife Research Center, 8711 37th Street SE, Jamestown, ND 58401, USA (Douglas_H_Johnson@usgs.gov).
BIRDS ON THE INTERFACE: HOW WETLAND BIRDS DEPEND ON GRASSLANDS

Wetlands are highly productive systems that provide habitat for a wide variety of avian and other species. Tens of thousands of wetlands have been drained or otherwise altered in North America, thus reducing their ecological value. With a greater understanding of the manifold values of wetlands, restoration has become increasingly popular. Wetlands are not isolated ecosystems, however, but are dependent on the surrounding landscape for maintaining their functional values. Many wetland birds of the interior grasslands also use terrestrial habitats. We investigated these relationships by censusing birds on more than 1000 wetlands in North Dakota and South Dakota during three years. Included were both natural and restored wetlands and wetlands of a variety of sizes and hydrologic regimes. We found, as expected, that wetland size strongly influenced bird populations, as did characteristics of the wetlands (such as wetland class and the extent of emergent vegetation). Moreover, features in the landscape (including the amount of grassland in the vicinity and the presence of semipermanent wetlands nearby) affected the use of wetlands by certain species of birds. Our study demonstrates interactive effects of wetland and terrestrial habitats on animal use and the importance of considering landscape features when restoring wetlands.

C47-08 **JOHNSON, JAMES,** John Barten, George E. Host, Richard P. Axler, Cynthia Hagley, and Barb Luikkonen. Three Rivers Park District, 3800 County Road 24, Maple Plain, MN 55359, USA (h2ojames@earthlink.net) (JJ, JB); Natural Resources Research Institute, University of Minnesota Duluth, 5013 Miller Trunk Highway, Duluth, MN 55811, USA (GEH, RPA); Minnesota Sea Grant College Program, University of Minnesota, 2305 East 5th Street, Duluth, MN 55812-1445, USA (CH, BL).
RESTRICTING THE USE OF PHOSPHORUS FERTILIZER TO IMPROVE WATER QUALITY: AN URBAN WATERSHED EXPERIMENT

Phosphorus-containing lawn fertilizers are often implicated as a key nutrient source contributing to the eutrophication of urban lakes, but specific real-world studies linking fertilizer use to water quality are uncommon. In 2001 and 2002 we monitored runoff from six residential watersheds in the Minneapolis metropolitan area. Three of these watersheds were located in the city of Plymouth where the use of P-containing fertilizers was restricted since 1995; the remaining three watersheds were located in Maple Grove which had no such restrictions. These watersheds were selected to be similar in terms of size, soil characteristics, impervious surface area, and topography. In addition, we collected detailed rainfall data, identified lawn care practices within each watershed, and examined data from lakes in each city to determine recent water quality trends. In 2001 the phosphorus export from the Plymouth sites was markedly lower than observed at the Maple Grove sites. Additionally, Parkers Lake (in Plymouth) experienced dramatic water quality improvement in the period since the fertilizer ordinance was implemented. These data suggest that the fertilizer ordinance adopted by Plymouth may be reducing phosphorus export from residential neighborhoods, thus improving the quality of lakes in the city. Results from 2002 will also be presented.

C44-05 **JOHNSON, JEFF A.,** and Peter Dunn. Department of Biological Sciences, University of Wisconsin–Milwaukee, PO Box 413, Milwaukee, WI 53201, USA (jefferyj@uwm.edu).
EFFECT OF HABITAT FRAGMENTATION ON LEVELS OF GENETIC VARIABILITY IN POPULATIONS OF GREATER PRAIRIE CHICKENS OVER A FIFTY YEAR PERIOD

The greater prairie chicken (*Tympanuchus cupido*) is threatened with extinction in several midwestern states. Population sizes have decreased due to habitat loss and fragmentation. The reduction of a large widespread population to several small isolated populations may lead to a reduction of genetic diversity due to random genetic drift and decrease in gene flow. Extant populations in Wisconsin have reduced microsatellite and mtDNA control region diversity compared to contemporary populations in Kansas, Nebraska, Minnesota, and Missouri. In addition, microsatellite diversity is significantly reduced in Wisconsin's Buena Vista population when compared to samples collected in 1951 from the same population. Genetic variation (microsatellite and mtDNA control region) was examined in the remaining three managed populations (Leola, Mead, and Paul Olson) in Wisconsin along with historic samples collected from the same populations in 1951-53. Our results suggest a loss of gene flow between managed populations in Wisconsin using microsatellite DNA, despite close proximity of populations (20-40 km). Consequently, loss of gene flow has reduced the effective population size thereby allowing genetic drift to influence levels of genetic variability. The ability of birds to disperse may be an important factor in the extirpation of small populations of prairie chickens over the last century.

S01-03 **JOHNSON, LUCINDA.** Natural Resources Research Institute, University of Minnesota Duluth, 5013 Miller Trunk Highway, Duluth, MN 55811, USA (ljohnson@d.umn.edu).
CONFRONTING CLIMATE CHANGE IN THE GREAT LAKES REGION: ECOLOGICAL VULNERABILITY TO CLIMATE CHANGE

The Great Lakes region encompasses boreal forests, prairies, hardwood forests, agricultural lands, thousands of lakes including the five Great Lakes themselves. This varied landscape is home to 60 million people, whose activities will strongly influence the impacts of global climate change. This talk will summarize the findings from an assessment of the potential ecological impacts of climate change on the region. Among the consequences expected from changing climate are: declines in winter ice duration with subsequent changes in temporal patterns of lake stratification; earlier spring flooding with consequent impacts on the timing and outcome of reproduction in fish, amphibians and birds; changes in the composition and, potentially, the productivity of forests; and increased length of growing season which will expand agriculture northward. Both negative and positive outcomes are expected. Warmer temperatures in winter will decrease heating costs, but allow pest species to expand northward. Lower water levels will decrease ship capacity, but will be offset by lengthened shipping season. The implications for conservation efforts will be complicated by the complex physiography of the region and presence of natural barriers to migration, such as the Great Lakes, and the ongoing human disturbances that result in landscape fragmentation and loss of habitat.

C32-03 **JOHNSON, ORLAY,** Kathleen Neely, and Robin Waples. National Marine Fisheries Service, Northwest Fisheries Science Center, Conservation Biology Division, 2725 Montlake Boulevard East, Seattle, WA 98112, USA (orlay.johnson@noaa.gov).
LOPSIDED FISH IN THE SNAKE RIVER – SO WHAT? COMPARISON OF INDICES OF DEVELOPMENTAL INSTABILITY AS A WAY OF ASSESSING ENVIRONMENTAL AND GENETIC STRESS IN ENDANGERED SALMONIDS

We compared indices of developmental stress in chinook salmon collected in the Snake River Basin during 1989 and early 1990s with fish collected at similar locations a decade later. The experimental design involves monitoring genetic and meristic characters in yearly samples and the purpose of the study was to evaluate the long term effects of outplanting hatchery-reared fish on natural and wild populations. During this period many salmonid populations across the region crashed, offering the opportunity to also evaluate whether this technique could be used to identify populations in trouble prior to demographic declines. Indices of directional (DA) and fluctuating (FA) asymmetry were developed from counts of seven paired bilateral characters. Elevated DA was detected in some hatchery populations, but few consistent patterns of DA or FA were detected in natural or wild populations. Comparisons of asymmetry among years revealed significant differences with post-crash asymmetry indices lower in almost all populations. This suggests high asymmetry may be an early indicator of demographic problems, but there is little correlation among asymmmetry indices and specific demographic changes. No correlation was found between the level of asymmetry and the level of heterozygosity within individual fish.

C13-04 JOHNSON, PIETER, Kevin Lunde, Derek Zelmer, and Kirwin Werner. Center for Limnology, University of Wisconsin–Madison, 680 North Park Street, Madison, WI 53706-1492, USA (pieter@jsd.claremont.edu) (PJ); The Roberts Environmental Center, Claremont McKenna College, W.M. Keck Science Center, 925 North Mills Avenue, Claremont, CA 91711-5916, USA (KL); Department of Biological Sciences, Box 4050, Emporia State University, 1200 Commercial Street, Emporia, KS 66801, USA (DZ); Department of Environmental Sciences, Salish Kootenai College, Pablo, MT 59855, USA (KW).
DEFORMED AMPHIBIANS DUE TO TREMATODE INFECTION: AN EMERGING DISEASE? EVIDENCE FROM MUSEUM SPECIMENS AND RE-SURVEY DATA

Although accounts of mass malformations in North American amphibian populations date to the 1940s, they are poorly documented and rarely explained. We reviewed information for nine historical accounts from California, Colorado, Idaho, Mississippi, Montana, Ohio, and Texas reported between 1946-1988. We then ask, (1) which cases were associated with *Ribeiroia* infection? (2) Are malformations still occurring at these sites? And if so (3) has the frequency or types of abnormalities changed? Each site was resurveyed between 1999 and 2002 and original voucher specimens redescribed and examined for trematode infection. We identified *Ribeiroia* in amphibians from six of eight historical sites, dating back as far as 1946. Malformations recorded historically at these sites included extra limbs, cutaneous fusion, and bony triangles. Of the six sites that supported amphibians upon resurvey, three continued to support severe limb malformations. Although no pesticides were detected, amphibians from each of these sites were infected with *Ribeiroia*. Taken together, these results suggest that *Ribeiroia* infection has historically been an important cause of mass malformations. We conclude that parasite-induced malformations are not a new phenomenon, but highlight the need for long-term research to evaluate their impacts on amphibian population viability, particularly if malformations are increasing in prevalence.

P050 JOHNSON, ROSALYN, Laura Gardiner, and Laura Machala. U.S. Environmental Protection Agency, Region 5, Environmental Planning Branch, Office of Strategic Environmental Analysis, 77 West Jackson Boulevard, Chicago, IL 60604, USA (johnson.rosalyn@epa.gov); Oberlin College, Oberlin, OH 44074, USA (LG, LM).
USING THE NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) PUBLIC COMMENT PROCESS TO PROTECT GREAT LAKES REGION RESOURCES

The National Environmental Policy Act of 1969 (NEPA) is a "sunshine" law requiring federal agencies to disclose the potential environmental and human health impacts of major federal projects. This poster is designed to indicate the project footprints of many agencies' projects that have been through the NEPA process in the Great Lakes Region, focusing on USEPA's Region 5 (IL, IN, OH, WI, MN, and MI), since the late 1990's. USEPA tracks, reviews, and publicly "grades" other agencies' major projects during the NEPA process. Yearly, USEPA's comments influence natural resources management and protection of human and environmental health in agricultural, urban, and preservation/conservation areas, as well as rivers and other water bodies. Because participation in the NEPA public comment process by scientists, naturalists, and researchers from all sectors is uncommon, USEPA encourages greater independent involvement by those individuals, especially in the areas of resource and impact assessment, mitigation planning, and ongoing communication between scientists and federal project managers. The poster will describe links and general information on how to engage in the NEPA public participation process.

S10-02 JOHNSTON, CAROL, Paul Meysembourg, and Tom Hollenhorst. Natural Resources Research Institute, University of Minnesota, 5013 Miller Trunk Highway, Duluth, MN 55811, USA (cjohnsto@d.umn.edu).
GIS-DERIVED INDICATORS OF ENVIRONMENTAL STRESSORS AND ECOSYSTEM RESPONSES OF GREAT LAKES COASTAL WETLANDS

Wetland inventories were compiled from existing sources for the eight Great Lakes states, and used in a GIS to derive landscape-scale indicators. "Coastal wetlands" can be defined within a fixed distance of the coast, within coastal counties, or within an elevation threshold above lake level. The density of wetlands within the coastal zone is partly a function of geology, but also a

function of agricultural and urban development, such that wetlands are themselves indicators of coastal environmental change. Palustrine wetland loss rates were estimated by comparing areas of hydric soils with current wetland areas. Wetland abundance and estimated loss rates were related to GIS-derived indicators of human disturbance, such as population density, road density, adjacent land use, and shoreline hardening. Within wetlands, measures of patch characteristics such as vegetation type, wetland size, wetland area:perimeter ratio, adjacent land use, and interspersion of wetland vegetation and open water can provide indicators of wetland integrity and habitat quality for wetland fauna.

C39-03 **JOHNSTON, DAVID,** and Andrew Read. International Marine Mammal Association, 1474 Gordon Street, Guelph, ON N1L 1C8, Canada (DJ); Duke University Marine Laboratory, Nicholas School of the Environment and Earth Sciences, 135 Duke Marine Lab Road, Beaufort, NC 28516, USA (DJ, AR).
ISLAND IN THE STREAM: MARINE MAMMALS FORAGE IN AN ISLAND WAKE IN THE BAY OF FUNDY, CANADA

Grand Manan Island, in the Bay of Fundy, functions as a large physical obstruction to the flow of strong tidal currents and produces a complex system of upwellings and eddies at its northern tip during flood tides. During 1999 and 2000 we documented a significant increase in the abundance of harbour porpoises (*Phocoena phocoena*) and fin whales (*Balaenoptera physalus*) in this feature during flood tides. In 2001 and 2002 we conducted oceanographic surveys to study the physical processes forcing this system. Combining Eulerian and Lagrangian oceanographic observations and RADARSAT imagery, we confirmed that this system functions as an island wake. During flood tides, water flowing rapidly (over 2m s^{-1}) past the northwest side of the island separates from its northern tip and produces a large anti-cyclonic eddy, and associated smaller eddies and upwellings, along an abrupt velocity front downstream. We hypothesize that this system physically aggregates zooplankton through a complex pattern of secondary flow, attracting large numbers of herring (*Clupea harengus*) and other fish. The regular occurrence of this feature provides a predictable aggregation of food for predators. Our study indicates that locating protected areas in predictable island wake ecosystems may be useful for conserving foraging habitat for marine predators.

C37-10 **JONES, JULIA,** Fortunat Andriahajaina, and Neal Hockley. Conservation Biology Group, Department of Zoology, University of Cambridge, Downing Street, Cambridge CB2 3EJ, UK (jpgj2@cam.ac.uk) (JJ); Orana Tsara Tantana, BP 1067, Fianarantsoa 301, Madagascar (FA); Vokatry ny Ala, BP1067, Fianarantsoa 301, Madagascar (NH).
CRAYFISH CONSERVATION IN MADAGASCAR

To assess the sustainability of a wild species it is essential to have good information on both the biology and status of harvested populations and on the level of harvesting to which they are subject. Using repeated mark and recapture sessions in 60 crayfish (*Astacoides* spp.) sites around Ranomafana National Park and daily interviews with harvesters, we investigate the sustainability of crayfish harvesting in the area. Crayfish harvesting is illegal inside the Park but remains the mainstay of a number of local communities. Our results suggest that harvesting crayfish is affecting population structure (removing the largest individuals) but that it may not be having a strong effect on the availability of commercial sized crayfish in all but the most heavily exploited sites. In addition crayfish harvesting appears to be on the decrease due to increasing opportunities for waged labour, remaining most important for poorer households and those headed by women. We suggest that allowing harvesting of the commonest species within Ranomafana National Park would not threaten the species with local extinct and may reduce conflicts with park management.

C24-06 Kamdem Toham, Andre, **MICHELE L. THIEME,** Jennifer D'Amico, Robin Abell, and Bernhard Lehner. World Wildlife Fund US, Conservation Science Program, 1250 24th Street NW, Washington, DC 20037, USA (michele.thieme@wwfus.org) (MLT, JD, RA, BL); World Wildlife Fund Programme pour le Gabon, B.P. 9144, Libreville, Gabon (AKT).
FORESTS AND FRESHWATER: INTEGRATION OF BIODIVERSITY PRIORITIES FOR THE GUINEAN-CONGOLIAN REGION

Home to the greatest species richness in Africa, the second largest contiguous forest block in the world, and the vast Congo River system, the Guinean-Congolian forest and freshwater region is globally outstanding and a clear focus for conservation in Africa. In March 2000, 160 terrestrial, freshwater, and socio-economic scientists convened in Gabon to outline a biodiversity vision for this region. Seventy-seven terrestrial and 50 freshwater priority areas were identified. Of the 1.25 million km^2 of terrestrial priorities, 47% of the area also covers freshwater priorities. Overlapping areas of high priority occur mainly within the Cuvette Centrale, Cameroon Highlands, Lopé-Abeilles-Chaillu area, and Minkébé Complex. As small biophysical changes (e.g., forest cover, hydrology) will likely have large effects on both terrestrial and freshwater biodiversity, we recommend integrating freshwater and terrestrial conservation initiatives in areas of overlap.

C40-04 **KAPLIN, BETH A.** Department of Environmental Studies, Antioch New England Graduate School, 40 Avon Street, Keene, NH 03431, USA (bkaplin@antiochne.edu).
FACTORS LIMITING RECOVERY OF BURNED TROPICAL RAINFOREST: SEED RAIN AND SEED FATE

Rates of tropical deforestation are undoubtedly high. A number of factors may impede recovery, including low rates of seed arrival and high rates of seed predation. Although many studies have focused on regeneration of abandoned agricultural lands, the recovery of burned forest demands attention. Burning of tropical forest to control rebels in Rwanda was a common practice during the political instability of 1994-1996. The purpose of this research was to investigate seed rain and seed survival as limiting factors in the early stages of regeneration in a burned patch of the Nyungwe Forest Reserve, Rwanda. I tested the relationship between seed rain and distance from forest / burn edge using seed traps placed at 50 m intervals along transects running into forest and into burns. Piles of seeds collected from ripe fruits were placed along the same transects to test for effective distance from edge and seed survival. The density of animal-dispersed seed was greater in intact forest than in burned forest. The number of animal-dispersed seeds decreased in the burn but was not significantly related to distance from forest edge. Seed predation was high in both intact and burned forest.

S04-09 Kapuscinski, Anne R., and **EMILY E. PULLINS.** Institute for Social, Economic and Ecological Sustainability, University of Minnesota, 186 McNeal Hall, 1985 Buford Avenue, St. Paul, MN 55108, USA (ark@fw.umn.edu).
INTERNATIONAL GOVERNANCE OF THE BIOTECHNOLOGY-BIODIVERSITY INTERFACE: SCIENTIFIC ANALYSIS AND SOCIAL DELIBERATION

Internationally, biotechnologists are developing marine genetically modified organisms (GMOs) that express a diversity of traits, from faster growth to production of pharmaceuticals, in fish, shellfish and algae. Developers are preparing and governments are reviewing applications for commercial production of marine GMOs in or near natural waters. International institutions dedicated to conservation missions (e.g. Convention on Biological Diversity, Global Environment Facility) play prominent roles in shaping regulatory approaches for these and other biotechnology products. This presentation will discuss three recommendations for increased participation by conservation biologists in addressing GMO-related conservation issues. First, research contributions by conservation biologists are of increasing importance, exemplified by research on the likelihood and biodiversity consequences of gene flow from transgenic fish to wild and feral relatives. Second, conservation biologists can affect decision making through policy analysis, as occurred when analysis of U.S. policy revealed important gaps and secrecy in regulation of proposed commercial releases of transgenic fish, with implications for both ecosystems and humans. Third, innovative policy and scientific linkages inspired by the interdisciplinary orientation of conservation biology are needed; this is illustrated by the Safety First Initiative's deliberations on development of publicly reliable, scientific standards to minimize potential harm of marine GMOs to marine biodiversity.

C24-02 Kareiva, Peter, John Wiens, and **MUTTULINGAM SANJAYAN.** The Nature Conservancy, 4245 North Fairfax Drive, Arlington, VA 22203, USA (masanjayan@tnc.org).
WHAT DO WE DO ABOUT BIODIVERSITY COLDSPOTS?

Nature is under peril and conservationists widely accept the need for a triage approach whereby limited funds go to the places where the need is greatest. Conservation groups have developed various schemes to delineate areas as globally important to conserve. Most of these efforts rely on some measure of species richness (plant diversity, bird diversity, ecosystem diversity), and focus on areas of greatest richness ("hotspots"). We present results that support the inclusion of three additional factors if the goal is not just identification, but also implementation. First, in linking human well-being to conservation, it is not necessarily how many species globally that are protected, but how many ecosystems are protected from egregious species loss. Threat levels of ecosystems do not always correspond to species richness. Second, many ecosystems of low species richness are hugely important to global ecology through the ecosystem services they provide. And third, conservation is not achieved in a socio-political vacuum; conservation investment pay-offs vary depending on governance, social stability, and economic condition. Unless we include these factors in deciding where global conservation should occur, we risk leaving many of the world's people and ecosystems out in the cold.

P038 **KARNS, BYRON,** Marcey Westrick, and Leonard Ferrington. St. Croix National Scenic Riverway, National Park Service, PO Box 708, St. Croix Falls, WI 54024, USA (Byron_Karns@nps.gov) (BK); Emmons & Olivier Resources, 651 Hale Avenue North, Oakdale, MN 55128, USA (MW); University of Minnesota, 306 Hodson Hall, 1980 Folwell Avenue, St. Paul, MN 55108, USA (LF).
A COMPARISON OF MACROINVERTEBRATES AS FACTORS IN DETERMINING BIOLOGICAL INTEGRITY: AN INDEX FOR GROUNDWATER QUALITY FOR MULTIPLE STREAMS

Currently, we are participating in a groundwater assessment study of certain water resources flowing into the St. Croix River from Washington County, Minnesota. The goal is to judge the feasibility of using terminal springs as indicators for overall groundwater quality. Water reaching the surface as a result of geology represents an amalgamation of all that has reached it along its underground course. Traditional groundwater assessments that rely on well testing only reflect a single temporal and spatial sample. Components of the study include geomorphology, water chemistry and physical attributes, and biological values at each of 21 streams along the St. Croix River. Samples and appraisals of these characteristics were repeated at each of the four seasons beginning with the fall of 2001. The biological element is determined chiefly by kick net invertebrate samples taken near a given transect at each stream. These samples will be sorted and the organisms identified to the family level or lower. For this presentation, the January macroinvertebrate data will be analyzed to determine each stream's diversity, and further compared to rank each stream as unique or representational. The results will be placed with other biotic and abiotic factors to index streams and monitor groundwater quality.

C03-01 KARRAKER, NANCY, and James Gibbs. Department of Environmental and Forest Biology, College of Environmental Science and Forestry, State University of New York, 350 Illick Hall, 1 Forestry Drive, Syracuse, NY 13210, USA (nekarrak@syr.edu).

A MACROECOLOGICAL PERSPECTIVE ON CONSERVATION STATUS OF AMPHIBIANS IN THE UNITED STATES

Many studies focused on determining the mechanisms responsible for amphibian declines have been conducted at small spatial scales. Macroecological approaches have recently been employed to investigate declines and extinctions in many different species, but such an approach has not been used extensively for amphibian species. We contrasted patterns in body size, clutch size, range size, and breeding habitat type with population status for amphibians of the United States. Imperiled salamander species generally had smaller body, clutch, and range sizes and tended to breed in terrestrial habitats. For frogs, we found no relationships between these parameters and population status. Notably, most recent reports of declines and extinctions have been associated with aquatic-breeding frogs, but declines in salamanders may not be detected as easily as in frogs because of their secretive and often solitary lifestyles. Identifying relationships between life history, ecological parameters, and population status may allow researchers to predict species that may be predisposed to declines, permitting time for implementation of population assessment and conservation measures as necessary.

C23-07 KEARNS, LAURA, Kimberly Hall, and Emily Silverman. School of Natural Resources and Environment, University of Michigan, Dana Building, 430 East University, Ann Arbor, MI 48109-1115, USA (lkearns@umich.edu) (LK, ES); Department of Fisheries and Wildlife, Michigan State University, 13 Natural Resources Building, East Lansing, MI 48824, USA (KH).

THE BLACK-THROATED BLUE WARBLER-BALSAM FIR RELATIONSHIP: IMPLICATIONS FOR CONSERVATION OF HARDWOOD FORESTS

Understanding the relationships between shrub-nesting Neotropical migrants and forest vegetation can help develop management guidelines for bird conservation. The Black-throated Blue Warbler (BTBW) *Dendroica caerulescens* requires dense forest understory that is harmfully altered by browsing white-tailed deer *Odocoileus virginiana*. In Michigan's Upper Peninsula, BTBWs are abundant in heavily browsed hardwood forests only when balsam fir *Abies balsamea* understory is dense. Greater BTBW abundance and higher proportion of older birds should indicate high habitat quality for BTBWs. To test if balsam fir is high quality habitat, we sampled abundance and ages of male BTBWs in sixteen plots varying in fir density in hardwood stands throughout the Hiawatha National Forest. Significantly higher numbers of BTBWs occurred on sites with higher fir densities, but age was not significantly correlated with density. Stepwise multiple regression indicated that BTBW abundance is best predicted by fir cover, deciduous cover, and deciduous average height. Although the relationship between BTBW abundance and fir density suggests that fir understory is important where deer browse is heavy, lack of a positive age association suggests that fir is insufficient as high quality BTBW habitat. We recommend maintaining fir understory, but conducting further research to delineate specific forest conservation guidelines.

C06-01 KELLER, REUBEN P., John M. Drake, and David M. Lodge. Department of Biological Sciences, University of Notre Dame, Notre Dame, IN 46556, USA (rkeller2@nd.edu).

KEEPING OUT THE NEXT INVASIVE MOLLUSC: A MODELLING APPROACH TO PREDICTING THE IMPACT OF FUTURE FRESHWATER MOLLUSC INTRODUCTIONS

Freshwater mollusc invasions have caused enormous ecological and economic damage in the Great Lakes, and more generally across the U.S. However, only a small proportion of introductions have led to impacts, with most introduced species having no measured effect. Ideally, all future introductions would be prevented to minimize further impacts, but current technology and reliance on international trade makes this unrealistic. Hence, it is imperative to predict which molluscs are most likely to cause impacts and concentrate resources on keeping those species out. To this end, we used logistic regression to analyze natural history data for species already introduced to the Great Lakes and found that just one parameter, per capita annual fecundity, is

adequate to discriminate between species that have caused measured impacts (n = 4) and those that have been apparently benign (n = 14). Expanding this analysis to all introduced freshwater molluscs in the U.S. (n = 8 with impacts, n = 20 benign), we found that two parameters – fecundity and whether the species hosts a parasite of concern – were adequate. We have used this model to predict the impact of some molluscs not yet in the U.S. Use of such models will enhance the ability of the U.S. to prevent unwanted introductions.

C01-10 **KELLER, ROBERT D.** The University of Tennessee-Chattanooga, Department of Biological and Environmental Sciences, 615 McCallie Avenue, Chattanooga, TN 37403, USA (robert-keller@utc.edu).
KEYSTONE WITH A VENGEANCE: EFFECTS OF AN EXOTIC SPECIES, THE EUROPEAN WILD BOAR (*SUS SCROFA* LINNEAUS), ON THE VEGETATIONAL STRUCTURE AND THE SMALL MAMMAL COMMUNITY OF THE OAK / HICKORY FORESTS OF THE GREAT SMOKY MOUNTAINS NATIONAL PARK

I compared vegetational characteristics and small mammal communities of two similar oak / hickory forests: one occupied by exotic European wild boars (*Sus scrofa* Linneaus) within the boundaries of the Great Smoky Mountains National Park, and one in similar areas outside of park boundaries where wild boars are absent. For vegetational comparisons, I used oak / hickory abundance and species diversity to compare vegetational components. For structural comparison, I used ground coverage, stems per unit area, and ground surface disturbance per unit area associated with wild boar occupation. To determine effects of coexistence with the wild boars, I used the most prevalent small mammal in the oak / hickory forest, the white-footed mouse (*Peromyscus leucopus*), as an indicator species. I examined estimated density of the indicator species in relation to mast production, average weight of the indicator species, the number of juveniles present, the number of reproductively mature individuals present, and dispersal of the indicator species to compare the two populations. Findings of this study indicate that the exotic European wild boar has become a keystone species, and that its presence negatively effects both the vegetational structure and the small mammal community of the oak / hickory forests of the Great Smoky Mountains National Park.

C26-07 **KELTY, RUTH,** and Steve Bliven. National Centers for Coastal Ocean Science, 1305 East-West Highway, SSMC4, #8215, Silver Spring, MD 20910, USA (RK); Bliven and Sternack, 49 Plains Field Drive, South Darthmouth, MA 02748, USA (Bliven@attbi.com) (SB).
BUILDING A SCIENCE-BASED DECISION SUPPORT TOOL FOR DOCK MANAGEMENT

The permit most frequently sought from coastal managers is for dock construction, and the number of permits issued each year is increasing. There is a perceived right to have a dock; many consider docks a characteristic part of the coastal landscape, and question existing permit review processes. Others consider docks a threat to public values and the environment. While it is clear that docks create shade, alter flow, introduce chemicals into the marine environment, and impact public access and navigation, literature quantifying these effects is limited. As coastal areas are developed and the number of permit requests increases, coastal managers are looking for a rational, science-based decision-making tool to guide their permitting decisions. In response to this need, NOAA hosted a workshop to synthesize the relevant science. Participants discussed what is known (and not known) about how docks and associated boating activities individually and collectively impact vegetation, sediments and sedimentation, contamination, navigation and public trust rights, and aesthetics/quality of life. This presentation presents the results of that workshop and 1) reviews the state of the existing knowledge, 2) identifies gaps in our understanding, and 3) presents recommendations to guide the development or revision of State dock and pier permitting processes.

C04-08 Khoury, Mary, **PAULA GAGNON,** and Roy Weitzell. The Nature Conservancy, Freshwater Initiative, 8 South Michigan Avenue, Suite 2301, Chicago, IL 60603, USA (mlammert@tnc.org) (MK, PG); NatureServe, 1313 5th Street SE, Suite 314, Minneapolis, MN 55414, USA (RW).
ASSESSING FRESHWATER BIODIVERSITY IN THE UPPER MISSISSIPPI RIVER BASIN: INSIGHTS FROM BIOLOGICAL COMMUNITY ANALYSIS

NatureServe and The Nature Conservancy have been working in partnership to identify areas of freshwater biodiversity significance in the Upper Mississippi River Basin. We are taking advantage of existing fish assemblage data to develop fish communities to 1) attribute aquatic ecological systems, and 2) evaluate how well we capture communities using our conservation approach. The first step was to create a standardized, spatially-referenced data set for the entire basin. We conducted a pilot analysis of these data in the basin's northern glaciated region to define fish community types. We had over 10,000 sites with assemblage data from which we selected samples that would best represent native assemblages. Sites were eliminated if they were sampled pre-1980; included non-native and hybrid occurrence records; had fewer than 4 species; and had < 20% natural cover in the system/watershed in which they were located. The final data set included 2207 sites and 111 species. All data were transformed to presence/absence for this analysis. Using cluster analysis in PC-ORD, we found clear repeating patterns of assemblages. In this talk, we will present the community types and how well they are represented in the areas of biodiversity significance.

P064 KIHSLINGER, REBECCA L., J. Louise Conrad, and Gabrielle A. Nevitt. Center for Animal Behavior, Department of Neurobiology, Physiology, and Behavior, University of California, Davis, One Shields Avenue, Davis, CA 95616, USA (rlkihs@ucdavis.edu).
THE ROLE OF THE EARLY REARING ENVIRONMENT IN PHENOTYPE DEVELOPMENT OF STEELHEAD ALEVINS

Salmon reared in hatcheries do not develop behaviors that are adequate for survival in natural streams; thus, the post-release survival rate of hatchery-reared salmon is significantly lower than among wild salmon. The early rearing environment plays a critical role in directing the future phenotype in salmon, making it a logical context for experimentation with methods of producing wild-type fish. We investigated the role of the structure in the development of steelhead (*Oncorhynchus mykiss*) alevins. Fish were reared in three control tanks and three tanks enriched with Mexican Beach Pebble (10 cm in diameter). Two thousand fish per tank were hatched in situ, and reared until emergence. Tanks were monitored with video to assess movement behavior. Fish were weighed and measured at emergence. Results indicate that fish reared in environments that contain structure are significantly heavier and longer at emergence than fish reared without structure. There were more moving fish per unit time in control tanks compared to tanks with structure. The larger body size and decreased locomotion among fish reared with structure may allow them to allocate more energy for somatic and neural growth, giving these fish a head-start when compared to fish reared in conventional hatchery practices.

C55-05 KING, CHRISTOPHER, and Markus Dyck. Department of Sustainable Development, Government of Nunavut, Iqaluit, Nunavut, X0A 0H0, Canada (cking@gov.nu.ca).
GEOPOLITICAL AND SOCIAL CHALLENGES OF POLAR BEAR CO-MANAGEMENT AND CONSERVATION IN NUNAVUT, CANADA

Until 1999, polar bear (*Ursus maritimus*) management in Canada's north was predominately administered through the principles and practices of western science. With the ratification of an indigenous (Inuit) Land Claim Agreement (LCA) in April of 1999, wildlife management in general became a shared responsibility between the territorial government and a wildlife management board, which was created under the auspices of the LCA. Even within the traditional scientific paradigm, managing the world's largest carnivore is a formidable challenge. Post-1999 polar bear co-management not only requires the government to meet and maintain sound scientific conservation principles, as required by the *International Agreement on the Conservation of Polar Bears*, but now must make the necessary adjustments to incorporate Inuit Traditional Knowledge as contained within the LCA. The social and political demands of synthesizing both schools of thought will require a concerted and collaborative effort from all parties involved. For example, initial population estimates for the M'Clintock subpopulation were based upon an immature attempt of synthesizing both schools of knowledge. Consequently, 30 years of harvest based on these estimates have ultimately resulted in a moratorium. The need to mitigate the cultural and scientific impact of the moratorium provides a positive yet precarious forum for both parties.

C14-01 KINGSBURY, BRUCE, John Roe, and Nathan Herbert. Center for Reptile and Amphibian Conservation and Management, Indiana-Purdue University, Fort Wayne, IN 46805-1499, USA (Kingsbur@ipfw.edu).
MAINTAINING WETLAND COMPLEXES: IMPLICATIONS FOR THE CONSERVATION OF THE IMPERILED COPPERBELLY WATER SNAKE

The northern populations of the Copperbelly Water Snake, *Nerodia erythrogaster neglecta*, are listed as federally Threatened, yet the ultimate mechanisms behind their decline are unknown. In contrast, a syntopic congener, the Northern Water Snake, *Nerodia sipedon*, remains abundant. In this investigation, we radio-tracked a sample of copperbellies and northerns to examine differences in patterns of wetland and upland use between the species. Copperbellies used an average of 4.1 wetlands as opposed to 2.1 wetlands for the northerns, and moved between them three times as often. They also used ephemeral and other shallow wetlands more than five times as frequently as the northerns. Finally, copperbellies were found in uplands about 29% of the time, an order of magnitude more frequently than were northerns. We suggest that the precipitous loss of shallow wetlands and the alteration of the surrounding upland matrix has more severely impacted copperbellies than northerns, and helps explain differences in the status of the two species. Conservation strategies for vagile semi-aquatic species that require multiple resources over broad spatial scales should focus on protecting and restoring large wetland complexes, and recognize the importance of intact uplands and small wetlands that help maintain wetland connectivity across the landscape.

P060 KINGSTON, JOHN, Daniel Engstrom, Edward Swain, Eugene F. Stoermer, Jeffrey Johansen, Gerald Sgro, Kristin Yanko, Amy Kireta, and Richard Axler. Natural Resources Research Institute, University of Minnesota, 5013 Miller Trunk Highway, Duluth, MN 55811, USA (jkingsto@umn.edu) (JK, AK, RA); St. Croix Watershed Research Station, Science Museum of Minnesota, 16910 152nd Street North, Marine on St. Croix, MN 55047, USA (DE); Minnesota Pollution Control Agency, 520

Lafayette Road, St. Paul, MN 55155, USA (ES); Great Lakes Research, University of Michigan, 501 East University Street, Ann Arbor, MI 48109, USA (EFS); Biology Department, John Carroll University, 20700 North Park Boulevard, University Heights, OH 44118, USA (JJ, GS, KY).
PALEOLIMNOLOGICAL ASSESSMENT OF ECOSYSTEM CONDITION IN GREAT LAKES DROWNED RIVER MOUTHS

Paleolimnological assessment of water quality in the St. Louis River Estuary (Duluth, MN; Superior, WI) shows that land use changes following European settlement have led to accelerated perturbation of the ecosystem over a period of 150 years. In dated cores, sediment accumulation, diatom populations, diatom-inferred water quality, and sedimentary pigment concentrations all point to decreased water transparency and increased nutrient loading in this heavily agricultural, urbanized and industrialized watershed. Historical photographs from Duluth in the late 1860s show extensive peat wetlands in the harbor, coincident with a period of higher water quality based on our environmental indicators. Paleolimnological assessment offers baselines, trends, and magnitudes of change using consistent methodology in depositional environments. In the case of the St. Louis River Estuary and many other sites in the Laurentian Great Lakes, it is difficult to envision any practical remedial action that could restore reference conditions to pre-European settlement baselines. Our research combines sediment core analysis from a Minnesota Sea Grant project with a recent USEPA-funded project to develop environmental indicators of condition for the coastal and nearshore zones of the Laurentian Great Lakes.

P088 **KITSON, LISA,** Jamie Coughlan, John Davenport, and Tom Cross. Department of Zoology and Animal Ecology, University College Cork, Lee Maltings, Prospect Row, Cork, Ireland (biobabe@ibl.bm).
DISTRIBUTION AND GENETIC DIFFERENTIATION OF A CRITICALLY ENDANGERED LIZARD IN BERMUDA

Bermuda has only one endemic terrestrial vertebrate. This is a primitive lizard known as The Bermuda Skink or Rock Lizard (*Eumeces longirostris*, Scincidae). The significant decline in abundance of this species has resulted from many human impacts including habitat destruction and alteration, introduction of foreign predators and entrapment in litter. An ecological understanding of this species is vital before successful attempts to protect and restore this species can be made. A large-scale distribution survey using pitfall traps has located major populations of skinks, which were previously unknown. The lizards now exist throughout the archipelago in isolated pockets and only one large population appears to exist on the mainland. Genetic sub-structuring within this species was investigated after morphological differences were recorded between different locations. Analysis of 3 geographically isolated populations of skinks using microsatellite techniques has shown that there is significant genetic differentiation. Future management of this species will include captive breeding and reintroduction. Therefore, it is important to consider these findings. The current distribution and genetic variation of the Bermuda Skink can now be interpreted using data on changes in sea level during the interglacial periods, anthropogenic impacts, habitat preferences, feeding ecology and swimming ability.

C38-10 **KLEIMAN, DEVRA G.,** and Katherine Ralls. Department of Conservation Biology, Smithsonian National Zoological Park, Washington, DC 20008, USA (dgkleiman@aol.com) (DGK, KR).
A CASE STUDY IN EVALUATION OF CARNIVORE CONSERVATION EFFORTS: THE BLACKFEET SWIFT FOX REINTRODUCTION PROGRAM

Despite frequent references to adaptive management and the importance of evaluating conservation programs, independent review of such efforts is rare. Moreover, many conservation programs fail to develop clear measurable objectives, monitor their progress, and change course when necessary. Thus, improvement in the status of rare and endangered species may be impeded and may not be cost-effective. The Sand County Foundation, an NGO conducting and promoting science-based habitat management, asked the authors to conduct an independent peer review of The Blackfeet Swift Fox Reintroduction Program. Sand County, through the Bradley Fund for the Environment, had supported this program since 1998, which involved a partnership between three private institutions, the Defenders of Wildlife, the Cochrane Ecological Institute and the Blackfeet Nation. We describe the process used to conduct the review and some of the results. Diverse stakeholders in swift fox conservation, within and outside the Blackfeet program, were interviewed using a standardized questionnaire. Interviewees were asked about the program's objectives and goals, measures of success, organization and structure as well as asked to give their opinion concerning the major achievements and limitations of the Program. The authors also conducted a site visit. The results and recommendations, summarized in a report, included a need for more coordination, internal and external communication, swift fox monitoring, and resources. It is noteworthy that the review process itself acted as an intervention and resulted in program changes prior to the completion of the final report.

C37-07 **KLEIN, ADAM,** and Jessica Fox. EPRIsolutions, 1299 4th Street, Suite 307, San Rafael, CA 94901, USA (adklein@earthlink.net).
SPECIES BANK AND TRADE PROGRAMS AS A MARKET-BASED INCENTIVE FOR RECOVERY OF T&E SPECIES: INDIANA BAT CASE STUDY

The ESA has been effective in identifying T&E species, but less successful in ensuring species recovery. New incentives are necessary to encourage landowners to create and/or enhance habitat for species' recovery. One such incentive is the development of bank and trade programs. A private party requesting an incidental take permit could purchase "species credits" from pre-established conservation banks, to provide mitigation for the take. We evaluated the potential for establishing an Indiana bat conservation bank in Ohio. We evaluated the potential to develop summer bat habitat, developed a methodology for determining bat "credits", provided estimates of bat credit value, and looked at the regulatory climate for the establishment of species bank and trade programs. A breeding colony (composed of 40-300 individuals) and 10 acres with one primary roost tree was defined as a credit unit, resulting in 1,200 potential Indiana bat credits. We estimate that Indiana bat credits would be worth $20,000-$50,000, based on land value and species credit prices in the U.S. Preliminary interviews with regulatory agency personnel indicated a reluctance to adopt this approach. Pilot studies on efficacy of species bank and trade programs will be necessary to evaluate the utility of such methods.

P116 KLEINTJES, PAULA, Stephen Fettig, Elisabeth Major, Dustin Vanoverbeke, and Dana Bickelhaupt. Department of Biology, University of Wisconsin–Eau Claire, Eau Claire, WI 54702, USA (kleintpk@uwec.edu) (PK, EM, DV, DB); Bandelier National Monument, Los Alamos, NM 87544, USA (SF).
RESPONSE OF BUTTERFLIES TO ELK BROWSING IN A MIXED CONIFER-ASPEN FOREST

Herbivory by high numbers of elk can influence the structure of aspen forests, but less is known about how such changes affect insect herbivores. In Bandelier National Monument, New Mexico, 1999-2002, we used randomized and replicated ungulate exclosure (60 x 60 m) and reference areas in an aspen-mixed conifer forest to test whether elk browsing *Cervis elaphus* affects adult butterflies. In each site we measured butterfly abundance and species richness, non-woody plant cover, height, richness and biomass, percent canopy, and aspen height and density. Butterfly abundance and species richness significantly differed among dates, treatment, and dates x treatment in 2001, the year of greatest precipitation prior to the sampling season. In other years, butterfly numbers only differed among sampling dates. Butterfly abundance and richness were positively correlated with forb biomass and aspen stem densities (0.5 - 2.0m ht) and stem densities significantly differed among heights and treatment. Results of ordination analyses indicated that species composition of late flying butterflies was best explained by greater forb biomass, blooming nectar species and aspen regeneration as a result of ungulate exclusion. Our results suggest that butterflies respond variably to elk browsing and primarily as a result of variation in annual and seasonal precipitation.

S02-05 KLEMENS, MICHAEL W. Wildlife Conservation Society, Metropolitan Conservation Alliance, 68 Purchase Street, Rye, NY 10580, USA (mca@wcs.org).
ASSEMBLING THE PIECES: A BRICKS-AND-MORTAR APPROACH TO CONSERVATION

Over the last two decades, the emergence of conservation science has created a foundation upon which to make ecologically sound land use decisions. Yet, those closing decades of the 20th century also witnessed an unprecedented spasm of wasteful land and natural resource consumption. This dichotomy is symptomatic of the wide gulf separating conservation science from land use planning and development. Traditionally, conservation scientists channeled outreach efforts through NGOs, academia, and state or federal agencies. However, we have been slow to engage the entire suite of stakeholders defining any given land use decision, including local and regional planning agencies, local governments, chambers of commerce, economic development partnerships, farmers, and the 'smart growth' and 'new urbanist' movements. Viewing these stakeholder groups as 'bricks,' our program serves as 'mortar.' We provide information, services, technical backup and expertise, as well as facilitation and training, to join these bricks together. This alliance of interests recognizes conservation as a mainstream community goal, not the agenda of a narrowly focused special interest group. Once conservation has been thus mainstreamed, communities actively seek biological information to make better land use decisions. This bricks-and-mortar model has met with success in the tri-state New York metropolitan region, implementing large-scale conservation planning at local and regional levels.

P119 KOMONEN, ATTE, and Jari Kouki. Faculty of Forest Sciences, University of Joensuu, PO Box 111, FIN-80101 Joensuu, Finland (atte.komonen@joensuu.fi).
THE EFFECT OF CLEARCUTTING ON POLYPORE-DWELLING BEETLES IN BOREAL FORESTS

We studied the effect of clearcutting on the occurrence and abundance of beetles inhabiting the fruiting bodies of *Trametes* polypores in Finland. We collected fruiting bodies from old-growth forests and adjacent clear-cuts, after which samples were taken into laboratory to rear the insects living inside the fungi. Six species of cisid beetles (Cisidae) accounted for 97% of the insect fauna. Of these, only *Octotemnus glabriculus* had higher frequency of occurrence and higher average abundance in the forest than in the clear-cut samples. *Sulcacis affinis*, *S. fronticornis*, *Cis hispidus* and *C. comptus* were more frequent and abundant in the clear-cut samples, whereas *C. boleti* did not show significant differences between the two management categories. The amount of fungal fruiting bodies in a dead tree was higher in the clear-cuts and explained most of the variation in species frequency and abundance. However, the management category had an independent effect on species abundance,

probably due to microclimatic factors. Our study indicates that forest management affects the distribution and abundance of common *Trametes*-dwelling cisids, but as long as logging residue contains deciduous elements and is not removed from the logging site, forest management is not a serious threat for these beetles.

C18-02 KOPER, NICOLA, and Fiona K.A. Schmiegelow. Department of Renewable Resources, University of Alberta, 751 General Services Building, Edmonton, AB T6G 2H1, Canada (nkoper@yahoo.com).
DUCKS AS SURROGATE SPECIES FOR AVIAN CONSERVATION IN WETLANDS AND PRAIRIES

Conservation programs are often designed using surrogate species, but the effectiveness of this strategy is unclear, and varies with habitat and species. Prairie ducks have characteristics of both flagship and umbrella species. We hypothesized that as a group, they may be suitable surrogate species for avian conservation in the dry mixed-grass prairie. We compared effects of cattle grazing management strategies designed to protect duck productivity, on duck, shorebird and songbird richness, abundance, and nest success. This study was conducted from 2000 until 2002, in wetlands, riparian transition zones, and dry mixed-grass prairie habitats, in 39 fields in southern Alberta, Canada. Point counts were used to measure avian richness and abundance, while both natural and artificial nests were utilized to measure nest success. Songbirds, shorebirds, and ducks responded differently to field size and grazing regime; each avian group selected different microhabitats as nest sites; and songbird and duck artificial nests were depredated by different predator communities. Ducks are therefore unlikely to be good surrogate species for avian conservation in this habitat, as optimum conservation strategies for ducks, songbirds, and shorebirds differ. The effectiveness of using surrogate species for conservation cannot be assumed, and must be determined before conservation plans are designed.

C16-04 KOTAGAMA, SARATH. Field Ornithology Group of Sri Lanka (FOGSL), Department of Zoology, University of Colombo, Colombo 3, Sri Lanka (fogsl@slt.lk).
EVOLVING CONCEPTS FOR ACHIEVING CONSERVATION IN SRI LANKA

Sri Lanka, as a developing country, is faced with the general problems of any third world country – increasing population, declining natural resource base, increasing urbanization and pollution, etc. In the midst of these growing problems Sri Lanka has set aside about 25% of the land cover as conservation areas for wildlife and forests. This presentation considers very briefly the major turning points in the development history of Sri Lanka that contributed to the changing landscape and the resulting impact on nature and wildlife. The resulting concerns of habitat deterioration and impact on the fauna and flora stimulated the conservation actions. At various times important actions were taken to achieve good results. The biggest obstacle had to do with overcoming the lobby of the developers that said "environmental and conservation concerns can come only after development" and that those who speak of conservation are "preventing the people from attaining better living standards by the developed nations." To overcome these criticisms and to forge forward conservation, it required developing indigenous convincing concepts and ideas from the nation's culture and religion. This presentation includes some of the significant concepts developed and used.

S04-04 KRAMER, DANIEL. Conservation Biology Graduate Program, University of Minnesota, 180 McNeal Hall, 1985 Buford Avenue, St. Paul, MN 55108, USA (kram0090@tc.umn.edu).
LAKE VIEWS: THE ECOLOGICAL DETERMINANTS OF INSTITUTIONAL STRUCTURE IN MINNESOTA LAKE ASSOCIATIONS

Common property resource problems are typically addressed in one of three ways: regulation, privatization, and voluntary collective action. Many recent studies have shown that collective action institutions are more effective than theory suggests. In Minnesota, lakes are primarily managed by state and local government. However, over six hundred lakes are jointly managed and monitored by local lake associations – essentially homeowner associations voluntarily organized around their respective lakes. Little is known about these lake associations. I surveyed all known lake associations in Minnesota in order to learn more about their lakes, institutional structure, activities, and members. I found that lake associations are organized primarily to promote environmental stewardship. Lake associations, however, vary widely in their institutional structure and character. I propose that institutional variability can be at least partially explained by the ecological context of lake associations and their lakes. I used survey data as well as ecological and social data in multivariate regressions and found that ecological context may help explain institutional variability among lake associations. Understanding the relationships between human institutions and ecological systems is useful to policy makers when deciding how to best address common property resource problems in complex and variable environments.

C05-10 KRISTAN, WILLIAM B., III, and J. Michael Scott. Idaho Cooperative Fish and Wildlife Research Unit, University of Idaho, Box 44-1141, Moscow, ID 83844-1141, USA (bkristan@uidaho.edu).
INTRINSIC AND ENDEMIC SOURCES OF PREDICTION ERROR IN HABITAT MODELING

Habitat modeling and map-based predictions are increasingly used as proxies for survey data in conservation planning, yet habitat models have distressingly poor predictive accuracy. Prediction accuracy is scored by comparing model predictions to observations, and tallying correct classifications, false positives and false negatives. A finding of high error rates is diagnostic of nothing, since errors can occur because of imperfect ecological understanding, sampling inadequacies, or a variety of other causes. Errors introduced by the structure of the habitat model, in combination with the structure of the map to which the model is applied, are intrinsic to the prediction process, can be measured independently of animal occurrence, and do not imply a misunderstanding of the ecological relationship represented by the model. We illustrate this using a univariate logistic regression. Additionally, spatial and temporal variation in population parameters is endemic to habitat ecology, and differences between the population from which a habitat model was derived and the population being predicted can inflate prediction error rates. We demonstrate one approach to adjusting predictions for differences in population density that has the additional benefit of being a way to detect density-dependent habitat use.

P004 KULKARNI, BALASAHEB GOVIND. M.R.A. Taherizadah, Department of Marine Zoology, The Institute of Science, Mumbai 400 032, India (balasaheb_k@hotmail.com).
DIVERSITY OF MACROBENTHOS AND WATER QUALITY INDEX IN GORAI CREEK OF MUMBAI (BOMBAY, WEST COAST OF INDIA)

Water quality and diversity index of benthos can be used as an indicator of anthropogenic pressure on the creek, and such studies are helpful for conservation measures of marine ecosystem. Gorai creek is situated in the north part of Mumbai and extends to the Borivali area, covering a distance of four kilometers. To assess its ecological status, we monitored inertial benthos and physico-chemical characteristics of the creek water for two years. Due to the muddy nature of the substratum, macro benthos like mudskipper of *Boleopthalmus* SP, gastropods, *Telescopium telescopium*, and *Potamides cingulates*, were found at higher density. Moreover, higher density of crab uca sp. were also noted in muddy-sandy mix shore. This is the only creek around Mumbai where substantial density of mangroves was noted. Among the physico-chemical characteristics, except high level of nitrate (201.3 to 237.3 ug/l), dissolved oxygen (4.92 to 7.41 mg/l), carbon dioxide (13.30 to 21.25 mg/l), biochemical oxygen demand (1.41 to 2.46 mg/l), phosphate (10.49 to 21.72 ug/l), and salinity (16.60 to 35.32 ppt) found within the normal range. This study suggests conserving benthic diversity of the creek, which is essential for healthy marine ecosystem.

C09-03 LABRAM, JILL, Amanda Peck, and Craig Allen. South Carolina Cooperative Fish and Wildlife Research Unit, Department of Aquaculture, Fisheries and Wildlife, Clemson University, Clemson, SC 29634, USA (jlabram@clemson.edu).
APPLICATION OF AN ACCURACY ASSESSMENT METHOD FOR GAP ANALYSES MODELS

Gap Analysis uses literature-based habitat affinities to create vertebrate predictive models and determine areas of high vertebrate species richness in the United States. However, these models need validation based on empirical data to assess their accuracy. We assessed how accurate South Carolina Gap Analysis vertebrate models were in predicting herpetofauna and mammal occurrence on the 78,000 hectare Savannah River Site. We trapped herpetofauna and mammals at seven landcover types for three years, and compared spatial correspondence between predicted and actual species richness for the 17 most common species. Spatial correspondence of species richness occurred in only one landcover type, with gap over-predicting richness in five of the seven landcovers of SRS. The average accuracy of individual models was 59%. The average commission error was greater (30%) than the omission error (11%). This led to gap models that predicted many areas of high richness, whereas our sample-based models indicated only one species-rich landcover. This may reflect gap models that are too general or insufficient trapping effort on our study areas. However, our comparisons and analyses were only applied to common species, so the former explanation is more likely. This indicates a need to continue to refine the gap vertebrate-modeling process.

C60-04 LACERDA, ANDRE EDUARDO BISCAIA DE, and Milton Kanashiro. Embrapa Amazonia Oriental, Trav. Dr. Eneas Pinheiro s/n. 66.095-100 Belem-PA, Brazil (andre@cpatu.embrapa.br).
LOGGING IMPACT ON TOTAL AND REPRODUCTIVE POPULATION OF JATOBA *HYMENAEA COURBARIL* L. – TAPAJOS NATIONAL FOREST, PA, BRAZIL

The Dendrogene project's (EMBRAPA/DFID) main objective is to assess the genetic loss and changes in ecological processes in managed forests in Brazilian Amazon. Jatoba *Hymenaea courbaril* L. is one of the most valuable wood species and is among the seven species investigated by the project. The 500ha study site is located at Tapajos National Forest (Belterra, Para). All trees ≥ 20cm DBH (178 trees) were identified, measured and plotted; the phenology and the reproductive biology has been studied. Based on a logging plan, it was possible to analyze the impact on the diameter distribution. However, due to total population

phenology monitoring it was possible to determine the reproductive size. The diameter which the trees start flowering is around 49cm; therefore 66.8% (119 individuals) of the population are reproducing. It is planned to have logged 44.9% (80) of the total population that represents 60.5% (72) of the reproducing trees considering 80cm as the minimum diameter for exploitation. However, the logging will affect 93% (80) of the trees above 80cm and there is no guarantee that the remaining ones will maintain the seed production, genetic variability and even the wood stocking levels.

S14-07 LANDON, LAURA, and David Mehlman. The Nature Conservancy, 4245 North Fairfax Drive, Suite 100, Arlington, VA 22203, USA (llandon@tnc.org).
INCORPORATING WIDE-RANGING SPECIES INTO ECOREGIONAL PLANNING

The Nature Conservancy's first step in the conservation process is to identify a portfolio of conservation areas that if conserved will represent the biodiversity of an ecoregion. However, the ecology and movements of wide-ranging groups such as anadromous fish, large carnivores and other terrestrial mammals, migratory birds, and some insects are difficult to incorporate into an area-based conservation planning process in ecoregion-sized units. While the Conservancy has developed an overall methodology for developing ecoregional plans, a consistent and conceptual framework for incorporating wide-ranging species and into these plans does not currently exist. Therefore, less than half of the ecoregional plans developed by the Conservancy incorporate wide-ranging species into first iteration plans. Some methodologies to address this problem in ecoregional plans are being tested, such as using habitat models based on field observations of target species (wide-ranging carnivores), coordinated planning across multiple ecoregions for the same conservation targets (migratory birds), and addressing wide-ranging species in intact ecoregions. We summarize the Conservancy's recent and on-going efforts to incorporate wide-ranging species into ecoregional plans and propose a methodological approach for future planning efforts.

C40-03 LANE, CYNTHIA, and Samuel Wright. Fairchild Tropical Garden, 11935 Old Cutler Road, Coral Gables, FL 33156, USA (clane@cannon.net).
ENVIRONMENTAL GRADIENTS IN A DISTURBED SOUTH FLORIDA COASTAL ECOSYSTEM

Residential development and tourism throughout Florida's Atlantic coastal areas have resulted in severe habitat destruction and degradation. Many plant species dependent upon these systems are now rare or endangered. Habitat restoration is a key component in their recovery. However, before developing appropriate coastal restoration plans, it is necessary to characterize key environmental gradients and their influence on vegetation. The functioning of these coastal systems is uncertain because of their highly altered condition, including complete alteration of topography. To characterize environmental gradients from the high tide line to inland areas, we established plots at 10 m intervals from coast to inland along randomly placed transects at two sites. Environmental factors measured in each plot included salt spray, sand movement, soil nutrients and chemistry, soil texture, soil moisture, and temperature and humidity. In the same plots data were collected on plant species composition and percent cover. Dune topography was mapped using laser surveying methods. Many of the environmental factors measured were significantly different between plots near the coast and those in more inland areas. For example, salt spray levels were highest near the coast, while many soil nutrients were higher at plots farther from the coast. Based on these results we identified ecological zones relative to distance from the coast and topography. For each zone we developed lists of species and average abundance. The characterization of environmental zones and associated species information will provide the basis for restoration planning in these and similarly disturbed coastal systems.

C13-01 LANNOO, MICHAEL, Daniel Sutherland, Perry Jones, Donald Rosenberry, Robert Klaver, David Hoppe, Pieter Johnson, Kevin Lunde, Charles Facemire, and Josh Kapfer. Muncie Center for Medical Education, Indiana University School of Medicine, MT 201, Ball State University, Muncie, IN 47306, USA (mlannoo@bsu.edu) (ML); Department of Biology and River Studies Center, University of Wisconsin–La Crosse, La Crosse, WI 54601, USA (DS, JK); U.S. Geological Survey, 2280 Woodale Drive, Mounds View, MN 55112 USA, (PJon); U.S. Geological Survey, MS 413, Bldg 53, DFC, Lakewood, CO 80225, USA (DR); U.S. Geological Survey, EROS Data Center, Raytheon, Sioux Falls, SD 57198, USA (RK); Division of Science and Mathematics, University of Minnesota, Morris, MN 56267, USA (DH); Center for Limnology, University of Wisconsin–Madison, 680 North Park Street, Madison, WI 53706-1492, USA (PJoh); Roberts Environmental Center, Claremont McKenna College, 925 North Mills Avenue, Claremont, CA 91711-5916, USA (KL); Ivy Tech State College, 590 Ivy Tech Drive, Madison, IN 47350, USA (CF).
MALFORMED FROGS: MULTIPLE CAUSES; A SINGLE SOLUTION?

While progress has been made in understanding the malformed frog problem, scientists still cannot identify with assurance specific causes of malformations at particular locations. To address this problem a team of specialists was assembled and I present our results on geographic distribution, water quality, parasite infection, and morphological patterns from 17 malformed frog sites and reference sites in Minnesota and Iowa. Malformed frog hotspots (> 5% malformed animals) occur in a broad line from northwest to southeast across Minnesota, associated with the North Central Hardwoods and Driftless Area ecoregions. Few hotspots occur in the southwestern grassland and northeastern boreal forested portions of the state. No single water quality

feature correlates with hotspots. Heavy infections of the trematode parasite Ribeiroia always indicate hotspots, but lesser Ribeiroia infections may or may not. Conversely, certain hotspots show no evidence of the presence of Ribeiroia. Among reference sites, two have no evidence of Ribeiroia. The most common hindlimb malformation type was ectromelia, followed by micromelia and the presence of spongiform bone. Limb hyperextension, amelia, and polymelia were the least common malformation types. Malformed frog hotspots are typically associated with compromised wetlands, and any solution to the malformed frog problem must include restoring these sites.

C02-01 LATCH, EMILY K., Olin E. Rhodes, Jr., Karen E. Mock, and Shane King. Department of Forestry and Natural Resources, Purdue University, West Lafayette, IN 47907, USA (emily@fnr.purdue.edu) (EKL, OER); Department of Fisheries and Wildlife, Utah State University, Logan, UT 84322, USA (KEM); Sul Ross State University, No. 5 Sunset Circle, Alpine, TX 79830, USA (SK).

RELATIVE UTILITY OF MOLECULAR MARKERS FOR WILD TURKEY MANAGEMENT

Extensive translocations of wild turkeys throughout the United States have brought the species back from near extinction over the past 50 years. The genetic implications of these translocations are poorly understood, and bring into question both subspecies integrity and the local genetic structure of populations. Advances in molecular genetics have given us the tools to address these sorts of questions in wildlife species; thus, the development of genetic markers specifically for use in wild turkeys is a high priority for their future conservation and management. We developed 17 microsatellite loci, and generated sequence data from both the cytochrome b gene and control region of mitochondrial DNA. We assessed the relative utility of these markers for elucidation of genetic structure at the population level, using translocated populations of eastern wild turkeys, and at the subspecies level, using relict populations of each of the 5 wild turkey subspecies. Microsatellites appear to be best suited to characterizing genetic structure at the population level, while control region sequences seem to resolve structure at larger scales. We also illustrate the power of these markers in detecting hybridization among subspecies in a reintroduced wild turkey population in the Davis Mountains region of Texas.

C29-01 LAURANCE, WILLIAM F. Smithsonian Tropical Research Institute, Apartado 2072, Balboa, Republic of Panama and Biological Dynamics of Forest Fragments Project, National Institute for Amazonian Research (INPA), Manaus, 69011-970, Brazil (laurancew@tivoli.si.edu).

FRAGMENTS AND FIRE: ALARMING SYNERGISMS AMONG FOREST DISTURBANCE, LOCAL CLIMATE CHANGE, AND BURNING IN THE AMAZON

Among major tropical regions, the Amazon is experiencing the world's highest absolute rates of deforestation and forest fragmentation. Long-term studies in central and eastern Amazonia reveal that fragmented forests are chronically disturbed by sharply elevated tree mortality, which apparently results from increased desiccation and wind turbulence near forest edges. This in turn accelerates necromass production and increases dry litter and wood debris on the forest floor. As a consequence, fragmented forests are far more vulnerable to destructive surface fires, which frequently arise in adjoining cattle pastures and can penetrate hundreds to thousands of meters inside fragment boundaries. In addition, fragmentation of forest cover appears to alter local patterns of convective circulation of the atmosphere, in ways that may increase forest desiccation. Positive feedbacks among forest fragmentation, regional climate change, and fire could potentially pose severe threats to Amazonian forests, especially in more seasonal areas of the basin. Wildfires are especially damaging during periodic El Niño droughts, which may be increasing in frequency or severity as a result of global warming.

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OVERWINTERING ECOLOGY OF AN ENDANGERED RATTLESNAKE (*SISTRURUS CATENATUS*) IN MISSOURI, USA

Information on the hibernation ecology of the endangered eastern massasauga rattlesnake (*Sistrurus catenatus*) is scant. In Missouri the only known stable populations of massasaugas occur on National Wildlife Refuges, where management practices (e.g. controlled burning) in the early spring and late fall may have deleterious impacts upon snakes. Eighteen massasaugas were studied using temperature sensitive radio transmitters on the Squaw Creek National Wildlife Refuge, Missouri, USA. The objectives of the study were to examine times of ingress and egress, overwinter mortality, and classify the overwintering microhabitat. I found that snakes exhibited longer activity periods than previously suspected, with ingress as late as 18 December, and that the selection of suitable hibernacula is a dynamic process, with snakes utilizing an average of 2.56 overwintering locations prior to their final ingress. Emergence and overwinter survival data will be collected in April 2003. Both the fact that activity periods are longer then previously believed and that snakes utilize a number of sites prior to ingress, have direct implications for the management and conservation of this imperiled species.

S07-01 LEE, PETER G. Global Forest Watch Canada, 10337 146th Street, Edmonton, AB T5N 3A3, Canada (GFWCanada@shaw.ca).
OVERVIEW OF BOREAL FORESTS IN CANADA AND BEYOND

At the global level, although the boreal region represents Earth's most extensive terrestrial biome and is home to some of the last remaining significant wilderness areas on the planet, the increase in world demand for forest products and energy is accelerating pressure on the biome. Using Landsat 7 ETM (plus) and other satellite imagery, Global Forest Watch Canada found that over 70 percent of Canada's boreal/taiga forest region remains as large, intact forest landscapes in Canada. On a global scale, in comparison with other nations of similar forest type, this is more than remains as large, intact forest landscapes in Russia, although Russia has twice the boreal/taiga area than Canada. Canada's boreal/taiga region is impacted in the southern portions by a massive increase in industrial activities – primarily timber, hydrocarbon, hydroelectric and mineral extraction operations – which is unprecedented in terms of both its huge scale and rapidity. A major challenge will be to ensure the maintenance of this global ecological treasure in the face of massive, imminent industrial pressures, misguided government policies and climate warming and other atmospheric threats. Strategic science and information would enhance our ability to move quickly and efficiently regarding conservation of Canada's boreal/taiga region.

C18-07 LEIMGRUBER, PETER, Chris Wemmer, Daniel S. Kelly, Khin Maung Zaw, Ye Htut, and Myint Aung. Conservation and Research Center, Smithsonian National Zoological Park, Front Royal, VA 22630, USA (leimgruberp@crc.si.edu) (PL, CW, DSK); Division of Wildlife and Nature Conservation, Ministry of Forestry, West Gyogone, Insein, Yangon, Myanmar (KMZ, YH, MA).
MANAGING TWO CRITICAL ELEPHANT RANGES IN MYANMAR

Myanmar harbors the second largest wild elephant population in Asia. Despite protection efforts in Myanmar, the species declined continuously throughout the last century. In 2001, we initiated an elephant-monitoring project at Alaungdaw Kathapa National Park (AKNP) and Htamanthi Wildlife Sanctuary (HWS). We estimated elephant populations using dung counts in recce-surveys along more than 500 km of trails and transects in each of the parks during 2001/2002. We assessed potential people-elephant conflicts using socio-economic surveys and by interviewing local villagers to determine their conservation awareness and attitudes. We also conducted oral interviews with elephant mahouts and park rangers to assess historic levels of people-elephant conflicts and identify historical events that contributed to elephant population declines. Dung counts were low in both parks, indicating overall low densities of wild elephants. HWS, the more remote of the two protected area, had much higher wild elephant densities than AKNP. Only one conflict between people and elephants occurred during our study. Differences in socio-economic factors and conservation attitudes did not explain differences in elephant population levels. Oral interviews, however, helped pinpoint reasons for dramatic declines in the species.

C49-05 LEMA, MATHIAS. East Usambara Conservation Area Management Programme, PO Box 5869, Tanga, Tanzania (mathiaslema@hotmail.com).
CONSERVING BIODIVERSITY AND BALANCING LIVELIHOODS OF LOCAL HUMAN COMMUNITIES IN THE EAST USAMBARA MOUNTAINS, TANZANIA

Protection of biodiversity in African 'hotspots' where human densities are high is often complicated by socio-economic conditions. We present a case study of the East Usambara Mountains, Tanzania, where recent incorporation of unprotected forest patches into the existing protected forest network has raised several issues of concern for managers and local communities. While conservation of biodiversity and watersheds is maintained by protecting large forest tracts in the East Usambaras, the socio-economic conditions of local communities has not received adequate attention. As a result of this human-land management conflict, forest conservation for biodiversity and watershed protection has been received negatively by local communities. We plan to introduce several of these conflicts (e.g. compensation for farmed land and crops, permitting local use of forest resources, etc.) that arose during the incorporation of a 600 ha forest patch. We discuss strategies implemented to resolve these issues (e.g. some compensation for land and crops, permission to use forest resources on a sustainable basis, etc.) and concerns raised by local communities. We rationalize our focus on essential education schemes to enable local communities to understand the utilities of biodiversity conservation and potential returns they could obtain from ecotourism, among other potential economic gains.

C52-01 LEPCZYK, CHRISTOPHER A., Volker C. Radeloff, Curtis H. Flather, and Jianguo Liu. Department of Forest Ecology and Management, University of Wisconsin–Madison, 120 Russell Labs, 1630 Linden Drive, Madison, WI 53706, USA (clepczyk@wisc.edu) (CAL, VCR); USDA Forest Service, Rocky Mountain Research Station, Fort Collins, CO 80526, USA (CHF); Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI 48824, USA (CAL, JL).
THE HUMAN INFLUENCE ON BIRDS ACROSS MIDWEST LANDSCAPES

Bird populations across the United States have fluctuated markedly in recent decades. Although numerous mechanisms have been put forth to explain these fluctuations, the ultimate factor is generally human influence. To assess the role of human influence on bird populations, we investigated both anthropogenic land cover and housing density, in relation to avian species diversity and trends of 12 species for the entire Midwest U.S. We hypothesized that (1) species diversity would be maximum at intermediate levels of human influence; (2) the amount of human influence affects the proportion of individuals of species occupying each landscape; and, (3) if birds display a relationship with human influence it will differ according to foraging or nesting guild. A negative relationship existed between avian diversity and both the number of housing units and the amount of anthropogenic land cover, with the latter relationship being stronger. Ten species displayed relationships with one of the two measures of human influence (housing or land cover). No significant differences existed in the species relationships to human influence based upon foraging or nesting guild. Humans have a detectable and broad scale influence on birds in the Midwest, but the influence does not appear to differ based on natural history factors.

S11-07 LI, FENGSHAN, and Mingjie Huang. International Crane Foundation, E-11376 Shady Lane Road, PO Box 447, Baraboo, WI 53913, USA (fengshan@savingcranes.org) (FL); Guizhou Environmental Protection Bureau, Zunyi Road, Guiyang, Guizhou, P.R. China (MH).
COMMUNITY INVOLVEMENT IN WETLAND AND WATERSHED MANAGEMENT AT CAO HAI NATIONAL NATURE RESERVE, CHINA

Local communities located in or near Chinese nature reserves are often regarded as destructive to natural resources or, at best, act passively. These rural communities are usually poor and are so dependent upon the natural resources of reserves, they cannot be ignored. Tension between local residents and natural resource managers is often high and, as a result, natural resources continue to degrade. Chinese nature reserves will not persist if this trend continues. Over the last ten years, we have implemented a program at Cao Hai National Nature Reserve in China to place farmers in the central role of the natural resource conservation and management, and to integrate nature conservation with community development. The project initially relied on two micro-finance mechanisms and emphasized farmer participation in decision-making and conservation. These programs succeeded, and we are now strengthening linkages between rural development and ecosystem conservation by implementing participatory activities. Farmers' livelihood, conservation awareness, and social well-being have improved as a result. The high plateau wetland ecosystem and its surrounding watershed are recovering. Our final phase of program development is to extrapolate these findings at Cao Hai to other nature reserves in China.

C38-06 LIND, AMY J. Department of Evolution and Ecology, University of California, Davis, One Shields Avenue, Davis, CA 95616, USA and USDA Forest Service, Sierra Nevada Research Center, Pacific Southwest Research Station, Davis, CA 95616, USA (ajlind@ucdavis.edu).
REINTRODUCTION OF A DECLINING AMPHIBIAN: DETERMINING AN ECOLOGICALLY FEASIBLE APPROACH THROUGH ANALYSIS OF DECLINE FACTORS, GENETIC STRUCTURE, AND HABITAT ASSOCIATIONS

Species reintroductions provide a model for integrating practical and theoretical aspects of conservation biology and developing suitable sets of analytical tools. Reviews have suggested that research is needed in several areas to improve the success of reintroductions: (1) causes of species declines, (2) genetic relationships of source populations, (3) social dynamics, (4) habitat associations, and (5) monitoring designs. Amphibians present distinct challenges due to unique ecological, genetic, and demographic characteristic such as low mobility and patchy distributions. This study focuses on a declining amphibian in California (the foothill yellow-legged frog, *Rana boylii*) and includes three components: (1) spatial analysis to determine the primary causes of decline, (2) description of range-wide genetic variation, and (3) quantification of habitat associations. One recent study suggests that agricultural chemicals and climatic factors may be involved in the decline. My work includes more detailed analyses of these threats and adds information on dams and water flow modifications – key influences on this stream-dwelling frog. Initial study of habitat associations shows that a narrow set of stream conditions are necessary for reproduction. Genetic data also indicate low variation throughout the range. I propose a model for integrating this and other information into reintroduction programs.

C42-03 LITVAITIS, JOHN. Department of Natural Resources, University of New Hampshire, Durham, NH 03824, USA (john@christa.unh.edu).
ARE NATURAL DISTURBANCE REGIMES RELEVANT BENCHMARKS IN HUMAN-DOMINATED LANDSCAPES?

In the northeastern United States, populations of many species affiliated with native shrublands and regenerating forests, collectively referred to as thickets, are declining rapidly. Efforts to maintain adequate amounts of thicket habitat via timber harvests are confronted by a range of contemporary land uses, a legacy of historic uses, and public opposition. At the same time, there is increasing support for timber harvesting methods that mimic natural disturbance regimes. Such an approach includes small, scattered patch cuts or single tree harvests. Unfortunately, this approach is hampered by traits that characterize forests in

the region, including ownership parcelization, landscape fragmentation, and a relatively young forest. Large, clustered harvests may be a more practical approach for providing early-successional habitats, especially in developed landscapes. Although this approach may deviate from the known range of natural variability, it may prove more successful in sustaining the regional pool of species that are dependent on thicket habitats. In more rural areas, silvicultural manipulations could be applied on a sliding scale relative to forest age, and begin to mimic natural disturbances as forests mature. Addressing the needs of plant and animal species that require thicket habitats in the northeastern United States will require creativity, a willingness to explore a variety of solutions, and public support.

C12-03 LIU, WEI, Hao Lu, Yalei Wu, Ning Yang, and Wenshi Pan. Department of Ecology, Evolution and Organismal Biology, 339 Science II Building, Iowa State University, Ames, IA 50011, USA (wliu3@iastate.edu) (LW); Oklahoma Medical Research Foundation, Oklahoma City, OK 73104, USA (HL); Department of Pathology, University of Alabama at Birmingham, Birmingham, AL 35294, USA (YW); Department of Cell Biology, University of Alabama at Birmingham, Birmingham, AL 35294, USA (NY); College of Life Sciences, Peking University, Beijing, 100871, P.K. China (WP).
DEVELOPMENT OF CONSERVATION STRATEGIES WITH BIOLOGICAL AND SOCIOECONOMICAL INVESTIGATIONS: A CASE STUDY ON WHITE-HEADED LANGUR

Combined biological and socioeconomical research can contribute significantly to wildlife conservation strategies. China's white-headed langur (*Trachypithecus leucocephalus*) is among the world's top 25 most endangered primates and its habitat is fragmented into seven isolated karst regions in Guangxi Province with a total estimated population of 700 to 800 animals. A biological research program was established in one of the three protected areas, Chongzuo, in 1996. In summer 1998 an extensive investigation of the landscape, human demography, and socioeconomics was performed in that area. The methods included field observations, face-to-face interviews with local residents, and data collection from government record. We found that high fuelwood consumption and expansion of sugarcane plantations are major reasons for the langurs' food shortage and habitat fragmentation. A negative feedback web caused the population to decrease before 1996. By building methane pools for local residents, fuelwood demand was reduced significantly. The first ecological park of China was founded there in 2002 to improve the local economics and initiate public awareness. A positive feedback web caused Chongzuo langur population to rise from less than 100 to more than 200 individuals. This represents a perfect example of sustainable development in wildlife conservation.

S06-04 LODGE, DAVID, David Finnoff, Cindy Kolar, Gary Lamberti, Brian Leung, Mark Lewis, Hugh MacIsaac, and Jason Shogren. Department of Biological Sciences, University of Notre Dame, Notre Dame, IN 46556, USA (lodge.1@nd.edu) (DL, GL, BL); Department of Economics, University of Central Florida, Orlando, FL 32816-1400, USA (DF); UMEC-USGS, 2630 Fanta Reed Road, La Crosse, WI 54603, USA (CK); Department of Mathematical Sciences, University of Alberta, Edmonton, AB T6G 2G1, Canada (ML); Biology Department, University of Windsor, Windsor, ON N98 3P4, Canada (HM); Department of Economics and Finance, University of Wyoming, Laramie, WY 82071-3985, USA (JS).
INCORPORATING ECOLOGICAL AND ECONOMIC VALUES IN RISK ANALYSES OF NONINDIGENOUS SPECIES IN THE GREAT LAKES

Noninidigenous species have changed Great Lakes biodiversity and ecosystem function more than any other human impact. Many fish species have been introduced intentionally and continue to have a strong human constituency, but far more fish and other species are introduced unintentionally and are universally disliked. For both intentional and unintentional introductions, however, even rudimentary risk analyses have been rare, and prevention of unwanted species practically nonexistent. Instead, society has largely reacted to new species, rarely with successful but costly control efforts (e.g., sea lamprey), and more commonly with resignation even in the face of substantial ecological and economic costs. Such passivity is unnecessary, and we advocate risk analyses that combine ecology and economics. Such analyses – based on recent advances in ecological and economic forecasting – provide guidance for choices among alternative prevention and control strategies. Examples include: forecasts of which fishes from the Ponto-Caspian basin are most likely to establish, spread, and have undesirable impacts in the Great Lakes; and forecasts of the economic value of preventing the continuing spread of zebra mussels. Such risk analyses strongly suggest that more societal investment in risk analyses and prevention will pay ecological and economic dividends.

C06-04 LOGGINS, RON, and Rick Sweitzer. Department of Biology, University of North Dakota, Grand Forks, ND 58202, USA (ronald_loggins@und.nodak.edu).
EXPANSION DYNAMICS OF WILD PIGS IN CALIFORNIA: POPULATION GENETIC STRUCTURE AND HABITAT AVAILABILITY

Wild pigs (*Sus scrofa*) are now widespread as feral populations throughout the world where their rooting and other activities seriously disrupts native ecosystems. Wild pigs were introduced to California during the Spanish colonial period where their distribution continues to expand due to deliberate introductions, hybridization between different types of wild pigs (feral pigs and Eurasian boar), and natural dispersal. Our study used genetic sequence information (mtDNA, ITS sequences) and hunter-killed pig

tag returns to describe the expansion dynamics and current distribution of different types of wild pigs in California. Mitochondrial DNA sequencing data indicates large scale population differences in wild pigs while the ITS sequencing has revealed regional differences in underlying population structure. From hunter-killed wild pig tag returns we developed a large-scale predictive habitat suitability/availability model, which was used to identify areas suitable for continuing range expansion by wild pigs. Linking statewide information on population genetic structure of wild pigs with the habitat model allows for a better understanding of historic and recent expansion of wild pigs in California. Further, our predictive habitat availability model will be valuable for mitigating current and future ecological damage by wild pigs in oak woodlands and other sensitive ecosystems in California.

P084 Long, Sarah T., and **STEVEN D. THOMPSON.** American Zoo and Aquarium Association Population Management Center, Chicago Zoological Society and Lincoln Park Zoo, 2001 North Clark Street, Chicago, IL 60614, USA (slong@lpzoo.org).
INBREEDING AND MORTALITY IN CAPTIVE MAMMAL POPULATIONS

The deleterious effects of inbreeding, commonly referred to as inbreeding depression, have long been recognized in domestic, laboratory, and captive animal populations in the form of lower fecundity, higher mortality, and slower growth rate. Inbreeding depression is of particular interest among biologists attempting to preserve small natural or captive populations in which matings among close relatives become more likely, yet little is known about the affects of inbreeding in many mammalian species being managed. Captive zoo populations represent a particularly important resource for studying the effects of inbreeding because they provide a wealth of data on non-domesticated animals across a broad range of species and over multiple generations. Although inbreeding depression has been documented in numerous captive mammal species, few studies have utilized data from several mammalian orders and tracked individuals throughout their lifetimes. I utilized data from captive populations to conduct a retrospective analysis of studbook records that track individuals of various species throughout their lifetime in zoos across North America. My analyses confirm the general pattern of a negative correlation between level of inbreeding and mortality and fecundity across several mammalian taxa and have significant implications for managing these species in captivity and in the wild.

C07-01 LONSDORF, ERIC, Stuart Wagenius, and Claudia Neuhauser. Department of Ecology, Evolution, and Behavior, University of Minnesota, 1987 Upper Buford Circle, St. Paul, MN 55108, USA (lons0011@umn.edu).
INBREEDING DECREASES AS POPULATION SIZE DECREASES IN A SELF-INCOMPATIBLE PRAIRIE PLANT: EMPIRICAL RESULTS AND THEORETICAL PREDICTIONS

This empirical and theoretical study of plant populations in fragmented habitat focuses on elucidating the joint effects of mating system and inbreeding on population persistence as a function of population size and isolation. Inbreeding is hypothesized to increase as population size declines; consequently, inbreeding depression is thought to contribute to extinction in fragmented habitats. Our empirical study of *Echinacea angustifolia*, a self-incompatible prairie forb, showed a positive relationship between inbreeding and population size. We built a spatially-explicit, individual based model to simulate and compare the responses of self-incompatible versus self-compatible plant populations to habitat fragmentation. In our model, each diploid individual has one mating locus (if self-incompatible) and six neutral loci; each locus has multiple alleles. Simulations of self-compatible species showed a negative relationship between inbreeding and population size. Self-incompatible species showed a positive relationship, as the empirical study, yet a higher risk of extinction than self-incompatible species. The decline in genetic diversity at the compatibility locus associated with declining populations explains this result. Seeds produced by matings between related individuals become less and less likely as compatibility diversity declines. Pollen limitation, rather than inbreeding depression, is likely to contribute to extinction in this system.

C58-06 LOVEJOY, THOMAS, and Ryan Valdez. The H. John Heinz III Center for Science, Economics, and the Environment, 1001 Pennsylvania Avenue NW, Suite 735 South, Washington, DC 20004, USA (lovejoy@heinzctr.org) (TL); Smithsonian Institution, National Zoological Park, Department of Conservation Biology, 3001 Connecticut Avenue, Washington, DC 20008, USA (RV).
AMAZON GIS: A KEY TO A SUSTAINABLE FUTURE

The eight-country region of the Amazon is one of the great conservation and development challenges of the world. It certainly represents the greatest single concentration of biodiversity anywhere, while also being an area of rapid environmental and developmental change. A variety of individual decisions are being made in each of the countries about highways, gas pipelines and other vectors of development with insufficient coordination between the governments or environmental agencies. At the same time in many of these countries, the growing involvement of civil society in the form of non-governmental organizations (NGOs) has become a developing force for environmental good. The Amazon-GIS (Geographic Information Systems) program at the Smithsonian National Zoo is a collaborative research venture to use the tools of GIS in creating an interactive, web-based resource for Amazon conservation. The program endeavors to display various interactive maps of the Amazon basin with

overlapping layers of conservation activity (protected areas, national parks, etc.) and selected vectors and effects of development (mining, road development, fire, etc.). It is intended to be a continually updated system for reference primarily by individuals whose work affects conservation in the Amazon and secondarily as a source of conservation-related information for the interested parties.

PL-04 LUBCHENCO, JANE. Department of Zoology, Oregon State University, 3029 Cordley Hall, Corvallis, OR 97331-2914, USA (lubchenj@bcc.orst.edu).
MUTINY FOR THE BOUNTY: THE SCIENCE, ETHICS AND POLITICS OF OCEAN CONSERVATION AND A PAEAN TO EARLY MUTINEERS

Although much of the rich historic bounty of oceans has been lost, there is hope that with enough will and savvy, the decline may be slowed and some of the wealth restored. A mutiny is underway to restore the bounty. Current mutineers include scientists, conservation activists, concerned citizens, fishermen, sailors, surfers, divers, business leaders, youth, religious leaders, political leaders, and others who are mobilizing on behalf of the bounty. They are creating the political will to effect meaningful change. Witness the strong recommendations just released by the Pew Oceans Commission and the continued active and collaborative engagement on the part of that diverse group of Commissioners. An inside look at the Commission's deliberations, hearings and interactions with political groups will provide a sense of the hopes and the immense challenges ahead. The roles of science, ethics and politics in meeting this challenge will be explored. Early mutineers were a few brave scientists and activists who worked tirelessly to alert others to the trends they were seeing and solutions they developed. Their courage, insight, political skill and courage started the mutiny. Early mutineers started raising awareness, mobilizing others, and reorienting their work to focus on ocean conservation long before it became popular. Most of them have been unsung heroes and heroines. The current growing mutiny would not have happened without their dedication. I will highlight the contributions of and thank a number of these early mutineers who have been insufficiently recognized. We can all take hope from their successes and passion, and join them to Seas the Day and recover the Bounty.

S12-02 LUNDQUIST, CAROLYN J., Simon F. Thrush, and Judi E. Hewitt. National Institute of Water and Atmospheric Research (NIWA), Gate 10, Silverdale Road, PO Box 11-115, Hamilton, New Zealand (c.lundquist@niwa.co.nz).
USING LANDSCAPE ECOLOGY TO DEFINE THRESHOLDS OF RESISTANCE TO FISHING DISTURBANCE IN MARINE SYSTEMS

Disturbance regimes (i.e., hurricanes, forest fires) have been modeled using landscape ecology to determine spatially explicit management strategies for many terrestrial plant communities. In marine systems, fishing disturbances by trawling or dredging the seafloor create similar large habitat disturbances subject to recolonisation and successional processes. Marine soft sediment organisms create much of their habitat's biogenic structure, and often have widely dispersing larval forms; thus, the effects of disturbance differ from terrestrial systems to some degree. We created a landscape model of fishing disturbance to examine combined effects of spatial extent and frequency of disturbance events on community structure of a benthic subtidal ecosystem subject to fishing disturbance that reduces the biogenic structure to a pioneer community stage. We demonstrate the existence of thresholds in disturbance scales beyond which functional extinctions of later successional community stages are likely. Highly structured benthic habitats, such as bryozoan and sponge habitats, are more likely to be negatively impacted by high frequency or larger spatial scales of disturbance. Our research implies that recovery times from disturbances are slower than previously expected, and that spatial management of these disturbances can lead to the prevention of functional extinctions and increased biodiversity in benthic habitats.

C02-08 LUO, SHUJIN, Jae-Heup Kim, Warren Johnson, Joelle Wentzel, Janice Martenson, Victor David, Marilyn Raymond, James L.D. Smith, and Stephen J. O'Brien. Laboratory of Genomic Diversity, National Cancer Institute, Frederick, MD 21701, USA (Luos@ncifcrf.gov) (SL, WJ, JW, JM, VD, MR, SJO); Conservation Biology Graduate Program, 180 McNeal Hall, 1985 Buford Avenue, St. Paul, MN 55108, USA (SL, JLDS); Samsung Advanced Institute of Technology, Suwon, Korea (JHK).
PHYLOGENETICS, POPULATION HISTORY AND CONSERVATION GENETICS OF TIGERS (*PANTHERA TIGRIS*)

The extant tigers, *Panthera tigris*, are generally divided into five subspecies: Bengal tiger *tigris*, Amur tiger *altaica*, South China tiger *amoyensis*, Sumatran Tiger *sumatrae* and Indo-Chinese tiger *corbetti*, based on geographic distribution and purported morphological differences. To establish objective methods for a better understanding of tiger evolutionary history, we have analyzed (1) allele variation in the nuclear MHC class II DRB gene, (2) 6kb of mitochondrial DNA sequences, and (3) microsatellite genotypes based upon 30 loci in about 100 tigers representing the whole geographic distribution. Relatively low genetic variation (6 DRB alleles, mt DNA nucleotide diversity $p = 0.00218$, microsatellite average heteozygosity $He = 0.549$) was found among all tigers, suggesting that the extant lineage of tigers experienced a genetic homogenization of the entire species. More recently, a combination of founder events, genetic drift and reduced gene flow has led to differentiation of some of the

populations, notably the Sumatran and the Amur populations, and to a certain extent the Bengal and the Peninsular Malaysian populations. On the other hand, a certain level of genetic connectedness has been revealed between the Indo-Chinese populations and possibly part of south China. The result will provide a sound basis for the maintenance or re-establishment of critical habitat linkages, or initiation of reintroduction programs in tigers.

C20-04 LUSTER, RYAN, Greg Golet, and Mike Roberts. The Nature Conservancy, Sacramento River Project, 500 Main Street, Chico, CA 95928, USA (rluster@tnc.org).
LARGE-SCALE RIPARIAN RESTORATION PLANNING: AN EXAMPLE FROM THE SACRAMENTO RIVER, CALIFORNIA, USA

The Nature Conservancy's (TNC) Sacramento River Project focuses on the protection and restoration of riparian and aquatic habitats along California's Sacramento River. The Project's work supports the larger vision to reconnect the river to its floodplain, allow river meander, and restore and protect riparian habitat while simultaneously improving the economic sustainability of farming on over 30,000 acres along a 106-mile stretch of the Sacramento River. TNC has implemented a sub-reach planning program that evaluates hydrologic effects of restoration from the standpoint of restoration impacts on important human services (e.g., flood damage reduction, water quality) and infrastructure on the floodplain. Sub-reach planning divides the river into 10-20 mile reaches that share similar attributes (e.g., geology, fluvial processes, and political boundaries). A key element to sub-reach planning is implementing baseline assessments (e.g., evaluate floodplain topography, develop stage-discharge relationships, classify soils, measure water table depth, conduct wildlife surveys) that are performed to characterize conservation properties and inform restoration and management planning. The presentation will discuss findings from the Chico Landing Sub-reach planning process and the baseline assessments on over 1,000 acres planned for restoration, including hydrologic modeling results, restoration community designs, and proposed research programs to evaluate the success of large-scale floodplain restoration.

P121 LYON, JON. Department of Biology and Environmental Science Program, Merrimack College, 315 Turnpike Street, North Andover, MA 01845, USA (lyonj@merrimack.edu).
A COMPARISON OF WOODY VEGETATION AND NON-NATIVE PLANT SPECIES IN FOUR RIPARIAN CORRIDORS ALONG A DISTURBANCE GRADIENT

High levels of variability and heterogeneity often characterize the plant communities and patterns of plant species diversity along riparian corridors. We have been analyzing woody vegetation (trees, shrubs) and soils along four riparian corridors in northeastern Massachusetts and southern New Hampshire. The four sites are located in watersheds with different disturbance levels and land use patterns. The main objectives of the study are to characterize and compare plant assemblages, ascertain key environmental variables correlated with vegetation patterns and assess the extent of non-native vegetation within and across the four riparian corridors. Transects were established along each riparian corridor and woody vegetation was sampled using standard quadrats. Vegetation and soil data were analyzed using classification and ordination techniques. Preliminary results indicate lower diversity and higher levels of non-native species in more disturbed corridors. However, non-native species were distributed heterogeneously. In addition, there were pockets of high diversity even in highly disturbed corridors. Ordination analyses indicated unique assemblages of woody vegetation both within and across riparian corridors. Woody species richness and diversity were positively correlated with soil nutrient levels. Woody species exhibited complex distribution and assemblage patterns within and across corridors that could not be attributed solely to watershed-level disturbance.

S09-06 MABEY, SARAH E. Research Coop Unit, Department of Zoology, North Carolina State University, Campus Box 7617, Raleigh, NC 27695-7617, USA (semabey@ncsu.edu).
CHANGING LIFE HISTORY TRADE-OFFS: THE CONSEQUENCES OF ALTERING MIGRATORY BIRD STOPOVER HABITAT

Although migratory birds occupy a central position in the realm of conservation, their mobile lifestyles present considerable ecological and political challenges to conservation scientists and practitioners. Migration has long been understood as a complex and costly behavior through which a bird may exploit ecological conditions that maximize survival and reproductive success. However, despite the history of empirical work relating to the life history trade-offs of occupying disjunct breeding and survival habitats, the risks of the movement itself are only now receiving adequate attention. While there is evidence that migration accounts for most of the mortality in first-year birds and may account for sex-specific differences in survival, ecologists have only begun to identify how migration events produce these results. Advances in stable isotope analysis, genetics, and tracking technology combined with studies of stopover behavior and energetics are overcoming the problems of connecting the spatially and temporally dynamic conditions of migration with individuals and populations, leading to more precise estimates of the true costs of migrating. I present a synthesis of empirical and theoretical work to explore three issues: 1) Are the rapid changes in habitat availability and suitability increasing the costs of migrating? 2) Can individuals compensate through life-history trade-offs? 3) What conservation actions are necessary to buffer the costs of migrating?

P048 MACK, ANDREW L., and Banak Gamui. Wildlife Conservation Society, Papua New Guinea Program, PO Box 277, Goroka, EHP, Papua New Guinea (amack@global.net.pg).
AN ASSESSMENT OF PROTECTED SPECIES LEGISLATION IN PAPUA NEW GUINEA

The government of Papua New Guinea lists 72 species as protected under the Fauna Protection Act of 1976. Rarity, degree of threat and endemism were apparently not consistent criteria for listing. Four listed species are globally cosmopolitan and common. Two species are introduced exotics. Only one species of New Guinea marsupial (other than Macropodids) is listed while several species of equal or greater rarity are not mentioned. At least eight listed bird species are ubiquitous and occur in primary and disturbed habitats. However, many species of extremely limited range are not listed. Only two common species endemic to the Bismarck and Admiralty Archipelagos are listed. The list also requires taxonomic updating because the systematic status of many taxa has changed. For example all birds of paradise are listed, but recent work shows several of those listed are not truly birds of paradise. Analyses for this paper will form the basis for a recommendation document to be presented to the Government of Papua New Guinea on the revision of species for the Protected Fauna list.

C22-04 MACNULTY, DANIEL, and Douglas Smith. Department of Ecology, Evolution, and Behavior, University of Minnesota, 1987 Upper Buford Circle, St. Paul, MN 55108, USA (macn0007@umn.edu) (DM); Yellowstone Center for Resources, Box 168, Yellowstone National Park, WY 82190, USA (DS).
WOLF AVERSION TO THE RISK OF PREY-CAUSED INJURY AND ITS IMPLICATIONS FOR REDUCING PREDATION ON LIVESTOCK

Wolf-livestock interactions are usually viewed apart from wolf interactions with wild ungulates. As a result, attempts to reduce wolf predation on livestock tend to ignore the biology underlying the wild analogue. We suggest that knowledge of key factors governing wolf predation on wild ungulates will point to new measures to reduce predation on domestic ungulates. We studied 486 wolf-elk and 75 wolf-bison interactions observed in Yellowstone National Park from 1995 to 2000. These observations show that elk and bison avoided predation if they confronted and physically intimidated wolves. Bison, which are generally larger than elk, confronted wolves more often than did elk. As a result, wolves spent more time watching and less time attacking bison compared to elk and consequently killed bison less frequently (1 kill every 25 interactions) than elk (1 kill every 4 interactions). These results suggest that wolves are averse to the risk of prey-caused injury. Therefore, measures that increase the risk of prey-caused injury in wolf-livestock interactions would likely decrease the probability of predation. This may provide an alternative to wolf removal where wolf-livestock conflict is chronic.

S01-02 MAGNUSON, JOHN J. Center for Limnology, University of Wisconsin–Madison, 680 North Park Street, Madison, WI 53706, USA (jjmagnus@wisc.edu).
CONFRONTING CLIMATE CHANGE IN THE GREAT LAKES REGION: PAST, CURRENT AND FUTURE CLIMATE CHANGE IN THE GREAT LAKES REGION

Confronting climate change is a major issue in conservation biology. The region has been warming over the last 100 years and has been getting wetter while precipitation events have become more intense. Future climate scenarios for the region have been simulated using General Circulation Models driven by possible increases in greenhouse gases. These scenarios are available in the U.S. Global Research Program's *Great Lakes Overview* in 2000 and in the Ecological Society of America and Union of Concerned Scientists' *Confronting Climate Change in the Great Lakes Region* in 2003. By 2090 temperatures are simulated to increase by 2 to 8ºC in summer and 4 to 7ºC in winter. Simulations of changes in precipitation are highly variable in direction and amount. Changes in the frequency of intense rain events are expected to increase based on climate comparisons. Temperature driven increases in evapotranspiration are expected to reduce water availability during the century. Such changes in climate are large and would be important to the biota. Human adaptations to such large changes clearly should include strategies to manage greenhouse gas emissions and storage. This is necessary but not sufficient. Strategies are sorely needed for conservation plans and practice in our changing climate.

C10-03 MAIN, MARTIN. Department of Wildlife Ecology and Conservation, University of Florida, Southwest Florida Research and Education Center, 2686 State Road 29 N, Immokalee, FL 34142-9515, USA (mbma@mail.ifas.ufl.edu).
THE FLORIDA MASTER NATURALIST PROGRAM: A STATEWIDE CONSERVATION EDUCATION EFFORT

The Florida Master Naturalist Program (FMNP) is an adult education program offered by the University of Florida and partner organizations. The mission of the FMNP is to increase awareness, understanding, and respect of Florida's environment among the public. Three independent modules, Freshwater Wetlands, Coastal Systems, and Upland Habitats are planned. Each module includes 40 contact hours of classroom, field, and practical instruction. Trained instructors use FMNP materials (videos, presentations, and workbooks) and requirements (field trips, speaking experience, group final projects) to prepare FMNP graduates to educate others in formal and informal settings. During 9/01-12/02, 27 Freshwater Wetlands courses were completed

graduating 521 FMNP wetlands naturalists. Surveys of graduates (55% return) revealed FMNP graduates provided 12,528 hours of volunteer service, obtained 12 new jobs, 6 promotions, and 24 new volunteer positions. Graduates were motivated to volunteer (91%), monitor their own lifestyle (69%), evaluate political candidates (79%), and take additional FMNP training (93%). Many personal life changes and success stories have been documented. The FMNP continues to grow. During September - December 2002 the Instructor ranks increased to 135 instructors representing 74 environmental education organizations/entities in 37 counties throughout Florida. Both Freshwater Wetlands and Coastal Systems training is being offered during 2003.

C25-07 MAISELS, FIONA, Patrick Boudjan, and Stephen Blake. Wildlife Conservation Society and New York Zoological Society, 2300 Southern Boulevard, Bronx, NY 10460-1099, USA (bomassa@uuplus.com) (FM, PB); Institute of Cell, Animal and Population Biology, University of Edinburgh, King's Buildings, Edinburgh EH9 3JT, UK (FM).
LARGE MAMMAL DISTRIBUTION IN NORTHERN CONGO IN RELATION TO HUMAN ACTIVITIES BEFORE LOGGING

One of the most remote, unroaded forest areas of northern Congo, 5000 km^2 northeast of the Nouabalé-Ndoki National Park, was about to be logged in 2002-2003. A conservation status survey was therefore carried out in the area, and in the northern 1000 square kilometres of the Park during 2001-2002, before logging started, to provide a baseline for future monitoring, especially for elephants. Georeferenced relative abundance data on large mammal and human indices were collected using recce methods (kilometric index). Elephants were found to strongly avoid existing villages, human activities, and a major navigable river by 15-20 kilometres. Using the degree of use of elephant paths as an indicator, elephants were shown to have retreated from human-influenced areas in the last few years. Significant relationships were found between distance outside the National Park boundary and elephant and human indices; and comparison of the areas inside and outside the Park showed that elephant sign was over twice as common inside the Park than outside. In addition, most other large mammal species were significantly more abundant inside the Park than outside. These results underline the importance of large and effective protected areas to wildlife, even in apparently remote sites.

C11-04 MAKI, KRISTINE, and Susan Galatowitsch. Department of Horticultural Science, University of Minnesota, 305 Alderman Hall, 1970 Folwell Avenue, St. Paul, MN 55108, USA (gies0038@umn.edu).
MOVEMENT OF INVASIVE AQUATIC PLANTS INTO MINNESOTA (USA) THROUGH HORTICULTURAL TRADE

The extent to which invasive aquatic plants move via accidental inclusion in aquatic plant orders or sale of prohibited species is unknown. Forty orders were placed to 34 aquatic plant vendors across the U.S. between May and September 2001 to determine the prevalence of movement into Minnesota via horticultural trade. Federal noxious weeds or Minnesota prohibited exotic species were acquired 92% of the time they were ordered and included *Alternanthera sessilis*, *Butomus umbellata*, *Hydrocharis morsus-ranae*, *Potamogeton crispus*, and *Lythrum salicaria*. Ninety-three percent of orders received from aquatic plant vendors contained a plant or animal species not specifically requested; 10% of these purchases contained federal noxious weeds or Minnesota exotic species. *Lemna minor* was the most common incidental receipt found per taxa and per purchase, although *Hydrilla verticillata*, *Lythrum salicaria*, *Salvinia molesta*, and *Potamogeton crispus* (all prohibited taxa) were also found. Misidentified plants were found in 15% of the orders; unordered seeds in 41%. The sale and transport of prohibited aquatic plants likely presents the greatest risk associated with the aquatic plant trade. Other important factors include misidentification leading to the unintentional sale of invasive plants and the incidental inclusion of species during translocation.

C35-04 MÄKI-PETÄYS, HANNALEENA, Lumi Yamamoto, Anatoli Zakharov, and Pekka Pamilo. Department of Biology, University of Oulu, PO Box 3000, FIN-90014 Oulu, Finland (hannaleena.maki-petays@oulu.fi) (HM, LY, PP); Institute of Ecology and Evolution, RUS-117071 Moscow, Russian Federation (AZ).
POPULATION DYNAMICS AND GENETIC STRUCTURE OF THREATENED ANT SPECIES IN FRAGMENTED FOREST LANDSCAPE

The importance of ants in forest ecosystems is widely known. However, in much of their distribution range, locally dominant wood ant species, *Formica lugubris* and *F. aquilonia*, are reported as threatened because of loss of suitable woodland habitat and inappropriate forest management. Mound-building ant colonies are sedentary, which facilitates monitoring the impact of habitat fragmentation in conservation attempts. In this study, 33-year long monitoring shows clearly that habitat fragmentation has large effects in colony structure of *F. lugubris* and *F. aquilonia*. Most of the small isolated nests disappeared soon after fragmentation and the total number of nests decreased. In addition, depopulation of anthills led to isolation of colonies. Microsatellites proved useful for genetically detecting recent changes in spatial population structure, even though the demographic changes were not obvious. Combining our results from demographic monitoring and genetic analyses shows the negative trends, even within short time periods, and habitat fragmentation seems a clear threat in a local scale with large negative effects in ant population viability. We conclude that forest management should pay special attention to the connectedness of threatened ant populations in order to avoid harmful effects.

C21-03 MALE, TIMOTHY. Environmental Defense, 1875 Connecticut Avenue NW, Washington, DC 20009, USA (tmale@environmentaldefense.org).
SETTING RECOVERY PRIORITIES – IMPROVEMENTS FOR A TWENTY-YEAR-OLD PROCESS

In 1983 guidelines, the U.S. Fish and Wildlife Service recognized the need to establish a priority system to guide funding decisions for endangered species recovery. I examined the Service's funding for mammals from 1989-1997 and priority ranks and species status from 1992-2000 to evaluate use of this system. I found that funding allocation did not reflect established priorities nor did funding affect a species' population trajectory. Instead, taxonomy, body size, and anthropocentric conflict were the only variables correlated with funding. Further, evidence suggests that priority ranks have not been assigned appropriately. These conclusions are unfortunate because the stated purpose of the system, to make the most appropriate use of the limited resources available for recovery, is worthwhile. The question remains whether 1) the Service should abandon efforts to apply its biologically sound priority system in favor of decision-making based on non-scientific criteria or whether 2) the existing priority system needs modification to make it more useful to and thus used by the Service? In choosing the latter, I make suggested improvements to the priority system that are easy to implement and recognize both the explicit goal of the ESA in preventing extinctions and its implicit goal of recovering species.

C58-04 MANDELIK, YAEL, Tamar Dayan, and Eran Feitelson. Department of Zoology, Tel-Aviv University, Tel-Aviv 69978, Israel (myael@post.tau.ac.il) (YM, TD); Department of Geography, Hebrew University of Jerusalem, Jerusalem, Israel (EF).
THE ROLE OF ECOLOGICAL IMPACT ASSESSMENT IN PROMOTING BIODIVERSITY CONSERVATION: A CASE STUDY FROM ISRAEL

Environmental Impact Assessment (EIA) is the process of determining the potential environmental consequences of projects, including their implications for biodiversity conservation. Today EIA is the most widely used method in environmental planning and management. In Israel, use of EIA has greatly increased since first implemented in 1982. However, its ability to address ecological impacts of development and promote biodiversity conservation has not been investigated yet. We investigated these issues by reviewing 50 Environmental Impact Statements (EIS) produced since 1995, and their corresponding guidelines, issued by the Ministry of Environment. Baseline data contained landscape descriptions and inventory lists of vascular plants and vertebrates, but lacked any meaningful quantitative data. Most EISs performed new field surveys, but didn't employ scientific methodology and disregarded spatial and temporal variation. Most EISs specified potential ecological impacts, but failed to quantify these effects or evaluate their ecological significance. Only a few addressed cumulative and indirect effects. Most EISs mentioned need for mitigation measures, but concentrated on visual mitigation, leaving the most serious impacts unmitigated. Most of the shortcomings mentioned were apparent in the guidelines issued by the Ministry of Environment. Therefore, ecological guidelines can be a powerful tool in upgrading ecological impact assessment and promoting biodiversity conservation.

P025 MANOLIS, JAMES, George Host, Mark White, Smita Mehta, Howard Hoganson, Malcolm Jones, Lee Frelich, Josh Bixby, Susan Bergman, Thomas Crow, and William Befort. Minnesota Department of Natural Resources / Minnesota Forest Resources Council, 500 Lafayette Road, St. Paul, MN 55155, USA (jim.manolis@dnr.state.mn.us) (JM); Natural Resources Research Institute, University of Minnesota Duluth, 5013 Miller Trunk Highway, Duluth, MN 55811, USA (GH, MW, MJ); Department of Forest Resources, University of Minnesota, 1530 Cleveland Avenue North, St. Paul, MN 55108, USA (SM, LF); Department of Forest Resources, University of Minnesota, North Central Experiment Station, 1861 Highway 169 East, Grand Rapids, MN 55744, USA (HH, JB, SB); USDA Forest Service, North Central Research Station, 1831 Highway 169 East, Grand Rapids, MN 55744, USA (TC); Minnesota Department of Natural Resources, Resource Assessment Unit, 413 Southeast 13th Street, Grand Rapids, MN 55744, USA (WB).
PAST, PRESENT, AND POSSIBLE FUTURE FOREST SPATIAL PATTERNS IN NORTHERN MINNESOTA

Past, present, and possible future forest spatial patterns were examined in a 58,000 km^2 region in northern Minnesota. We assessed pre-European disturbance characteristics on 42 sample blocks (each 37,000 ha) by digitizing line-notes from the 1847-1910 Public Land Survey. We assessed recent historical change on 2,300 ha plots within the line-note blocks, using aerial photos from the 1930s, 1970s, and 1990s. To examine potential future change, we used an ecological model called LANDIS and a spatial management scheduler called DP-Space. Key findings suggest: 1) While we can rapidly alter forest landscapes to generate smaller patches (based on historic analyses), spatial modeling shows that it might take much longer to regenerate large patches. This has strong implications for conservation issues, particularly those related to managing existing large intact patches on the landscape. 2) Simple rules, such as "cut in large blocks" can result in unintended consequences in future spatial patterns. Models can anticipate those consequences and suggest ways to avoid them. 3) There are no "one-size-fits-all" solutions to spatial pattern management. Natural physiographic features and land-use history determine different constraints and opportunities across complex landscapes. Spatial analysis can help determine appropriate management for specific areas and balance different interests.

S06-08 MARANGELO, PAUL. The Nature Conservancy, Michigan Chapter, 101 East Grand River Avenue, Lansing, MI 48906, USA (pmarangelo@tnc.org).
THE NATURE CONSERVANCY'S APPROACH TO AQUATIC BIODIVERSITY CONSERVATION IN MICHIGAN

Part of the Michigan Chapter of The Nature Conservancy's mission is to facilitate the conservation of biological communities in 81 aquatic conservation sites – a large number that presents strategic challenges to achieving this objective. In the past two years, we have employed a variety of approaches on a subset of sites with various levels of institutional resource commitment to work towards achieving our aquatic objectives with partner organizations. Examples of approaches include securing funds for to hire staff within partner organizations to work on implementation of jointly generated river conservation plans; expanding TNC staff capacity to focus on a high priority agricultural river and apply resulting strategies to all agricultural rivers; working with academic, non-profit, and state agencies on a river assessment with the goal of creating a pilot project to demonstrate the feasibility of incorporating ecosystem-based assessment criteria into state agency surface water assessment methodology; and contracting a small local non-profit to conduct a watershed assessment in a forested Upper Peninsula watershed. These projects have not yet matured to the point where they have yielded measurable conservation results, but do demonstrate a certain level of programmatic success that will guide our future approaches to aquatic conservation.

C01-02 MARCHETTI, MICHAEL P., and Peter Moyle. Department of Biology, California State University Chico, Chico, CA 95929, USA (mmarchetti@csuchico.edu) (MPM); Department of Wildlife, Fish, and Conservation Biology, University of California Davis, Davis, CA 95616, USA (PM).
HOMOGENIZATION OF THE FISH OF CALIFORNIA: SCALE DEPENDANCE AND FUTURE TRENDS

The decline of native fish populations and the invasion of non-native fishes are the two most notable trends in California's fish fauna over the last century. It has been suggested that interactions between these two forces can lead to the homogenization of a regional fauna. Here we examine evidence for biotic homogenization in the freshwater fishes of California at three spatial scales: zoogeographic provinces, watersheds, and individual stream reaches. In addition we examine relationships between watershed-scale environmental variables and a measure of homogenization. Our analyses suggests that homogenization is evident in California's fishes, is likely a scale dependant phenomena, and will likely increase in the future. In addition we find evidence that homogenized faunas are associated with watershed-level forces of human disturbance (water development and urban growth).

P071 MARET, TIMOTHY J., and Tracey Librandi. Department of Biology, Shippensburg University, Shippensburg, PA 17257, USA (tjmare@ship.edu).
HABITAT USE AND MOVEMENTS OF SPOTTED TURTLES, *CLEMMYS GUTTATA*, IN A HEAVILY MANAGED FOREST AREA

Populations of spotted turtles (*Clemmys guttata*) have declined in recent years throughout the northeastern United States and Canada, leading the IUCN to add them to the Red List of Threatened Species. Preservation of this species requires protecting sufficient habitat to support viable populations, which demands a thorough understanding of habitat requirements of this species. Movements of seven spotted turtles were determined using radio telemetry from spring through fall 2002 in a heavily managed state forest in Pennsylvania. The study area has an extensive history of timber harvest and is composed of patches of both intact forest and clearcut habitat. Spotted turtles were found primarily in and around a complex of vernal ponds that dried by late summer. Movements among ponds were common in the spring but declined during the summer. During late summer, turtles moved onto land to aestivate. Turtles showed no preference for forested habitats, often aestivating in clearcuts beyond the 30 m no-cut zone around ponds prescribed by the Pennsylvania Bureau of Forestry. All seven turtles returned to a single pond to hibernate in late fall. Based on these findings, we recommend several measures be taken to preserve important habitat and reduce turtle mortality during timber harvest activities.

S05-02 MARINI, MIGUEL. Departamento de Zoologia, IB, Universidade de Brasilia, Brasilia, DF, 70910-900, Brazil (marini@unb.br).
EDUCATION IN CONSERVATION BIOLOGY IN LATIN AMERICA AND THE CARIBBEAN

As one of the objectives of the ANA-Section of the SCB, I conducted a survey among Latin America and Caribbean universities to gather baseline data on current status of education in conservation biology. A preliminary survey among 47 universities from 12 countries has yielded the following results. Of the schools represented 72% teach at least one course in conservation biology, 79% of which require prerequisites, 76% have field classes, but only four had a degree in conservation biology. Based on the most important concepts taught, a mean course in the region teaches: 1) General aspects of conservation biology, 2) Biodiversity, 3) Fragmentation, island biogeography and metapopulations, 4) Concepts in ecology and evolution, 5) Extinction, 6) Threats and human impacts, 7) Sustainable development and use of biodiversity, and 8) Management and solutions. A more detailed course would include: 9) Genetics, 10) PVA, 11) Landscape ecology, 12) Field techniques, and 13) Emphasis on regional aspects or

other specific topics. Most courses were taught through theoretical classes, field practices and readings of scientific papers. Other important methods include discussion and debates and oral presentations by the students. Courses varied considerably in topics covered but had similar teaching methods. The final results of this survey will help future education policies through Latin America and the Caribbean.

C52-06 MARINI, MIGUEL, Romulo Ribon, and Renata Andrade. Departamento de Zoologia, IB, Universidade de Brasilia, Brasilia, DF, 70910-900, Brazil (marini@unb.br) (MM); Pos-graduacao em Ecologia, Conservacao e Manejo de Vida Silvestre, Universidade Federal de Minas Gerais, Belo Horizonte, MG, 30161-970, Brazil (RR, RA).
DO WE NEED CORRIDORS TO ENHANCE BIRD MOVEMENT BETWEEN FOREST FRAGMENTS?

Corridors have been suggested as a management solution to increase movement of animals between forest fragments in spite of little field data supporting its use. Here, I present data of three studies conducted in the Cerrado and in the Atlantic Forest of Brazil. First, a study with ~1600 color-banded birds revealed that 25 (48 %) out of 52 forest dependent species were able to use or disperse across open areas of at least 150 m of grasslands. Birds dispersed up to 2100 m between forest fragments separated by as much as 650 m of grasslands. Second, a study with 554 color-banded birds revealed that 20 forest-dependent species occurred in small (< 1 ha) natural forest patches immersed on a grassland matrix. Most movements between forests occurred between patches connected by corridors, but several birds crossed open areas as wide as 900 m. Third, a point count study revealed that of 11 antbirds, all occurred in forest fragments isolated 100 m from other fragments, but that 6 species occurred in fragments isolated 400 m. These studies show that many Neotropical birds are able to cross through the matrix, and that habitat management with stepping stones could substitute the use of corridors.

P018 MARKS, DAVID R. Department of Natural and Applied Sciences, University of Wisconsin–Green Bay, 2420 Nicolet Avenue, Green Bay, WI 54311, USA (marksd@uwgb.edu).
LOCAL HABITAT AND LANDSCAPE EFFECTS ON THE AVIFAUNA WITHIN COASTAL WETLANDS OF THE WESTERN GREAT LAKES REGION

Although the relationships of birds to local habitat and larger-scale landscape variables have been the focus of many studies, surprisingly few investigations have focused on wetland systems, especially coastal wetlands. These wetlands are of particular concern because of the high degree of anthropogenic stress associated with coastal urbanization and residential development. Coastal ecosystems are highly dynamic in nature and the relationship between habitat and species distribution are often confounded by temporal change. I have studied the avifauna within 63 coastal wetlands of the western Great Lakes region along Lake Michigan and Lake Huron during 2001 and 2002. Local habitat and landscape variables at these sites were quantified and associated with presence/absence of individual bird species. The local habitat variables were sampled by a releve sampling method and landscape variables were analyzed using 7-band LandSat Thematic Mapper satellite images. Results identify the most influential predictors for several key species of wetland birds. I also will discuss the effectiveness of these methods for describing the ecological condition of coastal wetland birds and for long-term monitoring of wetland bird populations.

S15-05 MARNANE, MICHAEL, Joshua Cinner, Tracy Clark, William Kiene, and Tim McClanahan. Wildlife Conservation Society, Asia Pacific Coral Reef Program, TESAG Department, James Cook University, Townsville, QLD 4810, Australia (jcinner@wcs.org) (MM, JC, TC); Wildlife Conservation Society, Indonesia Program, Jl. Pangrango #8, Bogor, Indonesia (WK); Wildlife Conservation Society, Coral Reef Conservation Project, Kibaki Flats #12, Bamburi, Kenyatta Beach, PO Box 99470, Mombasa, Kenya (TM).
CONSERVATION BENEFITS OF TRADITIONAL CORAL REEF MANAGEMENT: A CASE STUDY FROM AHUS ISLAND, MANUS PROVINCE, PAPUA NEW GUINEA

There is increasing debate as to whether traditional resource management practices by local communities in the Pacific Basin help conserve coastal and marine ecosystems. Previous studies in this area have been largely conflicting and inconclusive. This study explored the conservation benefits associated with traditional reef management practices at Ahus Island, off the north coast of Manus Island, Papua New Guinea. For generations, Ahus Islanders have prohibited spear and net fishing within six small reef areas. However, each of the restricted areas may be harvested with spears and nets to provide fish for a ceremonial occasion up to three times per year. Fish and coral communities were examined inside and outside a restricted area before and after a periodic harvesting event. Although the harvesting techniques caused some damage to corals, results indicate that the system was effective in increasing reef fish biomass inside the reserve. When compared to other management regimes in Papua New Guinea, this system did not meet as many conservation goals, but was able to fulfill utilitarian community goals with minimal social and spatial displacement of fishing effort.

C07-06 MARR, AMY. Centre for Applied Conservation Research, University of British Columbia, 2424 Main Mall, Vancouver, BC V6T 1Z4, Canada (amarr@interchange.ubc.ca).
TURNOVER OF FOUNDER AND IMMIGRANT GENES IN A WILD POPULATION OF SONG SPARROWS

Conservation biologists are interested in understanding the role of inbreeding and outbreeding in natural systems because they often plan to manage extinction risk by facilitating dispersal among habitat reserves. According to theory of population genetics, hybrid offspring produced by parents from different subpopulations should share fewer deleterious mutations than offspring produced by parents from the same subpopulation. This may result in heterosis, a phenomenon of increased vigour in hybrid offspring. Heterosis should allow the alleles of immigrants to inbred populations to spread more quickly than predicted from neutral expectations. However, it is also possible that a loss of local adaptation or genetic incompatibilities could impede the spread of immigrant alleles. I describe the natural pattern of spread and extinction of founder and immigrant genes in a wild population of song sparrows. My analysis involves 22 years of data on more than 700 adults for which inbreeding coefficients are known, all breeding attempts have been recorded, and all offspring have been color-banded. My results show that efforts to assess how much gene flow results from immigration may be misleading without monitoring performance of immigrants and their descendants over several generations. I conclude with suggestions of research ideas for those monitoring the success of dispersal corridors and translocation programs.

C48-09 MARTIEN, KAREN K., Paul Wade, and Barbara L. Taylor. Southwest Fisheries Science Center, 8604 La Jolla Shores Drive, La Jolla, CA 92037, USA (Karen.Martien@noaa.gov) (KKM, BLT); National Marine Mammal Laboratory, 7600 Sandy Point Way NE, Seattle, WA 98115, USA (PW).
AIC AND BIC AS MEANS OF CHOOSING BETWEEN HYPOTHESIZED POPULATION STRUCTURES

Population structure hypotheses have traditionally been tested using hypothesis-testing methods in which a hypothesized structure is compared to the null hypothesis of panmixia. Such an approach is problematic due to the low statistical power often associated with these tests. We present a new approach to investigating population structure in which the problem is recast as one of model choice. We use either the Akaike Information Criterion (AIC) or the Bayesian Information Criterion (BIC) to choose between population structure models. The models being compared can differ in both the number of populations they contain and the location of population boundaries. We test both methods using simulated data and compare their performance to that of the most powerful hypothesis testing method available, the chi^2 permutation test. We find that the relative performance of AIC and BIC depends on the degree of genetic differentiation between the populations being compared, with BIC excelling at the low levels of gene flow typical of Evolutionarily Significant Units and AIC performing best at the higher movement rates typical of management units. Both methods have an advantage of the chi^2 permutation test in that they allow a direct comparison between competing hypotheses rather than simply comparing each hypothesis to panmixia.

C18-06 MARTIN, DANIEL J., John D. Erb, Brock R. McMillan, and Tom A. Gorman. Department of Biological Sciences, Minnesota State University, Mankato, 242 Trafton Science Center S, Mankato, MN 56001, USA (danny.martin@dnr.state.mn.us) (DJM, BRM, TAG); Minnesota Department of Natural Resources, 1201 East Highway 2, Grand Rapids, MN 55744, USA (JDE).
AERIAL SNOW-TRACK SURVEYS FOR INDEXING POPULATIONS OF RIVER OTTER (*LONTRA CANADENSIS*): TESTING FOR OBSERVER BIAS

The ability of wildlife agencies to detect trends in populations of river otter (*Lontra canadensis*) is vital for management and conservation of the species. Methods for monitoring trends in populations of river otter have historically focused on harvest data or latrine surveys. However, researchers recently have suggested that indices based on those methods are likely inaccurate due to compounding economic and ecological effects and behavioral variability. We proposed the development of aerial snow-track survey methodology to assess populations of river otters because this method has been successfully used to monitor populations of other furbearer species. Additionally, aerial snow-track surveys allow the coverage of large areas in a short amount of time relative to alternative methods. However, a key assumption for snow-track surveys to be comparable through time is that variation in abilities of detecting river otter sign among observers must be small. We examined variation of detection of river otter sign among observers conducting aerial snow-track surveys to determine the feasibility of this method. Preliminary results suggest that variation among observers is small and further development of this index is warranted.

C29-02 MARTY, BECKY, Sara L. Webb, and Paul S. Conklin. Minnesota Department of Natural Resources, Itasca State Park, 36750 Main Park Drive, Park Rapids, MN 56470, USA (becky.marty@dnr.state.mn.us) (BM); Department of Biology, Drew University, Madison, NJ 07940, USA (SLW); 2048 Agate Lane NW, Solway, MN 56678, USA (PSC).
CONSERVATION OF OLD GROWTH PINE FORESTS: EFFECTS OF PRESCRIBED FIRE AND WINDSTORMS

Prescribed burns have been introduced at Minnesota's Itasca State Park whose 12,950 forested hectares include over 2800 ha of old growth *Pinus resinosa* and *Pinus strobus* forests of fire origin. Decades of fire suppression promoted a dense understory of tall

shrubs and, in patches, saplings of *Acer* spp. and *Abies balsamea*. To conserve and maintain these ancient pine forests, we treated portions of the park with management burns beginning in 1995. A network of 30 permanent vegetation plots established in 1965, and sampled six times since then, provides insight into fire consequences, with plots arrayed across burned, blowdown and control (undisturbed) areas. Results show that fire, as implemented in this project, did not damage ancient pines and did not change plant species richness. Fire did significantly thin out tall shrubs and understory saplings of *Acer* and *Abies*, increasing the potential for pine regeneration. Windstorms had very different consequences: imposing heavy mortality to the oldest pines, promoting heavier understory growth, and decreasing forb species richness in sites where maples dominated the pre-storm understory. We conclude that prescribed burns are promoting a trajectory of change that will support pine conservation and regeneration, while windstorms are shifting the forest away from pines.

C38-03 MASCHINSKI, JOYCE. Fairchild Tropical Garden, 11935 Old Cutler Road, Miami, FL 33156, USA (jmaschinski@fairchildgarden.org).
LESSONS FROM REINTRODUCTIONS OF ENDANGERED PLANTS AND SUGGESTIONS FOR IMPROVING PROTOCOLS TO ASSESS SUCCESS

In response to habitat destruction, population decline, or extreme rarity, reintroduction is often one of the strategies suggested for the conservation of rare species. Yet conventional methods of assessment have led many to conclude that reintroductions are impractical and unsuccessful. Reintroductions of 7 rare plant species in Arizona and Florida over the past 10 years exemplify several lessons: 1) It takes a long time to assess success. Climatic conditions often can abruptly change the survival of reintroduced plants. 2) Measuring variation across microsites can expand our general knowledge of the biology of the rare species and can help quantify factors likely to improve the success of future reintroductions. 3) Using demographic and genetic measures of the wild population to compare with the reintroduced population is an objective method to quantify success and is ultimately the most important measure of the conservation status of a rare species. For example, seedling survival of wild *Purshia subintegra* was 2% after 3 years, whereas seedlings from reintroduced seeds experienced up to 25% survival depending upon microsite. Incorporating demographic and genetics components into a long-term (10 yr) post-reintroduction monitoring program can increase the probability of success and can aid in the conservation of rare species.

S12-05 MASCIA, MICHAEL B. AAAS Fellow, U.S. Environmental Protection Agency, 223 Constitution Avenue NE, Washington, DC 20002, USA (mbm4@duke.edu).
FISH, FOWL, OR FOREST: DOES IT MATTER FOR CONSERVATION POLICY?

A review of the social factors that influence the performance of conservation policies reveals strong consistencies across terrestrial and marine systems. Participatory decision-making arrangements, clear resource use rights, active and accountable monitoring and enforcement systems, and readily accessible conflict resolution mechanisms each foster conservation success. The more specific policies and practices necessary to conserve biodiversity vary not by whether the focal system is terrestrial or marine, but in accordance with its biological and social attributes (e.g., population growth rate, legal structure). Significant opportunities remain for additional conservation research – across both terrestrial and marine systems – to identify best practices that foster success. Integrating this knowledge into conservation efforts, however, will generally be a greater challenge in terrestrial systems because of the organizational and institutional inertia that is associated with longstanding terrestrial conservation laws and practices.

C16-05 MASHAURI, SHEDRACK. East Usambara Conservation Area Management Programme, PO Box 5869, Tanga, Tanzania (shedrack@popmail.com).
REDUCING CONFLICTS BETWEEN LOCAL COMMUNITIES AND CONSERVATION OF BIODIVERSITY IN A TANZANIAN 'BIODIVERSITY HOTSPOT'

We address how ecotourism, researchers, and student-based environmental programs can harmonize conflicts between local communities and biodiversity conservation in Amani Nature Reserve, Tanzania. Approximately 50,0000 people benefit from the forest and land near the reserve. Because the local population has increased at 2.8% per annum, land tenure has become a serious issue, particularly for public and protected forests. Through interviews with local community members, we identified that health care, schools, and other forms of village development were essential needs. Currently, people are pessimistic about the goals of the reserve, largely because incorporation of their communities into the reserve's program is still underdeveloped. Our interviews showed that 93% of 200 local people rejected the release of their forested land for conservation just for the purpose of global environmental interests. However, 75% of interviewees wanted to jointly work with private sectors in managing their land for ecotourism purposes with a legal agreement to protect their benefits. Because ecotourism, researchers, and educational programs contribute economically and training-wise to local communities, we plan to integrate these economic and educational means more effectively with local community needs. Our research has shown a new direction in reducing conflicts between and among major stakeholders in conservation.

C33-09 MASONJONES, HEATHER, and Brooke Babson. Department of Biology, University of Tampa, 401 West Kennedy Boulevard, Tampa, FL 33606, USA (hmasonjones@ut.edu) (HM); Johns Hopkins University, Baltimore, MD 21218, USA (BB).
REPRODUCTION AND GROWTH IN A STRESSFUL ENVIRONMENT: THE EFFECTS OF MECHANICAL NOISE ON THE REPRODUCTIVE SUCCESS OF DWARF SEAHORSES (*HIPPOCAMPUS ZOSTERAE*)

Substantial evidence exists supporting the deleterious effects of low frequency, moderate intensity noise on marine mammals, but few studies have focused on the effects of this stimulus on other marine organisms. Dwarf seahorses (*Hippocampus zosterae*) were used as a model system to determine the effects of low frequency boat motor noise on their health, behavior, and reproductive success. Sound levels (ranging from 70-110dB and 60-600 Hz) were obtained from a library of coastal boat recordings and were manipulated by providing continuous noise, intermittent noise, and quiet treatments. Pairs were monitored through 3 reproductive cycles and offspring were followed for 10 weeks after birth. Adults in noise conditions showed a significantly higher incidence of gas bladder disease, behavioral differences, and had significantly longer gestation lengths than controls. Fewer offspring were born to continuous noise parents in addition to being smaller and having lower growth rates than control offspring. These results suggest a strong effect of low frequency noise on both adult and juvenile *H. zosterae*, indicating that this stressor may influence reproduction both in field populations and potentially in captive breeding programs. Future work will focus on the mechanics of this stress response and determine its importance in the field.

C15-05 MASOZERA, MICHEL, and Janaki Alavalapati. Wildlife Conservation Society, PO Box 1699, Kigali, Rwanda (mmasozera@wcs.org) (MM); School of Forest Resources and Conservation, Institute of Food and Agricultural Sciences, University of Florida, PO Box 110410, Gainesville, FL 32611-0410, USA (JA).
FOREST DEPENDENCY AND ITS IMPLICATION FOR THE MANAGEMENT OF THE BUFFER ZONE PLANTATIONS AROUND THE NYUNGWE FOREST RESERVE, RWANDA

Conservation of biodiversity in protected forest areas has become complex and challenging because of higher dependency of population on natural resources for agricultural, energy, nutritional, medicinal, and other needs. This study identifies the socioeconomic factors determining forest dependency of communities around the Nyungwe Forest Reserve (NFR) and its implication for the management of the buffer zone plantations around the NFR. This paper develops a forest dependency model for the Nyungwe forest Reserve in S.W. Rwanda. Data were collected from five peripheral villages around the Nyungwe Forest Reserve applying stratified random sampling procedures. The results show that agricultural income, household age, access to outside market, and household size are major determinants of forest dependency. Therefore, the paper suggests that buffer zones could play a major role in protecting the NFR if they are designed to provide economic benefits to local communities.

P067 MASTER, LARRY, Arlene Olivero, Pilar Hernandez, and Mark Anderson. NatureServe, 11 Avenue de Lafayette, 5th Floor, Boston, MA 02111, USA (larry_master@natureserve.org) (LM); The Nature Conservancy, Northeast Division Conservation Support Services, 11 Avenue de Lafayette, 5th Floor, Boston, MA 02111, USA (AO, MA); Department of Zoology, University of Toronto, 25 Harbord Street, Toronto, ON M5S 3G5, Canada (PH).
USING SMALL WATERSHED FISH, MUSSEL, AND CRAYFISH HISTORICAL AND CURRENT PRESENCE DATA TO DESCRIBE AQUATIC BIOGEOGRAPHY AND INFORM ITS CONSERVATION

Freshwater species are disproportionately at risk in the United States, which is a recognized hotspot for global freshwater biodiversity. The conservation of these species and the freshwater systems they inhabit depends on knowledge of the factors that underlie their patterns of distribution and rarity. Using a geographic information system we assigned all native freshwater fish species and all at risk (Heritage ranked G1-G3) mussels and crayfishes as currently or historically-only present by 8-digit Hydrologic Unit within the conterminous United States. State and regional experts reviewed the data to refine the small-watershed distribution for these species. TWINSPAN classification was then used on the multivariate dataset to break watersheds into successive hierarchical groups to investigate patterns in aquatic species distribution, diversity, and rarity within and between these taxonomic groups. The relative influences of hydrologic connections vs. other factors were compared against the classification using ordination and gradient analysis, and classification was also compared with existing ecoregional and zoogeographical classifications. Initial TWINSPAN breaks were explained by major drainage divisions with subsequent divisions influenced by climate, elevation, landform, geology, and drainage position. Patterns of species richness, species imperilment, and faunal intactness varied regionally and within and between drainages.

P065 MATTINGLY, HAYDEN, and David Galat. Department of Biology, Box 5063, Tennessee Technological University, Cookeville, TN 38501, USA (hmattingly@tntech.edu) (HM); U.S. Geological Survey, Missouri Cooperative Fish and Wildlife Research Unit, 302 ABNR Building, University of Missouri–Columbia, Columbia, MO 65211-7240, USA (DG).
PREDICTIVE PERFORMANCE OF A MICROHABITAT MODEL FOR A RARE OZARK STREAM FISH

The Niangua darter, *Etheostoma nianguae*, is a threatened stream fish endemic to the Osage River basin in southcentral Missouri, USA. Knowledge of Niangua darter habitat relationships has been identified as an important component of recovery. We assessed the predictive performance of a previously developed summer microhabitat model for this species. The original model was developed through multiple logistic regression, with water depth and mean substrate particle size serving as predictors of darter presence or absence. New data were collected in Little Niangua River and Maries River at microhabitats occupied (n = 16) and unoccupied (n = 72) by the darter. About one in four microhabitats was misclassified by the model and values of Cohen's kappa did not exceed 0.40, indicating that the model's performance could only be rated as fair. However, suitable microhabitats may be unsaturated due to low Niangua darter densities in the streams, which generally confounds model assessment for rare species.

C52-02 MATTSON, KIMBERLY M., and Paul L. Angermeier. Department of Fisheries and Wildlife Sciences, Virginia Tech, Blacksburg, VA 24061-0321, USA (mattsonh@vt.edu) (KMM); U.S. Geological Survey, Virginia Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife Sciences, Virginia Tech, Blacksburg, VA 24061-0321, USA (PLA).
THREAT ASSESSMENT IN CONSERVATION PLANNING: TRANSFERRING APPROACHES FROM TERRESTRIAL TO AQUATIC SYSTEMS

Cost-effective conservation of freshwater systems requires planning at large spatial scales, watershed-level frameworks, and recognition of factors that threaten biodiversity. We present findings from a meta-analysis of protocols used to assess threats to aquatic biota. Assessment protocols that integrate multiple threats are poorly developed and often based on obscure definitions. Most use qualitative rankings to estimate magnitudes of threats to system health. We found that GIS techniques are essential for performing watershed-level assessments, but the quality of available spatially explicit data varies greatly. Threat assessment methodologies for terrestrial systems cannot be directly applied to aquatic systems, so new multidisciplinary approaches are required for effective mapping and prediction. We are developing a new protocol to meet these challenges in an aquatic gap analysis of the Upper Tennessee River basin (UTRB), USA. Biota in the UTRB are highly imperiled and their major threats include agriculture, urbanization, mining, timber harvesting, roads, highway spills, effluents, and impoundments. Our protocol is focused on refining existing system modeling schemes for use within a watershed framework. Preliminary findings identified historical land use as an important underlying factor in threat assessment and determined that designation of conservation priority areas is usually conducted without knowledge of land use planning.

C57-02 MCDONALD, ROBERT, and Dean Urban. Nicholas School of the Environment and Earth Sciences, Duke University, Durham, NC 27708-0328, USA (robert.mcdonald@duke.edu).
EFFECTS OF FOREST EDGES ON WOODY PLANT COMPOSITION IN THE NORTH CAROLINA PIEDMONT: A LANDSCAPE APPROACH

Forest edges have been shown to have profound effects on abiotic and biotic conditions near the forest edge, altering the light, nutrient, and moisture regimes substantially. We conducted a study of more than 60 forest edges in the North Carolina Piedmont to determine how forest edges affect forest composition, regeneration, and the spread of woody exotic species. All stems, from seedlings to canopy dominants, were measured in a transect at each site, along with set of environmental and edaphic variables. All plots were located in a GIS system, and land cover data classified from a time-series of Thematic Mapper images were used to assess the age of each edge and its connectivity to other plots. Forest edges have significant effects on forest composition in all strata of the forest, with forest composition being most strongly affected in the forest understory and near older edges. In particular, woody exotic species abundance was elevated within 10 meters of an edge, particularly along road corridors and power line cuts. Effects were extrapolated to the landscape scale using land cover data, allowing for rough estimates of the importance of edge effects at different places in the Raleigh-Durham metropolitan area.

C52-05 MCKEEFRY, JASON F., and David J. Mladenoff. Department of Forest Ecology and Management, University of Wisconsin–Madison, 120 Russell Labs, 1630 Linden Drive, Madison, WI 53706, USA (jfmckeefry@wisc.edu).
RELATIONSHIPS BETWEEN WHITE-TAILED DEER ABUNDANCE, FOREST LANDCOVER, AND EDGE IN WISCONSIN LANDSCAPES

As regional deer management programs strive to limit problems from overabundant deer populations, fundamental understanding of broad-scale relationships between landscape structure and deer abundance will be required. To better understand broad-scale factors influencing deer abundance we analyzed existing spatial data on landscape structure and deer populations across the state of Wisconsin (USA). Specifically, we tested the hypothesis that deer abundance was positively related to the area of forest and edge in landscapes. We also examined several landscape metrics for their ability to contribute to modeling deer abundance in Wisconsin landscapes. The simplest and best models of deer abundance indicated that deer abundance was positively related to the area of landscapes in forest. Furthermore, for a given area of forest, the amount of edge had a positive effect on deer

abundance in northern Wisconsin, and when the entire state was analyzed. Forest land cover was more limiting to deer in southern Wisconsin. Landscape diversity (Shannon-Weaver) was similar to edge as a predictor variable in several models. These results support Leopold's original concept of edge effects, as well as the fragmentation-nutrition hypothesis.

P090 MCMILLAN, AMY, Mark Bagley, Diane Nacci, and Suzanne Christ. Biology Department, Buffalo State College, Buffalo, NY 14222, USA (mcmillam@buffalostate.edu) (AM); U.S. Environmental Protection Agency, National Effects Research Laboratory, Cincinnati, OH 45215, USA (MB, SC); U.S. Environmental Protection Agency, National Health and Environmental Effects Research Laboratory, Narragansett, RI 02882, USA (DN).

NO REDUCTION IN GENETIC DIVERSITY DESPITE RAPID ADAPTATION TO PCB POLLUTION: IMPLICATIONS FOR CONSERVATION OF LARGE ESTUARINE POPULATIONS

Anthropogenic stressors can have negative fitness impacts on populations by reducing population size through direct mortality or reduced reproduction. Evolutionary consequences of pollutants are inevitable if genetic diversity and structure is changed as a result of these impacts. We evaluated the genetic structure and diversity of *Fundulus heteroclitus*, a non-migratory fish found in abundance in estuaries along the east coast of the U.S., including a PCB-contaminated Superfund site in New Bedford Harbor (NBH), MA. Laboratory challenge experiments showed *F. heteroclitus* from NBH are adapted to high PCB levels while fish from uncontaminated sites are not. These results suggest that strong divergence has occurred in response to recent anthropogenic changes and has been maintained among populations with potentially high gene flow. We used AFLP analysis to determine whether genetic variability of tolerant *F. heteroclitus* populations in NBH is reduced relative to populations residing in less contaminated sites and to estimate the degree of genetic differentiation between populations with different sensitivities to PCBs. *F. heteroclitus* populations were differentiated at local scales but genetic diversity was not reduced in PCB adapted populations. Demographic factors, including large population sizes and high fecundity rates, appear to be the primary causes for these results.

C38-01 MCPHEE, M. ELSBETH, and Emily D. Silverman. School of Natural Resources and Environment, University of Michigan, 430 East University, Ann Arbor, MI 48109-1115, USA (mmcphee@umich.edu).

CALCULATION OF RELEASE NUMBERS FOR REINTRODUCTION PROGRAMS I: CONSIDERING INCREASED VARIATION IN NORMALLY DISTRIBUTED TRAITS

Long-term maintenance of captive populations, and release of captive animals into the wild, is one of many approaches to endangered species conservation. To assess captivity's effects on behavior, a simulated predator was presented and response behaviors measured in oldfield mice *Peromyscus polionotus subgriseus*. The animals tested were from four populations collected from Ocala National Forest, FL, that had been held in captivity for varying number of generations: 35, 14, 2, and 0 (wild-caught). Results show that the variance in predator response behaviors increases with generations in captivity. High behavioral variation in captive-bred animals can translate into decreased survivorship upon reintroduction to native habitats. We developed a series of calculations to determine "release ratio," the number of captive-bred animals needed to ensure that a certain number of individuals are within targeted behavioral bounds. In this talk, we present an example of release ratio calculation for normally distributed trait variables. We also present general results illustrating the functional relationship between release numbers, increased variation, and change in average behavior.

C09-07 MEHTA, SMITA, Lee Frelich, and Malcolm Jones. Department of Forest Resources, University of Minnesota, 115 Green Hall, 1530 Cleveland Avenue North, St. Paul, MN 55108, USA (meht0022@tc.umn.edu) (SM, LF); Natural Resources Research Institute, University of Minnesota Duluth, 5013 Miller Trunk Highway, Duluth, MN 55811, USA (MJ).

EXAMINING SPATIAL IMPACTS OF DIFFERENT HARVEST AND MANAGEMENT SCENARIOS USING LANDIS, AN ECOLOGICAL LANDSCAPE MODEL

Spatial modeling of forest patterns can provide information on the potential impact of various management strategies. We used LANDIS, a stochastic, spatially explicit, landscape model to simulate 120 years of forest change on the Nashwauk Uplands ecological subsection in northeastern Minnesota. We ran several forest management scenarios including current harvesting practices, no harvests, varied rotation ages, varied clearcut sizes, varied clearcut proportions, and landowner coordination. Our results show that the relative proportions of covertypes do not vary between scenarios. All scenarios reveal an increase in the spruce-fir covertype. Our results also show that most covertypes maintain mean patch sizes < 4ha across scenarios. The smallness of the patches and the lack of difference between scenarios are likely due to the highly varied physiography and historical landuse patterns on the landscape. Aspen/birch patches are larger in the no harvests scenario than the other scenarios. This suggests that harvests fragment the large aspen/birch patches created by fires. The characteristics and landuse history of the landscape constrains the viability of a large patch management strategy. The lack of significant differences in resulting spatial patterns among scenarios suggests that varying management strategies will have little effect on the landscape over the next 120 years.

S11-01 MEINE, CURT, James T. Harris, and Wellington Huffaker. Wisconsin Academy of Sciences, Arts and Letters, 1922 University Avenue, Madison, WI 53726, USA (curt@savingcranes.org) (CM); International Crane Foundation, E-11376 Shady Lane Road, PO Box 447, Baraboo, WI 53913, USA (JH); Aldo Leopold Foundation, PO Box 77, Baraboo, WI 53913, USA (WH).
CRANES, COMMUNITIES, AND CONSERVATION BIOLOGY: CONNECTIONS IN TIME AND SPACE

The engagement of local communities is fundamental to conservation efforts throughout the world. The world's fifteen crane species illustrate this principle particularly well. Cranes serve as catalysts, stimulating efforts to protect and restore the biological diversity and ecological functions of the ecosystems upon which they depend. Cranes are primarily wetland species, flourishing at the interface of aquatic and terrestrial communities. Their survival requires the adoption of ecosystem and landscape approaches to conservation. Cranes also co-exist with diverse human cultures, amid complex and constantly changing socio-economic conditions. The processes involved in conserving cranes, their natural habitats, and the human communities unfold only slowly. For all these reasons, the successful involvement of local communities is essential to – and a critical predictor of – long-term success in crane and wetland conservation programs. As experimenters and learners, we need to demonstrate sustained commitment to the people and resources we work with, and to the nurturing of outcomes. The symposium presentations that follow examine community-based conservation projects in Asia, Africa, and North America. Though varied in their landscapes and cultural contexts, these case studies suggest common themes for success, and serve as examples of Aldo Leopold's conservation ethic in practice.

C09-04 MENARD, SHANNON, Kelly Kindscher, and Dana Peterson. NatureServe, 1313 5th Street SE, Suite 314, Minneapolis, MN 55414, USA (shannon_menard@natureserve.org) (SM); Kansas Biological Survey, University of Kansas, 2021 Constant Avenue, Lawrence, KS 66047, USA (KK); Kansas Applied Remote Sensing Program, 2291 Irving Hill Road, Lawrence, KS 66045, USA (DP).
ECOLOGICAL SYSTEMS AS LAND COVER MAP UNITS FOR THE GAP ANALYSIS PROGRAM IN KANSAS

Using groups of U.S. National Vegetation Classification (USNVC) associations/alliances (ecological systems) that co-occur as a result of similar ecological dynamics, underlying environmental features, and/or environmental gradients may significantly improve the accuracy of USGS-GAP maps of existing vegetation. Many GAP programs have developed map units at varying, non-standard levels or have not reached the required 80% accuracy for an alliance map. Sixteen upland and wetland ecological systems developed for the Great Plains were used to re-aggregate the original Kansas GAP Vegetation Map. Accuracy levels of the ecological systems landcover map were calculated by comparing the classified data with 828 field or reference sites collected in 2000. Accuracy assessment analyses comparing the two methods indicated ecological systems had higher accuracy values and outperformed alliances overall. Within individual classes, using ecological systems resulted in a maximum increase in accuracy of greater than 70% for floodplain classes, and greater than 50% for specific upland classes. These results indicate that directly mapping ecological systems could further increase the accuracy of GAP vegetation maps and regionalize them such that they could be more easily used for habitat modeling. Ecological systems present a viable alternative to develop accurate vegetation units while maintaining the USNVC standard.

C13-03 MEREDITH, CHRISTY, and Howard Whiteman. Department of Biological Sciences and Hancock Biological Station, Murray State University, Murray, KY 42071, USA (christymeredith@yahoo.com).
RESPONSE OF AMPHIBIAN EMBRYOS AND LARVAE TO INCREASING NITRATE CONCENTRATIONS: SUBLETHAL AND LETHAL EFFECTS AT LEVELS FOUND IN AGRICULTURAL RUN-OFF

Recent studies show that nitrate exposure is a growing threat to amphibian larvae, causing lethal effects at levels found in agricultural run-off. However, the ambiguity of these studies makes it difficult to correlate exposure to amphibian declines, and sublethal effects are often untested. In this study, embryos and larvae of three species with notably different life histories, *Ambystoma mexicanum*, *Hyla chrysoscelis*, and *Rana clamitans*, were exposed to increasing levels (0, 5, 10, 30 60, 100, 300 and 500 mg/L) of nitrate in laboratory, static-renewal experiments. Nitrate had no significant lethal effects on embryos of the three species. Embryonic sublethal effects for *A. mexicanum* included a decrease in length at hatching with increasing concentration and earlier mean hatching dates in the two highest concentrations. *Hyla chrysoscelis* larvae were the most sensitive, followed by *R. clamitans* and *A. mexicanum*. *Hyla. chrysoscelis* and *R. clamitans* larvae experienced slowed growth in response to nitrate at levels as low as 10 mg/ L and *R. clamitans* larvae had lower final mass at ≥ 10 mg/L. Current water quality standards may be inadequate at protecting many species of amphibian larvae, especially from sublethal effects that are difficult to monitor but may ultimately impact entire ecosystems.

C42-04 MERENLENDER, ADINA M., Jeff Opperman, Colin Brooks, and Robert Coey. Department of Environmental Science, Policy, and Management, University of California, Berkeley, Berkeley, CA 94720-3110, USA (adina@nature.berkeley.edu) (AMM, JO); Hopland Research and Extension Center, 4070 University Road, Hopland, CA 95449, USA (CB); California Department of Fish and Game, PO Box 47, Yountville, CA 94599, USA (RC).
CONSEQUENCES OF CURRENT AND FUTURE LAND-USE FOR SALMON HABITAT IN THE RUSSIAN RIVER, CALIFORNIA

Increasing the extent of land-use in a watershed can result in adverse downstream effects. The first step to determining the probability that these affects will result in biologically significant consequences is to establish a causal linkage between land use and stream condition. To do this we examined the extent and distribution of land-cover in 60 sub-watersheds in the Russian River and the relationship to levels of fine sediment downstream. Our regression models reveal a clear association between land use/land cover at various scales and instream embeddedness indices calculated from California Department of Fish and Game field data on fish habitat. Local riparian cover had little influence on embeddedness levels compared with forest and shrub cover across the entire watershed. In addition, using a geographic information system, we have developed spatially explicit land-use change models which reveal likely areas of future agricultural and residential development that may result in cumulative watershed effects. This research suggests the processes that determine sedimentation operate at large scales, and riparian restoration will have little ability to influence levels of fine sediment within the stream reaches if land-use patterns continue as predicted throughout the basin.

C49-02 MEYERSON, FREDERICK A.B. 4907 Redford Road, Bethesda, MD 20816, USA (Frederick.Meyerson@brown.edu).
HUMAN POPULATION DENSITY, DEFORESTATION, AND PROTECTED AREAS MANAGEMENT: A MULTI-SCALE CENTRAL AMERICAN ANALYSIS

Human population density is a useful coarse filter to understand and project over-utilization of forest areas at multiple scales. This is particularly true where inhabitants of reserves are primarily dependent on biotic resources. In this study, population and forest cover data were analyzed at multiple spatial scales (Central America, Guatemala, the Peten, the Maya Biosphere Reserve, its sub-component reserve zones, and the town of Paso Caballos) and temporal scales (1940-1999 and projections through 2050). For the data sets considered in this analysis, which include a set of nested geographical scales, there is a significant inverse relationship between population density and remaining forest cover. The data indicate that there are conservation-relevant thresholds at many scales, both outside and within protected areas. The results also suggest that it would be valuable to re-consider the design and management of the Maya Biosphere Reserve and similar reserves, as well as the relation between population, reproductive health and protected areas conservation programs.

C01-01 MEYERSON, LAURA A., and Jamie K. Reaser. Global Invasive Species Programme, U.S. Office of the Secretariat, c/o The Smithsonian Institution, PO Box 37012, NHB MRC 105, Washington, DC 20013-7012, USA (meyerson.laura@nmnh.si.edu).
AN ASSESSMENT OF THE BIOLOGICAL AND SOCIO-ECONOMIC IMPACTS OF INVASIVE ALIEN SPECIES (IAS) ON ISLAND ECOSYSTEMS: RESULTS OF AN EXPERT'S CONSULTATION

The Global Invasive Species Programme, on behalf of the Convention on Biological Diversity, held a workshop in October 2002 that brought fourteen experts together to assess the biological and socio-economic impacts of IAS on island ecosystems. These questions were addressed: What are the major biological and socio-economic impacts of IAS on islands? What variables influence the impacts of IAS on islands? What are the "best practice" measures for the prevention, eradication, and control of IAS on islands? How do the principles/practices differ from continental systems? What gaps in knowledge exist and how can they be filled? The group concluded the following: Prevention, early detection, and rapid response are widely accepted as the best way to safeguard islands from IAS impacts. Fouling of marine organisms on ships and other mobile structures is a significant invasion pathway requiring greater attention. There is paucity of quantitative information on the impact of IAS on island ecosystems, making adaptive management and policy decision-making less than adequate. Capacity building activities must be strengthened so that scarce resources (financial, technological and human) can be fully leveraged to address, prevent and mitigate the impacts of IAS.

C07-02 MICHAELS, HELEN J., Xiujie Shi, and Randall Mitchell. Department of Biological Sciences, Bowling Green State University, Bowling Green, OH 43403, USA (hmichae@bgnet.bgsu.edu) (HJM, XS); Department of Biology, University of Akron, Akron, OH 44325, USA (RM).
THE EFFECTS OF POPULATION SIZE AND DENSITY ON GENETIC VARIATION AND MATING SYSTEM IN *LUPINUS PERENNIS*

Understanding the impacts of changes of population size and density on genetic variation and mating systems is critical to the evaluation of the effect of human activity on natural plant populations. We applied 6 microsatellite loci to the analysis of genetic variation in five paired large and small populations of the threatened species *Lupinus perennisi*. Although population size had no

significant effect on levels of heterozygosity for adult plants, large populations harbored significantly more alleles than small populations. We further characterized the mating system of 8 populations varying in size and density, using data from 5 polymorphic microsatellite loci. Progeny arrays of 11 open-pollinated offspring from 15-20 maternal plants per population were used to estimate mating system parameters under the mixed mating model. Multilocus outcrossing rates (tm = 0.72 to 0.95) indicated that *L. perennisi* is predominately outcrossing. Outcrossing rate varied among populations, while large populations had significantly higher outcossing rates than small populations. Furthermore, low-density populations showed a trend toward higher outcrossing rates. Given that all populations show considerable inbreeding depression regardless of size, our results help explain why previous studies have shown that small populations have lower seed production and higher abortion rates.

C24-08 MICHIRA, CHARLES, and Cohen Yosef. Department of Fisheries, Wildlife, and Conservation Biology, University of Minnesota, 1980 Folwell Avenue, St. Paul, MN 55108, USA (mich0286@umn.edu).
THE UTILITY AND RELIABILITY OF MAPPED BIODIVERSITY DATA IN DECISION MAKING FOR CONSERVATION AREA MANAGEMENT: A CASE STUDY OF SHOMPOLE GROUP RANCH IN KAJIADO DISTRICT OF KENYA

Understanding ecological systems allows researchers and managers to identify species-rich areas as candidates for specific management practices, thus optimizing biodiversity conservation. Decision making based on mapped species richness patterns may be sensitive to errors from unreliable data and models and decisions made without reference to data, or that use data based on poor survey or experimental designs, may lead to suboptimal decisions. Shompole wildlife conservancy, established by community members in a partnership with a hotel operator and local non-governmental organizations to promote biodiversity conservation and increase revenues from tourism, is facing problems such as lack of a clear land-use and management policy, lack of shared problem definition among stakeholders, lack of data and inability to efficiently use existing data for decision making. As a result, its infrastructure has degenerated and large ungulates no longer use certain parts of the conservancy due to disturbance and overgrown vegetation that was previously kept low by livestock that were driven out to pave way for its creation. This paper focuses on collecting data needed to address these problems and to have a better managed conservancy with infrastructures that don't interfere with critical wildlife habitats and with human settlement patterns that will minimize human-wildlife conflicts.

C13-02 MILAN, JENNIFER H., Richard P. Axler, Lucinda B. Johnson, and Catherine M. Johnson. Natural Resources Research Institute, University of Minnesota Duluth, 5013 Miller Trunk Highway, Duluth, MN 55811, USA (jmilan@nrri.umn.edu).
ULTRAVIOLET-B RADIATION DOSE TO *RANA SYLVATICA* IN VERNAL POOLS IN NORTHERN MINNESOTA

Widespread amphibian malformations and population declines have led to many investigations and theories of causation, including increases in solar ultraviolet-B (UV-B) (290-320nm) radiation. Recent laboratory-based studies established a dose-response relationship between UV-B and malformations in *Ranid* species. Our objectives were to calculate the temporal and spatial variation of UV-B dose in vernal ponds, use incident radiation measures to predict UV-B dose in nearby ponds, and predict malformation rates in these ponds based on a published risk model. To test the viability of the UV-B hypothesis in *Rana sylvatica* (wood frog), we used a multi-probe UV-B datalogger (UV Minder sensor) to measure daily and cumulative UV-B dose in two vernal pools in northern Minnesota during embryonic and larval stages (May 27, 2002 - August 12, 2002). Malformation rates predicted for these ponds ranged from zero to greater than 50%. Using incident UV-B radiation, the maximum daily UV-B dose in other vernal pools in the study area was predicted to be similar or higher than that measured directly in the two study ponds. Thus, vernal pools have a higher risk of amphibian malformation from UV-B than predicted based on previous studies in wetlands of northern Minnesota.

C34-02 Milbauer, Michelle, and **MARK LEACH.** University of Wisconsin–Madison Arboretum, 1207 Seminole Highway, Madison, WI 53711, USA (mkleach@facstaff.wisc.edu).
DO WE KNOW WHAT TO MEASURE? MANAGEMENT EFFECTS, VEGETATION CHANGE AND THE ASSESSMENT OF CONSERVATION STATUS

Assessing the status of native vegetation is an important conservation activity. In our view, assessment methods could be improved by considering trends in composition and community structure across sites with obvious differences in conservation status. Making use of John Curtis's historical data, we resampled with 1-m^2 > quadrats 21 tallgrass prairie remnants in Wisconsin that had been similarly sampled about 55 years previously. We included sites with large differences in fire and other conservation-management histories. Examination of changes in alpha (richness/m^2), gamma (richness/20m^2), beta (gamma/alpha) diversity, and "quality indices" can obscure trends in loss and invasion. For example, on average species diversity increased, but only because alien species increased more than native species declined (change in alpha = +2.6 and -0.8 for introduced and native species respectively). Even among the better-managed sites, habitat generalists are replacing species with high fidelity to prairie remnants. Changes in various resource-capture guilds varied generally as expected: woody, clonal, C3 grasses, and

monocarpic groups increased, while N-fixers, C4 grasses, and non-clonal groups declined. Using these examples, we discuss how knowledge of the relationship of conservation management and change of composition and structure can help conservationists better assess vegetation status.

S04-05 MILLER, CHERYL. Consultant, 176 Wildwood Avenue, Birchwood, MN 55110, USA (camiller@umn.edu).
AFTER THE DELUGE: CONSERVATION AND FLOOD PROTECTION IN THE RED RIVER BASIN

In the past decade, flooding has devastated many communities and farms in the Red River Basin, a prime-wheat growing region in the North Central United States. Floods and other large-scale environmental crises often precipitate a crisis in government as well, as conflicts increase among diverse stakeholders and pressures on various government institutions grow. In the Red River Basin, the conflicts among these stakeholders – up-streamers versus down-streamers, conservationists versus drainage interests, government agencies internally and among themselves – led to a formal mediation process which, when concluded, fundamentally overhauled the goals, policies, and organizational processes of existing institutions. The Red River Flood Damage Reduction Agreement established a fifteen-year, $250 million collaborative process among government and private groups, set ambitious flood protection and conservation goals, established stakeholder teams to design and implement projects, and called for new watershed plans to integrate flood reduction and conservation priorities such as buffering natural areas and waterways, restoring prairie and wetland ecosystems, and re-establishing more natural stream characteristics. Keys to the success of this Agreement are shared access to technical and scientific information about flooding and natural resources and stakeholder willingness to consider alternative approaches to reaching agreed-upon goals.

S03-09 MILLS, L. SCOTT, and Reesa Yale Conrey. Wildlife Biology Program, School of Forestry, University of Montana, Missoula, MT 59812, USA (smills@forestry.umt.edu).
DEMOGRAPHIC AND GENETIC MEASURES INDICATE EFFECT OF HIGHWAYS ON CONNECTIVITY

Although estimates of connectivity are fundamental to conservation, connectivity has been notoriously difficult to measure. Recent revolutions in mark-recapture and genetic analysis open up new possibilities for quantifying movement. We use a case study investigating the effects of highways on small mammals to show the benefits of combining demographic and genetic approaches. We established 4 trapping grids with equal spacing among grids on either side and parallel to highways, replicating the sampling over two summers for three 2-lane and two 4-lane highway sites in western Montana. Both genetic and mark-recapture data could be obtained for southern red-backed voles and deer mice. For red-backed voles, movement of marked animals across 2-lane highways was lower than parallel to highways (insufficient movements for 4-lane highways), but there was no detectable decrease in gene flow (Fst or assignment tests). For deer mice, both movement and gene flow was reduced at 4-lane but not 2-lane sites; the mark-recapture data also indicate that densities of deer mice are higher near the road. Only genetic data could be obtained for vagrant shrews; connectivity across highways was strongly reduced. Highways do appear to affect connectivity. An unresolved question is the level at which reduced connectivity becomes problematic.

C50-04 MILNE, SARA A., and Rick Sweitzer. Department of Biology, University of North Dakota, PO Box 9019, Grand Forks, ND 58202, USA (sara.milne@und.nodak.edu).
THE EFFECTS OF FIRE ON THE ECOLOGY AND DISTRIBUTION OF BLACK-TAILED PRAIRE DOGS AT THEODORE ROOSEVELT NATIONAL PARK

The black tailed prairie dog (*Cynomys ludovicianus*) is a keystone species whose activities historically occurred within the context of periodic fire, which likely influenced the distribution of the species related to aspects of their behavioral ecology. For example, if reduced herbaceous cover and more nutritious plant growth associated with fire improves habitat conditions for prairie dogs, prairie dog colonies may expand into recent burns when fires occur near existing colonies. To quantify the effects of fire on prairie dog dispersal, an experimental study was initiated to assess how fire may influence prairie dog population ecology at Theodore Roosevelt National Park, ND, USA. An experimental burn plot and adjacent unburned control plot were delineated and burned in spring of 2002, followed by mechanical removal of remaining herbaceous material. To track colony expansion, monthly assessments of burrowing activities were conducted, with all colony boundaries mapped by GIS. Behavioral observations were also used to assess potential differences in prairie dog activities between the experimental and control plots. Preliminary results from research in 2002 were that prairie dogs dispersed on average 2.7 acres into burned areas, constructing on average 54 new burrows/month, compared to unburned areas with no expansion and 15 new burrows/month.

C29-03 MOEN, RONALD A. Natural Resources Research Institute, University of Minnesota Duluth, 5013 Miller Trunk Highway, Duluth, MN 55811, USA (rmoen@nrri.umn.edu).
HOW CAN MOOSE BROWSING AND SUCCESSIONAL CHANGES AFFECT THE PROBABILITY OF FOREST FIRES: AN EXAMPLE FROM ISLE ROYALE?

Moose have been present on Isle Royale since the early 1900's. Selective foraging by the moose population, and fluctuations in the wolf and moose populations have altered the species composition and structure of the vegetation. Some of these changes may have altered the availability of fuel at ground level, and hence the probability that a forest fire will ignite and burn which is partly dependent on fuel loads. We used a simulation model of forest growth to predict changes in different Isle Royale forest types over the past 150 years, and for 50 years into the future based on present conditions. Predicted fuel load decreased as consumption of browse species by moose increased in the simulations. The effect of browsing on fuel load and species composition was greatest at higher moose densities, in cover types with more deciduous species, and in young forests. These predictions are consistent with field measurements and observations of existing Isle Royale forests.

C40-02 MOORE, SETH, Carl Richards, and Lucinda Johnson. U.S. Geological Survey, Great Lakes Science Center, Lake Superior Biological Station, 2800 Lakeshore Drive, Ashland, WI 54847, USA (samoore@usgs.gov) (SM); Minnesota Sea Grant College Program, University of Minnesota, 2305 East 5th Street, Duluth, MN 55812-1445, USA (CR); Natural Resources Research Institute, University of Minnesota Duluth, 5013 Miller Trunk Highway, Duluth, MN 55811, USA (LJ).
PRESENTING A HABITAT-BASED FRAMEWORK FOR THE RECOVERY OF REDUCED FISH POPULATIONS: A CASE STUDY DESCRIBING COASTER BROOK TROUT REHABILITATIVE ECOLOGY

We describe a framework to understand the ecology of coaster brook trout at multiple scales and how that information can be used to make recommendations for the recovery of this species. Coaster brook trout are a native species to Lake Superior for which rehabilitative efforts are necessary. We conducted a multi-tiered study to understand different aspects of coaster brook trout ecology as follows: 1) Identify large (landscape and watershed) and small-scale (habitat) features that predict coaster brook trout distributions in areas where remnant populations are extant, 2) Identify how habitat features influence the growth of juvenile coaster brook trout, 3) Relate the large-scale features to small-scale features, 4) Identify potential rehabilitation locations in areas where suitable habitat conditions exist at multiple scales. The best predictors of brook trout presence at smaller scales were conductivity, average stream depth, and proportion of riffles, while at larger scales the best predictors were percent conifer, less well-drained soils, and watershed slope. At small scales, juvenile brook trout growth rates were best predicted by conductivity, average stream width, proportion of riffles, and average pebble size, while only proportion of standing water could predict growth rates at a large scale. Percent early successional hardwoods, conifer, and standing water were most related to the small-scale habitat features that are important to brook trout. Our results were able predict locations with habitat conditions similar to those where coasters currently exist.

P103 MORGAN, MICHAEL, and David Norton. Department of Environmental Science, University of Wisconsin–Green Bay, 2420 Nicolet Drive, Green Bay, WI 54311, USA (morganm@uwgb.edu) (MM); Conservation Research Group, School of Forestry, University of Canterbury, Private Bag 4800, Christchurch, New Zealand (DN).
POPULATION DYNAMICS OF THE THREATENED NEW ZEALAND ENDEMIC, *MYOSOTIS COLENSOI*, AND IMPLICATIONS FOR ITS CONSERVATION

To assess its conservation status, the population dynamics of *Myosotis colensoi* was studied over a seven year period. In November 1991 62 permanent quadrats were established on a site in Castle Hill Basin, South Island. All mats within the quadrats were mapped and monitored. In 1991 mats produced an average of 2.9 seeds per flower, 2.9 flowers per lateral and 1.9 laterals per rosette. Mats averaged 5.0 rosettes while 92.5 percent of mats with two or more rosettes and 48.1 percent of single rosettes produced flowers. Over an eight week period 17.6 percent of seeds germinated without pretreatment. Only 16.5 percent of the 170 mats sampled in November 1991 survived to December 1998. However, 270 mats were counted in 1998, indicating that seedling establishment had more than compensated for low survivorship. *M. colensoi* also reproduces vegetatively with some mats containing as many as 36 satellite rosettes linked to a founder rosette. Reproduction appears not to pose any constraints on the long-term persistence of this species. No significant change in percent cover of invasive species (approximately 29 percent) occurred over the seven year study. In the short term, this population is expanding in number.

P102 MORRIS, DOUGLAS W., and James E. Diffendorfer. Department of Biology and Faculty of Forestry and the Forest Environment, Lakehead University, Thunder Bay, ON P7B 5E1, Canada (douglas.morris@lakeheadu.ca) (DWM); Department of Biology, San Diego State University, San Diego, CA 92182, USA (JED).
TAKING THE PULSE OF DISPERSAL: IS IT SOURCE-SINK DYNAMICS, BALANCED MIGRATION, OR HABITAT SELECTION?

Dispersal lies at the heart of spatial population dynamics, the persistence of populations, and their successful conservation. Typically, patterns in dispersal are interpreted to represent either the flux of individuals from source to sink habitats, or the balanced migration of individuals between habitats of differing quality. We illustrate that both patterns can be produced through ideal habitat selection in persistent populations. Dispersing individuals pulse between habitats as overall population size waxes

and wanes through time. Long-term data from mouse populations confirm habitat selection's role in dispersal. Conservation strategies that fail to link dispersal to temporal population dynamics and density-dependent habitat selection, and thereby misidentify source and sink habitats, may increase the risk of population extinction.

S10-05 MORRIS, JAMES T. Department of Biological Sciences, University of South Carolina, Columbia, SC 29208, USA (morris@biol.sc.edu).
INDICATORS OF COASTAL WETLAND RESPONSES TO RISING SEA LEVEL

Global warming may threaten the integrity of coastal wetlands because of an acceleration in the rate of sea-level rise. The stability of these ecosystems against historic rates of sea-level rise is explained by interactions among sea level, primary production, tidal range, and sediment accretion that regulate the elevation of the sediment surface toward an equilibrium with mean sea level. Coastal wetlands that are currently stable are poised at an elevation that is superoptimal for the marsh vegetation. As relative sea-level rises, primary production and biomass density increase, which enhances the efficiency of the marsh surface as a sediment trap. The equilibrium elevation decreases as the rate of sea-level rise increases. The productivity of marsh vegetation is maximized at an optimal elevation, which is a function of the rate of sea-level rise. However, the optimal elevation is close to a fatal limit. The near term stability of a coastal wetland can be assessed by measuring the biomass response to relative elevation and the current elevation of the marsh relative to the tidal range. There are related geomorphological indicators, such as pattens of tidal networks, and plant biophysical indicators, that might also signal a change in state and that could be monitored remotely.

C19-03 MORRIS, KATRINA M., and Timothy J. Maret. Department of Biology, Shippensburg University, 1871 Old Main Drive, Shippensburg, PA 17257-2299, USA (trinammorris@hotmail.com).
EFFECTS OF TIMBER MANAGEMENT ON POND-BREEDING SALAMANDERS

Timber harvesting can negatively impact salamander populations by increasing soil temperature, compacting soil and degrading habitat. Questions about the effects of timber management on pond-breeding salamanders remain unanswered, such as when clearcut habitat once again becomes suitable for salamanders. We investigated habitat use by Ambystomatid salamanders in an area that included recent clearcut as well as intact forest habitat. In addition, we investigated whether salamanders used habitat beyond the 30 meter buffer zone prescribed by the Pennsylvania Bureau of Forestry. We used drift fences and pitfall traps to capture adult spotted salamanders (*Ambystoma maculatum*) and marbled salamanders (*A. opacum*) during their breeding seasons. The study area contained habitats clearcut 11-12 years before the study. The three ponds in the study were surrounded by areas of clearcut and intact forest and drift fences were placed in both habitat types. We found that nearly half of captured individuals used habitat beyond the 30 meter buffer zone. Significantly more *A. maculatum* came from the direction of the clearcut. There was no significant difference between numbers of *A. opacum* coming from clearcut and intact directions. These results suggest that clearcut habitats may be utilized by adult pond-breeding salamanders after a relatively short regeneration period.

C37-08 MORSELLO, CARLA, Neil Adger, and Carlos Augusto Peres. Programa de Pós-graduação em Ciência Ambiental, Colméia Favo 15, Cidade Universitária (SP), CEP 05508-900, Brazil (c.morsello@uea.ac.uk) (CM); School of Environmental Sciences, University of East Anglia, Norwich NR4 7TJ, UK (CM, NA, CAP).
KEEPING TRADITIONAL SUBSISTENCE SYSTEMS OF AMAZONIAN INDIGENOUS GROUPS IN THE ADVENT OF MARKET INTEGRATION

Indigenous peoples are critical to conservation because of the large forest area they control and the low impact of their traditional subsistence systems. However, this role could be threatened by subsistence transformations, caused by increased market enrolment. But are all market activities equal? The study argues that the structure and organization of income-earning activities is key to the answer. This question is explored in the A'Ukre-Kayapó village, Brazilian Amazonia, with systematic data collected by a household survey, observations of time allocation and agricultural plot evaluation. The study confirms that market integration can produce transformations on subsistence, but variations in time allocated and incomes are important determinants of the outcomes. First, increased time spent on markets is not always related to a decrease in subsistence. Instead, the period of the year might be crucial, especially if it hinders swidden-agriculture. Second, higher and regular incomes are implicated in transformations, because they provide the means to avoid the risks and drudgeries of subsistence work. The study concludes that market integration does not necessarily lead to substantial transformation in subsistence, if we structure activities by taking into account the amount and seasonality of time investment, avoid regularity, and mimic traditional organization of the production.

C55-02 MOSELEY, ROBERT, Zhang Zhongyun, Xirao Yunzhen, and Guo Jing. China Country Program, The Nature Conservancy, Kunming, Yunnan 650051, P.R. China (rmoseley@public.km.yn.cn) (RM); Ethnology Institute, Yunnan Academy of Social Sciences, Kunming, Yunnan 650032, P.R. China (ZZ); Department of History, Yunnan University, Kunming, Yunnan 650091, P.R. China (XY); Yunnan Provincial Museum, Kunming, Yunnan 650032, P.R. China (GJ).
SACRED GEOGRAPHY: TIBETAN BUDDHISM AND BIODIVERSITY CONSERVATION PLANNING

Incorporating traditional knowledge and belief systems can enhance the success of protected areas in many parts of the world. For example, the sacred landscapes of Tibetan Buddhists have long protected biodiversity. In the Meili Snow Mountains on the Yunnan-Tibet border, China, a traditional conservation zoning system has been in place for over 1,000 years. In order to assess the importance of these spatially-explicit landscapes to protected area design, we mapped and overlaid them with biophysical themes commonly used for conservation planning. With local guides we delineated four zones of protection and use. Several ecoregionally important conservation targets are adequately conserved in the protected landscapes and require no additional protection. Not all land uses are restricted in these protection zones, however, and activities such as yak grazing heavily impacts some targets. We also found that much of the species-rich Mixed Forest ecosystem lies outside the protection zones, as do most legally protected plant species. We found this exercise to be especially useful in identifying site-level conservation targets and critical threats. The well-established sacred geography is being used to design conservation and management in a new protected area, thereby minimizing conflicts often generated by establishing reserves in China.

S01-01 MOSER, SUSANNE C. Global Environment Program, Union of Concerned Scientists, Two Brattle Street, Cambridge, MA 02238, USA (smoser@ucusa.org).
WHEN THE CLIMATE GETS TOUGH, WILL TOUGH SPECIES GET GOING? – SOUND SCIENCE IN SUPPORT OF CONSERVATION MANAGEMENT

A new report on the potential ecological impacts of climate change on the Great Lakes region, sponsored by the Ecological Society of America and the Union of Concerned Scientists, was released in April 2003. This report – *Confronting Climate Change in the Great Lakes Region: Sustaining the Ecology and Well-Being of Our North American Heartland* – is co-authored by prominent ecologists from the region and serves as the central vehicle of an extended outreach and education effort coordinated and carried out under the leadership of one of the nation's premier science-oriented environmental advocacy groups – UCS. Outreach is geared primarily toward state and local policy and decision-makers in the public and private sectors. It aims not only at raising awareness and understanding of climate change impacts on the region, but at helping natural resource and conservation managers to prepare for a changing climate. Building on past experiences and lessons learned in similar projects in other regions of the country, our model of local scientist/decision-maker interaction is proving highly effective. This symposium offers an opportunity to continue the mutual education and trust-building required for satisfying and useful interaction between researchers and ecosystem managers.

S11-06 MUHEEBWA-MUHOOZI, JIMMY, MAURICE WANJALA, Richard Beilfuss, Achilles Byaruhanga, Derek Pomeroy, and Bob Wishitemi. Wildlife Clubs of Uganda, Bushyeni, Uganda (derek@imul.com) (JMM); Kipsaina Wetlands Conservation Group, PO Box 18, Kipsaina, Kenya (MW); International Crane Foundation, E-11376 Shady Lane Road, PO Box 447, Baraboo, WI 53913, USA (RB); Nature Uganda, PO Box 27034, Kampala, Uganda (AB); Institute of Environment and Natural Resources, Makerere University, PO Box 7298, Kampala, Uganda (DP); Department of Tourism Management, Moi University, PO Box 1125, Eldoret, Kenya (BW).
COMMUNITY-BASED CONSERVATION OF CRANES AND WETLANDS IN THE LAKE VICTORIA BASIN OF EAST AFRICA

Lake Victoria basin has among the highest population densities in the world and landowners are increasingly compelled to cultivate erosive slopes and drain valley bottom swamps. As wetlands degrade and disappear their functions and values are lost, including vital habitat for Grey Crowned Cranes *Balearica regulorum* and other vulnerable species. Biodiversity conservation in this context depends on the capacity of rural communities to take innovative steps to manage their lands to sustain local economies and ecosystems. The Kipsaina Wetlands Conservation Group and Wildlife Clubs of Uganda have developed homegrown community-based wetland conservation programs in the basin based on practicable local land-use examples and fostered by strong, trustworthy local leadership. They reach schools, churches, and other institutions through workshops, seminars, debates, dramas, and choir performances, and engage thousands of young adults in wetland monitoring, conservation, and awareness activities. Site-specific educational materials draw from traditional knowledge and experiences of local people, using the Grey Crowned Crane as a flagship species for conservation. Farmer education programs promote alternative agricultural practices for fish farming, livestock grazing, agro-forestry, vegetable farming, and bee-keeping. We are working to scale-up from these localized efforts to develop a model program for community-based wetland conservation and self-reliance throughout the basin.

S06-05 MUMFORD, KAREN. Environmental Policy Program, Carl Vinson Institute of Government, University of Georgia, 201 North Milledge Avenue, Athens, GA 30602, USA (mumford@cviog.uga.edu).
GOVERNANCE CAPACITY FOR MANAGING NATIVE AND NON-NATIVE FISH SPECIES ON LAKE MICHIGAN

The fish community of Lake Michigan has changed considerably over time. Habitat degradation, over fishing, and invasion of the lake by non-native species have facilitated the reduction or extinction of native species and the establishment of non-native species. Paralleling these species shifts were shifts in the governance of the Lake and its fishes. Governance regimes have shifted from communal aboriginal to open access to state managed regimes and currently, to a collaborative regime involving stakeholders and tribal, state, federal, and bi-national management entities. Certain past governance regimes were incapable of preventing the loss of native species or thwarting invasions by non-native species. Why should we assume that the current governance structure is any better equipped to protect biodiversity – especially given increasing rates of species change in the Great Lakes? To address this question, I examine the ecological and social forces that shaped past governance of the fishery. This provides a context-rich approach for understanding how current conditions emerged. Next, I examine the emergence of collaborative governance as an extension of past governance regimes. Finally, I highlight potential policy strategies for improving the capacity of the current governance structure to protect native species and prevent invasions by non-native species.

C43-04 MUNTIFERING, JEFF, Tracy Hruska, Lee Perlow, Richard Jeo, Amy Dickman, and Laurie Marker. Round River Conservation Studies, 404 North 300 South, Salt Lake City, UT 84108, USA (rjeo@earthlink.net) (JM, TH, LP, RJ); The Cheetah Conservation Fund, PO Box 1755, Otjiwarongo, Namibia (AD, LM).
CHEETAH (*ACINONYX JUBATUS*) HABITAT CHARACTERISTICS ON COMMERCIAL FARMS IN NORTH-CENTRAL NAMIBIA

The largest extant population of cheetah (*Acinonyx jubatus*) in the world persists on privately owned commercial ranchland in north-central Namibia. Recent human-mediated impacts have resulted in bush encroachment – the conversion of grassland savannahs to dense, acacia-dominated thickets. Impacts of bush encroachment on cheetah habitat is poorly understood. We examined plot-level habitat characteristics for male cheetah coalitions on two commercial ranches. Using individual ranches as sample units, areas of high-use were identified using radio-telemetry locations to calculate 30% probability kernels. We randomly placed twenty-five plots in both high and low-use areas on two farms and measured shrub density, height, ground cover, hunting visibility and relative prey abundance. Although shrub density did not vary significantly between high and low-use areas, we found significant differences for two factors: hunting visibility and shrub height distribution for both farms. For one of the farms, high-use areas were found to have higher prey density. These data suggest cheetah may be utilizing areas with higher prey density and better hunting visibility and there may be trade-offs between these factors, presumably as behavioral adaptations to maximize hunting efficiency. We suggest that identification of specific habitat characteristics can prioritize ongoing habitat restoration and predator conflict mitigation efforts.

C48-01 MURPHY, MELANIE, Peter Zager, Steve Monfort, Adair Muth, and Lisette Waits. Department of Fish and Wildlife, College of Natural Resources, University of Idaho, Moscow, ID 83843, USA (mmurphy@uidaho.edu) (MM, AM, LW); Idaho Department of Fish and Game, 1540 Warner, Lewiston, ID 83501, USA (PZ); Conservation and Research Center, 1500 Remount Road, Front Royal, VA 22630, USA (SM).
DEVELOPMENT OF A NON INVASIVE METHOD FOR DETERMINING SEX RATIO AND PREGNANCY RATE IN AN IDAHO ELK HERD

Elk recruitment is low or has declined throughout north-central Idaho. The decline may be related to low pregnancy rates, low birth rates, poor calf survival, or other factors. As part of an elk recruitment investigation, we are developing a non-invasive approach to assess pregnancy rate for free-ranging elk populations. Elk fecal pellets from individuals of known sex and pregnancy status and from free-ranging animals of unknown sex and pregnancy status were collected during January through March, placed in plastic bags, and frozen. Fecal steroid metabolite level was determined for all samples and steroid metabolite levels > 1.4 micrograms/gram indicated pregnancy. Samples with low metabolite levels were from females that were not pregnant or males. To differentiate sex for those samples, we used PCR amplification of a section of the X and Y-chromosomes in duplicate. Samples identified as female were tested an additional six times to evaluated test accuracy. PCR amplification success was 60% (18/30) for known samples and 79% (142/180) for field samples. No sex identification errors were observed (160/160). This study illustrates the value of combining non-invasive genetic sampling with hormone analyses for population monitoring.

C41-03 MURRAY, DENNIS, Eric Cox, Warren Ballard, Todd Fuller, and Heather Whitlaw. Trent University, Peterborough, ON K9J 7B8, Canada (dennismurray@trentu.ca) (DM); University of Idaho, Moscow, ID 83843, USA (EC, deceased); Texas Tech University, Lubbock, TX 79409, USA (WB, HW); University of Massachusetts, Amherst, MA 01003, USA (TF).
PREDICTING EXTINCTION IN A PERIPHERAL MOOSE POPULATION

Moose numbers in northwestern Minnesota have declined dramatically during the last 3 decades but the cause of this decline remains unclear. We studied moose population ecology during 5 years by monitoring survival and production among cows and calves. The principal cause of death was parasitism, with up to 33% of animals dying directly from pathology associated with fluke infection. Fewer moose were killed by meningeal worm (5%) or undetermined infectious disease (25%). Animals succumbing to parasitism/disease had bone marrow fat levels that were indicative of starvation, and analysis of trace elements and blood profiles for the population also were characteristic of acute malnutrition. Moose survival generally was low compared to that found in other populations, and pregnancy rates were lower than those reported previously for this species. Population projection of these demographic attributes predicted a 10% decline in moose numbers per year, which corresponds to rate of decline observed during annual aerial censuses in the area. Because liver flukes and meningeal worms are native to white-tailed deer and deer densities have increased across much of the southern distribution of moose, we predict that peripheral moose populations such as that in northwestern Minnesota eventually will go extinct when deer densities and rates of parasitism are high, and immigration rates are low.

C56-06 MYERS, MARK, and Christopher Vaughan. Conservation Biology Graduate Program, University of Minnesota, 180 McNeal Hall, 1985 Buford Avenue, St. Paul, MN 55406, USA (myer0132@umn.edu) (MM); Department of Wildlife Ecology, University of Wisconsin–Madison, Madison, WI 53706, USA (CV).
MOVEMENT AND BEHAVIOR OF SCARLET MACAWS DURING THE POST-FLEDGING DEPENDENCE PERIOD

Knowledge of Scarlet Macaw (*Ara macao*) biology during the post-fledging period is limited, yet information about this important life stage is critical to developing effective conservation strategies for the species. We used radiotelemetry to study the post-fledging movements of eight Scarlet Macaws from an isolated and threatened population in central Pacific Costa Rica. For two of the fledglings, we present detailed data on behavioral development and social integration during the first 11 weeks out of the nest. Our results indicate that continued monitoring and protection of young macaws during the first two weeks post-fledging is a critical conservation measure. We identify a small remnant patch of mangrove forest as critical habitat for the species during the post-fledging period. Macaw fledglings were completely dependent on their parents' care for at least eight weeks after leaving the nest. During this period, macaw fledglings gradually developed flight and feeding skills, learned behaviors and movement patterns from their parents, and were incorporated into large social groups. Our results highlight the challenges facing management programs based on captive rearing and stress the importance of *in situ* conservation focused on nest cavity management and protection combined with environmental education and community involvement.

C12-04 NAGLE, FIONA. Conservation Biology Graduate Program, University of Minnesota, 180 McNeal Hall, 1985 Buford Avenue, St. Paul, MN 55108, USA (finagle@fw.umn.edu).
TASMANIA'S RESOURCE MANAGEMENT AND PLANNING SYSTEM: PLANNING AND DECISION-MAKING FOR ENVIRONMENTAL AND ECONOMIC SUSTAINABILITY

A critical policy challenge for forest and other landscapes is the intergenerational coordination of competing conservation and economic land uses. The Australian island state of Tasmania, as guardian of some of the world's last great forested wildernesses, has attempted to meet this challenge with its Resource Management and Planning System (RMPS): a unique and comprehensive legislative framework for land and resource management that mandates ecosystem preservation, sustainable development, participatory decision-making, and shared public-private responsibility. I examined the robustness of the RMPS process of land use planning in terms of: 1) Adaptability to changing environmental and social conditions; and 2) Potential for effective long-term outcomes. Methods included archival research, in-depth interviews, and surveys. I found that a legislative systems approach can provide a comprehensive, integrated, and equitable mode of improving environmental stewardship and economic viability. However, current structural and procedural gaps in RMPS lead to inconsistency, confusion, and potential abuse in its implementation. Tasmania's continuing efforts to shape and refine RMPS is highly instructive for the future of environmental and economic sustainability: to be most effective, holistic policies such as RMPS need solid top-down structural and procedural foundations as well as strong bottom-up citizen participation and scientific input.

C60-02 NDANGALASI, HENRY, Idris Kikula, and James Friedericks. Department of Botany, University of Dar es Salaam, PO Box 35060, Dar es Salaam, Tanzania (hjndangalasi@yahoo.com) (HN, JF); University College of Lands and Architectural Studies, University of Dar es Salaam, PO Box 35176, Dar es Salaam, Tanzania (IK).
EFFECT OF NON-TIMBER FOREST PRODUCTS EXTRACTION ON SPECIES DIVERSITY, SPECIES COMPOSITION AND FOREST STRUCTURE IN AN AFRICAN BIODIVERSITY HOTSPOT

Control of Tanzanian protected forests is by use of regulatory policy instruments. This strategy does not adequately identify nor protect Non-Timber Forest Products (NTFPs) that are commonly used by local communities living close to forests. As such the local communities continue to use protected forests "illegally." We examined the impact of plant-related NTFP extraction (fuelwood, building poles, medicinal plants, fruits, vegetables, etc.) on species diversity, composition and forest structure in a

Tanzanian forest, using 100 1000m^2 plots placed in disturbed (proximal) and undisturbed (distal) forest in equal numbers. All trees with DBH $\geq$ 10 cm were identified, measured and enumerated. Species diversity was significantly higher in the proximal than distal sites. Colonizing species dominated the proximal sites, an indication that disturbance caused by extraction of NTFPs favored their establishment. Total basal area was significantly higher in the distal sites than the proximal sites due to presence of mature trees in the former. Significant differences in DBH size class distribution between the two contrasting areas was evident; larger dbh size classes being confined to distal sites. We conclude that NTFP extraction in general threatens the stability of biodiversity, and that policing is not an effective means of protecting the forests.

C21-01 NEEL, MAILE C. Department of Natural Resources Conservation, University of Massachusetts, Amherst, MA 01003, USA (mailen@forwild.umass.edu).
PLANT CONSERVATION GENETICS AND THE U.S. ENDANGERED SPECIES ACT: A REVIEW OF THE LITERATURE AND ASSESSMENT OF ITS IMPACT ON ENDANGERED SPECIES CONSERVATION

Science is integral to implementation of the U.S. Endangered Species Act, one of the most important laws affecting biodiversity conservation. However, for science to play a vital role, research must contribute to understanding population trends or biological consequences of threatening activities, or to identifying actions that could guide species conservation and recovery. I reviewed the genetic diversity literature available for 748 endangered plant species in context of their biology and threats. This review included searching online databases for all species and compiling citations in 204 recovery plans covering 505 species. Information on biology and threats for each species were compiled from recovery plans and listing rules. Literature was categorized as addressing systematics, hybridization, population genetic patterns, or reproductive system and by type of marker used (morphology, allozymes, DNA sequence, etc.). Of the 151 species addressed in 246 published papers, 95 species had information related to population genetic patterns, 90 species to systematics, 45 to reproductive system, and 13 to hybridization. Allozymes were the most commonly used marker overall while morphology and allozymes combined were most common in systematics studies. Contributions of genetics studies to endangered species recovery could be improved by stronger linkages to species biology and threats.

C06-03 NEELY, DAVID A. Department of Biology, Saint Louis University, 3507 Laclede Avenue, St. Louis, MO 63103-2010, USA (neely004@bama.ua.edu).
RAPID RANGE EXPANSION IN INTRODUCED DARTERS (TELEOSTEI: ETHEOSTOMA) AND THE PARADOX OF DISPERSAL IN SEDENTARY TAXA

Darters of the genus *Etheostoma* represent one of the most diverse groups of freshwater fishes in North America. These fishes display strong patterns of drainage specificity and fidelity to particular geographic provinces, concurrent with a high proportion of imperiled taxa. Field studies of home ranges have generally indicated low rates of movement; however, chronology of distributional patterns of several species accidentally introduced into darter-depauperate drainages on the Atlantic Slope of the eastern United States suggests a latent ability for rapid dispersal. These findings are incongruent with the hypothesis that the patterns of geographic variation observed are due to an inability to disperse. The interaction between larval drift, adult movements, and natural patterns of distribution is poorly understood. Identification of constraints on dispersal in darter-depauperate drainages (e.g., Susquehanna, Potomac, New, Genesee) might prove beneficial in facilitating recovery efforts for imperiled darters in darter-diverse drainages (e.g., Ohio, Tennessee, Cumberland, Mobile, and the Ozarks).

S04-08 NEGA, TSEGAYE. Environment and Technology Studies Program, Carleton College, One North College Street, Northfield, MN 55057, USA (tnega@carleton.edu).
UNRAVELING THE TECHNOLOGICAL 'BLACK BOX': THE CONTRIBUTION OF SOCIOLOGY TO CONSERVATION BIOLOGISTS UNDERSTANDING OF TECHNOLOGY

As conservation biologists we usually think of our object of study as 'nature', but we are everywhere preoccupied with technologies. But do we have a coherent understanding of what a technology is, how technologies come into existence, or the relation between technology, society, and the environment? Prevalent approaches in studying technologies have mainly focused on showing the impact of technologies on the environment or in conducting Environmental Impact Assessments, leaving the technology itself and its design as a 'black box'. As a result, much of the discussion on the subject matter has not moved beyond blaming the hardware, the manufacturers, the economic system, or abstractions like 'politics'. It is argued that in order to go beyond finding a scapegoat, it is necessary to undertake a sociological enquiry into the technical content, inner workings, and design of technologies (i.e., their genesis and stabilization). For only then we can understand why technologies do not necessarily have to be the way they are, that they might work better, and they might be environmentally friendly. This is shown by exploring a particular case study-that of the reconstruction of the Nett Lake dam at Bois Forte Indian Reservation in northern Minnesota.

C31-06 NEL, JEANNE, Sarah Davies, and Dirk Roux. PO Box 320, Stellenbosch, 7600, South Africa (sjdavies@csir.co.za) (JN, SD); PO Box 395, Pretoria, 0001, South Africa (DR).
USING COMPATIBLE APPROACHES FOR SYSTEMATIC CONSERVATION PLANNING OF LAND AND FRESHWATER: GREATER ADDO ELEPHANT NATIONAL PARK, SOUTH AFRICA

The proposed expansion of the existing Addo Elephant National Park in South Africa has the potential of creating the most diverse conservation area on the African continent. To ensure the long term conservation of the region's biodiversity, a systematic conservation planning approach was used to prepare an integrated framework for conservation of terrestrial, marine and freshwater ecosystems. Most conservation planning exercises have a primary focus on terrestrial biodiversity, with aquatic ecosystems receiving only secondary attention. The conservation planning framework of this study attempted to address this shortcoming by applying a uniform approach to terrestrial and freshwater ecosystems. Land classes and larger mammal populations were used to represent terrestrial biodiversity patterns. Biodiversity patterns of riverine ecosystems were represented by classifying river reaches according to a 3-level hierarchy. Key biological and evolutionary processes were spatially defined for land and freshwater ecosystems. Explicit conservation targets were set for each of the biodiversity features and processes, taking into account the land transformation status. These spatial features, processes and targets were loaded into a conservation planning software package (C-Plan), which will be used to assist the national parks authority in making land-purchase decisions over the next five to ten years.

C37-03 NELSON, MICHAEL P. Department of Philosophy and College of Natural Resources, University of Wisconsin–Stevens Point, Stevens Point, WI 54481, USA (m2nelson@uwsp.edu).
THE HISTORICAL CONSERVATION VS. PRESERVATION DISTINCTION: FLAWED, UNHELPFUL AND DANGEROUS

The great early 20th Century battle over the Hetch Hetchy Valley in California's Yosemite National Park forged an oft-repeated approach to environmental thinking. The battle pitted the philosophy of conservation, championed by Forest Service Chief Gifford Pinchot, against what was assumed to be a competing philosophy of preservation, defended by the legendary American naturalist John Muir. The prevalence of this distinction is wide spread. The validity of this distinction is often simply assumed. I will first suggest that the historical accuracy of this distinction is problematic. More importantly, however, the contemporary extension of said distinction in light of current ways to understand environmental positions and policy suggestions is deeply flawed. In sum, the perpetuation of the conservation/preservation distinction, perhaps even as a matter of historical truth, is a wildly unhelpful even potentially dangerous manner in which to conceptualize environmental issues and solutions.

S04-02 NERBONNE, JULIA FROST, and Kristen Nelson. Conservation Biology Graduate Program, University of Minnesota, 200 Hodson Hall, 1980 Folwell Avenue, St. Paul, MN 55108, USA (jaf@fw.umn.edu).
MOBILIZING RESOURCES FOR CONSERVATION: PROMOTING CITIZEN ACTION THROUGH STREAM MONITORING

Conservation biologists have long recognized that to protect natural systems we need both knowledge and the capacity for action. We must invest resources in collecting data as well as in promoting direct change in how people relate to ecosystems. During the last decade citizens have been gathering to protect local streams by investigating aquatic life through a process called Volunteer Macroinvertebrate Monitoring (VMM). Is VMM accomplishing the goal of linking knowledge to action? We conducted a national survey of VMM groups and learned that while most VMM groups hope to produce valuable data about local streams, their primary goal is to promote public awareness of water quality. Our results illustrate that there is a range of different data quality standards among VMM groups. Using linear regression we show that citizen data quality relates to action only when the impact of financial resources is used as a weighting variable. We conclude by examining the relationship between resources utilized for knowledge generation, and those used to promote protective action. We suggest ways that citizen groups can balance their investment between collecting quality data and promoting direct change on behalf local ecosystems.

S03-08 NEVILLE ARSENAULT, HELEN, and Mary Peacock. Biological Resources Research Center/314, University of Nevada, Reno, NV 89557, USA (hneville@unr.nevada.edu).
GENETIC ASSESSMENT OF POPULATION DYNAMICS AND CONNECTIVITY AT VARIOUS SPATIAL SCALES IN LAHONTAN CUTTHROAT TROUT (*ONCORHYNCHUS CLARKI HENSHAWI*)

Salmonids represent a particular challenge in the study of connectivity. Homing behavior, coupled with infrequent dispersal, has engendered widespread application of the metapopulation concept to salmonids. However, the spatial scale at which metapopulation processes occur in salmonids is still unclear, and segregation of migratory and resident life history strategies across a landscape can create complex dispersal patterns that may not be predicted by current metapopulation models. Here we use microsatellite genetic markers to uncover how life history variation may affect dispersal patterns and potential metapopulation dynamics of Lahontan cutthroat trout within a watershed and at a landscape level. Results of FST, individual assignment, bottleneck and coalescent-based analyses reveal geographically segregated resident and migratory life histories

within a watershed. Headwater resident populations were highly differentiated from other populations, while migratory populations from confluence reaches were less differentiated and maintained higher levels of genetic variability. These patterns varied in response to levels of connectivity and isolation within the watershed. Evidence of genetic bottlenecks suggests that extinction and recolonization may be occurring at this scale and play an important role in watershed-level persistence. Landscape-level analyses suggest that similar dynamics likely operated historically and enabled regional persistence of populations in large, diverse river systems.

C37-02 NEWTON, JULIANNE L. Department of Natural Resources and Environmental Sciences, University of Illinois, College of Law, 504 East Pennsylvania Avenue, Champaign, IL 61820, USA (Julianne.L.Newton@Valley.Net).
ALDO LEOPOLD'S LAND HEALTH: BIODIVERSITY AND CONSERVATION IN WHOLE

How does biodiversity conservation fit into the bigger picture of conservation? And how might conservationists, each with a narrow interest, cooperate better to achieve their goals? Preeminent conservationist Aldo Leopold probed these questions, and came to answers that today's conservationists have largely forgotten. The conservation movement, Leopold decided, needed an overall goal; it needed to see conservation "as one integral whole," requiring "harmonious cooperation" between narrower land-use interests (e.g., timber and game production, water quality, wilderness recreation, farming, species preservation), landowners, and the public. An overall goal could reduce conflict among conservation efforts, while better explaining both the need for conservation and its ecological and ethical bases. Conservation challenged core American understandings about nature and culture, and without a clear, consistent message the movement would flounder. Sadly overshadowed by his land-ethic, Leopold's proposed goal of "land health" focused on three interconnected factors – "in place soils," intact food webs and nutrient cycles, and a conscious human-land relationship. Of particular interest to conservation biologists are the ways Leopold carefully linked species diversity and integrity to sustain land health, thereby showing the public how species conservation, while important in itself, also helped sustain the larger, vital "whole" of land conservation.

C01-07 NORDBY, J. CULLY, Andrew N. Cohen, and Steven R. Beissinger. Environmental Science, Policy and Management, University of California, Berkeley, 151 Hilgard Hall #3110, Berkeley, CA 94720-3110, USA (nordby@nature.berkeley.edu) (JCN, SRB); Biological Invasions Program, San Francisco Estuary Institute, 7770 Pardee Lane, Oakland, CA 94621, USA (ANC).
IMPACT OF AN INVASIVE ATLANTIC CORDGRASS ON BIRD POPULATIONS IN SAN FRANCISCO BAY SALT MARSHES

The invasion of an Atlantic cordgrass (*Spartina alterniflora*) into Pacific salt marshes provides an ideal system in which to investigate ecosystem-wide ramifications of exotic invasions. The changes in habitat structure and composition that accompany the *Spartina* invasion will likely have the greatest impact on species, such as birds, that are wholly dependent on the salt marsh system. Saltmarsh song sparrows in San Francisco Bay (*Melospiza melodia pusillula*) reside entirely within the salt marshes and are affected not only by the *Spartina* invasion directly, but also indirectly by competitive interactions with marsh wrens (*Cistothorus palustris*) who are occupying the newly available habitat. In this study, we examined how the cordgrass invasion affected breeding territory density, nesting habitat preferences and reproductive success of song sparrows in three study sites. We also examined breeding territory density of marsh wrens, territory overlap between the two species and the correlation with vegetation. We found that while song sparrows do nest in invasive *Spartina*, reproductive success was extremely low. We also found that sparrow and wren territories were segregated, and that wren territories were more highly correlated with invasive *Spartina*. These results suggest that the *Spartina* invasion could be negatively impacting saltmarsh song sparrow populations.

P128 NORDELL, SHAWN, Thomas Valone, and Morgan Ernest. Department of Biology, St. Louis University, St. Louis, MO 63103, USA (SN, TV); Department of Biology, University of New Mexico, Albuquerque, NM 87131, USA (ME).
THE EFFECTS OF FIRE AND GRAZING ON AN ARID GRASSLAND ECOSYSTEM

Disturbances can strongly affect ecological systems, but few studies have examined how multiple, potentially interacting disturbances might affect community structure and biodiversity. Grasslands are subjected to multiple disturbances such as grazing, fire, and drought and thus are ideal settings to study both the effects of single disturbance types and potential interaction effects. We examined short-term responses of grasses, shrubs, and rodents on experimental plots to determine how manipulations of livestock grazing and prescribed fire affect individual species and community structure in a shrub-invaded arid grassland. Protection from grazing for 2 years did not affect the vegetation of the study site. However, burning significantly reduced total grass basal cover by 20%. Thirteen perennial grasses were recorded and two grasses (*Aristida* sp. and *Eragrostis intermedia*) and Broom Snakeweed (*Gutierrezia sarothrae*) were found in lower abundance on burned plots in the growing season after plots burned. All honey mesquite (*Prosopis glandulosa*) survived the fire. Twelve species of rodents were captured and total rodent captures and the number of Banner-tailed Kangaroo Rat (*Dipodomys spectabilis*) did not differ among treatments. No significant interaction between burning and grazing was observed. Fire appears to have few short-term negative effects on species in this system.

P052 NORWOOD, CARLA, and William O. McLarney. Little Tennessee Watershed Association, 197 Thomas Heights Road, Franklin, NC 28734, USA (carla@ltwa.org).
USING BIOTIC INTEGRITY DATA FOR WATERSHED CONSERVATION IN RURAL SOUTHERN APPALACHIA: A CASE STUDY OF INDEX OF BIOTIC INTEGRITY, CONSERVATION MARKETING AND COMMUNITY EDUCATION IN THE UPPER LITTLE TENNESSEE WATERSHED

The Upper Little Tennessee River is a hotspot of aquatic biodiversity even within the Southeastern U.S., a region recognized for its rich fish and mussel communities. For 12 years, the Upper Little Tennessee River Watershed Project has utilized a volunteer-driven biomonitoring program to support the conservation of aquatic biodiversity, resulting in what is believed to be the largest amount of biological data for any comparably sized watershed in the world (450 sq. miles). The data collection process is environmental education at its best, drawing on a truly diverse mix of volunteers who come away with an understanding of how fish communities integrate many ecological health indicators. The data has been instrumental in the recent protection of 4600 acres in the watershed, representing one half of the river frontage along the most pristine portion of the river. The IBI ratings recently led to the passage of a stream protection ordinance in a county with no zoning regulations. We are extracting stories from the data to which rural people can relate. The collection and interpretation of complex biological data in rural western NC is emerging as one of the most effective means of involving the community in conservation issues.

S03-02 NOSS, REED. The Wildlands Project and Department of Biology, University of Central Florida, Orlando, FL 32816-2368, USA (rnoss@mail.ucf.edu).
CONNECTIVITY CONSIDERATIONS IN REGIONAL-SCALE CONSERVATION PLANNING

Conservationists' interest in connectivity began with observations of animals (usually game species) moving along habitat corridors in human-modified landscapes. Later, under the influence of island biogeographic theory, concern broadened to consider extinction and colonization dynamics of multiple populations on habitat islands. Modern interest in metapopulations, including source and sink dynamics, is an extension of this line of inquiry. Today, conservation planning typically applies sophisticated site-selection algorithms to assure representation of all species, habitat types, and other features of interest in a network of conservation areas. Nevertheless, application of selection algorithms, by themselves, generally does not result in a network of sites that meets the needs of wide-ranging animals and permits operation of natural processes and adjustment of entire biota to climate change. A combination of site-selection algorithms, spatially-explicit population models for fragmentation-sensitive species, and expert judgment on reserve network design offers promise for achieving comprehensive, long-term conservation. With functional connectivity, a network of conservation areas can be a whole greater than the sum of its parts. I provide examples of applications of these concepts and methods to several regions of North America over the last two decades and offer suggestions for improving planning methodologies to achieve multiple goals.

C50-01 NYBERG, DENNIS. Department of Biological Sciences, University of Illinois at Chicago, m/c 066, 845 West Taylor Street, Chicago, IL 60607, USA (csnp@uic.edu).
SEPARATING BIOLOGICAL CHANGE FROM 'NOISE' IN MULTIPLE SPECIES LISTS

Species lists are fundamental data in conservation biology. Multiple lists are typically merged. The entries include a number or errors that inflate the species present. I used six floristic inventories of a 2 ha prairie (JWP) in Glenview IL spanning 70 years and developed procedures to remove entries from merged lists to generate a 'true' flora. My procedure depends on accepting a single taxonomic authority (TA) to provide a list of legitimate species. First, the 418 different entries were reduced to 401 by eliminating differences in capitalization and spelling differences judged to be trivial. The second set of decisions involves synonyms and levels of specificity not recognized by the TA. One adds TA names if they are not already on the list. The legitimate species list contained 317 names. Some of the entries were probably never present. Using a variety of regional information and a sense of the likelihood of various types of errors, I conclude 32 species were never present at JWP, so the true flora is 285 species. Both colonization and local extinctions (including some surprising colonization by prairie species) have occurred. The current flora, latest list, has 240 species.

C30-03 NYHUS, PHILIP, Sara Zeigler, and Ron Tilson. Environmental Studies Program, Franklin and Marshall College, Lancaster, PA 17604, USA (philip.nyhus@fandm.edu) (PN, SZ); Minnesota Zoo, 13000 Zoo Boulevard, Apple Valley, MN 55124, USA (RT).
ABUNDANCE, DISTRIBUTION, AND EXTINCTION RISK OF THE CRITICALLY ENDANGERED SUMATRAN TIGER IN INDONESIA

Habitat loss, degradation, fragmentation, human-wildlife conflict, illegal harvesting, and political and economic instability threaten remnant populations of wild Sumatran tigers (*Panthera tigris sumatrae*) in Indonesia. Despite these challenges, no recent studies have combined landscape-level data with field-based studies to predict total tiger abundance and distribution across the

island. We used satellite imagery and other digital data to develop a Sumatra-wide GIS map of land use and land cover, topography, conservation status, human population density, linear features, and ecosystem type. Tiger density and edge effects in different habitat types were derived from a five-year field study carried out by the Sumatran Tiger Programme and published estimates from studies in three other national parks. Harvesting rates were based on a three-year study of poaching in southern Sumatra. A habitat suitability index was used to model tiger distribution and abundance. Model results were validated against data from camera-trap field studies. A spatially-explicit population viability analysis informed areas of high conservation value and extinction risk in isolated populations. We conclude that substantially fewer tigers remain compared to estimates made a decade ago and that conservation efforts need to focus on core tiger habitats near existing and planned national parks.

C54-07 OBERBAUER, THOMAS, Robert Copper, Robert Asher, Trish Boaz and Maeve Hanley. County of San Diego, Department of Planning and Land Use, Multiple Species Conservation Program Division, 5201 Ruffin Road, Suite B, San Diego, CA 92123, USA (thomas.oberbauer@sdcounty.ca.gov) (TO, RA, TB, MH); County of San Diego, 1600 Pacific Highway, Room 212, Mail Stop A6, San Diego, CA 92101, USA (RC).
PREDICTIVE SENSITIVE SPECIES MODELING IN SAN DIEGO COUNTY

San Diego County is known nationwide for the tremendous diversity of its plants and animals and the number of species that would be considered rare or endangered. The County of San Diego developed a GIS-based species-habitat relationships model to predict the potential distribution of all sensitive species (370) in San Diego County. The model uses six factors to assess whether a species would be predicted to occur within each cell that are habitat type, ecoregions, elevation, topography, soil parent material, and soil structure. The Species Distribution Model is a raster-based GIS model with 100ft^2 cells. The County, with input from local biologists familiar with the species, identified the fundamental biological and physical factors that would best predict the presence of each species. The model helps define the species survey requirements for developments projects requiring County approval under the California Environmental Quality Act. The Model is also used to assist in the calculation of the number of predicted species as a factor of the Habitat Value Index component in the Habitat Evaluation Model and to provide information for the Conservation Analysis for the North County Multiple Species Conservation Program (MSCP) Subarea planning process.

P076 O'BRIEN, CARRIE, and William McShea. Ecology Center, Utah State University, UMC 5205, Logan, UT 84322, USA (cobrien@cc.usu.edu) (CO); Smithsonian National Zoological Park, Conservation and Research Center, 1500 Remount Road, Front Royal, VA 22630, USA (WM).
SMALL MAMMAL DIVERSITY OF THE GAMBA COMPLEX, GABON

Four small mammal surveys were conducted in Gabon, West Africa from February-November 2002 within the Gamba Complex, a protected area bordering the Atlantic Ocean with an area of 11,000 km^2. We investigated the influence of oil production on small mammal diversity. Surveys used a combination of traps and pitfalls placed in transect lines within 10 km of the site's center. Two sites were located in mature forest 60 km inland. One site was an established drilling location and the other was beyond the oil property. The two coastal sites were within a savanna-forest mosaic; one was near an oil storage facility and the other was remote. 601 individuals of 24 species were captured with a total effort of 12,991 trap-nights. The inland forest sites (24 species, diversity(H) = 2.7; 20 species, diversity(H) = 2.0) had twice the species richness of the coastal sites (12 species, diversity(H) = 1.7; 9 species, diversity(H) = 1.7), which may be attributed to the lower plant diversity in the coastal forest compared to the inland forest. The impact of oil production on small mammals appears to be minimal. These are the first small mammal surveys in this region, and provide important baseline information about an area highly valued for its large mammal biodiversity.

P028 ÖCKINGER, ERIK, Olle Hammarstedt, Sven G. Nilsson, and Henrik G. Smith. Department of Ecology, Lund University, Ecology Building, SE-223 62 Lund, Sweden (erik.ockinger@zooekol.lu.se) (EÖ, SGN, HGS); Svärmarev. 28, SE-247 35 Södra Sandby, Sweden (OH).
BUTTERFLY POPULATION CHANGES IN SOUTHERN SWEDEN DURING 20 YEARS

Butterfly populations have been observed to decline in several parts of Europe. One of the main reasons is probably the loss of natural and semi-natural grasslands. In 2002 we conducted a re-survey of butterflies at 13 sites in southern Sweden, that were previously surveyed in 1980-1982, using a standard transect-counting method. All sites were dominated by semi-natural grasslands, and the areas vary from 9 to 49 ha. Species were classified according to mobility, host-plant specificity, overwintering stage, and whether they were red-listed or not. The mean number of species per site decreased significantly from 29.8 to 24.1. Site area had a significant effect on the number of species per site, but not on changes in species numbers. The mean population size decreased significantly. However, the response differed between mobility classes; the most mobile species showed a population increase, while the less mobile species showed a population decrease. Neither host-plant specificity, overwintering

stage, nor red-listing affected population change significantly. The fact that population declines are mobility-dependent confirm the importance of spatial factors for the conservation of butterflies. The decline of species numbers might be explained by changed land management.

C05-06 OETTING, JONATHAN, and Amy Knight. Florida Natural Areas Inventory, Florida State University, 1018 Thomasville Road, Suite 200C, Tallahassee, FL 32303, USA (joetting@fnai.org).
MAKING SENSE OF ALL THE NUMBERS: USING AN ITERATIVE SITE SELECTION MODEL TO SET CONSERVATION PRIORITIES FOR THE FLORIDA FOREVER PROGRAM

The Florida Forever Conservation Needs Assessment is a statewide analysis of resources to help inform the state's Florida Forever environmental land acquisition program. The Assessment, which includes 15 GIS data layers representing biodiversity, water, forestry, recreation, and cultural sites, is used to evaluate new acquisition proposals and to prioritize existing projects for acquisition. The large amount of resource information initially generated an overwhelming number of statistics, making use of the information difficult for decision-makers. In response, we convened a workshop of resource experts to help develop better analyses and presentation of these data. As a result, we are now using an iterative site selection model, based on a simulated annealing algorithm, to analyze resources statewide. The model evaluates nearly 50,000 300ha units to identify regions that efficiently contribute resources to the overall conservation portfolio. The model confirms that many of the current Florida Forever projects are targeting important resources, and proactively identifies areas of the state where new acquisition projects should be considered. Decision-makers are now able to incorporate the resource information more directly into their evaluations of potential land acquisition projects, and we are able to clearly measure and report progress of the Florida Forever program.

C46-09 OGLETHORPE, JUDY, and Lara Hansen. World Wildlife Fund, 1250 24th Street NW, Washington, DC 20037, USA (judy.oglethorpe@wwfus.org).
CLIMATE CHANGE KNOWS NO BOUNDARIES

Climate change respects no political boundaries. It is a global phenomenon, with effects ranging from local to global levels. Its impacts on biodiversity are likely to be immense; effects will be aggravated by stresses from human activities. Current attempts to limit greenhouse gas emissions will not prevent climate change as it is already occurring. Adaptation strategies are necessary to enable biomes, communities, species and ecological processes to adapt to change. Since ecological units often straddle international borders, adaptation at national and local levels alone is not enough. International collaboration is needed to promote adaptation at global and regional levels. This will require collaboration by countries which share ecological units and climatic, altitudinal and latitudinal gradients. Space along gradients is required for adaptation, coupled with alleviation of stresses to natural systems. There are many possible collaborative transborder mechanisms for adaptation. These include networks of reserves, transborder protected areas, and transborder conservation areas and corridors with appropriate land uses. Migratory species have special needs. Countries can collaborate over common regulations to limit non-climate stresses such as pollution. Artificial manipulation of shared ecosystems may be feasible in some cases. Research, monitoring and adaptive management are essential to ensure responses are effective.

P133 OLFELT, DAVID, Ken Gilbertson, and Joel Olfelt. Minnesota Department of Natural Resources, Division of Parks and Recreation, 1201 East Highway 2, Grand Rapids, MN 55744, USA (dave.olfelt@dnr.state.mn.us) (DO); Center for Environmental Education, University of Minnesota Duluth, 1216 Ordean Court, Duluth, MN 55812, USA (KG); Department of Biology, Northeastern Illinois University, 5500 North St. Louis Ave, Chicago, IL 60625-4699, USA (JO).
VISITOR MANAGEMENT AND REVEGETATION EFFORTS ON A DEGRADED LAKE SUPERIOR CLIFF EDGE

Cliff edge communities can be fragile because of thin soils and exposure to temperature, wind and moisture extremes. Many cliff edges are popular recreational areas and become damaged through use. Restoring or halting damage on such sites is challenging because of ongoing pressure from visitors and insufficient knowledge about suitable native plant restoration materials and techniques. Shovel Point, a popular hiking and climbing destination at Tettegouche State Park (Minnesota, USA) is such a site. We used visitor surveys to help evaluate climber acceptance of potential management actions that included "hardening" trail surfaces and climber access areas, and revegetating and restricting access to other areas. We chose *Danthonia spicata* and *Potentilla tridentata* to assess native plant species establishment techniques. We randomly assigned 450 plants of each species to 0.25m^2 plots with six different soil treatments. Visitor access to plantings was restricted but enhanced elsewhere on Shovel Point. Survival after one year for all treatments was 96.7% for *D. spicata* and 79.1% for *P. tridentata* but best with hydrogel. Appropriate revegetation techniques and an understanding of visitor expectations and behavior are both important for the success of restoration efforts at sites that have high ecological and recreational value.

P099 OLFELT, JOEL. Department of Biology, Northeastern Illinois University, 5500 North St. Louis Avenue, Chicago, IL 60625-4699, USA. (j-olfelt@neiu.edu).
EFFECTIVE POPULATION SIZES ARE VARIABLE IN THE PLANT SPECIES *SEDUM INTEGRIFOLIUM* SSP. *LEEDYI*

The probability of population persistence is thought to be directly related to effective population size (N_e), and is often used to guide management decisions for rare and endangered species such as *Sedum integrifolium* ssp. *leedyi*, a federally threatened (USA) plant species. I estimated demographic parameters in three southeastern Minnesota *S. integrifolium* ssp. *leedyi* populations in five growing seasons between 1997 and 2002. In each of the seasons I counted plants and recorded flowering rates for each population. Beginning in 1997 I permanently marked a total of 117 individuals, using them to estimate sex ratios, seed set, and death rates. Actual population sizes (N) were stable, or increased for each population, averaging 287, 624, and 931 individuals. Death rates were 10 to 20 percent per year. Estimates of N_e/N fluctuated dramatically in the smallest and largest populations, ranging from approximately zero to ≥ 0.63, but were relatively stable (0.61, Standard Deviation 0.05) in the intermediately sized population. The data suggest that the stable population may be demographically secure, but reinforce the idea, based on animal population studies, that more than several years' worth of data are necessary to obtain truly useful N_e/N estimates.

P100 OLIVIER, THOMAS. Green Creek Paradigms, LLC, 4632 Green Creek Road, Schuyler, VA 22969, USA (tolivier@cstone.net).
DESIGN GOALS AND APPLICATION OF A SIMULATION SYSTEM FOR CONSERVATION BIOLOGY

This paper presents a population simulation system developed to meet sometimes-conflicting requirements of conservation models. The system targets processes in animal populations subdivided by space or social groupings. Good conservation models must treat important particulars of population structure and landscape setting. However, models framed too particularly may have prohibitively limited applicability. Simulations that exploit methods and data structures indigenous to digital computers appear particularly well suited to meeting such heterogeneous requirements. In this vein, the simulation system presented here uses syntactically organized character strings and equivalent graphs to represent local population structures. It is implemented in Python and uses object-oriented methods to portray population features at varied levels of specialization. The system also contains a run-time link to a geographic information system. A model of a socially subdivided mammalian population has been built. The model includes age-specific survival and reproduction, migration of adult males between groups and fissions and fusions of groups, with fissions occurring along matrilineal lines. Model assumptions are similar to the organization seen in some species of Old World monkeys. Applicability of the system is shown in simulations illustrating interactions between demographic rates, infectious diseases, genetic structures and social structural events.

S05-03 OLIVO, CRISTIAN. Board Director ANA-SCB, Casilla 13794, La Paz, Bolivia (olivocris@yahoo.it).
SCIENTIFIC PRODUCTIVITY IN CONSERVATION BIOLOGY IN AUSTRAL AND NEOTROPICAL AMERICA

A preliminary search on scientific productivity on conservation biology in the countries of the Austral and Neotropical America is being carried out. The purpose of such an inquiry, is to have an approximate indicator about which is the actual degree of scientific productivity in the region, to know the scientific contribution per country. So far information was gathered for 16 countries to date. This information showed that only 5 countries have at least one international journal on conservation biology or that includes it. Also there are no national or international published journals on conservation biology in 8 countries, and there are three countries that have only national-published journals on conservation biology or that includes it. In these countries only 34% of the scientific productivity on conservation biology is published in international journals, 33% is published in local journals, and 33% is never published, and remain mainly as local institutional or NGO's scientific reports. This results suggest that the scientific productivity on conservation biology in the countries of the Austral and Neotropical America is much higher than normally is thought. But pitifully in many countries, there is not an appropriate divulgence of the scientific knowledge, and many scientific articles are published in local magazines that are not easily accessible in other countries.

C56-03 OLIVO, CRISTIAN. Casilla 13794, La Paz, Bolivia (olivocris@yahoo.it).
OUTWARD MIGRATION PATTERNS OF MISSISSIPPI KITES IN EASTERN LOWLANDS BOLIVIA

Bolivia is classified as a crossroads for Austral, Intratropical and Nearctic migrants. Concepción, one of the seven raptor migration watch sites identified to date in Bolivia, holds the highest counts of migrating raptors. Between 17 September and 26 November 2001, Mississippi Kite migration was monitored in Concepción, Eastern Lowlands, Bolivia. A total of 118,153 migrating kites were counted. The species migrated concentrated over the town of Concepción in big flocks. The mean passage rate between September-November was of 237.83 kites/hour. Kites were recorded between 1000 and 1400 hours. Kites did not fly in flocks of similar sizes throughout the day during all the study, flocks were larger around 1100 hours and between 1400-1600 hours. A

significantly difference between all previous counts and sightings of Mississippi Kites is that during 2001 fall migration most kites were seen migrating on the axis south-north, flying with northern-northwestern head winds rather than with lateral winds. The reason for this erratic movement is not known.

C51-07 OLSVIG-WHITTAKER, LINDA, and Simon C. Nemtzov. Department of Science and Conservation, Israel Nature and Parks Authority, 3 Am Ve'Olamo Street, Jerusalem 95463, Israel (Linda.Whittaker@nature-parks.org.il).
THE USE OF NETTING OVER FRESHWATER FISHPONDS IN ISRAEL AND ITS EFFECT ON WATERFOWL

Fish-growers use assorted anti-predation measures to protect fish, including netting suspended over fishponds to prevent birds from gaining access to the fish. We examined the effectiveness of this netting, and the problem of the nets entangling and killing waterfowl, at two fish farms in Israel. Data were collected on quantity and species of birds trapped under nets and dead birds entangled in nets. Fourteen different nets were used over the ponds, with mesh size varying from 2-40 cm. Variation in the degree to which they excluded or entangled birds was due to the type of net, condition of the nets, season of the year, pondside vegetation, etc. Redundancy analysis elucidated which net types were most problematic for waterfowl, and which species were most vulnerable to being trapped or killed. Multiple analysis of covariance determined which factors were most responsible for quantity of birds in the ponds. Quantity of live birds in the ponds was more a function of poor net maintenance, rather than net type. Quantity of dead birds correlated significantly with net's mesh size (more dead birds as mesh size got bigger). Large numbers of dead birds occurred in nets made of thin monofilament despite a small mesh size.

C50-02 OSTLIE, WAYNE R., Brian Schreurs, Jonathan L. Haferman, and Karen Poiani. The Nature Conservancy, Worldwide Office, 4245 North Fairfax Drive, Arlington, VA 22203-1606, USA (wostlie@tnc.org) (WRO); The Nature Conservancy, Midwest Resource Office, 1313 5th Street SE, Suite 314, Minneapolis, MN 55414, USA (BS); 3155 Fairlawn Lane, Prior Lake, MN 55372, USA (JLH); The Nature Conservancy, Hawaii Field Office, 923 Nuuanu Avenue, Honolulu, HI 96817, USA (KP).
UNTILLED LANDSCAPES AS RESERVOIRS FOR BIODIVERSITY IN THE GREAT PLAINS OF NORTH AMERICA

Modifications to the Great Plains landscape over the past 150 years has resulted in significant biodiversity declines. Few areas sufficiently large to sustain the full array of species and supporting ecological processes (at all scales) remain. To understand the impact of habitat loss on biodiversity, we undertook an identification from satellite TM imagery of the remaining untilled landscapes (> 38 km^2) in the bioregion; these were then assessed relative to imperiled species and ecological system coverages. We applied the concept of minimum dynamic area to identify those sufficiently large to sustain ecological processes at historical scales and all but regional-scale species. Analyses identified 1242 untilled landscape units (32.6% of total bioregion area), 42 of these meeting MDA estimates. Results determined that biodiversity is correlated with untilled landscapes to varying degrees. Only 2 untilled landscapes in the western Plains are sufficiently large to maintain the full complement of biodiversity and supporting ecological process. Landscape-scale conservation alone cannot completely address the needs of biodiversity in the Plains. Although long-term biodiversity conservation hinges on our ability to sustain untilled landscapes, it must be coupled with action at smaller scales, restoration of species and ecological systems to scale, and innovative strategies to abate threats.

C44-01 OSTROW, D. GIGI, Stephen Wing, and Michael Roy. Department of Marine Science, University of Otago, PO Box 56, Dunedin, New Zealand (ostde808@student.otago.ac.nz) (DGO, SW); Department of Zoology, University of Otago, PO Box 56, Dunedin, New Zealand (DGO, MR).
THE EFFECTS OF HYDRODYNAMICS ON GENE FLOW: THE GENETIC STRUCTURE OF BRACHIOPODS IN THE NEW ZEALAND FJORDS

Preservation of genetic diversity is important to the success of an overall conservation program. However, lack of knowledge about mechanisms of speciation in the marine environment is a major obstacle for marine conservation and management. New Zealand's 14 deep-water fjords have differing potentials for isolating planktonic larvae due to differences in levels of freshwater input, exposure to storm fronts, and depth and position of sills separating fjords from the outer coast. This provides a natural laboratory to examine effects of hydrologic regimes on genetic patterns of organisms inhabiting the fjords. Using amplified fragment length polymorphisms (AFLP), a multi-locus genetic marker, we explored genetic divergence in fjordic populations of two species of brachiopod, one with pelagic (*Terebratella sanguinea*) and one with brooded larvae (*Liothyrella neozelanica*). For both species, levels of genetic divergence between the southernmost populations, those located in Long Sound, and other fjordic populations indicate that the unique hydrodynamics of Long Sound (high retention of water) may play an important role in isolating populations of brachiopods. Understanding how these factors can contribute to genetic divergence in the fjords will allow us to determine those areas that are likely to harbor genetically unique groups and therefore merit special conservation status.

P068 OTIENO, MARK. Department of Zoology, Kenyatta University, PO Box 43844, Nairobi, Kenya (markotieno@yahoo.com).
THE ECOLOGICAL IMPACT OF THE INVASIVE WATER HYACINTH (*EICHHORNIA CRASSIPES*) ON THE PHYTOPLANKTON COMMUNITY DIVERSITY IN WASTE WATER HABITATS IN KENYA

Eichhornia crassipes is an invasive fresh waterweed currently threatening the ecology and biodiversity of fresh water habitats in Kenya. It has recently been introduced in some oxidation ponds in Nairobi. Ecological studies carried out to assess its impact on the phytoplankton community diversity established that it has serious ecological consequence on the phytoplankton community assemblage and caused drastic reduction on the diversity and density. Phytoplanktons play a key role in wastewater purification process. The findings would be crucial for waste disposal and management in establishment of water hyacinth control strategies to prevent further invasion to other sewage treatment plants.

P122 PAAP, KATHY, and Dennis Nyberg. Department of Biological Sciences, University of Illinois at Chicago, m/c 066, 845 West Taylor Street, Chicago, IL 60607, USA (Kpaap1@uic.edu).
INVASION OF REED CANARY GRASS IS ACCELERATED BY NITROGEN AND INHIBITED BY SUGAR ADDITIONS TO A SYNTHETIC WETLAND COMMUNITY

Phalaris arundinacea, reed canary grass (RCG), is the most common invasive species in Illinois wetlands and plays a large role in wetland degradation nation-wide. We studied the effect of sugar and Ammonium nitrate additions to synthetic wetland communities to which seedlings and seeds of RCG had been added. Each wetland community had 24 individuals (6 each of four native wetland species) planted in a tub which held 110 liters of soil. To six tubs we added 0.1 mole of sugar per week; to six we added 0.003 moles on Ammonium nitrate per week during the growing season in 2001 and 2002. The 3 treatment groups did not differ in the amount of biomass produced by the planted species (mean 435 g/pot in 2002). In 2002 the sugar added pots produced only 0.2 g RCG per pot, while 2.0 g was the mean of the controls and 4.8 g was the mean of the nitrogen added pots. Continuing increases in atmospheric nitrogen deposition are likely to aggravate the already serious invasion of *Phalaris* into native wetland communities.

C05-02 PAINTON-ORNDORFF, STEPHANIE, and Albert Todd. Center for Environmental Science, University of Maryland, Chesapeake Bay Program, 410 Severn Avenue, Annapolis, MD 21403, USA (steph_orndorff@yahoo.com) (SP); USDA Forest Service, Northeastern Area State and Private Forestry, Chesapeake Bay Program, 410 Severn Avenue, Annapolis, MD 21403, USA (AT).
IDENTIFICATION OF LANDS IMPORTANT FOR PROTECTING WATER QUALITY AND WATERSHED INTEGRITY IN THE CHESAPEAKE BAY WATERSHED

The Chesapeake Bay requires aggressive efforts to restore and protect critical areas and reduce pollutants. The Chesapeake 2000 Agreement offered a blueprint for restoration with unprecedented focus on conservation of valuable lands to meet long-term water quality and living resource goals. Resource lands (forests, farms, and wetlands) are under stress from both land use change and environmental stresses. The Chesapeake Bay Program was charged with identifying resource lands in the watershed that have the highest water quality, habitat, cultural and economic value and are the most vulnerable to loss. To identify the lands important for maintaining water quality and watershed integrity, a GIS model was developed that integrates various data sources, maps the coincident areas important for water quality (e.g., steep slopes, highly erodible soils, etc.), and highlights areas that are a priority for conservation. Thirteen variables were mapped and assessed in this model, with seven being analyzed at a 30 meter resolution and four being summarized by watershed, including ReVA indicators. Each variable was assigned a weight from 0 to 10 to emphasize variables with a greater influence on water quality. In addition, the variables were given value ranges based on their influence on water quality and scored from 0 (no influence) to 4 (highest influence). For each variable, the weight was multiplied by the score and assigned to each grid cell. Finally, all the variables were summed to highlight important resource lands to conserve for the protection of water quality and watershed integrity in the Chesapeake Bay watershed.

C08-05 PALIK, BRIAN, Darold Batzer, Leanne Egeland, and Christel Kern. USDA Forest Service, North Central Research Station, 1831 Highway 169 East, Grand Rapids, MN 55744, USA (bpalik@fs.fed.us) (BP, LE, CK); Department of Entomology, University of Georgia, Athens, GA 30602, USA (DB).
CONSERVING INTERACTIONS BETWEEN UPLAND FORESTS AND SEASONAL WETLANDS: TREE LITTER FLUX AND COMPOSITION

Conservation of seasonal wetlands is an important issue in many forest regions. These ecosystems remain poorly understood in terms of interactions with upland forest and how management of this forest affects wetland function. We hypothesized that an important interaction occurs through upland litter flux into the wetland and that alteration of this flux may affect invertebrate food availability and quality. Working in Minnesota, we found that 70% of litter entering wetlands comes from upland trees (aspen,

sugar maple, red maple, bur oak). The balance comes from black ash growing in the wetland. These litter sources differ in C to N ratios (upland > wetland), decomposition rates (e.g., black ash > sugar maple = aspen), and food quality. In litter feeding trials using tree-hole mosquitoes, we found better performance with bur oak > aspen > black ash > sugar maple > red maple. These data show strong interaction between seasonal wetlands and upland forest via litter, with implications for wetland invertebrates. Our research suggests that seasonal wetlands might be influenced by changes in litter quantity and composition in the upland. For example, upland clearcutting, altering ratios of upland to wetland litter, or changing abundance of latter successional upland species all might affect wetland invertebrates and dependent functions.

C02-06 PALKOVACS, ERIC P. Department of Ecology and Evolutionary Biology, Yale University, 165 Prospect Street, New Haven, CT 06520, USA (eric.palkovacs@yale.edu).
PHYLOGEOGRAPHY OF THE GREATER PRAIRIE CHICKEN INCLUDING THE EXTINCT HEATH HEN: IMPLICATIONS FOR CONSERVATION AND MANAGEMENT

Greater prairie chickens (*Tympanuchus cupido*) once roamed over much of North America, but over-hunting and human alterations to the landscape, especially the conversion of native prairie for agriculture, have resulted in range contraction, population fragmentation, and declines. The easternmost subspecies, the heath hen (*T. cupido cupido*), was particularly heavily exploited and eventually extirpated from the American mainland. It clung precariously to existence for about sixty years as a small, isolated population on the island of Martha's Vineyard, Massachusetts until finally going extinct in 1932. Presently, many remaining greater prairie chicken populations are declining, and the Attwater's prairie chicken (*T. cupido attwateri*) of the Gulf Coast may soon share the heath hen's fate if current population trends do not change. We used mitochondrial DNA sequence analysis to assess levels and patterns of genetic variation within and among populations and subspecies of North American greater prairie chickens, including the extinct heath hen. We analyzed field collected blood and feather samples from range-wide greater prairie chicken populations and examined genetic material from museum skin heath hen specimens. Our results indicate low levels of genetic divergence among populations, extant and extinct, making population supplementation and reintroduction potentially viable conservation strategies.

S03-03 PAQUET, PAUL C., Shelley M. Alexander, Chris T. Darimont, and Patti L. Swan. Faculty of Environmental Design, University of Calgary, Calgary, AB T2N 1N4, Canada (ppaquet@sasktel.net) (PCP); Department of Geography, University of Calgary, Calgary, AB T2N 1N4, Canada (SMA, PLS); Department of Biology, University of Victoria, Victoria, BC V8W 3N5, Canada (CTD).
THE INFLUENCE OF NATURAL LANDSCAPE FRAGMENTATION AND RESOURCE AVAILABILITY ON CONNECTIVITY AND DISTRIBUTION OF MARINE GRAY WOLF (*CANIS LUPUS*) POPULATIONS ON CENTRAL COAST, BC

During summers 2000 and 2001, we surveyed 36 islands and 42 mainland watersheds on British Columbia's Central and North Pacific Coast for wolves. Ostensibly, this remote ocean archipelago comprises North America's most pristine wolf population. We observed wolf sign at all locations. The maximum distance between occupied landmasses was 14 km. We postulated that distances between landmasses, juxtaposition of landmasses, characteristics of ocean waterways, physiographic features, prey availability, other carnivores, and human disturbance influenced wolf presence. We used remote sensing and Geographic Information Systems to examine the relationship between wolf presence and land and seascape characteristics. Independent variables included island size and shape, perimeter-to-area ratio, distance to nearest island, mammalian species composition, average current speed, water temperature, vegetative heterogeneity, greenness, wetness, percent cover, topographic complexity, aspect (eastness, northness), slope, elevation, deer potential, salmon escapement rate, richness of salmon species, old-growth forest, distance to forest cutblocks, distance to earthquake epicenters, and distance to residential sites. We used logistic regression and information criteria to model resource selection, assess factors predictive of wolf presence, and evaluate connectivity of subpopulations. We then used the model to evaluate prevailing theories of island biogeography.

C39-04 PARKS, JOHN, Robert Pomeroy, Lani Watson, Charles Ehler, Miguel Jorge, and Simon Cripps. Community Conservation Network, Honolulu, HI 96813, USA (john@conservationpractice.org) (JP); Department of Agricultural and Resource Economics, University of Connecticut Avery Point, Groton, CT 06340, USA (RP); NOAA, National Ocean Service International Program Office and World Commission on Protected Areas, Silver Spring, MD 20910, USA (LW, CE); Latin American and Caribbean Program, World Wildlife Fund, Washington, DC 20037, USA (MJ); Endangered Seas Programme, World Wide Fund for Nature, Gland, Switzerland (SC).
HOW IS YOUR MPA DOING? INTRODUCING A FRAMEWORK FOR EVALUATING MPA EFFECTIVENESS

As the use of marine protected areas (MPAs) for conservation has grown, so has recognition that empirically-based monitoring and evaluation of MPA performance is necessary to assess the effectiveness of, and improve on, MPA use. However, clear consensus and guidance as to the scope and methods to do this has eluded managers. To address this need, in 2000 the World Commission on Protected Areas and the World Wide Fund for Nature partnered to create the MPA Management Effectiveness

Initiative. During 2001 and 2002, a draft set of 44 management effectiveness indicators were developed through expert consultations. These indicators and their methods were tested at 17 MPAs around the world, and then revised based on testing results and experiences. A finalized framework of biophysical, socioeconomic, and governance indicators has been produced and will be available for use by MPAs worldwide. One conclusion from this effort is that while many sites increasingly are understanding how biological attributes are being influenced by their MPA, there is insufficient investigation of how socioeconomics and governance influence conservation success. Experience also suggests that there remains as much a need for clear guidance on effective design and appropriate management planning as there is for evaluating MPA performance.

C34-09 PATTERSON, AMANDA J., Anna Noson, Amy Dickman, Laurie Marker, and Richard M. Jeo. Round River Conservation Studies, 404 North 300 South, Salt Lake City, UT 84108, USA (rjeo@earthlink.net) (AJP, AN, RMJ); The Cheetah Conservation Fund, PO Box 1755, Otjiwarongo, Namibia (AD, LM).
FAILURE OF SCENT-LURES TO ELICIT RUBBING BEHAVIOR IN WILD-CAUGHT NAMIBIAN CHEETAH (*ACINONYX JUBATUS*)

Privately-owned, unprotected commercial ranchlands of north-central Namibia are thought to have the largest remaining population of cheetahs (*Acinonyx jubatus*) in the world, but this estimate is largely untested (Marker et al 1999, 2002). Currently, no adequate census technique has been developed for use on wild cheetahs. The use of scent-baited hair snares, combined with mark-recapture genetic analysis has been a successful census technique for other wild cats (e.g. McDaniel et al 2000). We tested three commercial scent lures: Tomcat™, Canine Call™, and Weaver's Solution™ and also tested Eternity™ and Obsession™ by Calvin Klein, canned pink salmon, canned sardines, cheetah anal secretions, and female and male cheetah faeces. All scent lures were tested on 14 wild-caught cheetahs located at the Cheetah Conservation Fund research station in Namibia. The approximate cheetah ages ranged from 28 months to 87 months, and their approximate time in captivity ranged from 17 months to 86 months. Scent-baited hair snare trials resulted in very little hair deposited for any scent lure used, with no snare collecting greater than a mean of 12.5 hairs. We did not observe rubbing behavior in wild-caught cheetahs that has been reported in other wild cats. These results suggest that alternative methods should be tested and implemented for census of Namibian cheetahs.

C55-03 PAULIN, JOSEPH B., Robin L. Larson, Evon Hekkala, and Richard Fergusson. Rutgers the State University of New Jersey, 80 Nichol Avenue, New Brunswick, NJ 08901, USA (jpaulin@eden.rutgers.edu) (JBP, RLL); Returned Peace Corps Volunteer, 8 Lincoln Avenue, Highland Park, NJ 08904, USA (EH); Center for Environmental Research and Conservation, Columbia University, New York, NY 10025, USA (RF); IUCN/SSC Crocodile Specialist Group, c/o General Manager, Baobab Farm, Malindi Road, Mombasa, Kenya.
CROCODILE FEARS AND THE SPIRIT OF THE KING: A MADAGASCAR STORY

Within Madagascar's Ankarafantsika Strict Nature Reserve lies Lake Ravelobe, sacred to villagers who say that ancestral spirits of a royal family reside within Ravelobe's waters. Their servants, now *Crocodylus niloticus* (Nile crocodile) also inhabit the lake. Between 1996 and 2000, people increasingly broke Ravelobe's taboos, some of which promote conservation. One such taboo, fishing with nets, depleted a main source of food for the lake's crocodile population. This angered the spirits. Locals believe that the spirits unleashed the crocodiles, who, for the first time, attacked people guilty of breaking Ravelobe's taboos, as well as innocent women and children. Several deaths gave impetus to an effort consisting of conservation research, education, and traditional ceremonies to consult the spirits themselves. While management officials considered exterminating Ravelobe's crocodile population, a team comprised of local villagers, reserve managers, Peace Corps volunteers, and researchers from the United States and Zimbabwe, sought to find solutions that would save human lives, crocodiles, and a traditional belief system that promoted conservation. Results include a resurgence of the traditional belief system of the area, enforcement of taboos by local residents, construction of wells as an alternative source of water, and no crocodile-related deaths for over 22 months.

C50-05 PAVLOVIC, NOEL, Ralph Grundel, and LuAnn Forste. U.S. Geological Survey, Great Lakes Science Center, Lake Michigan Ecological Research Station, 1100 North Mineral Springs Road, Porter, IN 46304, USA (Noel_Pavlovic@usgs.gov).
OAK SAVANNA PLANT DIVERSITY ACROSS A GRASSLAND-FOREST CONTINUUM

The distribution of plant diversity within the savanna ecosystems of the Midwest is poorly characterized, because little savanna remains, and it has been greatly modified. We examined how plant diversity varies across 25 historic sand savanna sites in Northwest Indiana as part of a larger study to examine faunal diversity. Due to differences in fire history and management, these sites exist today in a variety of states ranging from open fields, savannas and woodlands, oak scrub habitat and forests. We sampled the ground layer vegetation from twenty 1 by 2 m random plots in each of the sites. We quantified canopy closure, PAR, woody plant density, soil chemistry and 20 year fire history for each site. Plant species richness was highly positively correlated with PAR and frequency of recent fires, and negatively correlated with mean fire interval, canopy closure and tree density. Plot richness increased almost four-fold (5 to 19 species) from unburned to frequently burned sites. Oak savannas and scrub are

compositionally distinct from forests and open sites. Analysis on a plot basis demonstrates the compositional and indicator species uniqueness of oak savanna compared to prairie and forest. Oak savanna plant diversity is dramatically reduced by fire suppression.

S14-05 PAYNE, LAURA X., Brian A. Harrington, Julia K. Parrish, and Stanley A. Temple. Department of Wildlife Ecology, University of Wisconsin–Madison, Madison, WI 53706, USA (lxp@u.washington.edu) (LXP, SAT); School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA 98195, USA (LXP, JKP); Manomet Center for Conservation Sciences, Manomet, MA 02345, USA (BAH).
CONSERVATION PLANNING FOR MIGRATORY BIRDS AT HEMISPHERIC AND CONTINENTAL SCALES: LESSONS FROM SHOREBIRDS

Conservation planning for migratory birds in the Western Hemisphere has progressed substantially in recent years, including the development of a formalized decision-making process through which to assign conservation priorities to all bird species in all regions of North America. Despite its fundamental importance, this step is difficult to implement in practice because species may have conflicting habitat requirements. Traditional efforts to accommodate conflicting habitat needs have relied on local solutions (e.g., site-based management). However, technical advances for examining processes at large scales (e.g., stable isotopes, spatial and behavioral modeling) offer powerful insights for conservation planning. We use 20 years of shorebird surveys from >1,000 inland and coastal wetlands in the conterminous United States to quantify, using heterogeneity indices, the spatial patterns of 35 species of shorebirds during migration. Our results show that species with similar ecological habits use the continent in diverse ways. Further, a habitat- or energetically-based approach to shorebird conservation may fall short if socio-spatial context is ignored. We suggest ways of incorporating large-scale information into conservation planning, recognizing that as local habitat conditions (though not land ownership) may shift in response to global warming, planning must match the very large scales at which birds use the landscape.

C22-03 PEACOCK, ELIZABETH, and Mary M. Peacock. Program in Ecology, Evolution and Conservation Biology, University of Nevada, Reno, Mailstop 314, Reno, NV 89557, USA (peacock@unr.nevada.edu) (EP); Biological Resources Research Center, University of Nevada, Reno, Mailstop 314, Reno, NV 89557, USA (MMP).
QUANTIFICATION OF BLACK BEAR USE OF SALMON STREAMS

The irruptive spawning runs of Pacific salmon in Southeast Alaska influence many terrestrial and aquatic vertebrates, invertebrates and vegetation. This aquatic-terrestrial interaction has drawn much research attention; however, quantification of the importance of the salmon resource for particular species is rare. I have quantified the number of black bears using stretches of salmon streams in Southeast Alaska using genetic tagging. Over 800 hair samples were collected from five independent streams in 2000. DNA has been extracted and amplified at up to nine microsatellite loci. I will present results regarding the numbers of bears using each stream stretch, and how the population of bears changes over the course of the salmon run. For example, 70 unique individuals used a 1.8 km stretch of stream over the course of eight weeks. This information not only is valuable for those studying animal behavior and aquatic-terrestrial links, but invaluable for conservation and resource managers. For example, in order to widen riparian buffers from industrial logging it is necessary to demonstrate and quantify the importance of these streams for wildlife. Only population-level methods such as genetic tagging, as opposed to individual-based methods such as radio-telemetry, can provide such data.

C09-02 PECK, AMANDA, Jill LaBram, and Craig Allen. South Carolina Cooperative Fish and Wildlife Research Unit, Department of Aquaculture, Fisheries and Wildlife, Clemson University, Clemson, SC 29634, USA (apeck@clemson.edu).
DESCRIPTION OF AN ACCURACY ASSESSMENT METHOD FOR GAP ANALYSES MODELS

Gap Analysis vertebrate models need validation to assess their accuracy. The most common accuracy assessment used for gap models is to compare predicted species models with species checklists. We developed an accuracy assessment method for Gap Analysis species occurrence models by building sample-based models from monitoring data. Our key assumption is that our captures represent the "true distribution," using a criteria that >5% of the total captures are needed for a species to be considered "present" in a landcover. Composite species richness maps are created for the models, and spatial correspondence of species richness is determined by subtracting sample-based richness models from the predicted models. Omission and commission errors are calculated based on spatial correspondence for species richness, and based on percentage of area (i.e., hectares) and landcover (i.e., number of landcovers) agreement for individual species. The nodes of highest richness are compared by determining spatial correspondence for the models. Using data sets from long-term monitoring studies decreases errors associated with spatial and temporal variability in animal-habitat use and increases the odds of detecting rare species; thus they provide ideal data with which to assess the accuracy of gap models.

C25-04 PE'ER, GUY, Simone Katharina Heinz, Karin Frank, Christian Wissel, Uzi Motro, and David Saltz. Mitrani Department for Desert Ecology, Ben-Gurion University of the Negev, Sde Boker Campus, 84990 Sde Boker, Israel (peerg@bgumail.bgu.ac.il) (GP, DS); Department of Ecological Modeling, UFZ-Centre for Environmental Research Leipzig-Halle, Permoserstr 15, D-04301 Leipzig, Germany (SKH, KF, CW); Department of Evolution Systematics and Ecology, Hebrew University of Jerusalem, 91904 Jerusalem, Israel (UM).
VIRTUAL CORRIDORS: WHEN RESPONSE TO TOPOGRAPHY CANALIZES DISPERSAL

For animals with patchy or fragmented distribution, elements that direct dispersal between populations may affect connectivity patterns and, consequently, metapopulation dynamics. Since many animals respond to topography, it is of high importance to understand the patterns of dispersal in topographically complex landscapes. We present a spatially explicit, individually based model of dispersal in topographically complex landscapes, which is based on field observations on hilltopping behavior in butterflies. Males and virgin females fly upwards, seeking summits for the purpose of mating, while mated females search for patches. Simulations were performed in virtual and realistic landscapes varying in complexity, in order to assess the behavioral parameters that would optimize mating success and the efficiency of patch tracing. We then developed a graphical method of evaluating the directedness of movements using the dispersal kernels of reachability to patches. We demonstrate that slight response to topography is enough to canalize animal movement and create virtual corridors for dispersal, even when the landscape is seemingly non-directional. We demonstrate that simple response to topography results in highly canalized yet complex dispersal patterns, which are not necessarily self-evident. Such patterns should be considered when trying to predict connectivity patterns, metapopulation dynamics, and landscape vulnerability to alterations.

C54-05 PELLATT, MARLOW G., Anita Holtham, and Darren Bos. Parks Canada, Western Canada Service Centre, 300 - 300 West Georgia Street, Vancouver, BC V6B 6B4, Canada and School of Resource and Environmental Management, Simon Fraser University, Burnaby, BC V5A 1S6, Canada (marlow.pellatt@pc.gc.ca) (MGP, DB); Department of Biology, Queen's University, Kingston, ON K7L 3N6, Canada (AH).
PALEOECOLOGY OF SOCKEYE SALMON (*ONCORYNCHUS NERKA*) NURSURY LAKES ON THE WEST COAST OF CANADA

Parks Canada has undertaken a research program examining the utility of paleoecological methods in the understanding of long-term changes in salmon population and their relation to limnological conditions in and around Canada's west coast national park reserves and proposed national marine conservation areas. Diatom, cladocera, stable isotope, and pollen analyses have been performed on 210Pb dated sediments from lakes in or adjacent to Pacific Rim National Park Reserve of Canada, and reveal changes in forest structure, limnological conditions, and possibly salmon populations. The results of this research program contribute to our understanding of the role of marine derived nutrients in lake productivity along the west coast of Canada. This research indicates that while salmon-derived nutrients may be of key importance in juvenile salmonid development in some lakes, this may not be the case in all systems, especially those in which flushing rates are high. In these systems diatom communities appear to be more sensitive to fluctuations in salmon populations than stable isotope methods, provided that other changes in trophic status are minor. The role of this type of research in ecosystem management is important to Parks Canada and will assist in understanding the complexities of conservation ecology and fisheries.

C37-04 PERGAMS, OLIVER, J. Chris Haney, and Dennis Nyberg. Department of Conservation Biology, Chicago Zoological Society, Brookfield, IL 60513, USA (olpergam@brookfieldzoo.org) (OP); The Nature Conservancy, 4245 North Fairfax Drive, Suite 100, Arlington, VA 22203, USA (JCH); Department of Biological Sciences, University of Illinois at Chicago, 845 West Taylor Street, Chicago, IL 60607, USA (DN).
BROAD ECONOMIC INDICATORS PREDICT CONSERVATION EFFORT

Our hypothesis is that measures of conservation spending in the U.S. economically act as luxuries, and are closely and positively correlated with measures of economic success. If this hypothesis is correct, when the economy expands, excess capital exists in the system which is used for luxuries, including conservation spending. In this case we would expect conservation spending to increase. When the economy contracts, there is less or no excess capital in the system to be used for luxuries. In this case we would expect conservation spending to decrease. We tested this hypothesis by comparing selected conservation effort indicators [contributions to NGOs, no. of conservation graduate programs, National Park Service (NPS) visitation and acreage, no. of members of conservation professional organizations] with broad economic indicators [Dow Jones Industrial Average, S&P 500 Index, Gross Domestic Product (GDP), and Personal Income (PI)] using Spearman rank-order correlation analysis. Almost all correlations were positive and highly significant ($P < 0.0005$). Acknowledging the effect of relatively constant economic growth on our correlations, we adjusted for growth by comparing % year-to-year changes of all variables. We also estimated the lag period between economic indicators and conservation effort. We still found positive and highly significant ($P < 0.0005$) correlations between contributions and GDP/PI of the same year, NPS acreage and GDP/PI with a three-year lag, and NPS visitation and PI with a four-year lag. We then used linear regression to formulate predictive models for these variables.

P140 **PERLIK, MATTHEW,** Brock McMillan, Gregory Johnson, and John Krenz. Department of Biological Sciences, Minnesota State University, Mankato, S242 Trafton Science Center, Mankato, MN 56001, USA (mattperlik@yahoo.com) (MP, BM, JK); Western Ecosystem Technology, Inc., 2003 Central Avenue, Cheyenne, WY 82001, USA (GJ).
SPECIES COMPOSITION OF BAT MORTALITIES CAUSED BY WIND-ENERGY TURBINES AT BUFFALO RIDGE, MINNESOTA

Electricity-generating wind turbines have become an increasingly important source of energy in the United States. More than 350 wind turbines have been built along Buffalo Ridge, a glacial moraine, in southwestern Minnesota. These wind turbines have been found to kill bats. To begin to understand the impact of wind turbines on bats, we collected baseline data on the bat species affected and the composition of the regional community. Areas beneath 80 and 100 wind turbines were searched biweekly for bat carcasses during the summer of 2001 and 2002, respectively. Age, sex, and the number of bats killed by species were determined. Community composition in turbine areas and the region was sampled using mist nets and Anabat bat detectors. We found 71 and 40 bat carcasses in 2001 and 2002, respectively. In decreasing order of abundance, bats killed were the hoary (77%), eastern red (13%), big brown (5%), silver-haired (3%), and little brown myotis (2%). In contrast, the big brown bat (62%) dominated the regional community followed by silver-haired (17%), little brown myotis (11%), eastern red (7%), and hoary bats (3%). It appears that high-flying solitary bats are more susceptible to collision with turbines than other species.

C45-05 Perry, James A., and **STANLEY ASAH.** Department of Fisheries, Wildlife, and Conservation Biology, University of Minnesota, 1980 Folwell Avenue, St. Paul, MN 55108, USA (JAP); Water Resources Science, University of Minnesota, 115 Green Hall, 1530 Cleveland Avenue North, St. Paul, MN 55108, USA (asah0002@umn.edu) (SA).
THE STOICHIOMETRY OF DETRITUS AND DETRITIVORE FOOD QUALITY PREFERENCES IN A COLD STREAM

Conserving biological species often require knowledge about the relationship between that species and their food resources. Often, the emphasis is on food quantity. The resource ratio competition theory and the phenomena of homeostasis suggest that elemental stoichiometry or food quality, also plays a significant role in determining community structure. A leaf pack colonization experiment was conducted to investigate the effect of leaf elemental stoichiometry (C:N:P ratios) on detritivore food quality preferences and its implications on benthic community structure. In this experiment, leaves of the same species, *Nasturtium officinale* with significantly different C:N:P ratios were harvested, heat treated to destroy feeder deterrents, dried, weighed and packed in mesh bags for field exposure. They were allowed in competitive units to be colonized by benthic detritivores in a riffle stretch within a cold stream tributary of the St. Croix River, MN. The species, *Gammarus pseudolimnaeus*, *Physella gyrina*, *Brachycentrus americanus* and *Hesperophyax designatus* all demonstrated species specific preferences based on C:N:P stoichiometry. Our results indicate that food quality is equally important in determining species resource competitive ability. Elemental stoichiometry has implications on species conservation because competition for food resources is one of the many natural phenomena that lead to species extinction.

C20-07 **PFEIFER, SHARON,** Faith Balch, Hannah Dunevitz, Bart Richardson, and Siobhan Boylan. Minnesota Department of Natural Resources, Central Region, 1200 Warner Road, St. Paul, MN 55106, USA (sharon.pfeifer@dnr.state.mn.us).
SCALING UP POLICY, PLANNING, AND INVESTMENTS TO CONSERVE REGIONALLY SIGNIFICANT ECOLOGICAL AREAS

The Twin Cities Metropolitan Area (TCMA) consists of 189 municipalities, each responsible for land use decisions. The plethora of jurisdictional and cultural boundaries has contributed to habitat fragmentation and loss in the region and creates challenges for natural resource conservation. Taking a blind eye to jurisdictional and cultural boundaries, the DNR's regional ecological assessment identified 230,000 acres of high quality terrestrial and wetland habitats remaining in the TCMA. Simultaneously with the development of this regional assessment, the DNR participated for almost 2 years with the Metropolitan Council and a group of atypical external stakeholders to revise regional policies and practices. An important outcome of the participatory process was the creation of new natural resources policy, goals, and implementation strategies for inclusion in the Met Council's Blueprint 2030. The region's Blueprint 2030 provides limited, but important opportunities to scale up natural resource conservation to the regional level and includes: 1) natural resources policy integration into established regional Systems governed by the Metropolitan Council; 2) the incorporation of new natural resource policies and goals into the mandated local comprehensive planning process; and 3) changes to selection criteria and weighting of environmental considerations used in regional funding programs.

C37-01 **PHILIPPON, DANIEL J.** Department of Rhetoric, University of Minnesota, 78 Classroom Office Building, 1994 Buford Avenue, St. Paul, MN 55108, USA (danp@umn.edu).
THE CALL OF THE WILD: ALDO LEOPOLD, ECOLOGY, AND THE WILDERNESS SOCIETY

Of Aldo Leopold's sixty-one years, 1935 seems to have been the crucial one, a clear turning point in his evolving understanding of nature. It was the year he helped found The Wilderness Society, the year he purchased his Sauk County "Shack," and the year he first publicly used the term "land ethic." We explored the rhetorical context for the evolution of Leopold's wilderness thought

before and after 1935. We found that when Bob Marshall and others asked Leopold to join them in organizing The Wilderness Society, what they wanted was Leopold the forester and wildlife manager, but what they got was Leopold the ecologist. Unlike many historians, who have tended to minimize Leopold's role in The Wilderness Society, we claim that Leopold made two critical contributions that deeply affected the organization's scope and direction. First, he encouraged his fellow councilors to broaden the Society's justifications for wilderness preservation to include ecological criteria, particularly through collaboration with the Ecological Society of America, and, second, he encouraged them to broaden the Society's idea of "wilderness" to extend beyond traditional aesthetic notions and incorporate other kinds of land use.

C18-08 PIDGEON, ANNA M., Nancy E. Mathews, and Volker C. Radeloff. Department of Forest Ecology and Management, University of Wisconsin–Madison, 120 Russell Labs, 1630 Linden Drive, Madison, WI 53706, USA (apidgeon@facstaff.wisc.edu) (AMP, VCR); Department of Wildlife Ecology, University of Wisconsin–Madison, 226 Russell Labs, 1630 Linden Drive, Madison, WI 53706, USA (NEM).
STICK-TIGHTS AND NOMADS IN THE CHIHUAHUAN DESERT; CLASSIFICATION OF BIRD SPECIES BASED ON THEIR ABUNDANCE AND NEST SUCCESS PATTERNS

Multiple-year, landscape-wide assessments of avian demographic rates are important for conservation because there are often large variations in their spatial and temporal patterns. We examined spatial and temporal patterns of abundance and nest success rates for members of the avian community in a mosaic of seven habitat types in the northern Chihuahuan Desert over three breeding seasons. We found a variety of patterns. Some species belonging to a generalist food guild, exemplified by the Crissal Thrasher, were limited to a core nesting habitat type, with expansion into suboptimal habitat following a year of high nest success. In other species, belonging to specialist feeding guilds and exemplified by the Scott's Oriole, adult abundance shifted among habitats from year to year, in a nomadic fashion. This nomadism was not related to previous year's breeding success, vegetation quality or breeding density. Further, the patterns of nest density and nest success we found were not necessarily spatially-correlated with patterns of adult abundance. Given that patterns of adult abundance and patterns of nest success may be decoupled, we suggest that measures of both abundance and nest success will provide the best index to habitat quality.

P129 PIERCE, ANN, and Peter Reich. Conservation Biology Graduate Program, University of Minnesota, St. Paul, MN 55108, USA (ann.pierce@dnr.state.mn.us) (AP); Department of Forest Resources, University of Minnesota, St. Paul, MN 55108, USA (PR).
THE LOSS OF BLUFF PRAIRIES DUE TO INCREASES IN THE INVASION OF NATIVE EASTERN RED CEDAR: IS THE SYSTEM RESILIENT?

Bluff prairies have typically been spared from the plow and development due to steep topography, but Eastern red cedar, *Juniperous virginiana*, invasion has increased due to lack of fire. Important management questions are how does this invasion affect ecological properties and is the system resilient? To examine the effect of cedar invasion on ecological properties of bluff prairies and the resilience of these prairies, four research sites were established. Six cedar trees were selected on each site and that three were removed at the beginning of the experiment. Four plots were established in different slope positions surrounding existing and removed trees. Control plots were established in areas free of cedar trees. Results indicate there are significant differences in ecological properties relating to slope position under existing trees. During dry periods differences in properties such as soil moisture and temperature were significant when comparing existing tree plots versus removed tree plots. Properties such as soil moisture and temperature in the removed tree plots quickly approached those measured in control plots. Preliminary results indicate that eastern red cedar does affect ecological properties in the bluff prairie ecosystem but the system demonstrates resilience and various properties approach levels recorded in control plots.

P074 PIKE, DAVID A., Richard A. Seigel, and Rebecca B. Smith. Department of Biological Sciences, Towson University, Towson, MD 21252, USA (dpike1@towson.edu) (DAP, RAS); Dynamac Corporation, Mail Code DYN-1, John F. Kennedy Space Center, FL 32899, USA (RBS).
LONG-TERM CHANGES IN THE DEMOGRAPHY OF THE GOPHER TORTOISE (*GOPHERUS POLYPHEMUS*)

Long-lived species, including turtles and tortoises, are of general conservation concern because slight changes in recruitment rates can drastically affect population viability, yet may easily go unnoticed because of extreme adult longevity. For demographic changes to become apparent long-term data sets are needed; however few long-term demographic studies are available for the gopher tortoise, *Gopherus polyphemus*, even though it is listed as Federally Threatened or a Species of Special Concern throughout its range. From 1994-2002, we studied the demography of gopher tortoises at a protected site, the Kennedy Space Center, Florida, USA. Sex ratios varied temporally from male biased to female biased in various years, although in all years combined sex ratios were not different from 1:1. Mean body size also varied slightly among years, although not significantly.

Recapture rates increased linearly between 1994 and 1998, but declined precipitously thereafter. The change in recapture rates coincided with the discovery of Upper Respiratory Tract Disease (URTD) and a sudden increase in mortality rates of adults at the site; whether this decrease is associated with URTD or reflects higher recruitment rates during this period cannot be determined at this time.

P080 POMERANTZ, JULIE, Leon Pierrot Rahajanirina, Andoniaina Radosoa Andrianaivoarivelo, Harilala Rakotomanana, Edward Dubovi, Susan Wade, and Luke Dollar. Nicholas School of the Environment and Earth Sciences, Duke University, Durham, NC 27708, USA (fossavet@aol.com) (JP, LD); University of Antananarivo, Antananarivo, Madagascar (LPR, ARA, HR); New York State Animal Health Diagnostic Laboratory, College of Veterinary Medicine, Cornell University, Ithaca, NY 14852, USA (ED, SW).
DISEASES OF NON-NATIVE CARNIVORES: THREATS TO MADAGASCAR'S ENDEMIC FAUNA

Viral and parasitic diseases introduced by non-native carnivores threaten the health of Madagascar's endemic fauna. Evolution in isolation has left the animals of Madagascar naive to these foreign pathogens. Native populations stressed by habitat destruction, predation and competition with introduced species may be even more susceptible to the effects of disease. Man's companions, domestic dogs and cats, have brought introduced diseases to the forests edges. Populations of wild or feral cats also live within the forest and may act as bridges to the domestic cat population. Serologic surveys are revealing the patterns of disease prevalence in populations of introduced species and evidence of exposure among native carnivores. With knowledge of the parasites and diseases that plague the wild carnivores, it may be possible to prevent the spread of disease or to intervene in the case of an outbreak. Data regarding the prevalence of infectious diseases in the domestic carnivore population will be important for future monitoring and population risk assessment. They may also be a significant factor when determining policy regarding human activities within park boundaries.

S15-02 POMEROY, CAROLINE. Institute of Marine Sciences, University of California, Santa Cruz, Earth and Marine Sciences Building A 316, Santa Cruz, CA 95064, USA (cpomeroy@ucsc.edu).
SOCIAL, CULTURAL AND ECONOMIC CONSIDERATIONS FOR MARINE RESERVE DESIGN

Marine reserves have garnered considerable interest as a tool for ocean resource management. Whether intended primarily for the conservation of biodiversity and broad ecosystem management, or specifically for fishery management, the marine reserve design process requires scientific information on the biophysical and human environments, and the interaction between them. Yet while the biophysical dimensions of marine reserves have received considerable attention, their human dimensions have been neglected. The human dimensions include social, cultural and economic features such as use patterns; values, attitudes and beliefs; community organization and local institutions; and social, cultural and economic costs and benefits. Evidence from case studies in California, St. Lucia, the Philippines and elsewhere suggests that this imbalance contributes to the difficulties, and in some cases failure, of efforts to design effective marine reserves. Specifically, inadequate attention to the human dimensions in the decision-making process and in the design, implementation, management and evaluation processes have contributed to these problems. In contrast, where human dimensions information has been consciously and meaningfully integrated into marine reserve decision-making and design processes, those processes have resulted in a constructive and supported process, and the designation of marine reserves capable of achieving their goals.

C48-05 POMILLA, CRISTINA, and Howard Rosenbaum. Wildlife Conservation Society, Science Resource Center, 2300 Southern Boulevard, Bronx, NY 10460, USA (cp371@nyu.edu) (CP, HR); Department of Biology, New York University, 100 Washington Square, New York, NY 10012, USA (CP); American Museum of Natural History, Molecular Systematic Laboratory, 79th Street at Central Park West, New York, NY 10024, USA (CP, HR).
SOCIAL STRUCTURE AMONG RECOVERING HUMPBACK WHALE POPULATIONS ON THEIR BREEDING GROUNDS IN MADAGASCAR AND GABON BASED ON GENETIC MARKERS AND SURVEYS

Knowledge of mating systems and social organization can provide guidance for species conservation. Whale populations recovering from commercial hunting may benefit from a better understanding of extrinsic factors potentially impacting their sociality and reproduction. Biopsy samples and behavioral data were collected from 1996 to 2002 during surveys of Antongil Bay, Madagascar and of Gabon coastal waters to determine social structure of humpback whales on two Southern Hemisphere breeding grounds. Molecular sexing and eight nuclear microsatellite markers were used to investigate group types and sizes as well as patterns of relatedness. The distribution of group types and the significantly lower number of females in large groups were consistent with a polygynous mating system where males congregate to compete for females. Females preferred pairing with a male and all instances of groups including two females were mother-calf associations. Some within-pairs pairwise comparisons revealed higher relatedness scores than randomly sampled individuals, suggesting that related males may pair to cooperate during

competitive encounters and that female-male pairs may sometimes involve extended mother-juvenile kin association. These novel insights on the role of social interactions for humpback whales stress the importance for protection of critical habitat where reproduction and maternal factors influencing calf survival take place.

C28-04 POMPEI, VANESSA, and Francesca J. Cuthbert. Conservation Biology Graduate Program, University of Minnesota, St. Paul, MN 55108, USA (pomp0012@tc.umn.edu) (VP); Department of Fisheries, Wildlife, and Conservation Biology, University of Minnesota, St. Paul, MN 55108, USA (FC).
STOPOVER MIGRATION SITES USED BY GREAT LAKES PIPING PLOVERS

Birds from the Great Lakes population winter primarily along the Gulf of Mexico from southern Texas to Florida, and along the east coast of the U.S. as far north as North Carolina. However, very little is known about migration of Piping Plovers (*Charadrius melodus*) in any part of their range. This information may be critical for the conservation of the population, and will help to identify directions for future research. Although no studies have tracked individual birds during migration, it is possible to obtain information about stopover sites that plovers use. We compiled records (e.g. state atlases, bird journals, national journals, hotlines) of Piping Plover sightings from the "hypothetical migration pathway" used by Great Lakes birds as they move between known breeding and wintering sites. We used these data to identify current and historic stopover sites and to examine changes in sites over time. We located >1600 fall and spring stopover records. Our results show that Piping Plovers use sites throughout the migration pathway, and that they stopover during both spring and fall migration. These results indicate that protection of multiple sites within the migration pathway is potentially important for recovery of the endangered Great Lakes Piping Plover population.

C53-03 POPPELE, JONATHAN M. Conservation Biology Graduate Program, University of Minnesota, 100 Ecology, 1987 Upper Buford Circle, St. Paul, MN 55108, USA (popp0012@umn.edu).
CONVERSATION WITH NATURE: AN EPISTEMOLOGICALLY BASED ENVIRONMENTAL ETHIC FOR CONSERVATION BIOLOGY

There is a need for a rigorously developed environmental ethic that substantively informs how the scientific community, and society at large, interacts with the natural environment. Such an environmental ethic must be presented in practical terms, meaningful to both academic and lay audiences. Unfortunately, many insights from environmental philosophy are not clearly commensurate with environmental science, nor applicable to citizens' lives. I propose that an epistemologically grounded ethic based on the metaphor of respectful conversation with nature holds promise for conservation biology in North America. Such an ethic can be grasped intuitively by the lay person and may open the door to a more direct application of environmental ethics to the process of scientific inquiry. Conceptually, the process of hypothesis testing aligns with the metaphor of conversation. Such an ethic challenges the crisis-oriented, expert-driven approach to conservation common in American thinking, and instead promotes the inquiry and open dialog that are the hallmarks of grassroots democracy. It calls for greater collaboration between scientists and citizens, and highlights the value of amateur naturalists. It also lends conceptual support to the practice of adaptive management and to the use of non-invasive data gathering techniques by both scientists and lay people.

P089 PORTERFIELD, JEAN, Molly Fee, and Jessica Theorin. Department of Biology, St. Olaf College, 1520 St. Olaf Avenue, Northfield, MN 55057, USA (porterfi@stolaf.edu).
DISTRIBUTION AND POPULATION GENETICS OF THE BANDED DARTER IN MINNESOTA

Etheostoma zonale, the banded darter, is a small, freshwater, non-game fish that reaches the northwestern boundary of its range in southern Minnesota. Field work throughout southern Minnesota found the banded darter at many historical localities and at several new localities; overall the distribution in Minnesota is spotty. Population genetic information for populations isolated by distance to varying degrees is often useful in conservation decisions. DNA sequences of 550 nucleotides of the mitochondrial cytochrome *b* gene of 30 banded darters from seven localities in Minnesota were compared to the sequence of a banded darter from central Illinois. A high degree of similarity was found among individuals of all populations, with pairwise sequence divergences reaching only 0.6%. This result is consistent with some hypotheses of banded darter post-glaciation colonization, but further studies on the conservation genetics of this fish will incorporate a different molecular marker.

C44-02 POWERS, LINDSAY. Large Lakes Observatory, University of Minnesota Duluth, 109 RLB, 2205 East 5th Street, Duluth, MN 55812, USA (powe0285@d.umn.edu).
CONSERVATION GENETICS OF THE FRESHWATER MUSSEL *MARGARITIFERA FALCATA* FROM THE NORTHWESTERN UNITED STATES

Freshwater mussels are at great risk for losing genetic variability due to declining and increasingly fragmented habitat for themselves and the fish they depend upon for development and dispersal. I used starch gel electrophoresis to examine enzyme

variation in eleven populations of *Margaritifera falcata* from the Columbia River drainage basin, one population from the Klamath River drainage basin, and one population from the Malheur drainage basin. Of the thirteen populations sampled, three showed no genetic variability. Mean observed heterozygosity (H_o) for all populations was 0.038 with values ranging from 0 to 0.096. Seven of thirteen populations had at least one locus that did not meet Hardy-Weinberg expectations (Fisher's Exact Test, $p < 0.05$). In all cases these loci represented a deficit of heterozygotes ($F_{IS} > 0$). Based on Wright's F-statistics, within population genetic variation was 57% of total variation, while among population variation was 41%. The results of this study exhibit strong evidence that eight of the thirteen populations are undergoing some degree of self-fertilization. The remaining five populations are either monomorphic, or exhibit very low levels of polymorphism. Conservation strategies for this mussel should focus on the preservation of several geographically diverse populations.

C53-04 PREUS, LAURA, Thomas Fiutak, Kristen Nelson, and David Bengston. Conservation Biology Graduate Program, University of Minnesota, 180 McNeal Hall, 1985 Buford Avenue, St. Paul, MN 55108, USA and Minnesota Department of Natural Resources, 500 Lafayette Road, Box 10, St. Paul, MN 55155, USA (laura.preus@dnr.state.mn.us) (LP); Hubert Humphrey Institute of Public Affairs, 243 HHH Center, 301 19th Avenue South, Minneapolis, MN 55455, USA (TF); Department of Forest Resources, University of Minnesota, 115 Green Hall, 1530 Cleveland Avenue North, St. Paul, MN 55108, USA (KN); USDA Forest Service, North Central Research Station, 1992 Folwell Avenue, St. Paul, MN 55108, USA (DB).
FROM TRAILS TO TROUT: CONFLICT AND LEARNING IN LAND AND WATER DECISION MAKING

Citizen and stakeholder involvement in ecosystem management decision making has increased dramatically in the past decade. To address complex human-environment interdependencies, decision-making arenas must both: 1) incorporate group learning opportunities about ecosystem trends, and 2) manage conflict in productive ways. Two interactive decision-making arenas in Minnesota are examined to identify the factors related to participant knowledge about ecosystem trends and experience of group learning, and conflict. These interactive arenas address urban trout stream management (The Metro Trout Stream Watershed Protection Initiative) and assess issues in Minnesota forests (The Motorized Trail Task Force for developing state forest trails for All Terrain Vehicles). Results from over forty standardized, open-ended interviews with participants indicate the parallel and interactive nature of conflict and learning in influencing citizen satisfaction with ecosystem management decisions. These results are relevant for resource managers, scientists, and policy makers who design participatory arenas for ecosystem management.

S01-04 PRICE, JEFF. American Bird Conservancy, 6525 Gunpark Drive, Suite 370, PMD 146, Boulder, CO 80301, USA (jprice@mho.net).
CLIMATE CHANGE AND BIRDS IN THE GREAT LAKES REGION: IMPACTS, POTENTIAL SURPRISES AND THE NEED TO ADAPT MANAGEMENT PRACTICES

The global average temperature has increased approximately 0.6ºC. The balance of evidence obtained from meta-analyses of published studies suggests that a significant impact from this amount of climatic warming is already discernible in the form of long-term, large-scale alteration of animal and plant populations. These changes include phenological events having advanced approximately 5 days per decade as well as some shifts in species ranges. Models of changes in breeding distributions of North American birds predict that most species will undergo some shift in their ranges. In parts of the Great Lakes region, this could lead to an avifauna with a net loss of up to 30% of the Neotropical migrants occurring there. Unless all components of an ecosystem change at the same rate, an unlikely prospect, this potential disruption of ecosystems could impact forest health. For example, a loss of insectivorous birds could lead to insect outbreaks of increased severity and frequency. This talk will provide an overview of the projected changes in avian biodiversity in the Great Lakes region, discuss some of the possible ecological impacts and what steps managers and conservation planners can take to try to adapt to some of these changes.

P069 PRICE, STEVEN J. Cofrin Center for Biodiversity, University of Wisconsin–Green Bay, MAC Hall 212, 2420 Nicolet Drive, Green Bay, WI 54311, USA (prices@uwgb.edu).
ANURAN-HABITAT ASSOCIATIONS IN WESTERN GREAT LAKES COASTAL WETLANDS: THE ROLE OF HABITAT IN BIOLOGICAL INDICATOR DEVELOPMENT

Amphibians, especially frogs and toads, are increasingly employed as biological indicators because of their sensitivity to environmental degradation. However, their utility as indicators is complicated because relatively little is known about how natural habitat condition influences their distribution. I address this complication by quantifying the effects of habitat composition and scale on the distribution of several anuran species in 63 coastal wetlands of the western Great Lakes region. I conducted anuran-calling surveys and collected habitat variables at both local and landscape scales. Logistic regression was used to predict anuran distributions based on habitat variables. Results help identify the most important habitat variables for several anuran species as well as emphasize the most effective species-specific conservation strategies. The anuran-habitat analysis will be used in the development of anuran-based biological indicators of ecological integrity.

S08-02 PRINGLE, CATHERINE M. Institute of Ecology, University of Georgia, Athens, GA 30602, USA (Pringle@sparc.ecology.uga.edu).
HYDROLOGIC CONNECTIVITY: A NEGLECTED DIMENSION OF CONSERVATION BIOLOGY

Ecosystems throughout the world are threatened by habitat fragmentation caused by alterations in hydrologic connectivity. Hydrologic connectivity is used here in an ecological sense to refer to water-mediated transfer of matter, energy and/or organisms within or between elements of the hydrologic cycle. Dams, flow regulation, water diversion, and groundwater extraction are just a few of the many ways that human activities alter this property. Additionally, hydrologic connectivity perpetuates the flow of nutrients, toxic wastes, and exotic species in the landscape. The theoretical underpinnings of the conservation biology of fragmented landscapes were developed under a conceptual model of landscapes that were not yet entirely fragmented, and when awareness of hydrologic connectivity was in its infancy. The words 'stream' and 'river' do not even appear in the indices of major books on the subject of habitat fragmentation. Correspondingly, the debate among conservation biologists regarding the importance of size, shape, and configuration of biological reserves has ignored the importance of hydrologic connectivity. Here I highlight the consequences of aquatic fragmentation at levels from genes to ecosystems and on local to global scales. I will focus on the interacting effects of altered hydrology and contaminant transport, emphasizing the vulnerability of biological reserves.

C43-02 PRIOR, KENT, and Melissa Vance. Species at Risk Recovery, Canadian Wildlife Service, Place Vincent Massey, 4th Floor, 351 St. Joseph Boulevard, Gatineau, PQ K1A 0H3, Canada (kent.prior@ec.gc.ca).
CRITICAL HABITAT FOR SPECIES AT RISK: SCIENCE-BASED GUIDANCE FOR ITS IDENTIFICATION IN CANADA

The new Canadian Species at Risk Act (SARA - Bill C-5) requires the identification of critical habitat for some 260 nationally extirpated, endangered, and threatened species during the recovery planning process. Critical habitat is defined in SARA as the habitat necessary for the *survival* or *recovery* of a listed wildlife species. Operational guidance on how to best identify critical habitat is required to help standardize this mandatory task. Practical direction will promote a consistent, transparent, and science-based identification process resulting in defensible critical habitat proposals that encompass what is believed to be both necessary and sufficient to achieve survival or recovery of the species. To this end, through discussion papers, expert workshops, and heuristic case studies, our working group has drafted an iterative process for the identification of critical habitat. Proposed steps in this process are as follows: evaluate problem; establish conservation goal; assess feasibility; summarize species' ecology; locate species / habitat occurrences; model demography / habitat; subject model results to peer-review; identify critical habitat; implement protection, monitor efficacy; revise as necessary. Application of this draft procedure will be illustrated by examining the critical habitat requirements of a threatened population of black rat snakes (*Elaphe obsoleta*).

C47-06 PYKE, CHRISTOPHER R. National Center for Ecological Analysis and Synthesis, University of California, Santa Barbara, Santa Barbara, CA 93106, USA (pyke@nceas.ucsb.edu).
MULTI-SCALE CONSERVATION PRIORITY SETTING FOR THE ENDANGERED CALIFORNIA TIGER SALAMANDER USING NETWORK ANALYSIS

The Santa Barbara population of the California tiger salamander is threatened by habitat loss and fragmentation resulting from land-use and land-cover change. Designation of the salamander under the U.S. Endangered Species Act has made it a major factor in planning for agriculture and urban development in northern Santa Barbara County. This research developed new methods for identifying and prioritizing ponds, terrestrial habitat, and landscape linkages that are important for salamander conservation. The technique uses Geographic Information System-based networks to synthesize information across a range of scales and prioritize landscape features in a private-land dominated landscape. Five distinct sub-populations isolated by intervening land-use, such as intensive agriculture, roads, and urban areas were identified. The network analysis also revealed both degraded and high priority network nodes (ponds and terrestrial habitat) and edges (landscape linkages). The analysis indicated that remaining sub-populations are vulnerable to dramatic changes in overall connectivity with the loss of only few additional network nodes and edges. The protection of these critical features can reduce the sensitivity of the entire habitat network to future habitat loss and provide a foundation for population stabilization and ultimately species recovery.

C47-01 RADELOFF, VOLKER C., Roger B. Hammer, Adrian Treves, and Susan I. Stewart. Department of Forest Ecology and Management, University of Wisconsin–Madison, 1630 Linden Drive, Madison, WI 53706, USA (radeloff@facstaff.wisc.edu) (VCR, AT); Department of Rural Sociology, University of Wisconsin–Madison, 1180 Observatory Drive, Madison, WI 53706, USA (RBH); USDA Forest Service, North Central Research Station, 1033 University Avenue, Suite 360, Evanston, IL 60201, USA (SIS).
THE WILDLAND-URBAN INTERFACE IN THE UNITED STATES

The detrimental effects of humans on wildlife and plant populations are a major conservation problem. The wildland-urban interface (WUI) is where human development and (semi-)wild ecosystems intermingle. Human-wildlife conflicts, exotic species

invasions, wildfire risk to structures, and forest harvesting to reduce fuel loads are concentrated in the WUI. Our objective was to conduct the first national GIS based assessment of the WUI in the United States. Housing data were derived from the US Census at the block level, and integrated with vegetation data from the USGS National Land Cover Dataset. We estimated both intermix WUI (where wildland vegetation and housing intermingles within a census block) and interface WUI (housing within 1.5 miles of wildland vegetation). WUI is widespread in the fringes of metropolitan areas (e.g. Los Angeles, Denver), but also in rural areas rich in recreational amenities (e.g. the upper Great Lakes). The proportion of WUI is highest in the Midwest, but most of the absolute area occurs in the West. Intermix is the dominant WUI type. The national WUI assessment provides an indicator for human impacts on the environment and can facilitate in-depth studies on causal relationships between housing and wildlife or plant populations.

P013 RAKOTOARISOA, JEAN ERIC. The Peregrine Fund, BP 4113, Antananarivo (101), Madagascar and Department of Biological Sciences, Illinois State University, PO Box 4120, Normal, IL 61790-4120, USA (jerakot2@ilstu.edu).
BREEDING, FORAGING BEHAVIOR AND HABITAT CHARACTERISTICS OF THE SCALY GROUND-ROLLER (AVES: *BRACHYPTERACIAS SQUAMIGER*) OF MADAGASCAR

The Scaly Ground-Roller, *Brachypteracias squamiger*, of Madagascar is classified as a vulnerable species by the IUCN. Despite its status, little information is available on the behavioral ecology and breeding biology of this endemic species. The Scaly Ground-Roller was studied during two breeding seasons from October 1997 to January 1999 in Masoala National Park. Of the 269 prey items observed, earthworms (55%) and centipedes (21%) were the most numerous prey-types taken (n = 4 individuals). Nests were placed in ground burrows with tunnels that measured less than 10 cm in diameter and less than 1 m in depth. A single egg clutch was laid in each nest (n = 3 nests), and incubation and the nestling periods lasted 18 days and 24 days, respectively. Trees were only used for resting, perching when defending territories and roosting. A few times, individuals were seen foraging in clearcuts which suggests they might tolerate a certain degree of deforestation as long as the forest nest site is intact. The low reproductive rate (one young per nest) suggests that the species has a low ability to rebound from population decline and therefore is more vulnerable to demographic and environmental stochasticity.

P125 RAY, JULIE M., and Richard B. King. Department of Biological Sciences, Northern Illinois University, DeKalb, IL 60115, USA (z050051@wpo.cso.niu.edu).
POSSIBLE POSITIVE EFFECTS OF THE EXOTIC ROUND GOBY ON THE THREATENED LAKE ERIE WATER SNAKE

Long-term studies provide a unique opportunity to identify ecological factors that affect populations. The Lake Erie water snake (*Nerodia sipedon insularum*) is an Ohio state endangered and federally threatened species, which resides on the islands in Western Lake Erie. An extensive database of over 5000 captures spanning 23 years was analyzed to determine temporal patterns of variation in body size and condition. Maximum adult body size increased significantly in both females and males over time. Condition (a size-independent measure of relative mass) showed significant year-to-year variation, but no long-term temporal pattern was observed. These changes appear not to result from annual variation in weather. However, the introduction of the round goby (*Neogobius melanostomus*) to Western Lake Erie in 1995 has provided a new food base for *N. s. insularum*, and may account for increases in body size seen in this study. Thus, the introduction of *N. melanostomus*, a non-indigenous species, may have a positive impact on *N. s. insularum*.

C20-02 REDFORD, KENT H., and Michael Painter. Wildlife Conservation Society Institute, Wildlife Conservation Society, 2300 Southern Boulevard, Bronx, NY 10460, USA (kredford@wcs.org) (KHR); Wildlife Conservation Society Peru, Bolivia and Paraguay Program, Casilla 6272, Santa Cruz, Bolivia (MP).
BUILDING RELATIONSHIPS BETWEEN CONSERVATIONISTS AND INDIGENOUS PEOPLES BEFORE THE FOREST IS DESTROYED

The survival of both indigenous peoples and much of what remains of nature lies in the ability of both sides to find common ground. However, the map of this common ground is being torn to shreds by suspicion, shortsightedness and politics masquerading as science. Parks and protected areas have become the focus of conflict between conservationists and indigenous peoples, despite their strong potential to be areas where these two interest groups could cooperate. In this paper we provide a case study illustrating how effective such cooperation can be. The Kaa-Iya del Gran Chaco National Park and Integrated Management Area (KINP) was designed and implemented as the result of a collaboration between the Wildlife Conservation Society (WCS) and the Capitanía de Alto y Bajo Izozog, the organization representing the 9000 Guaraní people known as Izoceños. The park, encompassing approximately 3.5 million hectares of Bolivian chaco, is the only national park in the Americas established on the initiative of a Native American People, and the only one where a Native American organization shares primary administrative responsibilities with the national government.

P117 REEDER, KATY, Brent Danielson, William Hohman, and Diane Debinski. Ecology, Evolution and Organismal Biology, Iowa State University, 124 Science II, Ames, IA 50011, USA (reederka@iastate.edu) (KR, BD, DD); Natural Resource Ecology and Management, Iowa State University, 124 Science II, Ames, IA 50011, USA (WH).
FRINGE BENEFITS OF AGRICULTURAL CONSERVATION POLICY: FILTER STRIPS AND BUTTERFLIES

Since 1985, federal and state governments have been partnering with landowners to establish permanent vegetative cover on erodible cropland through cost-share programs such as the Conservation Reserve Program (CRP) and the Conservation Reserve Enhancement Program (CREP). These programs promote filter strips (grassy plantings along watercourses), which reduce sediment runoff and stabilize streambanks. Adding wildlife habitat is an additional goal of filter strip establishment. In 2002, we began studying the potential risks and benefits of filter strips for butterflies in the Minnesota and Des Moines River watersheds. We measured adult butterfly abundance, diversity, and mortality due to predation to determine whether filter strip width, vegetation structure or planting mix affect butterflies. Preliminary results indicate that the abundance of forbs is positively correlated with butterfly abundance. Predation rates on butterflies were not different between block and linear habitats. However, this may result from the fact that the primary predators observed were ground-dwelling rather than aerial.

C41-01 REGAN, HELEN, David Keith, and Mark Tozer. Department of Biology, San Diego State University, 5500 Campanile Drive, San Diego, CA 92182-4614, USA (regan@nceas.ucsb.edu) (HR); Biodiversity Research Group, NSW Nationl Parks and Wildlife Service, PO Box 1967, Hurstville, NSW 2220, Australia (DK, MT).
THE EFFECTS OF DISEASE AND FIRE ON THE LONG-TERM PERSISTENCE OF A PERENNIAL SHRUB: *XANTHORRHOEA RESINIFERA*

Xanthorrhoea resinifera is a long-lived plant occurring on the south-east coast of Australia. Like many perennial Australian shrubs, *X. resinifera* has a complex relationship with fire. Fire reduces the chance of survival of plants whilst triggers flowering and seed production. Populations of *X. resinifera* are subject to a range of threatening processes. While *Xanthorrhoea* may survive bushfires, such survival is highly structured in relation to plant size and fire intensity and frequency. Furthermore, *Xanthorrhoea* species are susceptible to the root pathogen *Phytophthora cinnamomi* which reduces survival of established plants. The long-term effects of these threats is poorly understood. We constructed a stochastic, individual-based model using 10 years of demographic data to investigate the effects of an altered fire regime and disease on the long-term persistence of sub-populations of *X. resinifera*. We included density dependent processes with con-specific neighbors as well as shading by neighboring Banksia plants. We demonstrate that the chance of long-term persistence depends on the timing of fire and the extent of disease. We show that the increased seed production and recruitment following a fire may somewhat alleviate the increase in mortality due to disease. In this way, fire could be a management tool for this species.

C19-02 REGOSIN, JONATHAN V., J. Michael Reed, and Bryan S. Windmiller. Department of Biology, Tufts University, Medford, MA 02155, USA (jonathan.regosin@tufts.edu) (JVR, JMR); Hyla Ecological Services, PO Box 182, Lincoln, MA 01773, USA (BSW).
TERRESTRIAL HABITAT USE BY POOL-BREEDING AMPHIBIANS IN THE EASTERN FOREST: A STUDY USING LARGE-SCALE FIELD ENCLOSURES

We studied terrestrial habitat use by spotted salamanders (*Ambystoma maculatum*), blue-spotted salamanders (*A. laterale*), wood frogs (*Rana sylvatica*), and eastern newts (*Notophthalmus viridescens*) at two sites containing three breeding pools. Large blocks of terrestrial habitat were enclosed by pitfall traps and fencing so that movement patterns of resident amphibians could be studied. Terrestrial densities within 26 field enclosures located 0-300 m from breeding ponds were generally low (Range 0-4 individuals of each species / 100 m^2). At one site, at least 40% of wood frogs, 52% of blue-spotted salamanders, and 60% of spotted salamanders overwintered > 100 m from the breeding pond. Males tended to overwinter closer to the breeding pond than females, although this relationship was not statistically significant for all species in all years. Adult wood frogs and eastern newts were largely absent from upland forest habitat adjacent to the breeding ponds during spring and fall, but entered these areas in significant numbers to overwinter. Wintering eastern newts, wood frogs, and blue-spotted salamander males were concentrated in one block of upland forest habitat north of the breeding pond. Juvenile recruitment fluctuated dramatically across years, resulting in considerable variation in the numbers of juveniles moving through terrestrial habitats. These results suggest that effects of habitat loss on adult and juvenile mortality might vary considerably across years and across seasons. In addition, protection of narrow buffer strips around breeding ponds might be even less effective than was previously thought, due to the disproportionate representation of males within these areas.

C33-03 Reilly, Steve, **TIM GERRODETTE,** Lisa Ballance, Wayne Perryman, Andrew Dizon, Karin Forney, Paul Fiedler, Paul Wade, and Meghan Donahue. NOAA Fisheries, Southwest Fisheries Science Center, 8604 La Jolla Shores Drive, La Jolla, CA 92037, USA (tim.gerrodette@noaa.gov) (SR, TG, LB, WP, AD, KF, PF, MD); NOAA Fisheries, Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle, WA 98115, USA (PW).
ARE DOLPHIN POPULATIONS RECOVERING?

The tuna-dolphin issue has been a prominent marine conservation issue for nearly 40 years. During the last 15 years, the bycatch of dolphins in the tuna fishery has declined greatly, leading to expectations of recovery. The results of a 5-year multidisciplinary study indicate that the most affected populations, northeastern offshore spotted dolphins and eastern spinner dolphins, are remaining at 20% and 35% of their pre-fishery levels, and that neither population is recovering as expected. Hypotheses to explain the lack of recovery are that the reported kill is not accurate, that there are effects of the fishery beyond the reported kill, that carrying capacity has changed, and that a lag occurs before recovery begins. Given available data, none of these hypotheses conclusively explains the lack of recovery, nor can any one hypothesis be clearly rejected. Further, the hypotheses are not mutually exclusive, and all may be operating to various degrees. The most likely explanation appears to be that chasing and encircling dolphins has unobserved effects on survival and reproduction. Because the fishery is intense, small unobserved effects would be sufficient to explain the lack of recovery, while the effect sizes of other hypotheses may not be sufficient.

C57-01 **RENJIFO, LUIS MIGUEL,** Fabio H. Lozano, Paula C. Caycedo, Elizabeth Jiménez, Javier Mendoza, Diana Patricia Ramírez, and Clara Inés Ríos. Instituto de Investigación de Recursos Biológicos Alexander von Humboldt, Calle 37 # 8-40 Mezzanine, Bogotá, D.C., Colombia (lmrenjifo@humboldt.org.co).
BIODIVERSITY CONSERVATION IN RURAL LANDSCAPES: A SEARCH FOR CONSERVATION OPPORTUNITIES

Biodiversity conservation in rural landscapes is increasingly important due to profound habitat transformation in many ecoregions, including most of the tropical Andes. Searching for conservation opportunities, we characterized biodiversity and socioeconomic characteristics of different landscape elements in an area of 2500 ha at middle elevation on the Colombian Central Andes. We found six landscape elements: large forest fragments, small forest fragments, riparian vegetation, edge, pastures, and exotic-tree plantations. Pastures and large forest fragments covered 45% and 30% of the landscape respectively. This landscape contained 158 bird species, 122 ant species, and 444 shrub and tree species. These included 2 threatened bird species, 14 threatened plants, and 3 new ant species. Based on an analysis having equal sample sizes, we found that large fragments were more species rich, followed by edges; the pasture matrix was the least species rich for all taxa. Large and small fragments had the highest similarity index; however, overall similarity indexes among landscape elements were low. We developed an index based on socioeconomic variables (describing landscape occupation by people, decision making processes, and production systems) to measure biodiversity friendliness. Most properties within this landscape had middle to high level on this index.

P046 **RENTZ, MICHAEL.** Conservation Biology Graduate Program, University of Minnesota, 180 McNeal Hall, 1985 Buford Avenue, St. Paul, MN 55108, USA (rent0009@umn.edu).
INTERNALIZING THE FOREST: INVESTIGATING THE APPLICATION OF TRADABLE PERMITS IN THE INTERNATIONAL TIMBER TRADE

Deforestation is a significant conservation threat worldwide. One driver of deforestation is the international timber trade, the impacts of which are made worse by not requiring those who profit from logging to pay the full ecological and social costs of their actions. Tradable permits may offer policy makers a way of guiding international trade while respecting national sovereignty. Typically, tradable permits require polluters to internalize the costs of their emissions by obtaining volume based permits equivalent to the amount of their emissions. Normally in natural resource extraction cases, companies obtain permits equivalent to the volume of resource extracted. The proposed tradable permits system is unique in quantifying the ecological impact of logging as the permitted activity, rather than wood volume or area logged. Projects determined to have greater ecological impacts will require more permits than projects of lesser impact, in an attempt to encourage more sustainable logging. Guidelines for determining logging impact and permit quantity and distribution are suggested. Trade in permits will allow nations to capitalize on their forests without cutting them by trading unused permits. Challenges and areas needing further research are discussed.

P059 **RESCHKE, CAROL.** Minnesota Department of Natural Resources, Minnesota County Biological Survey, 1568 Highway 2, Two Harbors, MN 55616, USA (carol.reschke@dnr.state.mn.us).
VEGETATION OF LAKE SUPERIOR ROCKY SHORES IN NORTHEASTERN MINNESOTA: COMPOSITION, DIVERSITY, SIGNIFICANCE, AND THREATS

The overall goal of this study is to promote conservation and appropriate management of sensitive rocky shoreline plant communities in heavily used state parks and public lands along Minnesota's Lake Superior shore. Shoreline plant communities include many lichens and mosses covering rock surfaces, along with disjunct arctic-alpine flowering plants, and a few state-listed rare species. The objectives of this study are 1) to collect vegetation data for refining classification and description of shoreline plant communities, and 2) to evaluate impacts of high visitor use by comparing areas of high visitor use with areas less frequently visited and presumably more pristine. Vegetation data were collected from 38 plots, including 189 species of lichens and bryophytes, and over 100 species of vascular plants. Vegetation analysis resulted in identification of six native plant communities. Plots from areas with high visitor use were compared to samples from relatively pristine areas, revealing that the main impacts of heavy use are reduced plant cover and diversity. Major causes are trampling and fires (campfires, brush piles, bonfires). A potential threat is also posed by construction of new stormwater and sewer systems along roads near the shore that may change hydrology of natural seeps along the shore.

C42-06 REYNOLDS, MARK, Julia Smith, and Gretchen LeBuhn. The Nature Conservancy, 201 Mission Street, 4th Floor, San Francisco, CA 94925, USA (mreynolds@tnc.org) (MR); Holy Names College, 3500 Mountain View Boulevard, Oakland, CA 94619, USA (JS); San Francisco State University, 1600 Holloway Avenue, San Francisco, CA 94132, USA (GL).
BIRD POPULATION DYNAMICS OF SIERRA NEVADA MEADOWS

Montane meadows of the Sierra Nevada are some of the most productive and imperiled habitats for breeding and migrating landbirds in western North America. The Nature Conservancy has recently established the Northern Sierra Project with goals of preserving more than 55,000 acres of currently unprotected mountain meadow habitats. Understanding natural and human influences on quality of montane meadow habitats for biodiversity in the Sierra Nevada is critical to evaluating the success of conservation actions, including direct preservation, mitigation and restoration. Livestock grazing, because of its effects on hydrology, geomorphology and vegetation, is thought to be a primary threat to montane meadow ecosystem function and specifically to ground-nesting and low shrub-nesting migrant and resident landbirds. Meadows in the northern Sierra vary in size, shape, elevation, hydrology, vegetation and current and historical management. To understand the effects of meadow management, including grazing, on bird populations, we have been sampling 50 meadows within the greater northern Sierra region (100 km^2 study area) over the past several years using standard monitoring protocols (point counts, mist-netting, nest searches). Meadows varied substantially in size, habitat heterogeneity, and landscape context. Large meadows generally had higher species richness ($r2 = 0.44$) and diversity ($r2 = 0.23$) and lower species evennness ($r2 = 0.17$). Meadows had unique species assemblages with low inter-meadow community similarity (mean Jaccard's index = 0.32 + 0.04). Wet meadows had significantly greater species richness than dry meadows. Meadows ranking high in species richness ranked high in multiple years. Landscape context, specifically the distance of meadow to its nearest neighboring wet meadow, was an important determinant of species diversity. Species richness decreased with erosion pavement and stream incision effects of livestock grazing. We hope to use bird population metrics to calibrate habitat restoration and measure conservation success.

C56-02 RICH, TERRELL D. U.S. Fish and Wildlife Service, 1387 South Vinnell Way, Boise, ID 83709, USA (terry_rich@fws.gov).
THE PARTNERS IN FLIGHT NORTH AMERICAN LANDBIRD CONSERVATION PLAN: SETTING CONTINENTAL PRIORITIES

Partners In Flight (PIF) has prepared the North American Landbird Conservation Plan, which provides geographic and habitat priorities for 449 species of landbirds that breed in the U.S. and Canada. The biological foundation of the plan is the PIF Species Assessment Database wherein species are scored on 6 attributes. For the first time, we present estimates of continental population sizes and population objectives for all landbirds. This plan will not replace Bird Conservation Plans written at the level of the state, province or physiographic area, but rather will initiate a new round of dialogue on population and habitat objectives at different geographic scales. The highest priority birds (102 species) constitute the new PIF Watch List. We also developed a list of "characteristic species" which include species that may not be rare or declining but which are integral to the biotic integrity of large habitats or regions. These species, along with the Watch List species, are addressed as species suites in the Plan. Our objective now is to help land managers use the PIF plans, along with those from other bird initiatives, to undertake effective habitat conservation actions in the proper geographic context.

C01-06 RICHARDS, DAVID, and Dianne Cazier Shinn. Montana State University, Bozeman, MT 59717, USA (davidr@montana.edu) (DR); EcoAnalysts, Inc., Moscow, ID 83843, USA (DR); Idaho Power Company, Boise, ID 83707, USA (DCS).
COMPETITION BETWEEN THE THREATENED BLISS RAPIDS SNAIL, *TAYLORCONCHA SERPENTICOLA*, AND THE INVASIVE NEW ZEALAND MUDSNAIL, *POTAMOPYRGUS ANTIPODARUM*

Point and nonpoint sources of pollution from agriculture, aquaculture, and hydroelectric facilities on the mid-Snake River, Idaho have fragmented and reduced habitat of the threatened Bliss Rapids Snail, *Taylorconcha serpenticola*. Since the mid 1980's the highly invasive New Zealand mudsnail, *Potamopyrgus antipodarum*, has colonized remaining Bliss Rapids Snail habitat. Densities of the New Zealand mudsnail in these habitats often exceed 300,000/m^2, can comprise > 95% of invertebrate biomass, and can alter aquatic food webs. Competitive impacts of the New Zealand mudsnail on the Bliss Rapids Snail are unknown. We conducted a series of laboratory and field experiments to determine if these two species compete both intra and interspecifically for limited food resources. Our results suggest that under controlled conditions growth rates of both species are affected by intraspecific competition and that the Bliss Rapids Snail is affected more by interspecific competition than is the New Zealand mudsnail. Growth rates were also affected seasonally and by habitat location. Both snails coexist in the Snake River drainage, therefore, these results do not completely describe competitive interactions that occur in the Snake River drainage. From this and other observations, we suggest that the Bliss Rapids Snail is negatively affected by the New Zealand mudsnail and that its current densities are probably lower than what would be in the absence of the New Zealand mudsnail. Finally, current drought conditions that have occurred and are predicted to occur in the near future, along with increased temperatures due to global warming, favor the New Zealand mudsnail.

P024 RICHARDSON, BART, Faith Balch, Siobhan Boylan, Hannah Dunevitz, and Sharon Pfeifer. Minnesota Department of Natural Resources, Central Region, 1200 Warner Road, St. Paul, MN 55106, USA (bart.richardson@dnr.state.mn.us).
USING GIS TO ASSESS ECOLOGICALLY SIGNIFICANT NATURAL RESOURCE AREAS IN THE TWIN CITIES SEVEN-COUNTY METROPOLITAN AREA IN MINNESOTA, USA

Using raster land cover data and working in ArcGrid, a series of GIS models were created to determine high quality, ecologically significant natural resource areas in the Twin Cities metropolitan area. The region's habitat experts helped to select seven vegetative communities that provide important habitat and are sensitive to human disturbance. Those vegetative communities were assessed and ranked according to their ecological function. Finally, all native plant communities mapped by the Minnesota County Biological Survey were incorporated. The parameters used to assess the ecological function of the sites were size, shape, species diversity, proximity to other natural areas, and incompatible adjacent land uses. After assessing the quality of each area by habitat type, a composite model was created wherein the areas were merged and re-ranked based on their combined preliminary rankings. Corridors that allow for movement between natural resource areas were also mapped. Preliminary findings indicate that about 230,000 acres, or about 23% of the Metro Region, meet our criteria for Regional Significance. The models will be available to land use planners and local units of government as a DNR ArcView Extension.

C57-04 RICKETTS, TAYLOR. Conservation Science Program, World Wildlife Fund, 1250 24th Street NW, Washington, DC 20037, USA (taylor.ricketts@wwfus.org).
COFFEE POLLINATION IN FRAGMENTED TROPICAL LANDSCAPES: CONSERVATION OF AN IMPORTANT ECOSYSTEM SERVICE

Ecosystem services both support human life and provide potentially powerful tools for biodiversity conservation. Crop pollination by wild pollinators is a particularly clear example of an ecosystem service of enormous economic value that is provided "for free" by many ecosystems. In this study, I am investigating the importance of native forest remnants as sources of wild pollinators to surrounding coffee crops in Central American agricultural landscapes. Working in coffee plots established along replicated distance gradients (0 - 1.7 km) from forest patches, I conducted both observations of bee visitors and manipulative experiments to measure pollen limitation in coffee. Diversity, abundance and visitation rate of bees, as well as pollen deposition rates on coffee stigmas, all decline significantly with distance from forest. Results from pollination experiments suggest a similar decline in coffee yields, but these results are less clear. Studies such as this could indicate the economic value of forest remnants as sources of ecosystem services to nearby surrounding crops. Demonstration of this value, in turn, may help to align the often-conflicting goals of conservation and development in agricultural landscapes.

C09-08 RIES, LESLIE, and Thomas D. Sisk. Center for Environmental Science and Education, Northern Arizona University, Box 5694, Flagstaff, AZ 86011, USA (Leslie.Ries@nau.edu).
PLACING EDGE RESPONSES INTO A PREDICTIVE FRAMEWORK

Responses to habitat edges are one of the most thoroughly studied phenomena in the ecological literature and have brought critical attention to the issue of habitat fragmentation. Although an avalanche of studies has been published in the past 20 years, we still lack a predictive framework to understand the patterns and variability reported in that literature. We present a model, based on habitat associations and resource distribution, that predicts whether edge responses are expected to be positive, negative or neutral for any species at any edge type. We present two tests of the predictive power of this model using bird data from the literature and our own butterfly data measuring edge responses in riparian habitat. In both cases, our model did well making predictions even though information on resource use was lacking for birds and little was previously known about how

butterflies respond to edges. In both cases, species showed variable sensitivity to edges, and we discuss a framework for understanding that variability. This model brings clarity to much of the edge literature and gives scientists and managers an underlying framework to predict how communities are likely to respond to fragmentation and other landscape-level changes.

C10-07 RIVERS, ERIKA, and Phil Regal. Conservation Biology Graduate Program, University of Minnesota, 100 Ecology Building, 1987 Upper Buford Circle, St. Paul, MN 55108, USA (lind0003@tc.umn.edu).
FRAMING ECOLOGICAL RISKS FROM GENETICALLY ENGINEERED ORGANISMS: CONSEQUENCES FOR PUBLIC UNDERSTANDING AND POLICY

As commercialization of genetically engineered organisms (GEOs) begins, it is important for concerned conservationists to appropriately frame for the general public the potential risks to biodiversity associated with ecologically viable engineered organisms. According to media analyst, Todd Gitlin, "Frames are principles of selection, emphasis, and presentation composed of little tacit theories about what exists, what happens, and what matters," (1980, p. 5). In an attempt to uncover how prominently frames of the "precautionary principle" appear in media coverage of GEOs, we used the LexisNexis Academic Index to select articles that addressed the ecological risks from GEOs in opinion-leading U.S. newspapers and major alternative news sources. We conducted a qualitative discourse analysis to uncover the media frames that were used to construct a broad, mediated definition of ecological risks from GEOs. We also conducted a quantitative analysis of sources used in the stories to determine how journalists explicitly acknowledge the sources of their information (and hence, the media frames). This paper analyzes the major frames that appeared in the opinion-leading press stories about GEOs and discusses the potential consequences of such frames on the public understanding and policy surrounding ecological risks from GEOs.

C24-03 RODRIGUES, ANA, Kevin Gaston, and Thomas Brooks. Department of Conservation Synthesis, Center for Applied Biodiversity Science, Conservation International, 1919 M Street NW, Suite 600, Washington, DC 20036, USA (a.rodrigues@conservation.org) (AR, TB); Biodiversity and Macroecology Group, Department of Animal and Plant Sciences, University of Sheffield, Sheffield S10 2TN, UK (KG).
MAXIMIZING PHYLOGENETIC DIVERSITY IN THE SELECTION OF NETWORKS OF PROTECTED AREAS: DOES IT MAKE A DIFFERENCE?

Species are frequently used as biodiversity currency in conservation planning. However, they are not all the same in terms of the amount of unique evolutionary history they represent, and that would be irreversibly lost if they would go extinct. The conservation of the evolutionary history of a given taxon may be directly addressed by maximising the phylogenetic diversity represented in networks of protected areas, but this requires good knowledge of the phylogenetic relationships amongst the species targeted for conservation. Here, we investigate the value of complementary reserve networks maximizing species diversity as surrogates for the representation of the underlying phylogenetic patterns. Examination of a diversity of scenarios revealed that this surrogacy value depends on the interaction between the structure of the phylogenetic tree and the patterns of species spatial distribution. Our results indicate that except in very extreme situations, probably rare in nature, the representation of phylogenetic diversity is likely to be well addressed by complementary sets maximising species diversity.

S05-01 Rodríguez, Jon Paul, **JAVIER A. SIMONETTI,** Martín Acosta, Lorena Calvo, Miguel Ângelo Marini, Cristian Olivo, Andrea C. Premoli, Arturo Sánchez-Azofeifa, and Miguel A. Vázquez. Centro de Ecología, Instituto Venezolano de Investigaciones Científicas, Apdo. 21827, Caracas 1020-A, Venezuela (JPR); Facultad de Ciencias, Universidad de Chile, Casilla 653, Santiago, Chile (jsimonet@uchile.cl) (JAS); Facultad de Biología, Universidad de la Habana, Calle 25 No. 455 entre J e I, Vedado, Ciudad Habana, Cuba (MA); Centro para Conservación de Biodiversidad de Guatemala, Distrito Cultural 4 Norte, Ruta 1 4-72 zona 4, Guatemala Ciudad, Guatemala (LC); Departamento de Zoologia, IB, Universidade de Brasilia, Brasilia, DF, 70910-900, Brazil (MAM); Casilla 13794, La Paz, Bolivia (CO); Universidad Nacional del Comahue, Quintral 1250, 8400 Bariloche, Argentina (ACP); Department of Earth and Atmospheric Sciences, University of Alberta, Edmonton, AB T6G 2E3, Canada (ASA); Borgeois N34-275 y Teresa de Cepeda, Quito, 0 17-12-257, Ecuador (MAV).
THREE YEAR STRATEGIC PLAN FOR THE AUSTRAL AND NEOTROPICAL AMERICA (ANA) SECTION OF THE SOCIETY FOR CONSERVATION BIOLOGY (2003-2005)

Austral and Neotropical America (ANA) houses an enormous share of the world's biodiversity. Not only does it rank highest in number of species for many groups of animals and plants, but it has contributed greatly to the well being of people around the world: potatoes, tomatoes, corn, and chocolate, are just a few of the New World ingredients commonly found on tables in every corner of the planet. In contrast, the region needs to build up the human and financial resources necessary to tackle the conservation of such biological wealth. The ultimate purpose of the ANA Section is to strengthen the discipline of conservation biology. We propose that we focus our efforts on: 1) informing the regional conservation community about the activities of the SCB and the ANA Section, 2) increasing regional capacity building opportunities, and 3) facilitating access to scientific

information. Among the specific targets that we aim to meet are: 1) deliver ANA Section "promotional" presentations in at least 6 scientific conferences per year, 2) offer at least three short courses per year, and 3) place at least 40-50 free subscriptions to Conservation Biology in key institutions throughout the region. To fulfill our plan we require about US$20,000 per year.

C04-04 ROGERS, DAVID, Thomas Rooney, Shannon Wiegmann, and Donald Waller. Department of Botany, University of Wisconsin–Madison, 430 Lincoln Drive, Madison, WI 53706, USA (darogers@wisc.edu).
COMPARISON OF SPECIES LOSS BETWEEN NORTHERN AND SOUTHERN WISCONSIN FORESTS OVER A FIFTY YEAR PEROID

Using a 50 year old baseline data set of 80 sites across Wisconsin, we compare rates of change in understory plant communities between the highly fragmented southern forests and the more contiguous northern forests. Both regions showed significant reduction in native species diversity and increased homogeneity with species that were intially rare showing the greatest declines. However, there were significant differences in both the intensity and types of changes that occurred between the two regions. The more highly fragmented southern forests experienced higher rates of native species loss (29% compared to 14%) and more intensive invasion by non-native plants both in terms of number of species (24 vs. 7) and in terms of their relative abundance (5.3% vs. 2.4%). Northern and southern Wisconsin forests also showed differences in the types of native species that showed significant changes in abundance, suggesting that different mechanisms are responsible for species loss between the two regions. In northern forests increased homogeneity and species loss were a result of increased cover of graminoides suggesting that logging related disturbance and deer browse were the dominant mechanisms of change. In contrast, increased homogeneity and species in southern forests were related to increases in woody plant density suggesting fire suppression as the main mechanism of change. These results underscore the importance of long-term monitoring of native communities to confirm and quantify region-wide declines in native plant species diversity as well as to provide a way to identify mechanisms of loss and provide management solutions to reverse this trend.

P077 ROGERS, ELIZABETH, and David Tiller. White Water Associates, Inc., 429 River Lane, Amasa, MI 49935, USA (eirogers@up.net).
USING PORTABLE SOOTED TRACK BOXES TO INVENTORY FISHER (*MARTES PENNANTI*) IN THE APOSTLE ISLANDS NATIONAL LAKESHORE, WI

Sooted track stations traditionally have been used to detect small mammals. The technique has the advantage of deployment for a period of time without needing frequent and costly tending. With this project, we report on an innovation of sooted track stations involving a lightweight collapsible box (Tracking Triangle™) holding plasticized feezer paper coated with a commercial aerosol soot, with adhesive "contact paper" to receive the sooted footprint. The specimen is then covered with transparent contact paper and photocopied. These units can be deployed under any weather conditions and left for extended periods of time. This technique was used on the Apostle Islands (2000 & 2001) to determine relative abundance of fisher. Fisher (including juveniles) were detected on three out of four islands and the mainland. Measurements of tracks were used in a discriminate analysis to distinguish males from females. Other mammals recorded by this technique included weasels, raccoon, black bear, squirrels, shrews, and mice. We conclude that for many mammals, Tracking Triangles™ offer an economical alternative to more costly means of detection. In this study, combining recorded home range sizes with discriminant analysis of gender allowed additionally for an estimate of fisher abundance on target islands.

C01-04 ROGOWSKI, DAVID L., and Craig A. Stockwell. Department of Biological Sciences, North Dakota State University, Fargo, ND 58105, USA (david.rogowski@ndsu.nodak.edu).
EFFECTS OF TWO INTRODUCED SPECIES, THE MOSQUITO FISH AND VIRILE CRAYFISH ON POPULATIONS OF THE ENDEMIC WHITE SANDS PUPFISH (*CYPRINODON TULAROSA*)

The potential impact of introduced species on rare taxa is of particular concern to conservation biologists. The White Sands pupfish (*Cyprinodon tularosa*) is a state listed endangered species of south central New Mexico (USA). Two of the four habitats occupied by White Sands pupfish are vulnerable to invasion by two exotic species, western mosquitofish (*Gambusia affinis*) and virile crayfish (*Orconectes virilis*). Using mesocosms I investigated the effect of these species on experimental populations of White Sands pupfish. Four treatments with 10 replicates were established each with a population of pupfish. After 2 weeks, exotics were introduced for three of the treatments; 1 crayfish, 4 crayfish and 5 adult mosquitofish. Pupfish population size was monitored for 16 weeks. A repeated measures MANOVA revealed a significant effect ($p < 0.0046$) of treatments on population size. Mosquitofish had a significant effect on population size ($p = 0.0169$). The effect of one crayfish was not significant ($p = 0.9082$), however 4 crayfish had a significant effect on population size ($p = 0.0033$). These exotic species pose a serious threat to White Sands pupfish and management to eradicate or control these species should be pursued by the White Sands Pupfish Conservation Team.

C06-02 **ROMAN, JOE,** and Stephen Palumbi. Organismic and Evolutionary Biology, Harvard University, 16 Divinity Avenue, Cambridge, MA 02138, USA (jroman@oeb.harvard.edu) (JR); Department of Biological Sciences, Stanford University, Hopkins Marine Station, Oceanview Boulevard, Pacific Grove, CA 93950, USA (SP).
A BATTLE ON TWO FRONTS: CRYPTIC INVASION OF GREEN CRABS IN THE WESTERN NORTH ATLANTIC

Most invasion records include an initial arrival date for a species, followed by range expansion. The European green crab, *Carcinus maenas*, was first recorded in North America in 1817 and currently ranges from Chesapeake Bay to the Gulf of Saint Lawrence. To track the history of this widespread invader, we sequenced a fragment of the mitochondrial CO1 gene from 287 crabs collected from Long Island to southeastern Prince Edward Island. Although green crabs have been present south of Cape Cod for almost two centuries, populations along the recent northern range extension show greater sequence variation than older southern populations, indicating that at least one cryptic invasion has occurred in the Canadian Maritimes. A dramatic cline extends along the Scotian Shelf to the eastern Bay of Fundy, where this new Maritimes invasion front overlaps with a lineage from the earlier Mid-Atlantic invasion. Exotic species transported in ballast water, such as *C. maenas* and the mussels *Dreisena polymorpha* and *D. bugensis*, often exhibit such high degrees of genetic diversity, increasing the chances of long-term survival and reducing the founder effect. Unnoticed, such multiple invasions can confound ecological studies, leading to misinterpretations about rates of spread and population origins.

P079 Romero, Aldemaro, and **JOEL CRESWELL.** Environmental Studies Program, Macalester College, 1600 Grand Avenue, St. Paul, MN 55105-1899, USA (romero@macalester.edu).
IN THE LAND OF THE MERMAID: HOW CULTURE, NOT ECOLOGY, INFLUENCED MARINE MAMMAL EXPLOITATION IN THE SOUTHEASTERN CARIBBEAN

Although some recent progress has been made in better understanding marine mammal utilization in the Southeastern Caribbean, no comparative analysis has been carried out to see how such practices originated, developed, and impacted the marine mammal populations in that region. We conducted studies for Venezuela, Trinidad and Tobago, Grenada, Barbados, and St. Vincent and the Grenadines. Our results show that each one of those countries developed a different pattern of marine mammal exploitation when it came to whaling and dolphin fisheries, but similar patterns regarding manatees. Whaling was carried out by different people for different lengths of time and in different historical periods. Dolphin fisheries also developed differently in different countries. Most local populations of manatees in this area were depleted during colonial times. We conclude that these five neighboring countries, although sharing essentially the same marine mammal species, developed different exploitation practices in terms of species targeted, capture techniques, and time periods in which that exploitation took place due to historical, political, social, and economic circumstances.

C54-03 **RONDININI, CARLO,** and Luigi Boitani. Department of Animal and Human Biology, University of Rome La Sapienza, Roma 00161, Italy (carlo.rondinini@uniroma1.it).
COMPARATIVE ANALYSES OF AFRICAN MAMMAL RICHNESS USING GEOGRAPHIC RANGES AND HABITAT SUITABILITY MODELS

Maps of species richness computed by overlapping geographic ranges are a useful tool for prioritising conservation efforts. We show how habitat suitability models can help refine and interpret richness maps. Geographic ranges and ecological requirements for 274 African mammals were collected and expert-reviewed. We used them to estimate the areas of occupancy by building habitat suitability models, in 1 km grid cells within each species range, based on land cover, distance to water, and elevation. We compared the richness map resulting from geographic ranges to that resulting from estimated areas of occupancy. The two maps are strongly and significantly correlated, identifying the same richness peak southeast of Lake Victoria. The peak in the model-based richness map is narrower and steeper, since the contribution of small-range species is lowered by a positive correlation between proportion of estimated area of occupancy and range size. Detailed analyses reveal maximum richness of small- and medium-range species in the tropical forests of the Congo basin. In contrast, maximum richness of large-range species is broadly equatorial, complementing the former and overlapping the distribution of savannah and open woodland. Habitat suitability models enhance this result, with small- and medium-range species preferring forests and large-range species preferring savannahs.

P096 **ROON, DAVID,** Katherine Kendall, and Lisette Waits. Department of Fish and Wildife, University of Idaho, Moscow, ID 83844, USA (roon8505@uidaho.edu) (DR, LW); U.S. Geological Surveys-BRD, Glacier Field Station, Science Center, c/o Glacier National Park, West Glacier, MT 59936-0128, USA (KK).
MICROSATELLITE GENOTYPING ERROR AND DEMOGRAPHIC ASSESSMENT: A SIMULATION TEST OF THE EFFECTIVENESS OF SEVERAL COMMON ERROR-CHECKING PROTOCOLS

Non-invasive genetic sampling (NGS), in conjunction with microsatellite genotyping, is an increasingly prominent tool in demographic research. However, inaccurate genotyping can seriously inflate 'minimum number alive' and mark-recapture

estimates. Researchers engaged in large-scale NGS studies have typically used error-checking methods that are intuitive, but not statistically evaluated. We tested the effectiveness of two of these methods through computer simulations. Microsatellite allele frequency distributions and other model parameters were based on data from the Greater Glacier Bear DNA project. Simulations were iteratively run using a range of sampling intensities, trapping occasions, and per-locus genotyping error rates. Simulated data sets were error checked using two methods frequently described in the literature, and finalized capture histories were analyzed using program CAPTURE. In the absence of error checking, estimates were biased above the true N, with percentage relative bias (PRB) exceeding 200% for some simulations. All error-checking methods were effective in reducing bias in population estimates to < 5% when per-locus error rates were less than 0.01. When per-locus error ranged from 0.01 to 0.09, PRB ranged from < 5% to > 50%. Levels of bias varied with per-locus error rate, the error-checking method, levels of sampling intensity, and the number of trapping occasions.

C04-03 ROONEY, TOM, Shannon Wiegmann, Dave Rogers, and Don Waller. Department of Botany, University of Wisconsin–Madison, 430 Lincoln Drive, Madison, WI 53706, USA (tprooney@facstaff.wisc.edu).
THE FATE OF TWELVE ANCIENT RED AND WHITE PINE FOREST STANDS: FIFTY YEARS OF BIOTIC IMPOVERISHMENT IN AN ENDANGERED ECOSYSTEM

Noss and Peters (1995) identified ancient red and white pine forest as an endangered ecosystem type in the United States, but they noted that the absence of baseline data prevented them from assessing the degree to which remaining stands are degraded. Because the Plant Ecology Laboratory at the University of Wisconsin collected baseline data from several pine forests in the 1940s and 50s, we were able to revisit some of these sites and determine the extent of biotic impoverishment over the past 50 years. In 2000, we resurveyed forest canopy composition and the presence of all vascular understory plants in each of 120 quadrats at 12 of these sites in northern Wisconsin. Where red and white pine were still dominant (8 of 12 sites), the average combined relative basal area of these species declined from 77% in 1950 to 60% in 2000. Native species density significantly declined an average of 18% per site. A single exotic species were present at one site in 1950. By 2000, exotics were at 7 sites. The relative abundance of animal-pollinated plants declined 18%. Our data indicate ancient red and white pine forests have undergone significant biotic impoverishment in recent decades.

P108 ROOT, KAREN. Department of Biological Sciences, Bowling Green State University, Bowling Green, OH 43403, USA (kvroot@bgnet.bgsu.edu).
ASSESSING THE VIABILITY AND POTENTIAL EFFECTS OF MANAGEMENT OPTIONS FOR THE FLORIDA PANTHER

The Florida panther, *Puma concolor coryi*, is a highly endangered mammal found only in south Florida, which faces rapid human population growth and the accompanying pressure for development and land conversion in this region. As part of an assessment of the viability of the Florida panther for United States Fish and Wildlife Service, I developed a stochastic, spatially-explicit, stage-based model for the panther population based on long-term survey data and detailed habitat data. Using the model, I explored the long-term viability of the panther, the effects of habitat loss, and potential recovery options such as natural dispersal and translocation to increase the number of panther populations. The model suggested that the long-term survival of the Florida panther required maintenance of the current habitat configuration and condition indefinitely. The overall risk of extinction could be decreased by establishing additional populations, if sufficient habitat was available and there was adequate dispersal. Additional habitat loss or catastrophes would significantly increase the risk of extinction for this species. This ecological risk analysis provides valuable guidelines for the protection and recovery of the endangered Florida panther.

C46-03 ROOT, TERRY L., Brandon C. Root, and Stephen H. Schneider. Department of Biological Sciences, Stanford University, Stanford, CA 94305-5020, USA (troot@stanford.edu) (TLR, SHS); Eastview High School, Apple Valley, MN 55124, USA (BCR).
BOUNDING THE UNCERTAINTY OF POSSIBLE ECOLOGICAL CONSEQUENCES OF GLOBAL WARMING

We compare the possible ecological consequences of two different global warming predictions made by the Intergovernmental Panel on Climate Change – one assumes continued intense fossil fuel use (FI) and the other assumes technological development (T) allowing much less fossil use. By 2100 the average global temperature is predicted to be 4.5°C for FI and 2.6°C for T. We determine the 10th and 90th percentiles around these values, assuming temperature increases will be larger at the higher latitudes than the lower ones. We calculate the increase in temperatures by latitude assuming both FI and T scenarios along a longitudinal transect running from Houston, TX, through Churchill, Manitoba and on north. For temperature-sensitive birds with winter ranges crossing the transect, we determine where their northern ranges could be for FI and T. For example, by 2100 the globe could warm such that if the American Goldfinch tracked the isotherm currently associated with its northern range edge, there is a 10% chance that it could shift (assuming habitat is available) from just north of Minneapolis to above the Arctic Circle assuming the FI scenario, and to areas just south of Churchill for the T scenario. Either way the change could be undesirably dramatic.

C46-01 ROSALES, JON. Conservation Biology Graduate Program, University of Minnesota, 180 McNeal Hall, 1985 Buford Avenue, St. Paul, MN 55108, USA (jrr@fw.umn.edu).
CREATIVE COMMODIFICATION: AN EMERGING MODEL OF ENVIRONMENTAL MANAGEMENT

Climate change science indicates that disruptive impacts on biological organisms are apparent and forecasted to increase in frequency and intensity. In response, an international regime to make carbon a commodity to be bought, sold, and banked was developed by the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) and took form with the Kyoto Protocol. The Protocol and its flexibility mechanisms – Joint Implementation, the Clean Development Mechanism, and, the most ambitious, emissions trading – are entering into force and represent an emerging model of environmental management. It is therefore time to take stock of what this global environmental treaty represents; what it portrays as legitimate tools for environmental management; and what future conservation regimes based on this model might look like. Information was gathered from over forty interviews of key advocates and critics of emissions trading attending the last three UNFCCC Conference of Parties meetings. Advocates held to a least-cost measure while critics to an equity-based principle of policy effectiveness. This presentation summarizes these story lines and then considers the potential successes and failures of comparable commodification schemes for the management of biological organisms that may follow in the aftermath of this treaty.

C48-04 ROSENBAUM, HOWARD, Cristina Pomilla, Peter B. Best, Ken P. Findlay, and Marcia Engel. Wildlife Conservation Society, Science Resource Center, 2300 Southern Boulevard, Bronx, NY 10460, USA (hrosenbaum@wcs.org) (HR, CP); Department of Biology, New York University, 100 Washington Square, New York, NY 10012, USA (CP); Mammal Research Institute, University of Pretoria, c/o South African Museum, PO Box 61, Cape Town 8000, South Africa (PBB); Oceanography Department, University of Cape Town, Rondebosch 7701, South Africa (KPF); Projeto Baleia Jubarte / Instituto Baleia Jubarte – Praia do Kitongo s/n°, Caravelas-Bahia, CEP 45900-000, Brazil (ME).
ASSESSING POPULATION STRUCTURE OF HUMPBACK WHALES IN THE SOUTH ATLANTIC AND INDIAN OCEANS: USING GENETIC DATA FOR CONSERVATION MANAGEMENT

In the Southern Hemisphere, humpback whale, *Megaptera novaeangliae*, distribution in tropical areas occurs within seven primary wintering regions used for regional and international management. For certain regions, the necessary population genetic data for defining management units has not existed. These management regions are defined by The International Whaling Commission as the southwestern Atlantic (region A), southeastern Atlantic (region B) and southwestern Indian Oceans (region C). Here, we present the first genetic analysis of free-ranging humpback whales sampled on seven breeding grounds or migratory corridors distributed within these three recognized wintering regions around Africa and South America. Mitochondrial DNA control region sequences for 400 individuals show high haplotype and nucleotide diversities, indicating genetic variation of these populations has not drastically decreased due to past exploitation. An analysis of molecular variance showed significant population structure is found across regions A, B, and C. Pairwise comparisons using mitochondrial haplotype frequencies reveal both significant differences and connectivity between individual breeding grounds and migratory corridors within and between larger oceanic regions. The results are a critical step toward more effectively evaluating complex patterns of population structure, gene flow, and current stock boundaries used for international conservation of Southern Hemisphere humpback whales and their wintering habitats.

P017 ROSS, JEREMY D., Allan D. Arndt, Roger F.C. Smith, and Juan L. Bouzat. Department of Biological Sciences, Bowling Green State University, Bowling Green, OH 43403, USA (rossjd@bgnet.bgsu.edu) (JDR, JLB); Department of Zoology, Brandon University, Brandon, MB R7A 6A9, Canada (ADA, RFCS).
RE-EXAMINING THE HISTORICAL RANGE OF THE GREATER PRAIRIE CHICKEN, *TYMPANUCHUS CUPIDO*, THROUGH DNA ANALYSIS OF MUSEUM COLLECTIONS

Greater Prairie Chickens (GPC), once distributed across North American grasslands, have disappeared from Canada and portions of USA. Reintroduction efforts focus on restoring species within their historical range. Yet, under the prevailing *following the plough* hypothesis, GPC are assumed to have invaded the Canadian prairies as a result of range expansion after habitat modification by European settlers. Seventy-five specimens from museum collections were used to estimate the acquired range of the GPC and the expansion rate necessary to support the *following the plough* hypothesis. In addition, we performed mtDNA sequence analysis of 39 samples, comparing genetic diversity in *original* and *expanded* ranges. Provenance data indicated that by the early 1900's, GPC range extended to the northern limits of the mixed-grass prairie, requiring an estimated expansion rate of 20,000 km^2/year over 20 years. Genetic analysis revealed no significant differences in levels of genetic diversity between *original* and *expanded* distributions. Overall, mean sequence diversity within ranges (0.017) was greater than between ranges (0.002). Phylogenetic analysis showed monophyletic grouping of some *expanded* and *original* haplotypes. These results suggest that the historical GPC range, prior to European settlement, included the mixed-grass prairies of Canada. GPC's Canadian status as an extirpated non-native species may need re-examination.

C34-06 ROSSON, JAMES F., JR. USDA Forest Service, Forest Inventory and Analysis, 4700 Old Kingston Pike, Knoxville, TN 37919, USA (jrosson@fs.fed.us).
TEMPORAL TRENDS IN FOREST STAND STRUCTURE ON THE LOWER MISSISSIPPI RIVER ALLUVIAL PLAIN PHYSIOGRAPHIC SECTION, USA

The lower Mississippi River Alluvial Plain has been heavily disturbed throughout most of the twentieth century, either from the harvest of bottomland hardwoods or conversion of forest land to an agriculture land use. Forest Inventory and Analysis (FIA) data were used to assess changes in species composition and stand structure between plots measured in the 1970's and re-measured in the 1990's on the Alluvial Plain of Arkansas, Tennessee, Louisiana, and Mississippi. The area of study encompasses approximately 1,200 sample plots dispersed over 102,870 sq. kilometers. Since the 1970's there has been some indication of stand improvement across this large area. Mean basal area increased from 17.2 (S.E.M. = 0.33) to 21.3 (S.E.M. = 0.34) sq. meters per ha. The number of tree species per plot increased from 4.44 (S.E.M. = 0.09) to 5.40 (S.E.M. = 0.09), and there was an improvement of plot evenness of tree species from 0.54 (S.E.M. = 0.01) to 0.64 (S.E.M. = 0.02) (McIntosh Evenness Index on a scale between 0.0 and 1.0). Major stand dominants were *Taxodium distichum*, *Celtis laevigata*, and *Liquidambar styraciflua*. Assessing changes in forest composition across large regions is challenging but these and other indicators provide an important index in determining degrees of change in forest-stand structure in heavily disturbed areas such as the lower Mississippi Alluvial Plain.

C19-05 ROTHERMEL, BETSIE B. Division of Biological Sciences, University of Missouri, 105 Tucker Hall, Columbia, MO 65211, USA (bbrd7b@mizzou.edu).
ASSESSING LANDSCAPE RESISTANCE AND COMPLEMENTATION FOR AMPHIBIANS BASED ON MIGRATORY BEHAVIOR OF JUVENILES

Using experimental releases and mark-recapture, I investigated the migratory behavior of juvenile amphibians (Genus *Ambystoma* and *Bufo*) in relation to landscape composition. Newly metamorphosed amphibians emigrating from artificial pools on forest-field edges showed a preference for forest and moved farther in forest than in field habitats. Juvenile salamanders also experienced higher dehydration rates in the fields. In another experiment, I examined orientation by salamanders emigrating from pools placed in pastures 5-50 m from forest. Salamanders oriented randomly at 10 of the 18 pools. Mean movement vectors at the remaining pools rarely corresponded with direction to nearest forest. On average, only 20% of migrating salamanders ever reached the forest. The behavioral avoidance of fields in the first experiment indicates non-forested habitats may have high landscape resistance for dispersing amphibians and that habitat fragmentation could lead to isolation and reduced probability of recolonization of local populations. Results of the second study imply that juvenile amphibians have limited ability to perceive distant habitat and that breeding sites lacking connectivity with suitable terrestrial habitats may act as population sinks. Thus, both landscape resistance and landscape complementation (i.e., proximity between aquatic and terrestrial habitats) may affect the persistence of pond-breeding amphibians in fragmented landscapes.

S12-03 ROWELL, KIRSTEN, Karl W. Flessa, David L. Dettman, Martha Roman, and Jose Campoy. Department of Geosciences, University of Arizona, Tucson, AZ 85721, USA (krowell@geo.arizona.edu) (KR, KWF, DLD); IMADES, Apdo. postal 452, San Luis Rio Colorado, Sonora, C.P. 83449, Mexico (MR); CONANP/SEMARNAT, Apdo. postal 452, San Luis Rio Colorado, Sonora, C.P. 83449, Mexico (JC).
DOUBLE THE TROUBLE: SUSTAINING MARINE AND RIVERINE PROCESSES IN THE ESTUARINE RESERVA DE LA BIOSFERA ALTO GOLFO DE CALIFORNIA Y DELTA DEL RIO COLORADO, MEXICO

The success of the Reserva de la Biosfera Alto Golfo de California y delta del Rio Colorado, Mexico depends on both regulating fishing practices and restoring riverine processes. Although fishing practices are an important cause of fishery declines and species endangerment in the northern Gulf of California, the lack of Colorado River flow to the 283,000 sq. km estuarine portion of this federally protected area has also affected commercial as well as non-commercial marine and estuarine species. In the absence of exhaustive sampling and monitoring data, we use oxygen isotopes to determine the role of river water in economically important and endemic fishes (threatened *Cynoscion othonopterus* and endangered *Totoaba macdonaldi*). Oxygen isotopes in the otoliths of these fish indicate that brackish water habitat is sought during these species' early life history. Similarly, the biogeography of the rare and endemic clam, *Mulinia coloradoensis*, is defined by the fresh water plume of the Colorado River. Fishing practices are not the only problem in this reserve; the lack of river flow is also an important issue. Estuarine reserves need to ensure natural river flow regimes as well as protect species from harmful fishing practices.

C43-03 ROZYLOWICZ, LAURENTIU. University of Bucharest, Center for Environmental Research and Impact Studies, 1 N. Balcescu Avenue, 70111 Bucharest, Romania (rlaurentiu@hotmail.com).
THE HERMANN'S TORTOISE (*TESTUDO HERMANNI BOETTGERI* MOJSISOVICS, 1888) FROM ROMANIA: STATUS, THREATS AND CONSERVATION ACTIONS

Hermann's tortoise (*Testudo hermanni boettgeri* Mojsisovics, 1888), populating the South-Western part of Romania, Balkan Peninsula and Southern Italy, is one of the most threatened land tortoise species. The main threats affecting its existence are mechanical destruction of habitat, pollution, trade, etc. In Romania, the number of individuals is continuously declining, today being less and less present in the landscape, a reason to be included in the Romanian Red List for threatened species. Unfortunately, the legislative framework is only theoretical for the time being, a generalised phenomenon being the paper park syndrome, an extremely dangerous fact, because it confers a not-real safety for those not aware of the real situation. The state-of-the art is emphasised by the poor knowledge related to species, the most relevant fact being the one that the Romanian literature in the field indicates *Testudo hermanni hermanni* (present only in the Western part of Europe), although species holotype *Testudo hermanni boettgeri* is present in Romania (Orsova, harbour on the Danube River). Starting with 2000, University of Bucharest started an extended research programme for this species that includes captive breeding and habitat restoration by reintroduction of individuals. The present paper tries to reveal a 2-year experience in field research, to define species status in Romania, to evaluate the distribution of Hermann's tortoise using Geographical Information System (GIS), to announce the threats identified in the field, and to evaluate the impact they have on the species. Based on these, the paper presents the conservation actions to be applied in the field in order to prevent species extinction.

C10-04 RUIZ CORZO, MARTHA "PATI". Sierra Gorda Biosphere Reserve, National Commission of Natural Protected Areas, Arroyo Seco 306, Col. Estrella, Queretaro, QRO, Mexico (gesgiap@yahoo.com.mx).
RAISING AWARENESS AND SUPPORT FOR NATURAL PROTECTED AREAS MANAGEMENT AND RESTORATION

In a mega-biodiverse ecoregion of 1 million acres live 100 thousand extreme poverty private property owners in Central Eastern Mexico. Operating since 1987, the Grupo Ecológico Sierra Gorda (GESG) reaches 16,000 children each month in 170 rural schools in the area implementing an ambitious environmental education project. The grassroots promoters carry out extensive fire prevention campaigns within the Reserve and its buffer zones and GESG coordinates inter-institutional support to stimulate productive diversification through 25 different projects as a way to combat poverty and diminish its pressure on natural resources. Capacity building attends to forest producers and non-forest producers and improves natural resource management standards. 35% of the population migrates to work in the United States, so establishing bakeries, carpentries, dried flower production, commercial forest plantations and community based eco-tourism projects require productive skill training, equipment and long-term accompaniment. Civil participation is key: we rely on the citizen reforestation network, volunteer surveillance for crimes against natural resources, community committees for project follow-up and the coalition of forest-fire prevention brigades. All of the above has been achieved thanks to having permanent environmental awareness and interaction with local communities over the last 16 years. Civil participation and gaining the support of the critical mass is the key to conservation around the world. Case study of civil-federal co-management.

P127 RUNDLÖF, MAJ. Department of Ecology, Lund University, Ecology Building, SE-223 62 Lund, Sweden (majrundlof@mail.com).
MEADOWS AND PASTURES - GRASSLAND MANAGEMENT AND LANDSCAPE EFFECTS ON BUTTERFLY DIVERSITY

The area of traditionally cut hay-meadow has decreased strongly in Sweden. Changed management and fragmentation are important factors responsible for the decline of butterflies in a large part of Europe. Butterflies on eight matched pairs of farm, one farm in each pair with both meadow and pasture and the matching farm with only pasture, were recorded. Meadows had more species and higher total population density than pastures. The number of species in the meadow was positively related to the area of the meadows. The total number of butterfly species in pastures had no relation to the pasture area, but it was negatively related to grazing pressure. There were no significant differences in species number or number of individuals between pastures or farms with or without a meadow. The results indicate that meadow is a better butterfly habitat than pasture and that area is an important factor that governs the number of butterfly species that occurs in the meadow. For pastures, grazing pressure is much more important than their area. The fact that there was no difference between pastures and farms within a pair indicates that meadows probably do not function as source habitat for the majority of the butterfly species studied.

C43-01 Rusk, Bonnie L., **DAVID E. BLOCKSTEIN,** and Stanley A. Temple. Grenada Dry Forest Biodiversity Conservation Project, PO Box 4879, Boulder, CO 80306, USA (blrusk@aol.com) (BLR); National Council for Science and the Environment, 1707 H Street NW #200, Washington, DC 20006, USA (DEB); Department of Wildlife Ecology, University of Wisconsin–Madison, 226 Russell Labs, 1630 Linden Street, Madison, WI 53706 (SAT).
UPDATE ON THE CONSERVATION OF THE ENDANGERED GRENADA DOVE AND DRY FORESTS OF GRENADA, WEST INDIES

The Grenada Dry Forest Biodiversity Conservation Project, funded by the Global Environment Facility (GEF) and the World Bank, offers the best hope for saving the endangered Grenada Dove (*Leptotila wellsi*). The four-year project, begun in 2002, includes habitat characterization, research and monitoring, research on Grenada Dove and other dry forest species, public environmental

education, and capacity building. The project is being implemented by the Grenada Forestry and National Parks Department and builds on Grenada's National Forest Policy. The government of Grenada has already protected the only two sites currently occupied by Grenada Doves as the Mt. Hartman National Park and Perseverance Estate Dove Sanctuary. The Grenada Dove is of the most endangered doves in the world with a population of some 100-130 individuals.

C35-03 **RUSSELL, KIMBERLY NORRIS,** and Sam Droege. Division of Invertebrate Zoology, American Museum of Natural History, Central Park West at 79th Street, New York, NY 10024, USA (krussell@amnh.org) (KNR); U.S. Geological Survey, Patuxent Wildlife Research Center, 12100 Beech Forest, Laurel, MD 20708-4083, USA (SD).
THE POTENTIAL CONSERVATION VALUE OF UNMOWED POWERLINE STRIPS FOR NATIVE BEES

The land area covered by powerlines in the United States (over five million acres; Knight and Kawashima 1993), exceeds the area of most national parks including Yellowstone. In parts of Europe and the U.S., electric companies have altered their land management practices from annual mowing to periodic extraction of tall vegetation. To investigate whether this alternate management practice could produce higher quality habitat for native bees, we compared the bee fauna collected under un-mowed powerline sites and nearby mowed grassy fields at the Patuxent Wildlife Research Center (MD). Surveys were conducted in the spring of 2000 at a total of 16 sites using forty modified pan traps at each site. Powerline sites had more spatially rare species and a richer bee community than the grassy fields, although the difference was less pronounced than we expected. Further analyses suggest that the surrounding, non-grassland landscape has a strong influence on the bee species collected at the grassland sites. With the recent collapse of honeybee populations, improving habitat for native bees, which also pollinate plants, is critical. This study suggests that un-mowed powerline strips have the potential to provide five million acres of bee-friendly habitat in the U.S. if current management practices are altered.

P124 **RUSSELL, LELAND,** and Svata Louda. Department of Biological Sciences, University of Nebraska–Lincoln, Lincoln, NE 68588-0118, USA (frussell@unlnotes.unl.edu).
CAUSES OF TEMPORAL AND SPATIAL VARIATION IN INTERACTION STRENGTH BETWEEN AN INVASIVE BIOCONTROL WEEVIL AND AN ACQUIRED NATIVE HOST PLANT

One way to improve our ability to predict the potential nontarget effects on native species by exotic insects proposed as biological control agents before introduction might be to determine the factors underlying temporal and spatial variation in their numbers and activity. We have tested this idea, using the interaction of the invasive biocontrol weevil, *Rhinocyllus conicus*, with its acquired native host, *Cirsium undulatum*, as a model system. Using 12 years of data on *C. undulatum* flowering and four years of data on numbers of *R. conicus* in mid-grass prairie, we examined three hypothesized mechanisms for variation in seed head herbivory: 1) changes in herbivore abundance, 2) herbivore-host phenological synchrony, and 3) variation in amount of host resource available. Abundance of *R. conicus* adults, phenological synchrony, and total number of thistle flower heads, of *C. undulatum* plus its coexisting congener *Cirsium canescens*, all significantly affected use of *C. undulatum* in multiple regression models. Phenological synchrony and flower head abundance were critical to explaining use of *C. undulatum* relative to *C. canescens*. These results provide new, quantitative information that confirms the postulated importance of phenological synchrony and herbivore abundance in interaction strengths and nontarget impacts of exotic insect species.

C51-06 Russello, Michael, and **GEORGE AMATO.** Center for Environmental Research and Conservation, Columbia University, New York, NY 10027, USA (russello@amnh.org) (MR, GA); Wildlife Conservation Society, Science Resource Center, Bronx, NY 10460, USA (MR, GA).
MOLECULAR PHYLOGENETICS REVEALS TAXONOMIC UNCERTAINTY AND EVOLUTIONARY NOVELTY AT RISK IN AMAZONA PARROTS

An unfortunate attribute shared by nearly all members of the genus *Amazona* is their endangerment due to continued habitat destruction and harvesting for the pet trade. Recently, two additional species (*A. auropalliata* and *A. oratrix*) were elevated to CITES Appendix I. In spite of this listing, a phylogenetic analysis of *Amazona* revealed ambiguity in current taxonomic designations of Yellow-headed parrots (*A. ochrocephala*, *A. oratrix* and *A. auropalliata*). This is particularly problematic given the highly endangered status of the group, as clear taxonomic designations are critical for monitoring the pet trade and for subsequent law enforcement. Furthermore, the current study revealed previously unknown patterns of evolutionary novelty that should be considered in prioritizing conservation efforts for this group. The general relevance of phylogeny for informing taxonomy and identifying evolutionary novelty are discussed within the context of conservation efforts for Amazon parrots. Specifically, an integrated conservation management plan for the members of this genus should include targeted representation for *in situ* and *ex situ* management from specific clades whose component species are at risk of extinction. Within this framework, conservation efforts may be directed to ameliorate the current anthropogenic threats confronting these unique birds while preserving a representation of their evolutionary history.

P006 **RUSTERHOLZ, KURT,** Norm Aaseng, John Almendinger, and Dan Wovcha. Division of Ecological Services, Minnesota Department of Natural Resources, 500 Lafayette Road, PO Box 25, St. Paul, MN 5155, USA (kurt.rusterholz@dnr.state.mn.us) (KR, NA, DW); Division of Forestry, Minnesota Department of Natural Resources, 413 Southeast 13th Street, Grand Rapids, MN 55744, USA (JA).
MINNESOTA'S NATIVE PLANT COMMUNITY CLASSIFICATION

Minnesota Department of Natural Resources ecologists have completed a new statewide native plant community classification focusing on forest and wetland communities, based on multivariate analysis of vascular plant data from more than 4500 vegetation samples from across the state. This hierarchical classification incorporates the DNR's Ecological Land Classification System at the higher levels and allows for classification of existing vegetation at the lowest levels of Native Plant Community Type and Subtype. This classification provides a framework for forest management and biodiversity protection. For example, the DNR Division of Forestry is currently developing management recommendations at the level of the Native Plant Community Class. Each Class was delineated using multivariate analysis of plot data with canopy tree data removed, informed by landform and soils data; as such, Classes are considered analogous to the concept of habitat type. Native Plant Community Types and Subtypes, determined using understory and canopy tree data, are the primary units used for mapping and as coarse filters for biodiversity conservation. Our presentation will illustrate how this classification has been used to map plant communites in a northern Minnesota state park.

P039 **RYKKEN, JESSICA,** Andrew Moldenke, and Samuel Chan. Department of Entomology, Oregon State University, Cordley Hall, Corvallis, OR 97331, USA (rykkenj@science.oregonstate.edu) (JR, AM); USDA Forest Service, Corvallis Forestry Sciences Laboratory, 3200 SW Jefferson Way, Corvallis, OR 97331, USA (SC).
EFFECTS OF RIPARIAN FOREST MANAGEMENT ON THE DISTRIBUTION OF EPIGEIC INVERTEBRATES IN THE CASCADES RANGE OF OREGON

Headwater streams comprise the vast majority of stream habitat within the Douglas fir forests of the Pacific Northwest; yet, until recently, have received little protection. Because leaving forested reserves along headwater streams may take a large amount of land out of timber production, it is critical to evaluate their role in maintaining the biological integrity of aquatic and riparian communities. Invertebrates are an important yet often overlooked component of the riparian zone. We compared microclimatic variables and epigeic invertebrate distributions in three headwater riparian treatments (forested, clearcut, clearcut with 30m riparian reserve). We sampled invertebrates in pitfall traps along 70m transects perpendicular to the stream. Ordination analysis revealed elevation, treatment, and distance-from-stream to be important variables in ordering sites with similar species composition. Air and soil temperature and relative humidity in riparian reserves were more similar to forest than to clearcut conditions, and also showed some distance-from-stream/edge effects. We conclude that canopy removal affects microclimatic variables, which, in turn, produce changes in the distribution of epigeic invertebrates. Differences are most pronounced between forested and clearcut sites. Riparian reserves are most similar to forested sites, and therefore are likely serving an important role in maintaining biological integrity in headwater stream riparian zones.

C41-05 **SABO, JOHN L.,** and Leah R. Gerber. Department of Biology, Arizona State University, PO Box 871501, Tempe, AZ 85287-1501, USA (john.l.sabo@asu.edu).
MANAGING INTRODUCED SPECIES: BETTER AND CHEAPER ALTERNATIVES TO TOTAL ERADICATION?

The notion that introduced species can reduce the viability of native (threatened) species has been studied only from the perspective of predictions from deterministic models of 2 species interactions. These approaches unfortunately do not incorporate a very important aspect of population viability – environmental stochasticity. We use stochastic population models representing 2 species competition and predator-prey interactions to evaluate the relative efficacy of four alternative management scenarios for increasing the population viability. These scenarios include 1) No Management, 2) Complete Eradication, 3) Reduction of Abundance, and 4) Reduction of Variance of introduced species. We find that contrary to expectations from deterministic theory, reducing the variance (e.g., environmental stochasticity) of introduced species often has a larger effect than reducing the abundance of these pests on the viability (defined as population persistence) of threatened species. More importantly, variance reduction is typically an equally effective action than total eradication. This suggests that recovery efforts for species threatened by introduced predators may get a bigger bang for the buck by maintaining consistent rather than zero densities of introduced species.

C57-03 SABOR, ALEXIA A., Volker C. Radeloff, Roger B. Hammer, and Susan I. Stewart. Department of Forest Ecology and Management, University of Wisconsin–Madison, 1630 Linden Drive, Madison, WI 53706, USA (aasabor@wisc.edu) (AAS, VCR, RBH); USDA Forest Service, North Central Research Station, 1033 University Avenue, Suite 360, Evanston, IL 60201, USA (SIS).
RELATIONSHIPS BETWEEN HOUSING DENSITY AND FOREST TYPE, STAND AGE, AND FOREST OWNERSHIP IN THE UPPER LAKE STATES

Nonmetropolitan areas throughout the U.S. Midwest are undergoing significant increases in housing unit density. Such rural sprawl is especially prominent in areas with attractive recreational and aesthetic amenities, and demand for second and vacation homes is particularly high in and around forested areas. Thus, quantifying the effects of housing change on land use change, forest structure and composition, and ecological function is critical to good forest conservation and natural resource management. We combined Forest Inventory and Analysis (FIA) survey data with U.S. Decennial Census data to examine the relationship of housing density within a 1.5 km radius of forest plots to forest type, stand age, and forest ownership in Michigan, Minnesota, and Wisconsin. Housing density was significantly lower in areas dominated by lowland forest types and highest in areas dominated by xeric, oak-hickory forests. Middle levels of housing density were associated primarily with stands of mesic, upland forest. There was no clear correlation with housing density for young and mid-aged forests, but older forest was found only in areas with low housing density. Ownership by private individuals, corporations, and state or local governments was most likely to be associated with higher levels of housing density. These results can be used to help identify forest lands of conservation interest that are most likely to be impacted by future changes in housing density and may assist organizations in appropriately targeting education programs or conservation easements.

C18-03 SADINSKI, WALTER. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Road, La Crosse, WI 54603, USA (wsadinski@usgs.gov).
THE PRACTICAL ROLE OF AMPHIBIANS IN PROACTIVE MONITORING OF ENVIRONMENTAL STRESS

Losses of populations usually result from changes in the intensity of one or more stressors in ecosystems. Such changes and losses continue to occur at an unprecedented rate. We rarely monitor ecosystems proactively to relate changes in stressors to trends in the statuses of populations before losses occur. When we do have such opportunities, one challenge is to know which populations to study. We know that "sensitive" and "tolerant" can vary with the population and stressor in question, even though we are not likely to know how beforehand. Given this challenge, it is hard to overlook the usefulness of amphibians. They can be inventoried, monitored, and manipulated experimentally in ways that can lead to increasing complexity and sensitivity of monitoring programs. We took advantage of these invaluable traits initially to evaluate the status of Yosemite toads in Yosemite National Park, but ultimately to determine that they are ideally suited to monitor for effects of climate change. We have begun to inventory and monitor up to a dozen species of amphibians in several states of the Upper Midwest with goals of evaluating their statuses and determining which populations are appropriate to monitor for effects of various stressors.

C26-05 SALAFSKY, NICK, Marcia Brown, Janice Davis, Caroline Stem, and Richard Margoluis. Foundations of Success, 4109 Maryland Avenue, Bethesda, MD 20816, USA (Nick@FOSonline.org).
ARE LEARNING NETWORKS WORTH THE INVESTMENT? INITIAL RESULTS FROM AN ONGOING INVESTIGATION

In theory, "learning networks" or "learning portfolios" can provide practitioners with the ability to compare experiences, share success and failures, and enhance our collective knowledge about the conditions under which various conservation strategies work and do not work. Unfortunately, in practice learning networks tend to be difficult and expensive to implement. To answer our title question, we first conducted a review of learning networks in conservation as well as other disciplines. We used the results to define and categorize different types of networks. We then developed a framework for assessing learning networks of conservation projects. Our dependent variables include conservation success, generation of knowledge, and the capacity of individuals and institutions involved in the network. Our independent variables include a host of factors related to the design and implementation of the learning network. We are currently testing this framework by collecting data on a series of historical and ongoing learning networks in conservation. Our overall experience has been that learning networks are even harder to successfully implement than we initially imagined. However, we have learned a great deal about what works and what does not work and have found that under specific conditions, learning networks can be worthy of investment.

C26-04 SALZER, DANIEL, and Nick Salafsky. The Nature Conservancy, 821 SE 14th Avenue, Portland, OR 97214, USA (dsalzer@tnc.org) (DS); Foundations of Success, 4109 Maryland Avenue, Bethesda, MD 20816, USA (NS).
ALLOCATING RESOURCES BETWEEN ACTION AND MONITORING: A PRACTITIONER'S GUIDE

Millions of dollars are spent annually worldwide on biodiversity conservation projects. Conservation projects must achieve a balance between taking conservation action, evaluating the effectiveness of actions taken, and monitoring the general status of biodiversity conservation targets and the threats they face. Conservation practitioners often struggle with decisions regarding the

allocation of limited resources among these competing needs. Many conservation projects have only a limited monitoring component while other projects have an inexplicably high investment in a single type of monitoring. We offer a conceptual framework to help guide conservation practitioners towards a logical allocation of resources between taking action and different types of monitoring depending on the situation that they are facing. The framework consists of a decision tree that includes an explicit evaluation of three questions: (1) Are there substantial threats facing the conservation entities?; (2) Are there clear and feasible actions known to be effective at abating identified threats?; and (3) Does the project team have high confidence in their understanding of the overall conservation situation? Based on this tree, we present six scenarios that illustrate a range of logical allocations of resources between taking action and different categories of monitoring.

C01-03 SANDERSON, BETH L., Katie Barnas, and Michelle Rub. NOAA Fisheries, Northwest Fisheries Science Center, 2725 Montlake Boulevard East, Seattle, WA 98112, USA (Beth.Sanderson@noaa.gov).
NON-INDIGENOUS SPECIES IMPACTS ON THREATENED AND ENDANGERED SALMONIDS IN THE PACIFIC NORTHWEST

Non-indigenous species are recognized as one of the top environmental threats to global diversity and have been cited as a cause of decline in 42% of species listed under the US Endangered Species Act. During their life cycle, salmonids traverse large geographic areas spanning freshwater, estuary and ocean habitats where they encounter numerous non-native species. To date, the cumulative impact of non-indigenous species on salmonids has not been described or quantified. In this paper, we examine the extent to which introduced species are a potentially important risk to threatened and endangered salmon, ultimately by contributing to higher levels of life-cycle mortality. We identify and categorize all documented introduced species in the Pacific Northwest, including fish, invertebrates, birds, plants, amphibians and others. Where data exist, we quantify the impact of non-indigenous species on populations of threatened and endangered salmonids. For example, birds and fish predators are reported to consume 0-40% of juvenile salmon in some habitats. These data indicate that the impact of non-indigenous species on salmon is equal to or greater than commonly addressed impacts (habitat, harvest, hatcheries and hydro-system) and suggest that managing non-indigenous species impacts may be imperative for the recovery of these fish.

C24-05 SANDERSON, ERIC, Peter Coppolillo, Claudio Campagna, and John Croxall. Wildlife Conservation Society, 2300 Southern Boulevard, Bronx, NY 10460, USA (esanderson@wcs.org) (ES, PC); Centro Nacional Patagonico, 9120 Puerto Madryn, Argentina (CC); British Antarctic Survey, High Cross, Madingley Road, Cambridge CB3 OET, UK (JC).
FROM LANDSCAPES TO SEASCAPES: TRANSLATING LANDSCAPE SPECIES CONSERVATION TO THE SEA, WITH AN EXAMPLE FROM THE SOUTHWEST ATLANTIC

In recent years conservation biologists have embraced many of the ideas of landscape ecology in their conservation planning, including connectivity, context and scale. At the Wildlife Conservation Society we have used a set of carefully selected species, called "landscape species," to guide us in setting site-based conservation priorities. To date, however, most of our work has focused on terrestrial systems. In this presentation, we report on how the conceptual features of landscape species conservation planning were adapted for a particular marine system: the southwest Atlantic. This region is renown for its high biological productivity as well as its national and international fisheries, set against a complicated set of jurisdictional and management boundaries. We found that in comparison to terrestrial systems, this marine system requires individual landscape units that are typically much larger than their terrestrial equivalents; that physical determinants of landscape structure are critically important in driving landscape structure, but are highly dynamic in space and time, at scales both larger and faster than found in many terrestrial systems, thus necessitating definition of geographically flexible conservation units; and that the kinds of ecological functions and socioeconomic importance of various species are related to a few but key landscape-level interactions.

C50-08 Sanjayan, Muttulingam, **MATTHEW J. KAUFFMAN,** Matti Nghikembua, Mary K. Tilton, and Richard Jeo. The Nature Conservancy, 4245 North Fairfax Drive, Arlington, VA 22203, USA (MS); Department of Environmental Studies, University of California, Santa Cruz, Santa Cruz, CA 95060, USA (mattkau@ucsc.edu) (MJK); Cheetah Conservation Fund, Otjiwarongo, Namibia (MN); Department of Fisheries and Wildlife Biology, Virginia Tech, 149 Cheatham Hall, Blacksburg, VA 24060, USA (MKT); Round River Conservation Studies, Salt Lake City, UT 84108, USA (RJ).
GRASSLAND CONSERVATION IN SOUTHERN AFRICA: INTERACTIONS BETWEEN UNGULATE GRAZING, RODENT POPULATIONS AND THORNSCRUB ENCROACHMENT

Historical evidence suggests that some parts of Africa have lost extensive grasslands to encroachment by thornscrub or 'bush' habitat. In Namibia bush encroachment is an acute conservation problem, which has reduced grassland habitat for key species of conservation concern (i.e., cheetahs) and impaired local ranching economies. Potential explanations for the loss of grasslands include overgrazing, fire suppression, and the loss of the megaherbivores. This study explores the potential role of seed predation by rodents in preventing the recruitment of thornscrub species. In a multi-year replicated study in central Namibia, we investigated the direct effect of ungulate grazing on thornscrub encroachment, as well as the indirect effects of grazing on rodent populations. We monitored fenced exclosures (1 ha in size) to assess the effect of large grazers on grassland plant community

composition and rodent abundance. Closed capture mark-recapture analysis indicated an over 4-fold increase in rodent numbers where ungulate grazers were excluded compared to control plots. Seed removal experiments revealed that these elevated rodent numbers may influence recruitment of thornscrub species through increased seed predation. Thus, the conservation of increasingly rare grassland habitat in Namibia may be facilitated by an indirect effect of ungulate grazers on rodent populations.

P104 SANTORA, MAURA, and Christine Moffitt. Idaho Cooperative Fish and Wildlife Research Unit, Department of Fish and Wildlife Resources, University of Idaho, PO Box 441136, Moscow, ID 83844, USA (sant9594@uidaho.edu).
MODELING EFFECTS OF *MYXOBOLUS CEREBRALIS* ON THE POPULATION DYNAMICS OF *TUBIFEX TUBIFEX* AND *ONCORHYNCHUS MYKISS*

Declines in intermountain western United States rainbow trout, *Onchorynchus mykiss*, populations have been attributed to whirling disease, caused by the *Myxobolus cerebralis* parasite. Models of the impact of this specific pathogen on its two host populations have not been published, as of yet. We have developed the foundation for a deterministic model of the epidemics of *M. cerebralis* through review of existing published literature. The dynamics of the model are regulated by parameters such as the basic salmonid and *Tubifex tubifex* host demographic reproduction, growth, and mortality rates; parasite production and decay rates; and disease transmission and recovery rates. We examine the influence of these parameters on host population numbers in order to assess which cause greater population declines over a unit of time. Preliminary results indicate only a small decrease in susceptible rainbow trout numbers with increasing prevalence of infection in the *T. tubifex* population, and that transmission probability most likely has the greatest effect on infected and susceptible trout numbers. We discovered gaps in knowledge of the population dynamics of *M. cerebralis* through the practice of building this model from literature review. Future development of the model should focus on parameter probability distributions, parsimony, validation, and inclusion of environmental modifiers to be more useful to fish managers trying to contain whirling disease in the wild.

P114 SATO, KAZUNORI. Department of Systems Engineering, Faculty of Engineering, Shizuoka University, 3-5-1 Johoku, Hamamatsu, 432-8561, Japan (sato@sys.eng.shizuoka.ac.jp).
EXAMINATION ON CRITERIA FOR THE ENDANGERED SPECIES

For the conservation of rare species, there are various criteria to determine endangered species from the regional or the country level to the international. In some of these, e.g. IUCN red list categories, the objective (or quantitative) method using data for the criteria is clearly shown. Although it is pointed out that there is inconsistency between some criteria, each of which should be applied independently, e.g. on the criteria of IUCN red list categories, criterion A concerns only the rate of population reduction, but should also be linked to the population size if it is available without the contradiction to the estimation of extinction probability by criterion E. Here I consider the effect of finite size of population for these criteria by using a simple model, and examine the consistency between them. Besides that I show how much degree the geographical structure of population (including criterion B of IUCN red list categories) affects these criteria. As the result I conclude that the criteria should be reflected by the cumulative field data as possible as we can use.

C12-02 SAVANICK, SUZANNE, and Jim Perry. University of Minnesota, 186 McNeal Hall, 1987 Upper Buford Circle, St. Paul, MN 55108, USA (sava0054@umn.edu).
CAMPUS BIODIVERSTY: LINKING SUSTAINABILITY, BIODIVERSITY AND EDUCATION AT HIGHER EDUCATION INSTITUTIONS

Conservation biologists historically focus on biodiversity as a connection between biological and social issues. The goal of such work is to empower human societies to make more informed decisions about biological values. However, there remains a disconnect between conservation biology research and the educational institutions with which many of us are affiliated. Recent efforts in campus sustainability bridge that disconnect. In these efforts, students, faculty and/or staff collect data on environmental impacts, plant native vegetation in campus landscapes or advance sustainable building technologies. At the University of Minnesota, the Sustainable Campus Initiative links the academic and the management sides of the institution. We work collaboratively to improve the environment and increase teaching opportunities. Currently, students, staff and faculty are working together on an environmental assessment and a campus wetland restoration. The results have changed measurably the sustainability of the campus environment and the ways we teach students about landscapes and decision making. These types of efforts offer an opportunity for conservation biologists. Through such projects, students may learn about environmental and biodiversity issues, as well as learn the process of implementing institutional change, a skill needed for implementing the goals of conservation biology.

C54-01 SAYRE, ROGER, Leonardo Sotomayor, Carter Roberts, and Timothy Boucher. The Nature Conservancy, 4245 North Fairfax Drive, Arlington, VA 22203, USA (rsayre@tnc.org).
PROTECTION OF GLOBAL TERRESTRIAL BIOMES AND ECOREGIONS – AN ECOGEOGRAPHIC PERSPECTIVE

We conducted a spatial overlay of global protected areas on global terrestrial ecoregions to quantify the extent and distribution of protected area coverage of the planet's 14 terrestrial biomes and 866 terrestrial ecoregions. We used a hierarchical framework where ecoregions are organized into biomes (major habitat types) and distributed across eight biogeographic realms. We calculated percent protection values for each biome type and ecoregion, both globally, and within realms. Globally, biome coverage by protected areas ranged from a high of 7.3% (Montane Grasslands and Shrublands) to a low of 0.6% (Temperate Grasslands, Savannas, and Shrublands). Representative, replicate protection of a biome, defined as extent of protected area coverage in all ecoregions of that biome, was highest in Boreal Forests (93% of ecoregions with coverage), and lowest in Flooded Grasslands and Savannas. 238 ecoregions were without protected area coverage. We also looked at human influence in biomes, ecoregions, and protected areas, and found that protected areas are frequently located in areas of high human influence. These analyses point to the need to increase the amount, target the distribution, and ensure the quality of protected areas to achieve a more comprehensive and representative protection of the biodiversity of our planet.

P107 SCHAEFER, JAMES. Biology Department, Trent University, 1600 West Bank Drive, Peterborough, ON K9J 7B8, Canada (jschaefer@trentu.ca).
LONG-TERM RANGE RECESSION AND THE PERSISTENCE OF CARIBOU IN THE TAIGA

Spatial patterns can help in understanding the decline and future prospects of threatened species. Employing a novel spatial approach, I analysed long-term changes in occupancy by taiga-dwelling caribou to estimate their rate of disappearance and time to extirpation in Ontario, Canada. Patterns of range recession, 1880-1990, indicated that half of historic woodland caribou range has been lost, a rate of disappearance of 34,800 square kilometres per decade and northward range recession of 34 km per decade. The mean metapopulation density, the abundance of discrete winter groups, was one group per 1,900 square kilometres, suggesting that an average loss of 18 caribou wintering areas per decade during this period. There was strong coincidence between the recent southern limits of caribou occupancy and the northern front of forest harvesting, implying an anthropogenic agent of decline. The estimated time-to-extirpation of forest-dwelling caribou in Ontario, inferred from the sustained rate of disappearance, was 91 years (95% confidence interval: 57-149 years). Persistence of woodland caribou may depend on spatial separation from human incursion.

PL-02 SCHINDLER, DAVID W. Department of Biological Sciences, University of Alberta, Edmonton, AB T6G 2E9, Canada (d.schindler@ualberta.ca).
THE CUMULATIVE EFFECTS OF LAND-USE CHANGES AND OTHER HUMAN ACTIVITIES ON BOREAL FRESHWATERS

Boreal freshwaters receive both direct and indirect stresses from human activity including climate warming, increasing UV radiation, acid precipitation, and activities both in terrestrial catchments and on water bodies. Climate warming has caused massive reductions in the river flows of western boreal North America, with adverse consequences for downstream ecosystems. Increasing forest fire causes changes to nutrient and water inputs, increased transparency, changed thermal stratification, and increased exposure to UV radiation. Increased road access for logging, mineral and hydrocarbon exploration, and other development allows increased exploitation of predatory sport fishes, causing trophic cascades that contribute to declining water quality. Hydroelectric developments flood forests and wetlands, causing massive releases of greenhouse gases and mercury from decaying vegetation. Clearcut logging removes scarce base cations from regions with acidic soils, increasing the vulnerability of softwater boreal lakes to acid precipitation. Clearing of boreal forest for agriculture increases the input of nutrients to freshwaters. Protecting boreal freshwaters will require integrated land-water management, where the cumulative effects of stresses are considered, rather than treating problems in isolation as we have done in the past.

C52-03 SCHLOSSER, ISAAC, and Carol Johnston. Department of Biology, University of North Dakota, Grand Forks, ND 58202-9019, USA (isaac_schlosser@und.nodak.edu) (IS); Natural Resources Research Institute, University of Minnesota Duluth, 5013 Miller Trunk Highway, Duluth, MN 55811, USA (CJ).
HISTORICAL PATTERNS OF LANDSCAPE ALTERATION BY BEAVER AND SUBSEQUENT IMPLICATIONS FOR THE CONSERVATION BIOLOGY OF FISHES

The objective of this presentation is to integrate the results from two separate but related studies that assessed the impact of beaver on boreal forest landscapes in northern Minnesota and their associated fish assemblages. We used six aerial photographs taken between 1940 and 1986 to determine the impact of beaver recolonization on the structure and formation of aquatic habitat patches, and then examined the influence of regional geomorphic boundaries and local successional processes associated with beaver activity on spatial variation in fish assemblages. Our results indicate the rate and size of aquatic patch formation varies

dramatically during beaver re-colonization, and the habitat patches themselves are highly dynamic, exhibiting shifts between successional environments that are relatively 'open' (without intact beaver dams) and those that are relatively 'closed' (with intact beaver dams). The shift from relatively 'open' to 'closed' successional environments profoundly influences the trade-off between fish production and fish diversity. Consequently, the maintenance of both a productive and diverse fish assemblage requires the entire range of successional habitats on the landscape. The ultimate impact of this successional patch dynamics on fish assemblages is, however, strongly influenced by the regional geomorphic context in which it occurs.

P132 SCHLÜTER, EVEROSE N., and J. Michael Reed. Department of Biology, Tufts University, Medford, MA 02155, USA (everose.schluter@tufts.edu).
MOSS PERSISTENCE IN FOREST REMNANTS

Habitat fragmentation can increase extinction risk for many species. A situation where habitat fragmentation is of particular concern is in industrial forests, where the landscape is often a mosaic of forest types and mature forest is lost. For the past five years, we have studyied moss communities within an industrial forest in Maine, USA. Since biological responses to disturbance can be slow to develop, we conducted a study of forest remnants. Remnants were buffer strips between clearcuts, created 8 to 10 years prior because of legislative restrictions on harvest practices. The biological goal was to create refugia for species unable to persist in a newly harvested landscape. We evaluated their effectiveness for mosses, sampling 17 replicates of three treatment types: remnant forests, adjacent harvested areas, and intact forests of similar habitat. Preliminary analyses indicate that moss species richness was highest in the buffer strips and lowest in the harvested areas. Although moss community composition was similar between remnant and intact forest, we found a greater number of disturbance specialist species in the buffer strips. Forest structure and substrate availability affected moss occupancy in the different treatments. Preliminary analyses indicate that remnant forest strips act as short-term refugia for forest mosses.

S07-07 SCHMIEGELOW, FIONA K.A. Department of Renewable Resources, University of Alberta, 751 General Services Building, Edmonton, AB T6G 2H1, Canada (fiona.schmiegelow@ualberta.ca).
LARGE-SCALE CONSERVATION PLANNING FOR CANADA'S BOREAL FORESTS

There exists an unparalleled opportunity for pro-active conservation planning in Canada's boreal forest. There similarly exists no model for how this might proceed, given the unique attributes of this system and situation. Whereas most conservation efforts have been reactive, tackling defined spatial units that are largely treated as static entities, the large spatial extent and inherently dynamic nature of the boreal biome calls for a different approach. Many of the paradigms that characterize conservation science simply do not apply. Here, I present a new, collaborative initiative that strives to reverse many of these paradigms, placing emphasis on maintenance of intact communities and resilient systems, rather than defining minimum critical levels for species persistence. Our approach refines the concept of ecological thresholds to deal with applications suited to large-scale conservation planning. It explicitly incorporates the diversity of forest composition, natural disturbance regimes, land-use history and tenure arrangements that characterize Canada's boreal forests. Our objective is to articulate a national vision for boreal conservation, while recognizing the need to develop implementation frameworks at regional levels. The latter is achieved through assembly and analysis of empirical data using multiple criteria, and at multiple spatial scales.

C46-02 SCHNEIDER, STEPHEN H., and Terry L. Root. Center for Environmental Science and Policy and Department of Biological Sciences, Stanford University, Stanford, CA 94305-5020, USA (shs@stanford.edu).
WILL CLIMATE CHANGE BE "DANGEROUS" FOR PLANTS AND ANIMALS?

At the Rio Conference in 1992, the United Nations Framework Convention on Climate Change (UNFCC) was signed by over 150 nations (including the U.S.) A principal objective of the UNFCC was to prevent "dangerous anthropogenic interference" with the climate system. Hundreds of long term ecological studies combined into meta-analyses show that about 80% of 1473 species that do show change have changed in the direction expected with warming (global surface air temperature has warmed about 0.6°C since 1900), and that on average plants flower or birds lay eggs some 5 days per ten years earlier in the Spring (Root et al. 2003). The Intergovernmental Panel on Climate Change, Working Group II (2001) suggested that although there is a discernible influence of recent temperature trends on plants and animals, more significant damages are likely to occur from warming of beyond a few degrees. We explore the likelihood of "dangerous" climate change by projecting a plausible range of emissions scenarios, jointly with a probability distribution for the sensitivity of the climate to greenhouse gas increases. A disturbing fraction of such projections implies very large (>3.5°C) climatic changes by 2100, which combined with fragmented habitats, poses a great risk for biodiversity preservation.

C13-05 SCHOFF, PATRICK, Catherine Johnson, Anna Schotthoefer, Lucinda Johnson, Rebecca Cole, Camilla Lieske, Joseph Murphy, and Val Beasley. Natural Resources Research Institute, University of Minnesota Duluth, 5013 Miller Trunk Highway, Duluth, MN 55811, USA (pschoff@nrri.umn.edu) (PS, CJ, LJ); Department of Veterinary Biosciences, University of Illinois at Urbana-Champaign, 2001 South Lincoln Highway, Urbana, IL 61802, USA (AS, CL, JM, VB); U.S. Geological Survey, National Wildlife Health Center, 6006 Schroeder Road, Madison, WI 53711, USA (RC).
ESTIMATIONS OF THE PREVALENCE OF MALFORMATIONS IN FROGS FROM THE UPPER MIDWEST

Observations of large numbers of malformed frogs in the U.S. and Canada suggest that the rate of amphibian malformations has recently increased. Frog skeletal malformation prevalence was determined in a set of randomly selected wetlands in Illinois, Wisconsin, and Minnesota over four consecutive years. A total of 5975 metamorphic frogs representing eight species were collected in 1998 - 2001 from 73 sites in 14 clusters. Thirty-eight sites (52%) contained malformed specimens. Skeletal malformations were identified in 108 (1.8%) frogs. Six of the eight species collected had malformed specimens, with rates among species ranging from 1.4% (*Rana pipiens*) - 3.3% (*Pseudacris crucifer*). Hindlimb malformations predominated in all species and in all four years, identified particularly as ectromely (missing limb), partial limbs (brachymely), or limb segments (e.g. brachydactyly). Other abnormalities, involving eyes, forelimb, skin, and pelvis, were also found. Sites with malformed specimens were geographically clustered in all four years, but the cluster locations were not the same in any year. The malformation rates reported here are higher than the rate determined for metamorphic frogs collected from similar sites in Minnesota in the 1960s, and thus, appear to represent an elevation from the historical baseline malformation rate.

P027 SCHULTE, LISA A., Anna M. Pidgeon, and David J. Mladenoff. USDA Forest Service, North Central Research Station, 1831 Highway 169 East, Grand Rapids, MN 55744, USA (laschulte@fs.fed.us) (LAS); Department of Forest Ecology and Management, University of Wisconsin–Madison, 120 Russell Labs, 1630 Linden Drive, Madison, WI 53706, USA (AMP, DJM).
ONE HUNDRED FIFTY YEARS OF CHANGE IN FOREST BIRD HABITAT: USING HISTORICAL DATA TO SPATIALLY ESTIMATE SPECIES DISTRIBUTIONS IN WISCONSIN

Evaluating bird population trends requires baselines, and population data from the late 1960s are frequently used. However in the northern Lake States forest conditions have been undergoing succession since the great cutover of the late 1800s; thus, we propose pre-Euroamerican settlement as an alternative baseline for bird habitat change assessment. We constructed models of bird-habitat relationships from published data, and mapped the presettlement and present habitat distribution of three forest birds: the Blackburnian Warbler, Black-Throated Green Warbler, and Pine Warbler. Historical habitat data were gathered from the original Public Land Survey records and current conditions were modeled from forest inventory data. Model robustness was assessed by comparing current habitat distribution to actual breeding bird locations from the Wisconsin Breeding Bird Atlas. All three bird species show an expansion in habitat range and a degradation in habitat quality since presettlement times. Range expansion has occurred largely because of forest incursion into previously open habitats, and because of the development of pine plantations. Sources of degradation include loss of hemlock and white pine from the northern hardwoods forests and loss of large trees. Our maps provide a powerful tool for assessing changes in bird distributions and population levels over the last 150 years.

C41-02 SCHULTZ, CHERYL B., and Paul C. Hammond. School of Biological Sciences, Washington State University, 14204 NE Salmon Creek Avenue, Vancouver, WA 98686, USA (schultzc@vancouver.wsu.edu) (CBS); Department of Entomology, Oregon State University, Corvallis, OR 97331, USA (PH).
DEVELOPING QUANTITATIVE RECOVERY CRITERIA FOR ENDANGERED INSECTS: CASE STUDY OF THE FENDER'S BLUE BUTTERFLY (*ICARICIA ICARIOIDES FENDERI*)

The U.S. Endangered Species Act (ESA) requires that recovery plans establish "objective, measurable" criteria on which to base listing decisions. In a review of 27 recovery plans for listed insects, we found that recovery criteria poorly linked to species' biology. We used population viability analysis to develop quantitative recovery criteria for insects whose populations sizes can be estimated, and applied this framework in the context of a recently listed butterfly, the Fender's blue (*Icaricia icarioides fenderi*). We use a simple diffusion-approximation approach developed to estimate extinction risk from count-based census data. Of 12 sites that were surveyed for at least 8 years, only 1 population had a high likelihood of persistence. Given observed variation in population growth rate ($s2 = 0.79$), and an initial population size of 300 butterflies, a minimum average growth rate (l) of 1.83 would be needed for there to be a 95% probability that a population would survive 100 years. We recommend downlisting and delisting criteria based on these results and analyses of several independent sites.

S09-02 SCHWARTZ, MARK. Department of Environmental Science and Policy, University of California, Davis, One Shields Avenue, Davis, CA 85616, USA (mwschwartz@ucdavis.edu).
MOVEMENT AS A RESPONSE TO CLIMATE CHANGE: WHAT TREES TELL US ABOUT DISPERSAL, CLIMATE CHANGE AND CONFLICTING CONSERVATION OBJECTIVES

Rates of historical tree migrations suggest that a large proportion of plant diversity is at risk of extinction as a consequence of global warming. Species may be lost and communities may be disrupted as a result of shifting climatically constrained distributions coupled with limited dispersal ability. These problems are exacerbated by habitat fragmentation. Understanding constraints placed on plants and their abilities to respond to global climate change are integral to comprehensive planning for conservation. Limits to the rate of dispersal-mediated changes are uncertain but maximum rates of observed migrations during the Holocene are not close to required movement rates under global warming scenarios. The result is a potential migration lag, the consequence of which is extinction for species with limited distribution. A second problem facing conservationists is a detection problem. Lack of recruitment, premature death, and elevated mortality rates all have proximate causes that are not easily linked to climate change. Finally, conservation typically uses natural community composition as a target. Augmenting movement of plants into new environments may solve a dispersal limitation problem and help maintain diversity, but creates new problems associated with defining conservation goals. These are not future scenarios, but problems faced by today's conservation managers.

C59-04 SCHWARZKOPF, LARRY. Fond du Lac Natural Resources Program, 1720 Big Lake Road, Cloquet, MN 55720, USA (larryschwarzkopf@fdlrez.com).
RESTORATION OF WILD RICE LAKE ON THE FOND DU LAC RESERVATION

The wild rice lakes on the Fond du Lac Reservation were severely impacted by a judicial ditch system, which was excavated between 1916-1921. The partial drainage of five wild rice lakes resulted in the loss of hundreds of acres of open water wild rice habitat and the encroachment of competing vegetation. The wild rice lakes were restored to their historical size by the construction of four concrete water control structures. The restoration of the wild rice habitat requires an ambitious program of mechanical control and removal of most of the competing vegetation. The Fond du Lac Natural Resources Program is conducting the wild rice habitat restoration work, and is cooperating with the Fond du Lac Tribal and Community College and the University of Minnesota Duluth to study the wild rice ecology and the changes to the plant community and bottom sediments. The wild rice lakes will be described and the restoration plans, activities, and results will be presented.

C42-05 SEHGAL, AJAY. Deputy Conservator of Forest, Punjab University, #2858, Sector 37C, Chandigarh, 160 036, India (ajaysehgalifs@yahoo.com).
ENVIRONMENTAL IMPACT ASSESSMENT OF ENGINEERING INTERVENTIONS ON RESTORATION OF ECOSYSTEM OF A MANMADE WETLAND – A SUCCESS STORY

Engineering interventions were taken up for the restoration of the biodiversity of a manmade wetland situated in the shadow of ecologically sensitive and geologically unstable Shivalik foothills forming a part of the fragile Himalayan eco-system. It establishes the linkages of hill denudation with environment and poverty in the Sukhomajri catchment of Sukhna – a 3km^2 rain-fed protected national wetland. The problem of siltation was so acute that several agricultural fields were converted into 20 metre deep and wide gorges from the uncontrolled rainwater coming from the catchment, reducing the pondage capacity of wetland by 60%. Commercially sensitive and economically exploitative attitudes of locals subjected this ecosystem to stress, leading to alteration and hampering of its functions, and then to ultimate destruction. The project drastically reduced silt flow, improved ground water recharge and moisture regime apart from providing food, forage, fuel, flood and social security. The paper, apart from commenting on community based restoration and sustainable management of wetland and critically assessing the performance of engineering interventions, also attempts to focus on the ecological principles that are real tangible parameters of sustainability of the wetland habitat.

P115 SEI, MAKIRI. Program of Organismic and Evolutionary Biology, University of Massachusetts, 611 North Pleasant Street, Amherst, MA 01003, USA (makiri@nsm.umass.edu).
THE ENDANGERED CANADIAN BUTTERFLY LARVA THAT EATS SALT MEADOW CORDGRASS CAN TOLERATE SALTWATER SUBMERGENCE

Management of an endangered species requires knowledge of the target species' ecology. The maritime ringlet (*Coenonympha tullia nipisiquit* McDunnough, Satyrinae, Nymphalidae) is a federally endangered, rare butterfly that inhabits six salt marshes in northern New Brunswick and a few salt marshes in the GaspT Peninsula of Quebec. Neonate larvae require microhabitats rich in salt meadow cordgrass (*Spartina patens* (Aiton) Muhl.) that flood regularly. The inornate ringlet (*C. tullia inornata* Edwards) is a common, widespread subspecies that occurs in meadows near the maritime ringlet populations. I tested whether the maritime ringlet has adapted to its high-salinity habitat by submerging larvae of the maritime ringlet and the inornate ringlet in saltwater for varied duration. The submergence caused high mortality among the inornate ringlet larvae; whereas most of the maritime ringlet larvae survived up to 24 hours of submergence. Neonate inornate ringlet larvae raised on *S. patens* died within a week, even though maritime ringlet larvae thrived on it. The result indicates that the maritime ringlet has adapted to salt marsh habitat after its divergence from the inornate ringlet.

C03-05 SEIGEL, RICHARD A., James R. Lee, Rebecca B. Smith, and Jeffrey Demuth. Department of Biological Sciences, Towson University, Towson, MD 21252, USA (rseigel@towson.edu) (RAS, JRL); Dynamac Corporation, Mail Code DYN-1, John F. Kennedy Space Center, FL 32899, USA (RBS); Department of Biology, Indiana University, Bloomington, IN 47405, USA (JD).
VALUE OF NATURAL VERSUS CREATED WETLANDS FOR MAINTAINING REPTILE AND AMPHIBIAN BIODIVERSITY

Freshwater wetlands are being destroyed at an alarming rate worldwide. Mitigation efforts often take the option of replacing these habitats in order to maintain biodiversity, but the long-term value of created wetlands remains poorly known. At the Kennedy Space Center in Florida, natural freshwater habitats are limited to freshwater swales and mesic hammocks. These habitats are subjected to road construction, alteration in drainage, and disturbances from feral hogs. Created wetlands at this site include roadside ditches and excavated limestone pits. From 1994-2002 we compared the species richness and abundance of reptiles and amphibians between roadside ditches and natural wetlands (swales), primarily using aquatic traps. Data analysis of over 4100 trap nights suggests that species richness and abundance in roadside ditches is surprisingly high. Although ditches are subject to rapid changes in water levels and occasional saltwater intrusion, some amphibian and reptile species are more common in ditches than in swales (e.g., green water snakes). Conversely, some species are restricted to swales (e.g., black swamp snakes). Our data suggest that resource managers interested in preserving overall biodiversity in an area should focus not only on natural habitats, but should consider created habitats as potentially important sites as well.

C51-04 SEKERCIOGLU, CAGAN, Gretchen Daily, and Paul Ehrlich. Stanford University Center for Conservation Biology, 371 Serra Mall, Stanford, CA 94305-5020, USA (cagan@stanford.edu).
ECOLOGICAL CONSEQUENCES OF BIRD EXTINCTIONS

Birds play major ecosystem roles as pollinators, predators, scavengers and seed dispersers. However, 20% of bird species are extinction-prone (threatened or near-threatened), and 13% are ecologically extinct (threatened or extinct), and thus contribute little to ecosystem processes. One quarter of frugivorous species and a third of herbivorous, piscivorous and scavenging species are extinction-prone, raising the possibility of drastic changes in ecosystem processes as a result of extinctions and severe population reductions. Many montane bird species are at risk, particularly those confined to a narrow altitudinal band; they are further threatened by climate change. Based on three different scenarios, we predict that by 2100, 6-14% of all bird species will be extinct and 14%-33% will be ecologically extinct, with highest extinction concentrations expected to occur in Madagascar, New Zealand, Oceania and Austral, Indomalayan, and Palearctic regions. In these areas, bird groups mentioned above, as well as nectarivores, are predicted to lose 9%-32% of their species, and overall, 17%-57% of species will contribute negligibly to ecosystem processes. Bird-mediated ecosystem processes and services, particularly decomposition, pollination, and seed dispersal, as well as pest control, will decline as a result of actual and ecological extinctions, especially since specialized and irreplaceable taxa are most likely to disappear.

S04-03 SENANAN, WANSUK. Department of Aquatic Sciences, Faculty of Science, Burapha University, Bangsaen, Conburi 20131, Thailand (wansuk@buu.ac.th).
ON-FARM MONITORING PROGRAM: A STEP TOWARDS AQUATIC CONSERVATION IN CENTRAL THAILAND

Conservation of aquatic resources in heavily utilized areas, such as the Chao Phraya River basin of Central Thailand, has been challenging due to diverse land uses. The catfish aquaculture sector has strong interests in protecting the surrounding aquatic environment because critical inputs, such as fresh water and broodstocks, are dependent on healthy ecosystems. A team of researchers and fish farmers initiated an on-farm monitoring project to evaluate impacts of genetic quality of broodstock on growth of offspring and to engage farmers in systematic data collection. This program incorporated farmers' knowledge about fish biology and researchers' expertise on conservation genetics. Preliminary genetic data indicate different levels of genetic diversity in various broodstocks (average H at 3 loci = 0.75, 0.53 for central and southern populations, respectively) and potential effects of the differences on the quality of offspring. Preliminary interviews of farmers involved in this project suggest that they are concerned about natural fish populations, but feel that their possible conservation actions are limited. This monitoring program could serve as a foundation for an environmental monitoring program at a larger scale. Work in progress includes further genetic analyses and the evaluation of farmers' attitude towards aquatic conservation after participating in this project.

S11-08 SEXSON, DEANA, Jeb Barzen, and Ted Anchor. University of Wisconsin–Madison, NPM Program, 1575 Linden Drive, Madison, WI 53706, USA (dlsexson@facstaff.wisc.edu) (DS, TA); International Crane Foundation, E-11376 Shady Lane Road, PO Box 447, Baraboo, WI 53913, USA (JB).
IS THERE A CONTRADICTION BETWEEN ECONOMICALLY VIABLE POTATO PRODUCTION AND ECOSYSTEM MANAGEMENT ON FARMS AND ADJOINING LANDS?

The World Wildlife Fund, the Wisconsin Potato and Vegetable Growers Association, and the University of Wisconsin have worked since 1996 to identify and accelerate adoption of pest, crop, and farm management practices to reduce the ecological

footprint of potato production in Wisconsin. Collaboration goals include: increased Integrated Pest Management, reduced use of high-risk pesticides, ecosystem restoration, increased biodiversity, and improved soil and water quality. This has been a grower-driven process throughout the Collaboration effort. So far the Wisconsin potato industry has greatly reduced high-risk pesticide use and an eco-potato standard has been developed to provide a marketplace incentive for ecologically grown potatoes. This effort is now being expanded to include more direct ecosystem priorities. A pilot project to conduct on-farm audits of native prairie, savanna, and wetlands is underway. Following this we will develop farm plans to conserve and restore these important ecosystems. Providing one-on-one interaction with potato growers allows farm management plans to be integrated holistically with surrounding areas. The ultimate goal of this work is to integrate these activities by growers into potato eco-label standards thus directly involving society in the maintenance of commodities such as clean water and biological diversity as well as food production.

C59-01 **SHEPHERD, STEPHANIE,** and Diane Debinski. Department of Ecology and Evolutionary Biology, Iowa State University, 124 Science II, Ames, IA 50011, USA (shepherd@iastate.edu) (SS); Department of Ecology, Evolution, and Organismal Biology, Iowa State University, 124 Science II, Ames, IA 50011, USA (DD).
THE UTILITY OF BUTTERFLIES AS INDICATORS OF PRAIRIE RECONSTRUCTION DEVELOPMENT AND SUCCESS

Developing ecological restoration techniques is especially important for areas of high anthropogenic alteration, such as the tallgrass prairies and wetlands in Midwestern states. Because the primary focus of many restoration projects is to restore the plant community, we wanted to examine how prairie restoration may affect important prairie pollinators such as butterflies. We surveyed the plant and butterfly communities in 12 native prairies and 24 reconstructed prairies that differed along a gradient of vegetative diversity and quality. Total butterfly richness was significantly higher on native versus reconstructed prairies but richness correlated with only two vegetation characteristics: cover of bare ground ($r = -0.38$, $p = 0.02$) and the cover of duff ($r = 0.30$, $p = 0.07$). Total butterfly abundance was not significantly different on native versus reconstructed prairies but it was negatively associated with cover of bare ground ($r = -0.35$, $p = 0.03$). Specific host plants are important for many species, but these findings suggest that vegetation management – and not just vegetation composition – may have a large effect on butterfly species richness. We hypothesize that the vegetative composition of the adjacent landscape may influence local species richness by providing colonists from nearby sources.

C27-05 Shick, Katherine, and **JOHN GOODBURN.** School of Forestry, University of Montana, Missoula, MT 59801, USA (goodburn@forestry.umt.edu).
EFFECTS OF PATCH- AND LANDSCAPE-LEVEL CHARACTERISTICS OF FOREST VEGETATION STRUCTURE ON THE RELATIVE ABUNDANCE OF SNOWSHOE HARES

Snowshoe hares (*Lepus americanus*) are important forest herbivores currently receiving intense management interest since they are the primary winter food source for threatened Canada lynx (*Lynx canadensis*). One primary strategy for lynx conservation is the provision of suitable snowshoe hare habitat that includes dense conifer vegetation just above winter snow levels, but little is known about how hare habitat suitability might be affected by the forest vegetation structure at multiple scales. The objective of this study was to examine the interaction of different patch- and landscape-level structural characteristics on the relative abundance of snowshoe hares in subalpine forests of western Montana. Vegetation structure and hare fecal pellet counts were sampled in 47 stands from two study areas. As expected, understory structural characteristics (e.g., horizontal cover within 2 m of ground level) were the most important predictive variables at the patch level, although the importance of characteristics varied among stand types. Linear regression models incorporating horizontal cover along with canopy tree basal area explained 56% of the variation in hare pellet density across all stands. Landscape variables related to vegetation structure within a 1500 m buffer (e.g., patch type diversity, proportional abundance of patch types) can substantially improve model performance.

C60-03 **SILAYO, DOS SANTOS ARISTARICKY,** Riziki Silas Shemdoe, Shabani D. Mnyonga, and Stephen Philemon Kingazi. Sokoine University of Agriculture, PO Box 3012, Chuo Kikuu, Morogoro, Tanzania (dsilayo@yahoo.co.uk) (DSAS, RSS, SDM); Tanzania Graduate Farmers Association, PO Box 3284, Morogoro, Tanzania (SPK).
IMPACT OF BANNING SOFTWOOD HARVESTING TO HARDWOOD SPECIES ON THE SLOPES OF MOUNT KILIMANJARO, TANZANIA

Natural forests covering a total of 107,828ha with catchment values surround Kilimanjaro Mountain. Human settlements with their home gardens and small woodlots surround these forests. Establishment of softwood plantation forests in 1950s, which involved clearing of natural forests, aimed at providing alternative forest produce. In recent years, shortage of logs as a result of aphid attack on *Cupressus* spp. and postponement of planting on plantations was observed. Information gathered using multiple data collection methods revealed that logging contractors and sawmills have turned to home gardens, convincing people to sell whatever timber tree available which were traditionally serving in Agroforestry. Illegal pit sawing in the reserved forest has been accelerated. The main preferred species include: *Macaranga kilimanjarica*, *Ocotea usambarensis*, *Xymalos monospora*,

Podocarpus latifolius, *Fagaropsis angolensis* and *Iillex mitis*. *Prunus africana*, which is an endangered species listed in appendix 3 of the IUCN red-book, is of no exception. Extension education accompanied with deliberate efforts to restore the plantations' situation is vital. Meanwhile, since the home gardens are continuously under agricultural pressures, natural regeneration is seen to be impossible, and the local people should be encouraged to replant on the removal of trees to ensure sustainable supply in the future.

P043 **SILBERNAGEL, JANET.** Department of Landscape Architecture, University of Wisconsin–Madison, 1450 Linden Drive, Madison, WI 53706, USA (jmsilber@wisc.edu).
COMPILING SPATIAL NARRATIVES FOR INTEGRATED CONSERVATION

Many times conservation planning could be enhanced with approaches to capture the complex dynamics of people and land in a holistic framework. Long held paradigms about how knowledge is acquired and applied in the ecological sciences may be trespassed. One such leap is to include qualitative 'narratives' – stories compiled about a place, its people, and the relationship between. Narratives may be compiled from varied forms of landscape information. For example, expressions of regional identity can be found in physical landscape evidence – forms and patterns, as well as landscape paintings, maps, photography, and local craft. A shared sense of place, therefore, is expressed in a local groups' reflection of their landscape through cultural artifacts of everyday life. In this poster I present, by way of conservation work in the Lake Superior region, USA, ways in which landscape patterns and visual expression can be used together to connect sequences of a landscape story to enrich conservation plans and build community trust. Most importantly, I suggest a meshing of qualitative knowledge with geographic sciences to synthesize spatial narratives for conservation ecology. The spatial narrative is a conceptual framework to bring the qualitative experience of place together with the geoscience's approach of space.

P093 Silva, Marivana, **MILTON KANASHIRO,** Peter Coventry, and Ian Thompson. Universidade Federal do Pará, Tv. Leandro Ribeiro s/n. 68 600-000 Bragança-PA, Brazil (MS); Embrapa Amazonia Oriental, Trav. Dr. Eneas Pinheiro s/n. 66 095-100 Belem-PA, Brazil (milton@cpatu.embrapa.br) (MK, PC, IT).
SEXUAL RATIO AND SPATIAL DISTRIBUTION OF POPULATIONS OF *BAGASSA GUIANENSIS*: IMPLICATIONS OF DIOECY FOR FOREST MANAGEMENT

The Dendrogene project (EMBRAPA/DFID) develops ways to evaluate the impacts of logging on forest biodiversity, aiming for the sustainable use of forest. *Bagassa guianensis* represents one of the ecological groups amongst the tree species studied by the project and is the subject of this study. It is a dioecious, pioneer tropical tree of high commercial value. In dioecious species forest management may modify the sexual ratio and the spatial and temporal distributions of the sexes, leading to changes in pollen dispersion, production of seeds, and ultimately regeneration. This work is part of the ecological and genetic studies that are being developed in 3 different forest areas in the Brazilian Amazon (Pará State) that are under management. Maps of localization of the individuals have been generated which permitted the calculation of indices for spatial sexual segregation. *Bagassa guianensis* is a species that tends to occur as aggregated populations, has sexual differences related to diameter, and differentiated sexual ratios between the studied regions. These results contribute to the understanding of the population dynamics and to inform the debate on the regenerative capacity of species following disturbances due to timber logging.

C34-03 Silver, Scott C., Linde E.T. Ostro, Laura K. Marsh, Leonardo Maffei, Andrew J. Noss, **MARCELLA J. KELLY,** Robert B. Wallace, Humberto Gómez, and Guido Ayala Crespo. Wildlife Conservation Society, Queens Zoo, 53-51 111th Street, Flushing, NY 11368, USA (SCS); Wildlife Conservation Society, Bronx Zoo, 2300 Southern Boulevard, Bronx, NY 10460, USA (LETO); Los Alamos National Laboratory, Ecology Group (RRES-ECO), Mail Stop M887, Los Alamos, NM 87545, USA (LKM); Wildlife Conservation Society, Bolivia, Casilla 6272, Santa Cruz, Bolivia (LM, AJN); Department of Fisheries and Wildlife Sciences, 106 Cheatham Hall, Virginia Tech, Blacksburg, VA 24061-0321, USA (MJK); Wildlife Conservation Society, Bolivia, Casilla 3-35181, San Miguel, La Paz, Bolivia (RBW, HG, GAC).
THE USE OF CAMERA TRAPS FOR ESTIMATING JAGUAR (*PANTHERA ONCA*) ABUNDANCE AND DENSITY USING CAPTURE/RECAPTURE ANALYSIS

Jaguars (*Panthera onca*) are important conservation icons across their range for several reasons: the role they play in ecosystems as top carnivores, their cultural and economic value, and the conflicts they present with livestock. Yet, jaguars have historically been difficult to monitor and as a result, little is known of their ecology and population status. This paper outlines a systematic camera trapping methodology for censusing jaguars. At five different study sites, we used a grid of camera traps deployed for two months, identified individual animals from their coat patterns, and estimated population abundance using capture-recapture statistical models. Studies were conducted in the Mayan rainforest of Belize and the Chaco dry forest and Amazonian rainforest of Bolivia. Densities ranged from 2.8 to 8.8 adult individuals per 100 km^2, based on 7 to 11 observed animals, 16 to 37 combined

"captures" and "recaptures," 486 to 2280 trap nights, and 117 to 458 km^2 sample areas. This technique will be used to continue long-term jaguar monitoring at these sites, to compare across further sites, and to develop population models. This methodology is currently the only systematic jaguar population survey technique, and can potentially be applied to other species with individually recognizable markings.

C38-02 SILVERMAN, EMILY, and M. Elsbeth McPhee. School of Natural Resources and Environment, University of Michigan, 430 East University, Ann Arbor, MI 48109-1115, USA (esilver@umich.edu).
CALCULATION OF RELEASE NUMBERS FOR REINTRODUCTION PROGRAMS II: CONSIDERING VARIANCE CHANGES IN NON-NORMALLY DISTRIBUTED AND CORRELATED TRAITS

The selective pressures associated with captive environments can be different from those in which a species evolved. For example, captivity may relax selection, resulting in increased variation in a multitude of traits; additionally, directional selection might cause a shift in mean trait values. In this talk, we will expand on the development of a "release ratio," useful for conservation programs attempting to determine the number of animals needed for successful reintroductions. Previous work demonstrated release ratio calculation for normally distributed traits. Because ecological and behavioral variables often do not follow the normal distribution, this talk will extend the normal calculations to consider variables with other distributions. We will present results for behavioral variables that follow the exponential and beta distributions. We will also discuss calculation of an estimated ratio for unspecified distributions and use bootstrapping methods to calculate release ratios for correlated variables. Some general conclusions about release ratio properties will be presented with the oldfield mouse *Peromyscus polionotus subgriseus* as a case study: for this species our calculations indicate that 150 captive-bred animals should be released to obtain a target population of 100 animals. Further extensions of the release ratio will be outlined.

C60-05 SIMONETTI, JAVIER A., Ramiro O. Bustamante, and Audrey A. Grez. Facultad de Ciencias, Universidad de Chile, Casilla 653, Santiago, Chile (jsimonet@uchile.cl) (JAS, ROB); Facultad de Ciencias Veterinarias y Pecuarias, Universidad de Chile, Santiago, Chile (AAG).
HERBIVORY AND ABUNDANCE OF *ARISTOTELIA CHILENSIS* IN FOREST FRAGMENTS IN CENTRAL CHILE

Fragmentation is a widespread threat to forest in central Chile which modifies biological interactions in the biota surviving in forest remnants. Herbivory is lower in fragments than in continuous forests. Here, we experimentally assess whether differences in herbivory rates translates into higher survival and densities of seedlings in forest fragments. Nursery-grown seedlings of *Aristotelia chilensis* were transplanted into a continuous forest (Los Queules National Reserve) and four adjacent forest fragments. A group of seedlings was protected against insect herbivores through insecticide application. Survival rate was assessed after a growth season. The density of naturally grown seedlings has been monitored since 1998 in permanent plots. We also assessed the probability that any adult tree could be replaced by a seedling of *A. chilensis*. Seedlings protected from herbivores exhibited higher survival than control seedlings, particularly in fragments. Seedling density was significantly higher in forest fragments. Transition probabilities suggest that *A. chilensis* could increase its relative abundance in fragments, a speculation supported by a sustained increase in seedling density through time. Therefore, forest fragmentation might impinge upon forest dynamics and structure changing plant-animal interactions. FONDECYT 1010852.

C49-03 SINCLAIR, ROSS. Wildlife Conservation Society, Papua New Guinea Program, PO Box 277, Goroka, E.H.P., Papua New Guinea (rsinclair@global.net.pg).
THE CONSERVATION AND MANAGEMENT OF MEGAPODES (AVES: MEGAPODIIDAE) IN PAPUA NEW GUINEA

In Papua New Guinea 98% of land is in customary ownership and this precludes the establishment of large state-owned parks. All decisions on land-use practices are made at the family or clan level. To successfully incorporate results of conservation research into the management practices of resource owners, simple management prescriptions must be generated that are understood by local people and that they feel will benefit them. To illustrate this approach, I present research and management recommendations for three genera of megapodes (Aves: Megapodiidae) in New Guinea. These megapodes incubate their eggs in mounds of decaying organic material, which they rake together on the forest floor. Humans harvest eggs from incubation mounds, and hunting of birds at them is widespread. Other threats to megapodes include industrial logging and mining, and subsistence forest clearance. These practices are often unsustainable and have lead to the disappearance of megapodes in some parts of New Guinea. Through research on megapode behavior at mounds, selection of mound-sites, and through experiments on the physical changes in mounds during egg harvests, I was able to make recommendations on the location of no-take areas, timing and practice of egg harvests, and guidelines for cutting of trees close to mounds.

C52-08 SJÖGREN, JÖRGEN. Department of Conservation Biology, Swedish University of Agricultural Sciences (SLU), Box 7002, SE-750 07 Uppsala, Sweden (jorgen.sjogren@nvb.slu.se).
EFFECTS OF FOREST-FUEL HARVEST ON THE SUPPLY OF DEAD WOOD

A large number of forest species depend on dead wood. Coarse woody debris has generally been regarded as the most important substrate and there is also a great deficiency of this substrate in today's managed forests. However, a large part of the volume of dead wood has finer dimensions. Forest-fuel harvest is increasing rapidly in Sweden, and implies that tops, twigs and small-diameter stems, otherwise left after cutting, are removed and used as bioenergy. This practice will cause a substantial decrease in the volume of fine-fraction dead wood at the early stages in the forest rotation. I found that logging-residue piles on clearcuts, to later be extracted, contain ~ 80% of the number of residue parts. The mean total surface area of main stems of tops and twigs > 1cm in thick-end diameter, and stem parts was 510 m^2/ha; with 75% for the logging residue to be removed and 25% for the retained fraction. Although not intended, more than 1/3 of stems > 10 cm in thick-end diameter outside piles are extracted. The study provides valuable background data for analyses of flora and fauna connected to dead wood, in relation to logging residue harvest.

C36-02 SLATTERY, STUART, Llwellyn Armstrong, and Michael Anderson. Institute for Wetland and Waterfowl Research, Ducks Unlimited Canada, Box 1160, Stonewall, MB R0C 2Z0, Canada (s_slattery@ducks.ca).
SCOTER AND SCAUP DECLINES: MUTUAL CAUSES OR MUTUALLY EXCLUSIVE?

Scoter (*Melanitta* sp.) and scaup (*Aythya* sp.) populations declined by about 50% in their core breeding areas during the past 24 years. These birds breed primarily in the western boreal forest of North America but generally winter in ecologically and spatially different areas. Hypotheses about declines are difficult to prioritize for testing because of insufficient information on breeding, staging, and wintering ecology, so we do not know why declines are occurring or where to direct conservation efforts, either demographically or geographically. However, because these taxa overlap mainly on breeding areas, spatial and temporal patterns of correlation between breeding population sizes may provide insight into where constraints occur. We used the North American Breeding Waterfowl Survey data to test predictions about patterns of covariation between scoter and scaup populations. Continental population indices were only correlated after 1978, largely driven by high ($r = 0.87$) correlations the Northwest Territories (NWT). In addition, patterns of variation in population trends across regions of different bird densities were identical for both taxa within the NWT. Our results are consistent with the hypothesis that scoter and scaup populations are limited by similar factors, and that those constraints occur on breeding grounds in the Canadian boreal forest.

C27-02 SLAUSON, KEITH, William Zielinski, and John Hayes. USDA Forest Service, Pacific Southwest Research Station, 1700 Bayview Drive, Arcata, CA 95521, USA (kslauson@fs.fed.us) (KS, WZ); Department of Forest Science, Oregon State University, 321 Richardson Hall, Corvallis, OR 97331, USA (KS, WZ, JH).
HABITAT SELECTION AND CONSERVATION OF A REMNANT POPULATION OF AMERICAN MARTENS IN COASTAL CALIFORNIA

A recognized subspecies of American marten (*Martes americana humboldtensis*) has severely declined within coastal northwestern California; a single population occupying < 5% of its historical distribution is known to remain. To investigate habitat selection by this population a 12x14 random-systematic grid with 2-km spacing was established over the region known to be occupied. A two-station track plate sample unit was established at each point on the grid and run for 16 consecutive days. Habitat characteristics were measured using GIS at two spatial scales, each stand that encompassed a grid point and 1-km radius around each grid point. An information-theoretic approach was used to develop and rank 57 *a priori* resource selection probability functions; 15 stand, 25 1-km radius, and 15 mixed scale. The 3 best models shared the same two stand scale variables, seral stage and shrub cover. Martens were detected most frequently in old-growth conifer dominated stands with dense shrub cover and in areas with a lower proportion of timber harvest. Marten detections occurred significantly ($p < 0.001$) more on U.S. Forest Service (USFS) lands available for harvest than in reserves. Martens were not detected on industrial timberlands. Restoration of unsuitable habitat should encourage both large tree and dense shrub regeneration.

S11-03 SMIRENSKI, SERGEI, and Elena Smirenski. Biological Department, Moscow State University, Vorobyevy Gory, Moscow 119899, Russia (sergei@savingcranes.org) (SS); International Crane Foundation, E-11376 Shady Lane Road, PO Box 447, Baraboo, WI 53913, USA (ES).
FROM APATHY TO PARTNERSHIP: INVOLVING LOCAL COMMUNITIES AT MURAVIOVKA PARK FOR SUSTAINABLE LAND USE (AMUR REGION, RUSSIA)

Russia's continued deep economic and political crisis produced widespread alcoholism, drug abuse, crime, child abandonment, apathy, hopelessness, and cynicism. In 1994, local people were suspicious and resistant to the establishment of the first privately operated territory in Russia. Long-term protection of endangered species, however, requires active involvement of local residents.

By 2002, over 1,500 local students and teachers participated in international summer camps and workshops organized by the International Crane Foundation and Muraviovka Park, becoming strong allies of the park and crane ambassadors in their communities. The park's activities produce local job and income opportunities and provide materials and services to orphanages, schools, libraries, and low-income families. The park became one of the major organizers of educational, cultural, and social programs in the region, attracting attention of mass media and the international community. The park is steadily integrating in its community, which is playing a growing role in the park's mission. Summer camps, establishment of the Center for Social Adaptation of Orphans, and reforestation program have become possible due to cooperation with local administration, schools, libraries, universities, coops, and families. As more local people are supporting park activities, the future of the park, its cranes and wetlands, is becoming brighter.

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GEOMORPHIC COMPLEXITY, HYDRAULIC REFUGE AND THE DISTRIBUTION OF FRESHWATER CETACEANS IN ASIA'S FLOOD-PLAIN RIVERS: IMPLICATIONS FOR MANAGING WATER DEVELOPMENT

Large flood-plain rivers in Asia support tremendous biodiversity including several species of freshwater cetaceans. These animals have a generally clumped distribution in deep counter-current pools (i.e., within the boundaries of lateral eddies) where they find refuge from the hydraulic forces of downstream flow and where biological productivity is concentrated. In the Karnali River, Nepal, which supports the farthest upstream distribution of Ganges River dolphins *Platanista gangetica gangetica*, significantly greater fish abundance and species richness and diversity, and greater invertebrate genus richness were found in two-km segments that supported dolphins (and contained large counter-current pools) versus those that did not support dolphins (and did not contain large counter-current pools). The affinity of cetaceans for counter-current pools appears to be greatest in upstream reaches where relatively greater energetic constraints are imposed by higher velocity flows. Counter-current pools result from the interaction of downstream flow with complex geomorphic features, a situation maintained by dynamic hydrologic and sediment deposition-erosion regimes. When these regimes are altered by the construction of dams and embankments, channels often become simplified and biologically impoverished. Our working hypothesis is that the fine-scale distribution of freshwater cetaceans can be used as an informative tool for managing water development in large flood-plain rivers.

C25-02 SMITH, HENRIK G., Mans Bruun, and Martin Granbom. Department of Animal Ecology, Lund University, S-2223 62 Lund, Sweden (Henrik.Smith@zooekol.lu.se).
SIMULTANEOUS INTERFERENCE AND EXPLOITATION COMPETITION FOR UNEQUALLY DISTRIBUTED RESOURCES

Bird populations have been suggested to be size-regulated by either food availability or availability of safe nest-sites. The availability of food and the quality of nest-sites may vary at different spatial scales. Thus, in heterogeneous landscapes, birds may face a trade-off between food and safe nest sites when selecting habitats during the breeding season. When selecting habitats, birds may face exploitation (and possibly interference) competition for food resources and interference competition for safe nest-sites. We experimentally demonstrate that the distribution of the colonially breeding European starling (*Sturnus vulgaris*) is affected by such an interaction by manipulating food and nest-site availability in a heterogeneous agricultural landscape. This interaction causes the breeding population to be distributed in a non-ideal free way, if the risk of ending up as a floater was not accounted for in the fitness calculations. We argue that this mechanism of population regulation in the starling may cause a source-sink pattern explaining why both reproductive success and population sizes of starlings have declined in Sweden, but without spatial correlation.

C31-04 SMITH, JAMES L.D., Schwann Thunikorn, Theerapat Preayurasiddhi, Chachawan Pisdamkham, Peter Cutter, Peter Leimgruber, Chris Wemmer, and Anuk Patanawiboon. Department of Fisheries, Wildlife and Conservation Biology, University of Minnesota, St. Paul, MN 55108, USA (jlds@fw.umn.edu) (JLDS, PC); National Parks, Wildlife and Plant Conservation Department, Bangkok, Thailand (ST, TP, CP, AP); Conservation and Research Center, Smithsonian Zoological Park, Front Royal, VA 22630, USA (PL,CW).
ASIA'S TENNASSERIM RANGE TRANSBOUNDARY PROJECT: AN 'OPEN' CONSERVATION MODEL

There is consensus among tiger biologists that tiger numbers have continued to decline at an increasing rate in the past 10-11 years despite the concerted efforts of tiger range state governments, local and international NGOs and major funding programs dedicated to tiger conservation. Most conservationists agree that action is needed more than continued efforts to count tigers. We describe an emerging approach driven by ecological roots in landscape ecology, metapopulation dynamics, and viability analysis coupled with the social underpinnings that encompass community based conservation and citizen science. This effort is being applied to 2 of the 6 potential refugia for tigers, the Terai Arc Landscape (in Nepal and India) and the Tennasserim Range (in Thailand and Myanmar). An 'open' model of conservation is being developed to encourage wide participation of local NGOs,

provincial conservation forums, international NGOs and national and local governments. This collaborative approach, long requested by funding agencies, has been incubating among many individuals and institutions for over a decade. It is coming to fruition because tigers are in a dire situation, funds post 9/11 are tight, and there is realization that local participation can bring creativity and motivation to sustain conservation.

C38-07 SOUTER, NICHOLAS J., C. Michael Bull, and Mark N. Hutchinson. School of Biological Sciences, Flinders University, GPO Box 2100, Adelaide, SA 5001, Australia (nsouter@adam.com.au) (NJS, CMB); South Australian Museum, North Terrace, Adelaide, SA 5001, Australia (MNH).
ADDING BURROWS TO ENHANCE A POPULATION OF THE ENDANGERED PYGMY BLUE TONGUE LIZARD, *TILIQUA ADELAIDENSIS*

The endangered pygmy blue tongue lizard, *Tiliqua adelaidensis*, occupies spider burrows in a population near Burra, South Australia. In each of 12 20 x 20 m plots at that population, we added 36 artificial burrows, providing about a ten fold increase in suitable burrows for lizards. Over three surveys during the spring and summer of 2001-02 there were significant increases in lizard numbers in the experimental plots relative to the controls, both for adult lizards and for new recruits after clutches were produced. This local increase in population density may be due to lizards locating suitable burrows more easily where burrow numbers were supplemented. The increased availability of high quality burrows may also reduce mortality among lizards searching for suitable burrows. Additional burrows also led to an increase in local density of a burrow-dwelling centipede that is a potential predator of lizards, but there was no evidence of predation, and any negative predation impact was outweighed by the beneficial effect of providing more burrows.

P063 SPAETH, JOHN, and Denice N. Robertson. Department of Biological Sciences, Northern Kentucky University, Highland Heights, KY 41099, USA (robertsonde@nku.edu).
SPATIAL AND TEMPORAL POLLUTION IMPACTS ON NATIVE FISH DIVERSITY IN THE OHIO RIVER WATERSHED

Conforming to Section 303(d) of the Clean Water Act, the Kentucky Division of Water has prioritized impacted bodies of water for total maximum daily load of organic pollutants. Despite First priority listing, official evaluation of the health of streams, especially native biodiversity, is done on a limited spatial and temporal scale. We monitored water quality parameters and sampled fish communities in four First priority streams in the Ohio River watershed several times per year to determine the effects of point and non-point source pollution on diversity and abundance of native species. We then compared species heterogeneity indices and conducted BACI (Before After/Control Impact) analysis to determine diversity patterns in impacted and non-impacted habitats. Species richness and evenness of native fishes were significantly lower at all impacted First priority sites. In some portions of the watershed, seasonal increases in pollutants (e.g. winter use of ethylene glycol to de-ice airplanes at the Greater Cincinnati/Northern Kentucky International Airport) were particularly destructive on local fish diversity. Other streams were impacted year round by sedimentation, sewage from rural settlements, and runoff from urban sprawl. These results provide quantitative insights into pollution impacts on biodiversity of a threatened Northern American freshwater ecosystem.

S06-06 SPANGLER, GEORGE R. Department of Fisheries, Wildlife, and Conservation Biology, University of Minnesota, 1980 Folwell Avenue, St. Paul, MN 55108-6124, USA (GRS@finsandfur.fw.umn.edu).
SOVEREIGNTY: POLITICAL AND BIOLOGICAL DIVERSITY IN RESOURCE MANAGEMENT

The notion of "diversity," interpreted by most biologists as a measure of species richness of a biotic community, frequently conveyed an image of "stability" or "climax communities" in the lexicon of early ecologists. Subsequently, its participial derivative, "diversification" has become a key feature of strategies to insulate biological communities from catastrophic change that would have dire consequences for those dependent upon such communities. Parallel notions of "stability" and "minimizing risk" arise in consideration of investment portfolios, agricultural planting strategies, and product development in manufacturing. In all these cases, the impetus for diversification is acknowledgement of a certain degree of unpredictibility in the forces that govern production. Leaving aside for the moment the general problem of how best to characterize diversity, I will concentrate on exploring the ways in which disparate objectives arising from diverse political and cultural interests provide both opportunities and constraints in deriving benefit from natural resources. The two cases under consideration are development of wild rice, *Zizania palustris*, as an agricultural commodity, and the salmonid fisheries of the Great Lakes. In both of these cases, contemporary practice has been both fostered and limited by the sovereign status of the participants.

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MAKING AN INVERTEBRATE FOCAL TAXON WORK: THE SCARABAEINAE RESEARCH NETWORK

The scarcity of data on the distribution, taxonomy and population status of invertebrates has seriously hampered efforts to include invertebrate biodiversity in the conservation process. The development of focal taxa that may serve as surrogates for wider patterns of invertebrate biodiversity has therefore become a high priority for the conservation and research communities. To date, however, almost no proposed invertebrate focal taxa have emerged with sufficient support by a body of research, methods and taxonomic infrastructure to serve as functioning focal taxa. The newly-formed Scarabaeinae Research Network is a diverse network of over 40 researchers committed to developing the practical and scientific infrastructure necessary to establish scarabaeine beetles as a focal taxon for use in ecology, biogeography, systematics and conservation practice. Through annual meetings, electronic communication and databasing tools, we are designing standardized methods for sampling scarabaeine communities worldwide, synthesizing scarabaeine taxonomic and identification resources, developing priorities for scarabaeine research on key global conservation issues, and establishing model approaches for future networks dedicated to developing other invertebrate focal taxa. This project will unite an unprecedented network of taxonomists, ecologists and conservationists to broadly accelerate the pace of scarabaeine research and enhance its usefulness in conservation contexts.

C38-08 SPENCER, WAYNE D. Conservation Biology Institute, 815 Madison Avenue, San Diego, CA 92116, USA (wdspencer@consbio.org).
EXPERIMENTAL SALVAGE TRANSLOCATION OF ENDANGERED STEPHENS' KANGAROO RATS WITHIN A SMALL, SATELLITE POPULATION

In 1997, I co-discovered a new population of the endangered Stephens' kangaroo rat (SKR; *Dipodomys stephensi*) outside the species' known range in San Diego County, California. A 2001 Biological Opinion allowed extension of an airport runway through the heart of the population in exchange for mitigation and management to achieve no net loss of species' carrying capacity. As part of a management plan to achieve this, and in coordination with species recovery planning, I prepared and implemented an SKR salvage operation prior to construction. During fall 2001, we removed 45 SKR from the construction zone, held them captive until April 2002, and released them into a fenced and improved habitat area. The 1.5-acre enclosure had been control-burned during November and hand scraped to improve habitat condition. Some captives suffered spontaneous bone breakage or hair loss indicative of metabolic deficiencies associated with a demonstrated lack of genetic diversity. Thirty-six surviving SKR were released into artificial burrows and monitored with night-vision scope and trapping both before and after the enclosure fence was removed four weeks later. First year monitoring results show high survivorship, site fidelity, and reproduction in the release site, which now supports the densest population in the area.

C39-01 STARGER, CRAIG J. Department of Ecology, Evolution and Environmental Biology, Columbia University, MC 5557 - CERC, 1200 Amsterdam Avenue, New York, NY 10027, USA (cjs52@columbia.edu).
CORAL TRANSPLANTATION TO FISHED AND UNFISHED REEFS IN KENYA

Marine protected areas (MPAs) are a very common method for restoring ecosystem function. They act as places where natural recovery can occur undisturbed by human activity. However, natural recovery following large scale coral bleaching may not occur at all. The field study presented here explores the feasibility of using coral transplantation as a technique to restore coral reefs following a global bleaching event. Corals transplanted to a marine protected area (Malindi Marine National Park) in Kenya experienced significantly lower survivorship than corals transplanted to a heavily fished reef (Ras Iwatine) adjacent to the Mombasa Marine Reserve. Restoration can therefore be used in unprotected areas that are adjacent to MPAs. Increased coral cover restores the reef building function of benthic communities. Increased topographic complexity may also enhance the spillover effect by serving as habitat for adult and juvenile fish exported from the MPA. It is most important to note, however, that survivorship based on species, transplant size, and management will vary from one project to the next. For this reason, small scale pilot studies should always be performed before undertaking large scale restoration projects.

P134 STAUBER, KINNAN, and Dave Johnson. 4139 Lake Avenue South, Duluth, MN 55802, USA (kkstauber@aol.com) (KS); 2920 Minnesota Avenue, Duluth, MN 55802, USA (DJ).
COST-EFFECTIVE USE OF TOURIST EXCLOSURES FOR THE REJUVENATION OF *AMMOPHILA BREVILIGULATA* ON MINNESOTA POINT

There are many obstacles to sand dune restoration and erosion control along Lake Superior's Minnesota Point in Duluth, Minnesota. Most have human origins. This restoration project combines inexpensive tourist exclosures, an ongoing public-awareness campaign and propagated / rejuvenated state-listed beach grass in a plan now proven to be both cost-effective and successful. Annual coordinated tree-plantings, fencing installations and maintenance, and detritus removal are now established

routines. Wooden boardwalks and dune bridges have recently been incorporated, with an immediate, measurable benefit. The results of this work are visible using historic and annual photographic comparisons. Chronic problems include invasive exotics, vandalism to structures and planted areas, wind erosion and seasonal climate variations. These variables affect the success / failure ratio of transplanted or introduced vegetation, as do incompatible methodology, lack of water and suitability of plant material. Other problems are bureaucratic or political, including overlapping city and state jurisdictions and a complex permitting process. This is a local issue with global ties. Concerns about threatened and invasive beach grass species, public access and overuse, and diminishing Great Lakes dune habitats make this type of restoration project a priority.

C03-06 STEEN, DAVID A., and James P. Gibbs. Department of Environmental and Forest Biology, College of Environmental Science and Forestry, State University of New York, 350 Illick Hall, 1 Forestry Drive, Syracuse, NY 13210, USA (Swampwalker@hotmail.com).
POPULATION STRUCTURE OF FRESHWATER TURTLES IN RELATION TO THE DENSITY OF ROADS SURROUNDING WETLANDS

Due to the reproductive ecology of turtles, turtle populations may have difficulty coping with the loss of sexually mature individuals associated with road mortality during nesting migrations and dispersal, yet the effects of roads on the distribution and population persistence of turtles have not been well studied. To address the issue, turtles were trapped in 37 small, freshwater wetlands distributed across a steep gradient of road density within central New York state. Wetlands were categorized according to the road density within a 1 km radius. For the painted turtle, *Chrysemys picta*, the percent of males in low road density sites was found to be significantly lower than in wetlands surrounded by a high road density. The mean mass and condition of male painted turtles was found to be significantly lower in wetlands with low road density. The road density surrounding wetlands, and associated vehicle-induced road mortality, likely alters the population structure of painted turtles. These effects may lead to eventual extirpation of local turtle populations near roads.

C49-07 STEIN, JULIE, Christina Ellis, Izabella Koziell, and Brian McGuinn. The Jane Goodall Institute, 8700 Georgia Avenue, Suite 500, Silver Spring, MD 20910, USA (jscabin@aol.com).
GRAY WOLF RECOVERY BY THE NEZ PERCE TRIBE: ILLUSTRATING A NEW FRAMEWORK FOR CONSERVATION CONFLICT TRANSFORMATION WITH A NORTH AMERICAN CASE STUDY

Conservation initiatives often meet with resistance from local people when policies impose change by interfering with strongly held values, or by threatening livelihoods. Lessons gleaned from community based conservation tell us that conservationists must work with communities to achieve sustainable conservation, and that benefits must be tied to conservation to provide incentives for conserving habitat and species. A conceptual model was developed integrating ideas from the fields of community reconciliation, conservation and development, and by assessing conservation and community conflict through field evaluations of projects across Africa. This framework for conservation was tested in an alternate context through semi-structured community interviews with the Nez Perce tribe's Gray Wolf Recovery Program in Idaho. The Nez Perce saw the larger conflict over wolf recovery as an opportunity to build partnerships and credibility as wildlife managers, and to create a platform for positive change. The primary benefits for the tribe appear to be linked to core values such as identity. Our results also suggest that conservation organizations must recognize that identity issues often underlie prolonged conservation conflicts. Conservation organizations globally have a key role to play in assisting communities to see conflict as opportunity, and to create self-sustaining structures for conflict transformation.

S07-02 STELFOX, J. BRAD, and Shawn Wasel. Forem Technologies, Box 805, Bragg Creek, AB T0L 0K0, Canada (bstelfox@telusplanet.net) (JBS); Alberta-Pacific Forest Industries, Inc., Bag 8000, Boyle, AB T0A 0M0, Canada (SW).
ALBERTA'S BOREAL FOREST: A LANDSCAPE IN TRANSITION – IMPLICATIONS FOR SUSTAINABLE LANDSCAPES AND LANDUSE

This presentation will focus on the past, current, and future scale and rate of landscape transformation in Alberta's boreal forest. Using A Landscape Cumulative Effects Simulator (ALCES), this presentation tracks historic land use practices in northern Alberta and projects a future landscape based on industry and government estimates of development for the energy, forestry, transportation, and agricultural sectors. The anthropogenic footprint in boreal Alberta is not stationary, but growing at an exponential rate for many landuse variables. Conservative estimates of annual rates of activity relating to the oil and gas, forestry and transportation sector, as simulated by ALCES, suggest that significant losses (10-20%) to the upland forest land base of northern Alberta are likely to occur during the next forest harvest rotation (100 years). Densities of linear features (roads, seismic lines, pipelines) currently average 2.5 km/km^2 and are expected to approach 10 km/km^2 if current metrics are applied to future landuse trajectories. The future ability of the landscape to provide appropriate levels of biological and physical services, production of petrochemical and agricultural resources, aesthetic appeal, and homes and infrastructure for people will largely be determined by how well society recognizes the cumulative effects of our land use practices, by whether society has the vision

and fortitude to develop a landscape plan that seeks balance to the competing demands on this landscape, and the commitment by which this landscape plan is implemented. An important component to seeking a balance between landuse practice and ecological integrity lies in a better understanding by managers of how all landuses conduct their practices and in devising a more integrated approach to laying out such features as roads. Significant savings to capital budgets and reduced ecological risk await those managers prepared to "think outside the box" and contribute to landscape planning across "meaningful" space and time.

P002 STEWART, JANA, Steve Aichele, Alex Covert, Jim McKenna, and Dora Passino-Reader. U.S. Geological Survey – WRD, 8505 Research Way, Middleton, WI 53562, USA (jsstewar@usgs.gov) (JS); U.S. Geological Survey – WRD, 6520 Mercantile Way, Suite 5, Lansing, MI 48911, USA (SA); U.S. Geological Survey – WRD, 6480 Doubletree Avenue, Columbus, OH 43229, USA (AC); U.S. Geological Survey – BRD, Tunison Laboratory of Aquatic Sciences, 3075 Gracie Road, Cortland, NY 13045, USA (JK); U.S. Geological Survey – BRD, Great Lakes Science Center, 1451 Green Road, Ann Arbor, MI 48105, USA (DR).

THE GREAT LAKES AQUATIC GAP PROJECT FOR RIVERINE AND COASTAL SYSTEMS

An Aquatic Gap project is underway to map the biodiversity and habitat of aquatic species for riverine and coastal systems of the Great Lakes region. The project is part of the USGS National Gap Analysis Program with the goal of determining the gaps in the representation of these species and habitats within protected areas. For the riverine component, projects are underway in MI, NY, OH and WI where the U.S. Geological Survey is working with State natural resource agencies. The project will develop an ecological stream classification based on habitat characteristics that describe stream geology, geomorphology, temperature and flow using a valley segment classification approach. The stream valley segments will be linked to the occurrence of aquatic biota in order to map known and predicted distributions of aquatic species. Aquatic species occurrences will be overlaid with maps of protected areas to determine gaps in biodiversity conservation. For the coastal component, a pilot effort has begun to develop a habitat characterization for near-shore systems. Coastal units will be classified according to characteristics that relate to fish species including terrestrial shore type, slope, vegetation, wind and wave energy. Activities are being coordinated so that results are comparable across the Great Lakes region.

C07-07 STOCKWELL, CRAIG, Andrew Hendry, and Michael Kinnison. Department of Biological Sciences, North Dakota State University, Stevens Hall, Fargo, ND 58105, USA (Craig.Stockwell@ndsu.nodak.edu) (CS); Redpath Museum, McGill University, Montreal, PQ H3A 2K6, Canada (AH); Department of Biological Sciences, University of Maine, Murray Hall, Orono, ME 04469, USA (MK).

EVOLUTION AS A SHORT-TERM CONCERN FOR CONSERVATION BIOLOGY

Contemporary evolution is associated with some of the same anthropogenic factors causing the current extinction crisis; overexploitation, habitat degradation, and the establishment of exotic species. Here, we consider the relevance of contemporary evolution to conservation biology in two contexts; actively managed species and exotic species. Contemporary evolution is of concern for species that are actively managed. For instance, populations established as "refuges", may undergo rapid evolutionary divergence from ancestral populations to the point they are mal-adapted to their native habitat. Contemporary evolution also has important implications for the establishment and control of exotic species. First, exotic species may undergo rapid evolution in response to novel selection pressures. Evolutionary potential may explain some of the success of certain exotics. Second, exotic species may evolve resistance to control measures. Thus, control measures should be considered in an evolutionary context. In all cases, evolutionary potential is influenced by factors such as population size, genetic variation, and the strength of selection. Small populations have little potential for rapid evolution; however, large populations may not evolve rapidly enough in the face of extreme environmental change (catastrophes). Collaborations between resource managers and evolutionary biologists may allow us to better understand the relationship between contemporary evolution and conservation.

C05-01 STRITTHOLT, JAMES, and Dominick DellaSala. Conservation Biology Institute, 260 SW Madison Avenue, Suite 106, Corvallis, OR 97333, USA (stritt@consbio.org) (JS); World Wildlife Fund, 116 Lithia Way, Suite 7, Ashland, OR 97520, USA (DD).

CONSERVATION ATTRIBUTES OF ROADLESS AREAS IN THE PACIFIC NORTHWEST, USA

On January 12, 2001, the USDA Forest Service adopted the Roadless Area Conservation Rule protecting approximately 24 million hectares of national forest land. However, the rule is now in jeopardy by various administrative directives aimed at weakening its protections. Much has been speculated about the importance of inventoried roadless areas (IRAs) for conservation, but few studies have examined specific conservation attributes of these areas. We conducted a comprehensive analysis of IRAs within six ecoregions of the Pacific Northwest, USA. Seven criteria were examined including: threatened and endangered species, key watersheds for salmonids, old growth forests, elevation representation, physical habitat representation, plant community representation, and landscape connectivity. Overall, IRAs added 1.5 million hectares (7% of the study area) to the existing protected lands (3.3 million hectares, 15% of the study area). Results varied widely between the six ecoregions

examined for the various attributes. In general, IRAs were found to be very important in contributing to conservation in the study area. However, IRAs combined with existing protected areas did not achieve many conservation goals making additional conservation measures in the region necessary even if the Roadless Area Conservation Rule is upheld.

C60-01 STROH, ESTHER D. U.S. Geological Survey, Northern Prairie Wildlife Research Center, Missouri Field Station, 373 McReynolds Hall, University of Missouri, Columbia, MO 65211, USA (esther_stroh@usgs.gov).
CONSERVATION OF DISJUNCT POPULATIONS: HOW LOCALLY RARE MICROCLIMATES PROVIDE PROTECTION TO RELICT SPECIES

Unusual habitats with microclimates that differ from the surrounding landscape can support disjunct populations of species far from the core of their common range. Disjunct populations may harbor rare or unique alleles not found in core populations and are therefore worthy of protection even if the species as a whole is not faced with extinction. Currently, little is known about abiotic conditions that maintain disjunct species in their refugia. In southern Missouri, populations of three Pleistocene relict plants (*Campanula rotundifolia*, *Zigadenus elegans*, and *Galium boreale*) co-occur on some north-facing bluffs along the Jacks Fork River. I used small data loggers to continually record temperature, humidity, and light intensity from May 1999 through July 2002 at three relict sites. Compared to the surrounding habitat, relict sites exhibit higher humidity and are protected from wide swings in daily temperature year-round. This provides a physiologically less stressful habitat and explains in part their ability to support disjunct populations in an otherwise unsuitable region. The ability of the sites to provide sufficient moderation of temperature in extreme years or under climate change scenarios is likely related to their proximity to water in a hydrogeomorphically dynamic system.

P072 STROJNY, CAROL A., and Malcolm L. Hunter, Jr. Department of Wildlife Ecology, 5755 Nutting Hall, University of Maine, Orono, ME 04469, USA (carol_strojny@umit.maine.edu).
EFFECTS OF HARVESTED CANOPY GAPS ON FOREST AMPHIBIANS

Harvesting can have a negative effect on amphibian populations by altering forest floor microhabitats. Creating small-scale canopy gaps modeled after natural disturbance patterns may facilitate the maintenance of amphibian abundance in managed forests. To quantify the effects of harvested gaps, we compared the relative abundance of forest amphibians in 44 harvested gaps, 19 natural canopy gaps, and 36 closed-canopy forest plots located in central Maine. We also examined the effect of gap aspect on amphibian abundance to determine if north and south aspects influence amphibian distribution. Amphibians were sampled using 3-m fences with live pitfall traps. To study gap aspect, 7 natural gaps and 23 harvested gaps had pitfall arrays positioned every 5 m along the entire north-south transect of the gap. Initial results comparing captures per 100 trap nights indicate that species identified as sensitive to canopy removal (*Ambystoma laterale*, *Rana sylvatica*, and *Plethodon cinereus*) were slightly more active in full-canopy sites than in harvested gaps. Within gaps, there appears to be no distinct pattern in amphibian captures between northern and southern aspects. We will have an additional field season in 2003.

P035 STROMMEN, SARAH, Anna Baggio, Melissa Lindsay, Scott Kidd, William Willers, and Beth McKechnie. Friends of the Boundary Waters Wilderness, 401 North 3rd Street, Minneapolis, MN 55401, USA (sarah@friends-bwca.org) (SS, ML); Wildlands League, Chapter of the Canadian Parks and Wilderness Society, Toronto, ON M5V 3A8, Canada (AB); Canadian Parks and Wilderness Society, Manitoba Chapter, Winnipeg, MB R3C 2H6, Canada (SK, BM); Superior Wilderness Action Network, Sandstone, MN 55072, USA (WW).
COMPLETING A CANOE COUNTRY VISION: PRESERVING GREAT LAKES AND BOREAL WILD LANDS

Over three centuries, people have worked to preserve the forests and lakes of the Minnesota-Canada border region as a wilderness canoe country. Areas like the Boundary Waters Canoe Area Wilderness, Voyageurs National Park, and Quetico Provincial Park have been protected. Recent studies suggest that these areas may not be large enough to preserve biodiversity over time. In 2001, we initiated work on a wildlands network to reconnect the wilderness cores of the old "north woods:" boreal and Great Lakes forests. The planning region, called Heart of the Continent, encompasses parts of Minnesota, Wisconsin, the Upper Peninsula of Michigan, Manitoba, and Ontario. Planning methodology developed by The Wildlands Project was used to identify six goals to heal and preserve intact ecosystems. Goals included restoring habitat connectivity for wide-ranging species, especially large carnivores and ungulates, and allowing natural processes to take place throughout the region. Objectives for each goal were developed, and identification of focal species and mapping of natural and constructed features was started. Initial work indicated that while parts of the Heart of the Continent region were heavily fragmented, sufficient landscape connectivity existed to create a wildlands network.

C40-05 STROMMER, LAURIE, and Sheila Conant. Department of Zoology, University of Hawaii, Honolulu, HI 96822, USA (strommer@hawaii.edu).
ACACIA KOA PLANTATIONS AND FOREST RESTORATION IN HAWAII

Forest communities in the Hawaiian Islands have been transformed by human occupation, with declines and extinctions of forest bird populations the result. *Acacia koa*, an endemic co-dominant tree in wet montane Hawaiian forests, is the current focus of reforestation projects with both ecological restoration and economic goals. Our study compares avian and vegetation communities in two koa reforestation areas with those in nearby native forests. Over the study period we have observed foraging activity in the koa reforestation areas by six native forest passerines, including one endangered species (*Hemignathus munroi*). This compares with eight species that are common in nearby native forest. Vegetation survey results indicate that, in some cases, koa reforestation areas develop into forests that resemble native Hawaiian forests in structure and species richness, though not necessarily in species composition and evenness. Our results suggest that the establishment of *A. koa* plantations may facilitate native ecosystem regeneration on degraded lands; additional efforts may be necessary to ensure development of a diverse understory. This study has implications for future conservation and management efforts in which native tree plantations might be tools for restoration of degraded lands.

C28-03 SU, LIYING, Jeb Barzen, and Tim Moermond. Department of Zoology, University of Wisconsin–Madison, 457 Birge Hall, Madison, WI 53706, USA (liyingsu@students.wisc.edu) (LS, TM); International Crane Foundation, E-11376 Shady Lane Road, PO Box 447, Baraboo, WI 53913, USA (JB).
RELATIONSHIPS BETWEEN SANDHILL CRANE HABITAT USE AND FARMING PRACTICES IN WISCONSIN

We studied relationships between habitat use by sandhill cranes and land cover changes in agriculture areas in spring for five years in central Wisconsin. We collected crane and land cover data throughout our 8,600-hectare study area that was a heterogeneous mixture of agriculture, wetlands, and forest. Cranes selected emergent wetlands and tended to stay close to those wetlands while extensively using adjacent, surrounding agriculture areas. Within this selection matrix, temporal changes in agricultural land-use further altered selection by cranes. The agriculture landscape is a dynamic mosaic influenced by seasonal succession and by human land-uses. Land cover components changed daily as the growing season advanced. Both availability and spatial configuration of crane habitat shifted with these temporal changes. Habitat selection by cranes varied significantly at different farming stages (stubble, plowed, planted, and germination) for both corn and soybean fields. Crop rotations, combined with different farming techniques, created different textures of habitats that had a great influence on crane habitat use. These ecological models, in turn, have helped us devise strategies for reducing crane damage to crops. Since private land ownership still dominates North America, helping farmers co-exist with wildlife is a crucial component to maintaining biological diversity in our landscape.

P056 SUNDELL, RONALD, and Carl Lindquist. Environmental Science Program, Northern Michigan University, 1401 Presque Isle Avenue, Marquette, MI 49855, USA (rsundell@nmu.edu) (RS); Central Lake Superior Watershed Partnership, 1030 Wright Street, Marquette, MI 49855, USA (CL).
THE NEED FOR BUFFER ZONES ALONG THE GREAT LAKES SHORELINE

River and inland lake buffer zones are proven to protect water quality and important habitat, yet there is no coordinated effort to incorporate buffers for the Great Lakes shoreline. There are many well known benefits to buffer zones such as trapping pollutants and sediments, preserving riparian habitat and wildlife corridors, and providing aesthetics and recreational opportunities. Marquette County, and in particular Chocolay Township, Michigan provide a good example of how integrating natural features inventories, river and shoreline monitoring and assessments, and appropriate land use planning ordinances (e.g., dune protection) can produce an effective shoreline protection plan. Many shoreline areas along our Great Lakes are not currently protected and some areas have already been significantly degraded by inappropriate development. The Michigan Land Use Institute projects an 80 percent increase in second home development over the next 20 years. While local townships and counties can implement individual ordinances, a more comprehensive approach using state and/or federal standards would be beneficial. With current political and budget constraints for acquiring land, protecting shoreline through the use of buffers is an effective, low cost method and should be included in the Great Lakes Management Plans (LaMPs) recommendations to achieve water quality and terrestrial habitat goals.

C05-05 SWAIN, HILARY, Jonathan Oetting, and Amy Knight. Archbold Biological Station, PO Box 2057, Lake Placid, FL 33862, USA (hswain@archbold-station.org) (HS); Florida Natural Areas Inventory, Florida State University, 1018 Thomasville Road, Suite 200C, Tallahassee, FL 32303, USA (JO, AK).
FLORIDA'S ACQUISITION AND RESTORATION COUNCIL: OVERSIGHT OF AN EXTENSIVE CONSERVATION LANDS PROGRAM

Florida has an international reputation for successful public acquisition of conservation lands. The state has acquired about 4.5 million acres including state parks, forests, and wildlife and water management areas, much in the last two decades. Federal lands represent a further 4 million acres. All conservation lands together total just over 25% of Florida's total area. The question is often asked; how did this level of acquisition happen at a state level? The lead author serves on the Acquisition and Restoration Council ARC, the body appointed to oversee the state's land acquisition program (Florida Forever and its predecessor Preservation 2000) and make recommendations to the Cabinet and the legislature. This presentation will provide a history of the priorities, programs, and funding that has supported acquisition programs, as well as insight into the role of ARC. It will detail the extent and nature of lands that have been acquired, and the degree to which they have, over the years, cumulatively accrued towards meeting statewide conservation goals. The talk provides important perspective for work by Oetting and Knight on the development of an iterative site selection model to continue the design of the protected area network in Florida.

C02-03 SWANSON, BRADLEY J. Department of Biology, Central Michigan University, Mt. Pleasant, MI 48859, USA (swans1bj@cmich.edu).
INFLUENCE OF HABITAT ON PATTERNS OF GENETIC VARIATION IN SUCCESSFULLY REINTRODUCED POPULATIONS OF MARTENS

The American marten (*Martes Americana*) was eliminated from Michigan sometime in the 1930s. Recovery efforts were initiated in 1958 and the population size of the marten has recovered to the point where harvesting is allowed. We analyzed marten data from across the upper peninsula of Michigan. We analyzed 256 marten samples from carcasses returned to the Michigan DNR that included location, age, and sex data. We used the program STRUCTURE, which incorporates a Baysian approach using Markov Chain Monte Carlo simulations, to determine clusters of genetically similar individuals. STRUCTURE found the marten population to be portioned into 5 unique populations. Minimum convex polygons were created around points of capture for all animals within a genetic cluster to create biological population boundaries. Heterozygosity and allelic diversity were positively correlated with closed canopy area in a population. We found evidence of dispersal between populations based on individuals that clustered genetically with one population but were captured in a different population. The majority of dispersal was between nearest neighbor populations and exhibited a male bias. The major habitat variables influencing dispersal rates were amount and type of cover type and total amount of roads separating populations.

C23-05 SWANSON, HEATHER, and Alexander Cruz. Department of EPO Biology, University of Colorado, UCB 334, Boulder, CO 80309-0334, USA (heather.swanson@colorado.edu).
URBANIZATION AND PATCH SIZE EFFECTS ON PONDEROSA PINE FOREST BIRDS IN NATURALLY PATCHY HABITATS

Anthropogenic fragmentation effects on bird communities have been widely discussed in the literature. Many studies have shown that the surrounding landscape may have a profound effect on the patterns found. Many western forests show spatial patterns resulting from natural heterogeneity of the forest environment that are similar to those seen in human fragmented forests. To examine whether a relationship between urbanization and bird communities existed, we looked at the abundance and diversity of ponderosa pine bird species in naturally patchy forests west of Boulder, Colorado. Our objectives were to quantify the patterns occurring in bird communities across sites of varying size, isolation and distance to urbanization. We examined the bird communities in twelve sites varying from 4 ha to over 500 ha in size and 0 m to 2 km distance from urbanization. We determined degree of urbanization in the surrounding environment using aerial photographs, satellite data and ArcView GIS. We found that both size and urbanization in the surrounding landscape did affect both abundance and diversity of the bird community found. Overall this data suggests that even in naturally patchy ecosystems, both size of patch and urbanization may be important variables to consider when managing for forest bird species.

C01-09 SWEITZER, RICK, Juanita Constible, and Dirk VanVuren. Department of Biology, University of North Dakota, Grand Forks, ND 58202, USA (richard_sweitzer@und.nodak.edu) (RS, JC); Department of Wildlife, Fish, and Conservation Biology, University of California, Davis, Davis, CA 95616, USA (DV).
ECOLOGICAL IMPLICATIONS OF BISON ON SANTA CATALINA ISLAND, CALIFORNIA

Introduced species are an important conservation problem in general, but they are especially problematic on islands by impacts on invasion prone communities supporting relatively high proportions of endemics. Bison are native to most of North America, notably excluding Santa Catalina Island off the coast of southern California where a herd was introduced in 1926. Because of their size, nutritional needs, and grazing and wallowing activities, bison may significantly impact island endemic plants and animals. We assessed multiple potential effects of bison on Santa Catalina Island from January 2001 to April 2003 using a variety of observational and experimental methods including fenced exclosures, island-wide censuses and transects, and estimates of carrying capacity for several management options. Results include that bison are significantly altering important components of grassland and riparian plant communities, facilitating the spread of non-native plants via wallowing behaviors, and consuming island-endemic woody shrubs. Subsequent to their introduction, bison on Santa Catalina Island have become culturally and

economically important to island residents. We suggest a balance between these interests and restoring the ecological integrity of the island by reducing bison numbers and restricting them to a small area of the island in numbers that will not significantly damage plant communities.

C20-09 **SWENSON, RAMONA,** and Elizabeth Gray. The Nature Conservancy, Cosumnes River Preserve, 13501 Franklin Boulevard, Galt, CA 95632, USA (RS); The Nature Conservancy, 201 Mission Street, 4th Floor, San Francisco, CA 94105, USA (EG).
SETTING PRIORITIES FOR TAKING CONSERVATION ACTION: CASE STUDIES FROM CALIFORNIA

Priority setting is required for effective and efficient conservation action. Conservation planning by The Nature Conservancy has identified hundreds of sites in California's Central Valley and Central Coast that are important for conserving biodiversity of these ecoregions. However, we can take action at only a fraction of sites at a given time. Currently, no methodology exists that guides selection of highest priority sites. Our goal was to evaluate the planning process and identify sites of immediate highest importance. We applied biological criteria first, such as diversity (representation and distribution of communities) and viability (size, richness, lack of fragmentation). This process focused attention on 40-50 sites per ecoregion. We then considered threats (type, degree) and opportunities (funding, political context). The greatest threats in the Central Valley were water management, invasive species and habitat loss due to home development; in the Central Coast, the greatest threats were residential development, incompatible agricultural practices (grazing, viticulture) and invasive species. Opportunities were much more site-specific. This analysis shapes where and how we will act in the near term, and steers us to high-leverage strategies. Science-based planning leads us to biologically important sites, but selecting where to act is often driven by social and economic factors.

C40-01 **SWITALSKI, ADAM,** John Bissonette, Tom Deluca, Charles Luce, and Mary Ann Madej. Wildlands CPR, 126 East Broadway, Suite 25, Missoula, MT 59802, USA (adam@wildlandscpr.org) (AS); U.S. Geological Survey, Utah Cooperative Fish and Wildlife Research Unit, College of Natural Resources, Utah State University, Logan, UT 84322-5290, USA (JB); School of Forestry, University of Montana, 402 Science Complex, Missoula, MT 59812, USA (TD); USDA Forest Service, Intermountain Research Station, 316 East Myrtle Street, Boise, ID 83702, USA (CL); U.S. Geological Survey, Western Ecological Research Center, 1655 Heindon Road, Arcata, CA 95521, USA (MAM).
WATERSHED BENEFITS FROM ROAD REMOVAL

More than 885,000 kilometers of roads have been built on public land over the past century. These roads have facilitated resource extraction, recreation, and transportation. However, the lifespan of many roads is finite leaving us with questions of what to do once a road outlives its usefulness. At a certain point, the benefits of roads are outweighed by the negative impacts. Road removal is being used as a form of wildland restoration on public and private lands. Although many Forests and Parks have created protocols for road removal, the science of road removal has not caught up with the pace at which such removals are being carried out. We reviewed the hydrologic, geomorphic, and ecological impacts of road removal, identified gaps in our understanding, and propose future road removal research questions. Road removal creates a disturbance in the short-term which may temporarily increase sediment loss and decrease wildlife habitat. However, long-term monitoring and research has shown that road removal reduces chronic erosion and mass wasting. Further research is needed to determine how effectively road removal restores terrestrial and aquatic habitat.

S03-07 **TALLEY, DREW M.** Department of Environmental Science and Policy, University of California, Davis, One Shields Avenue, Davis, CA 95616, USA and University of South Florida, Tampa, FL 33620, USA (dmtalley@ucdavis.edu).
HABITAT LINKAGES AT THE LAND-SEA INTERFACE

Natural environments, even those traditionally considered "insular," are not isolated from the effects of often quite distant habitats. Habitats are functionally linked through a number of processes, broadly involving the movement of organisms or materials across boundaries. Cross-boundary linkages can be demographic (e.g., source-sink dynamics or metapopulations), physical (e.g., sedimentation), trophic (spatial subsidies), or some combination of these forms. These connections between habitats are ubiquitous at the marine/terrestrial interface, occurring across a vast range of temporal and spatial scales. Habitat connectivity at the land/sea interface commonly creates dominant effects on community structure and population dynamics that ramify through both ecosystems. Here we focus on the mechanisms and importance of connectivity at the marine/terrestrial boundary, and discuss the implications of these connections to both theoretical and conservation ecology.

P098 Tallmon, David, Mark Beaumont, and **GORDON LUIKART.** Laboratoire des Popualtions d'Altitude, UMR CNRS 5553, Universite Joseph Fourier, F38041 BP53 Cedex 9, Grenoble, France (dtallmon42@yahoo.com) (DT, GL); School of Animal and Microbial Sciences, University of Reading, Reading, RG6 6AJ, UK (MB).
EFFECTIVE POPULATION SIZE ESTIMATION USING APPROXIMATE BAYESIAN METHODS WITH SUMMARY STATISTICS

The effective size of a population (Ne) is a critical parameter to estimate in evolutionary and conservation studies. Small Ne populations suffer from inbreeding effects and decreased ability to respond to selection, both of which can increase extinction risks. Previous attempts to estimate Ne have focused on either genotypic information or allelic information. Commonly used methods include gametic disequilibrium, heterozygote excess, the temporal method and M. It is desirable to develop a method that combines both genotype and allele frequency information at multiple loci. We used a recently developed Bayesian approach to approximate the likelihood surface or posterior distribution for current and ancestral values of Ne. The method uses simple summary statistics from combined multilocus genotypic and allelic data taken from either one, or a number of temporally spaced samples to estimate known Ne and changes in Ne. The advantages of the approach over previous methods are a) it includes the use of multilocus genotypic information in a likelihood-based framework, and b) the method runs relatively rapidly on a computer in contrast to many other Bayesian methods. We present results quantifying the performance of this method relative to existing ones. This method should help scientists and managers to assess efficiently and quickly the genetic and demographic risks faced by threatened populations.

C48-10 TAYLOR, BARBARA, Karen Martien, and Melissa Pespeni. Southwest Fisheries Science Center, 8604 La Jolla Shores Boulevard, La Jolla, CA 92038, USA (Barbara.Taylor@noaa.gov) (BT, KM); Department of Biology, University of California San Diego, La Jolla, CA 92093, USA (MP).

OPTIMIZING mtDNA SEQUENCE LENGTH TO MAXIMIZE POWER TO DETECT POPULATION STRUCTURE

Many endangered or threatened species have experienced large recent declines in abundance and still have high genetic diversity. Ironically, this presents problems in detecting population structure because only small sample sizes are available and many haplotypes are represented by a single individual (unique). Because the most powerful statistics are frequency comparisons, these unique haplotypes contribute little to no population structure information. We use simulations to show that the choice of sequence length strongly effects statistical power: short lengths result in low power, medium lengths in the highest power and long lengths in reduced power resulting from the high proportion of unique haplotypes. We develop and test a method to optimize the sequence by removing base pairs contributing the highest number of unique haplotypes. We increase power by maximizing the sequence examined and then selectively removing sites contributing too much variance. The new method's utility is demonstrated using data from harbor seals and Steller sea lions.

P131 Teketay, Demel, **DAGNE DUGUMA,** and Dawit Mamushet. Ethiopian Agricultural Research Organisation, PO Box 2003, Addis Ababa, Ethiopia (DT); Ethiopian Agricultural Research Organisation, Forestry Research Center, PO Box 30708, Addis Ababa, Ethiopia (frc-dbs@telcom.net.et) (DD, DM).

PHENOLOGY, HOST RANGE AND GEOGRAPHICAL DISTRIBUTION OF MISTLETOES IN ETHIOPIA

Loranthaceae and Viscaceae families, 'mistletoes', are represented by 28 and 7 species in Ethiopia, respectively. To distinguish their host, phenology, abundance and geographic distribution, a herbaria search of 297 specimens at National Herbarium of Ethiopia and Alemaya University Herbarium was carried out through confirmation of existing field situation. Variations in host preference and specificity, geographic distribution, and phenological pattern were evident among species of a family and different families. *Englerina woodfordioides* was found to be the most abundant (18%) mistletoe clustered in the southwestern part and growing on wide ranges of hosts, followed by *Visum tubeculatum* (15%). Mistletoes have occurred in broad geographic ranges from 300 (Acacia-Commiphora woodland) – 3000 m a s l (Subafroalpine vegetation). Greater tendency of clustering was, however, observed in central and southwestern Ethiopia. Disturbed forests, road margins, riverbanks and exposed trees or shrubs were the preferred niches. Four endemic species of Loranthaceae were also identified from southern and eastern part, where endemism is predominant. Some mistletoes are used for medicine, fodder and food, while others pose considerable damage to the flora of the country. Their contribution to the parasitic plant diversity is substantial, nonetheless, information on their biology, ecology and economic importance is still vacant, with the ceaseless vegetation (host) degradation that urges on further investigation.

C20-03 TEWINKEL, LESLIE, Karen Vigmostad, Rich Greenwood, and Megan Seymour. U.S. Fish and Wildlife Service, 1 Federal Drive, Fort Snelling, MN 55111-4080, USA (leslie_tewinkel@fws.gov) (LT); Northeast-Midwest Institute, 218 D Street SE, Washington, DC 20003, USA (KV); U.S. Fish and Wildlife Service, 77 West Jackson Boulevard (G-17J), Chicago, IL 60604, USA (RG); U.S. Fish and Wildlife Service, 6950-H Americana Parkway, Reynoldsburg, OH 43068-4132, USA (MS).

TOOLS AND PARTNERSHIPS FOR THE CONSERVATION OF GREAT LAKES ISLANDS

The Great Lakes basin contains the largest inland island system on earth with an estimated 30,000 islands. These islands serve as nesting sites for waterfowl, stopover sites for neo-tropical birds, habitat for rare species, spawning and nursery areas for native and recreationally important fishes, and refuges for remnant plant communities. Threats to the islands such as development and non-native species are increasing, yet lack of basic knowledge and the myriad of jurisdictions involved hinder a comprehensive conservation effort. In order to focus resources and coordinate efforts among Great Lakes managers and biologists, EPA's Great

Lakes National Program Office and the U.S. Fish and Wildlife Service sponsored an islands workshop in December 2002. Eighty individuals from Canadian and American environmental, academic, and governmental institutions participated. The workshop resulted in the planning and development of five products: an islands ranking and classification system, a model conservation strategy for landscape and local scales, a communications campaign, a Great Lakes aquatic and coastal GAP, and increased utility of a Decision Support System. The completion of these products, ongoing commitment of workshop participants, and involvement of additional partners will ensure that sufficient efforts are devoted to conserving this significant natural resource.

S02-04 **THEOBALD, DAVID,** and N.T. Hobbs. Natural Resource Ecology Lab, Colorado State University, Fort Collins, CO 80523-1499, USA (davet@nrel.colostate.edu).
EVALUATING LAND USE PLANNING ALTERNATIVES ON PRIVATE LANDS

Typically, land use planning activities seek to identify high value areas for conserving biotic resources, particularly on private land that is developing rapidly. Although general conservation principles exist on how to set priorities, ambiguity remains about how best to integrate these principles into the planning process. We offer a general framework to incorporate conservation principles when evaluating how planning alternatives would affect important habitat. The framework contains four components: stakeholder involvement, spatial modeling of critical habitat and development patterns, analysis of alternative scenarios, and evaluation and monitoring. We will illustrate this framework using a case study from Summit County, Colorado, USA. Based on our indicators of the area of effected habitat and length of roads, careful development of lands through cluster design offers the lowest level of impact of the development scenarios identified.

C35-02 **THOMAS, SHELLY L.,** and Stephen A. Woods. Department of Biological Sciences, University of Maine, Orono, ME 04469, USA (shelly_thomas@umit.maine.edu).
THE INFLUENCE OF FOREST HARVEST GAPS ON CLICK BEETLE (COLEOPTERA: ELATERIDAE) COMMUNITIES INHABITING DOWN COARSE WOODY DEBRIS IN MAINE, USA

Although insects are an important component of forest ecosystems, little is known about the effects of forest management practices on insect communities. To address this deficit, we examined how click beetle communities in a mixed hardwood-softwood forest in Maine are affected by the German harvest method *femelshlag*. This method creates gaps in the canopy producing differences in microclimate to which insects might respond. Specifically, we compared the differences in community composition of click beetles between harvested gaps and full canopy sites. We used emergence traps to capture adult click beetles as they emerged from CWD. We collected 32 species and found that microhabitat variables such as decay class, wood type (softwood or hardwood), and location in or out of harvest gaps significantly affected community composition between sites. The more abundant species were then analyzed separately to clarify the differences among species and the interactions among variables. In addition to the results obtained for community, size of CWD was significant for certain species. This study lays the groundwork for successful conservation of forest insects through greater knowledge of species assemblages and the effects of harvesting on their habitat requirements.

P019 Thompson, Frank R., III, John R. Sauer, and **RICH W. PAGEN.** USDA Forest Service, North Central Research Station, University of Missouri–Columbia, 202 ABNR, Columbia, MO 65201, USA (frthompson@fs.fed.us) (FRT, RWP); U.S. Geological Survey, Patuxent Wildlife Research Center, 11510 American Holly Drive, Laurel, MD 20708-4017, USA (JRS).
IS LANDSCAPE CHANGE DRIVING DECLINES IN BREEDING BIRD POPULATIONS IN THE NORTH CENTRAL UNITED STATES?

Breeding bird population trends determined from the Breeding Bird Survey (BBS) indicate populations of some species are declining and others are increasing. It is unclear whether these declines are the result of changes in breeding, wintering, or migratory habitat or non-habitat factors. No studies have examined the relationship between changes in bird populations and changes in habitat at this scale because of a lack of spatially explicit data on habitat change. We used data from the BBS and a recent Landscape Change Assessment by the North Central Research Station to determine if changes in forest bird populations are related to changes in the amount of forest in the landscape (measured in 1-km pixels) surrounding BBS routes during the period 1980 to 2000. Preliminary results show a strong relationship for many species between mean bird abundance and the mean amount of forest during the time period. However, there was little support for models relating changes in bird population to changes in the amount of forest. These results suggest that while strong habitat relationships exist for some species, changes in breeding habitat did not seem to be driving population change. Several alternative hypotheses could explain these results. Habitat change may not be the primary factor driving population changes during this period. In fact, habitat changes were small compared to bird population changes. Alternatively, the remotely-sensed habitat data we used may not be able to detect finer scale habitat changes that could have been driving population change.

C21-04 THORNTON, HANNAH E.B., Carl Lewis, and Javier Francisco-Ortega. Florida International University, University Park, Miami, FL 33199, USA (hannahboeker@yahoo.com) (HEBT, JFO); Fairchild Tropical Garden, 11935 Old Cutler Road, Miami, FL 33156, USA (HEBT, CL, JFO).
GENETICS AND MANAGEMENT OF *JACQUEMONTIA RECLINATA*, A FEDERALLY ENDANGERED COASTAL DUNE PLANT

Genetic research has become widely accepted as an integral part of programs to conserve rare plants. Researchers use the results of population genetic studies to evaluate the health of rare plant populations and to guide efforts to restore those populations. The success of restoration efforts often depends upon the ability of researchers to translate the results of genetic work into direct management recommendations. We used Random Amplified Polymorphic DNA analysis to assess the levels and patterns of genetic diversity within populations of *Jacquemontia reclinata* (Convolvulaceae) a federally endangered species endemic to the coastal dune system of southeastern Florida. In the last decade, intensive coastal development has reduced by half the numbers of *J. reclinata* individuals and caused the extirpation of 6 out of 16 populations. Preliminary results show low levels of genetic diversity within individual populations, and within the species as a whole. Despite distances of 30 miles or more between most populations, preliminary results show little population differentiation. Close connections between researchers and land managers, and the commitment of an NGO to maintain an *ex situ* collection of the species, enable the incorporation of genetic data into plans to restore *J. reclinata*.

P012 TIMM, SARAH A., Christine M. Custer, and Douglas A. Olsen. U.S. Geological Survey, Upper Midwest Environmental Science Center, 575 Lester Avenue, Onalaska, WI 54650, USA (stimm@usgs.gov).
BOOTSTRAPPING TO CREATE NON-PARAMETRIC CONFIDENCE INTERVALS FOR SELECTION RATIOS OF FEEDING SITES OF GREAT BLUE HERONS ON THE UPPER MISSISSIPPI RIVER SYSTEM

Selection ratios are often used in resource selection studies to give an indication as to whether or not a particular resource (often a habitat) is being selected, avoided, or used in proportion to availability. Selection ratios are advantageous because they do not depend on what types of habitats are deemed available (unlike chi-squared tests). Confidence intervals do, however, depend on the assumption that selection ratios are normally distributed, something that appears to be true only if each category (selected and available sites) has a 'moderately large' (e.g. $n \geq 5$) sample size. When these assumptions do not hold, bootstrapping can be used to create confidence intervals free of distributional assumptions. Data from a study of Great Blue Heron (*Ardea herodias*) feeding sites in the Upper Mississippi River System are used as an example.

P136 TIX, DANIEL, and Iris Charvat. Plant Biology Department, University of Minnesota, 220 BioScience Center, 1445 Gortner Avenue, St. Paul, MN 55108-1095, USA (DT, IC) (dtix@cbs.umn.edu).
THE EFFECTS OF SPRING ABOVEGROUND VEGETATION REMOVAL ON A RESTORED PRAIRIE PLANT COMMUNITY

Aboveground litter accumulation on tallgrass prairies may be detrimental to species establishment and overall plant diversity. This project compares an untreated control to two types of aboveground vegetation removal: manual removal (haying) and prescribed burning. Treatments were performed in early May for two consecutive years. The Murphy Lake prairie has 100-m^2 plots with 10 replicates in a randomized complete block pattern. Vegetation in each plot was sampled in ten 1-m^2 quadrats for frequency and number of flowering stems of each species. After two years, the removal treatments had more native species ($p < 0.05$) and native forb species ($p < 0.01$) per m^2 than the untreated plots. Native legumes were significantly more common, in terms of frequency, on removal plots than on the control ($p < 0.05$). Warm-season grasses produced the most flowering culms on burned plots; whereas, the hayed plots had more flowering culms than on the control plots ($p < 0.05$). Furthermore, native annual forbs were more abundant on the removal plots than on the control plots ($p < 0.001$). Therefore, frequent vegetation removal by haying or burning can help to favor the establishment of certain native plants on a restored prairie.

C40-06 TOWNS, DAVID, and Ian Atkinson. Science and Research Unit, Department of Conservation, Private Bag 68-908 Newton, Auckland, New Zealand (dtowns@doc.govt.nz) (DT); Ecological Research Associates of New Zealand, PO Box 48-147, Silverstream, Upper Hutt, New Zealand (IA).
THE SIGN OF AN ANCIENT MARINER? SEABIRD EFFECTS ON ISLAND RESTORATION IN NEW ZEALAND

New Zealand is the breeding ground for 25% of the world's seabird species. Many of these are species that build burrows and most of them are confined to offshore islands. On these islands, burrowing seabirds may act as ecosystem drivers through soil disturbance and nutrient subsidy from marine sources. However, seabird populations have been devastated by introduced predators. Success with the removal of these predators from islands now raises possibilities for ecosystem restoration. But conceptual models developed from interaction webs indicate that islands that have scarce seabird populations are likely to follow successional pathways different from islands where seabirds are abundant. We investigate this possibility by comparing the composition of seabird-modified soils on islands that have had introduced predators and those where predators have never been present. We conclude that some soils show evidence of fossil seabird activity and retain high concentrations of total phosphorus

and cadmium even where seabirds are rare. These soils can therefore maintain the seabird subsidy long after the birds have gone. However, islands with low seabird numbers lack the physical effects of the birds and therefore have little vegetation destruction and soil disturbance, and less acid soils than densely burrowed islands.

P130 TRACEY, CHRISTOPHER, Juan L. Bouzat, and Helen J. Michaels. Department of Biological Sciences, Bowling Green State University, Bowling Green, OH 43403, USA (ctracey@ecologytechniques.org).
POPULATION DIFFERENTIATION FOR PHENOTYPIC PLASTICITY IN THE THREATENED PLANT *LUPINUS PERENNIS*: DOES POPULATION SIZE MATTER?

Phenotypic plasticity is the ability of individuals and populations to alter their morphology in response to changes in environmental conditions. Differences in the amount and pattern of phenotypic plasticity provide an estimate of how populations respond to potential environmental perturbations, a fundamental concern of conservation biology. We performed a greenhouse experiment to examine the response of four large and four small populations of *Lupinus perennis* under two light environments (full sun and 70% shade). We estimated the amount and patterns of phenotypic plasticity within and among populations, and evaluated potential effects of population size. All measured traits (biomass, leaf number, petiole length and specific leaf area) exhibited significant responses to light ($P < 0.01$). Populations revealed variable levels of plasticity, as indicated by the coefficients of variation of reaction norm slopes. In addition, we found significant levels of population differentiation for plasticity in most traits (i.e., treatment by population interaction). Specific leaf area, a trait directly linked to light-related physiological processes, reveled a significant effect of population size, showing a reduction in phenotypic plasticity in smaller populations ($P < 0.005$). Differences in phenotypic plasticity reflect the potential response of plant populations to environmental changes, therefore, should be considered in any conservation effort.

S03-04 TRACEY, JEFF A., Jun Zhu, and Kevin Crooks. Department of Wildlife Ecology, University of Wisconsin–Madison, 226 Russell Labs, 1630 Linden Drive, Madison, WI 53706, USA (jatracey@.wisc.edu) (JT, KC); Department of Statistics, University of Wisconsin–Madison, 1210 West Dayton Street, Madison, WI 53706, USA (JZ).
USING ANALYSIS AND MODELLING OF INDIVIDUAL-BASED PUMA AND BOBCAT MOVEMENT TO ASSESS LANDSCAPE CONNECTIVITY IN THE SOUTHERN CALIFORNIA ECOREGION

The southern California ecoregion has been severely impacted by urban and agricultural development, yet assessments of the functional connectivity of the present landscape and possible future landscapes in this region are lacking. These assessments would allow conservation organizations and resource agencies to take proactive steps to preserve habitat linkages in this fragmented system. Because connectivity is an interaction between landscapes and animal movement, models of movement on heterogeneous landscapes may be useful tools for connectivity assessments. We outline a research project focusing on the analysis and individual-based modeling of puma and bobcat movement on geographic information system representations of the southern California landscape. Pumas require large core areas of habitat, are particularly sensitive to fragmentation, and are therefore excellent indicators of connectivity at the ecoregion scale. Bobcats are less sensitive to fragmentation and are excellent indicators of connectivity at smaller spatial scales. We will develop new techniques to analyze movement data, use these techniques to analyze radio-telemetry data from pumas and bobcats, construct individual-based movement models based on the results of the analysis, and use these models to assess landscape connectivity in the southern California ecoregion. Our movement models will allow us to identify and design movement corridors for pumas, bobcats and other species, and help protect landscape connectivity in southern California.

C05-09 TRAKHTENBROT, ANA, and Ronen Kadmon. Department of Evolution, Systematics and Ecology, Hebrew University of Jerusalem, Giv'at- Ram, Jerusalem, 91904, Israel (tana@pob.huji.ac.il).
REPRESENTING SPECIES DIVERSITY: A TEST OF THE EFFICIENCY OF CLUSTER ANALYSIS BASED ON ENVIRONMENTAL FACTORS

Preserving species diversity requires designing a nature reserves network that is representative of the regions' biota. Lack of information on species distribution resulted in using surrogates for this data in locating reserve networks. One promising attitude is to use the regional diversity of abiotic conditions to represent the species diversity, employing cluster analysis as a tool to select sets of sites that span the full range of the regional environmental conditions. As yet, this approach has rarely been tested for its efficiency. Our main objective was to evaluate the efficiency of cluster analysis based on environmental factors in representing species diversity, using the flora of Israel as a case study. Additionally, we addressed the previously neglected issue of the results' sensitivity to variation in clustering methods. Our results indicate that both the total number of plant species and the number of the rare woody species is significantly higher for clustering-based selection of sites than for sets of sites selected at random. These results were robust despite the variation in efficiency among clustering-based networks generated using different clustering techniques. The overall results suggest that cluster analysis based on environmental factors may serve as an efficient tool in representing species diversity.

S11-05 TRAN, TRIET, and Jeb Barzen. Department of Botany and Ecology, Vietnam National University – Ho Chi Minh City, 227 Nguyen Van Cu, District 5, Ho Chi Minh City, Vietnam (ttriet@hcm.vnn.vn) (TT); International Crane Foundation, E-11376 Shady Lane Road, PO Box 447, Baraboo, WI 53913, USA (JB).
BUILDING TRUST AND LONG TERM COMMITMENT THROUGH WETLAND AND CRANE CONSERVATION IN SOUTHEAST ASIA

War brought dramatic environmental changes to Southeast Asia in the 1960s and 70's, with repercussions that will continue well into the 21st century. Military use of herbicides, dredging, bombing, and fire resulted in extensive denudation of land. Ironically, war and its immediate aftermath held off development pressures for thirty years or more, preserving extensive areas of wetland. Since the 1980s peace has emerged across this region, bringing massive development and rapid social change. Simultaneously, the region has been home to exciting new programs to repair the damages of war across broad landscapes. Though hopeful, the time available to implement these solutions is short. As such, in confronting these challenges governmental institutions (which have a dominant role in land-use issues in Southeast Asia) should not be thought of as a "curse," nor as the salvation. Our challenge is to engage the region's governments in a positive manner by providing sustainable development alternatives. Concomitantly, we must also implement tangible restoration projects that demonstrate what is possible, while responding to the needs of local, often impoverished, people. Such projects are complicated and require long-term commitment. Two wetland restoration efforts in the Mekong Delta (Plain of Reeds and Ha Tien Plain) exemplify our process.

C04-07 TRAUT, BIBIT. Graduate Group in Ecology, Department of Wildlife, Fish, and Conservation Biology, University of California, Davis, One Shields Avenue, Davis, CA 95616, USA (bhtraut@ucdavis.edu).
ECOTONES: AREAS OF CONSERVATION IMPORTANCE

Conservation is often focused on identifying and protecting communities with high biodiversity. However, conservation of transitional areas between communities and ecosystems (ecotones) has received less attention, although recent work suggests that these may be diversity hotspots (e.g. passerines and ants). I tested the hypothesis that ecotones are areas of increased richness. Specifically, I predicted that the marsh/upland ecotone functions as an area of increased plant and spider diversity. I tested this hypothesis by surveying 4 marshes in Point Reyes, California; replicate parallel transects were placed adjacent to the ecotone (i.e. midmarsh and upland) and within the ecotone (i.e. high marsh) and vegetation composition and heights were measured. Spider composition was determined from pit trap and D-Vac collections. Survey results showed that the high salt marsh ecotone harbored increased richness, for both plants and spiders. Part of this is related to the increased tip height diversity of the vegetation. Additionally, unique "ecotone" species were found in the high salt marsh suggesting that ecotone species could prove to be useful indicators for mapping and the inclusion of them in ecosystem restoration may be critical. These results emphasize that our conservation attention and research needs to focus on ecotones as well.

C21-05 TRAYLOR-HOLZER, KATHY, Ronald Tilson, and Jeff Muntifering. IUCN Conservation Breeding Specialist Group, 12101 Johnny Cake Ridge Road, Apple Valley, MN 55124, USA and Department of Conservation Biology, University of Minnesota, St. Paul, MN 55108, USA (kathy@cbsg.org) (KTH); Minnesota Zoo, 13000 Zoo Boulevard, Apple Valley, MN 55124, USA (RT, JM).
FADING STRIPES: THE SOUTH CHINA TIGER CRISIS

Endemic to China, wild South China tiger (*Panthera tigris* amoyensis) populations declined precipitously in the 1950s and 1960s due to government anti-pest campaigns, dropping from 4,000 to fewer than 100 tigers by 1986. An eight-month Sino-American field survey of eight priority tiger sites in China, including 392 camera trap-nights, found no evidence of wild tigers, few prey species, extensive habitat conversion, and no evidence of livestock depredation. Results indicate that no viable wild tiger populations remain. A captive population of 57 South China tigers exists in 20 Chinese zoos and is in a current demographic and genetic crisis. Low reproductive success and a small genetic founder base threaten this population. Gene diversity has declined to 71.5%; unfortunately no founder stock is available from the wild for genetic supplementation. The Chinese State Forestry Administration has established a reintroduction project at Meihuanshan to pursue the release of captive tigers into potential tiger habitat, which will include habitat restoration, prey stocking and "barbarization" of captive tigers. The current captive population is unlikely to be able to stock such a program. One potential option is hybridization of captive South China tigers with other tiger subspecies. Options for the survival of this subspecies are limited.

C08-01 TREBITZ, ANETT, John Brazner, and Danny Tanner. U.S. Environmental Protection Agency, Mid-Continent Ecology Division, 6201 Congdon Boulevard, Duluth MN 55804, USA (trebitz.anett@epa.gov).
FISH-HABITAT RELATIONSHIPS IN GREAT LAKES COASTAL MARSHES

Despite numerous studies documenting fish use of particular habitat elements, the role of habitat mosaics in supporting wetland fishes is poorly understood. USEPA's Mid-Continent Ecology division has initiated research to identify relationships among fish

and habitat in coastal marshes of the Great Lakes, as part of a longer-term project to develop habitat-based criteria for protection of aquatic ecosystems. We sampled 24 wetlands across all 5 Great Lakes in 2002 selected according to a factorial design (riverine vs. lagoon morphology, upper vs. lower ecoprovince), and will sample an additional 24 wetlands in 2003. We characterized fish assemblages, aquatic vegetation, algal activity, water quality, sediments, wetland morphology and human impacts using a sampling design that yields information about fish-habitat relationships by plant growth zones (emergent, submergent, open water), by fluvial environments (backbays, channels, lake-like areas), and at the whole wetland scale. Preliminary results show significant differences in plant cover and diversity and in fish abundance and composition between wetland types and along a gradient of nutrient loading. We will present approaches to characterizing habitat complexity and variability and aggregating to the wetland scale. *This abstract does not necessarily reflect EPA policy.*

S02-01 TREMBLE, DAVE. Sauk County Department of Planning and Zoning, 505 Broadway Street, Baraboo, WI 53913, USA (dtremble@co.sauk.wi.us).
LAND USE PLANNING THAT WORKS

Planning has become an increasingly important function of local government, providing the legislative foundation needed to legitimize and support regulatory and alternative growth management strategies. Public participation in the identification of development and resource protection goals, creation of supporting policies and establishment of implementation programs is now a mandate of "Smart Growth" – styled planning legislation. Participatory planning processes, if well-designed and managed, afford a significant degree of constructive involvement for citizens at all levels of the society. Technical and scientific expertise among these citizen planners varies, especially in rural communities where natural resource conservation is a critical concern. Organizers are challenged to help identify effective roles for all participants and to ensure that each voice is heard. In this environment of democratic participation and local process control, how can conservation concerns and objectives be most effectively articulated and implemented? The "Land Use Planning that Works" segment relates the Sauk County, Wisconsin experience in creating and implementing plans that attempt to balance regional resource conservation objectives with local control of the planning process in a dynamic environment of state statutory planning requirements, unique resource conservation issues and opportunities, persistent apathy toward public service and vocal private property rights advocacy.

C33-07 TREML, ERIC A., Patrick N. Halpin, and Lincoln F. Pratson. Nicholas School of the Environment and Earth Sciences, Duke University, Box 90328, LSRC, Durham, NC 27708, USA (eat4@duke.edu) (EAT, PNH); Earth and Ocean Sciences, Duke University, 103 Old Chemistry Building, Durham, NC 27708-0230, USA (LFP).
THE IMPACT OF THE EL NIÑO SOUTHERN OSCILLATION (ENSO) ON THE DISPERSAL POTENTIAL OF PELAGIC LARVAE IN THE SOUTH PACIFIC

Pelagic larval exchange, or connectivity, between marine benthic communities is a fundamental component to their population dynamics and therefore their effective conservation and management. As marine conservationists, it is necessary to understand the patterns and variability in ocean current dynamics, as they govern the dispersal potential of many marine organisms. The sea surface current patterns in the South Pacific are often dominated by El Niño Southern Oscillation (ENSO) episodes. Here, we use a spatially explicit, hydrodynamical-ecological modeling approach to characterize the dispersal potential of pelagic larvae in the South Pacific throughout the ENSO cycle. Spatial analysis reveals striking differences in both the distance, and the direction, of larval dispersal throughout the region. Temporal comparisons between seasons and among years highlight the great variability within these time-scales. A three-year contrast between a 'normal year' (1997), a strong El Niño (1998), and strong La Niña episode (1999), gives insight into the impacts of this cycle on the connectivity between marine populations. Clearly, the seasonal and year-to-year patterns in connectivity between marine populations need to be considered in the development of conservation plans and the implementation of marine protected areas.

S09-03 TRENHAM, PETER, and Lloyd Gamble. Section of Evolution and Ecology, University of California, Davis, Davis, CA 95616, USA (PT); Department of Natural Resources Conservation, University of Massachusetts, Amherst, MA 01003, USA (LG).
MOVING FROM METAPOPULATIONS TO LANDSCAPES: CONSERVATION OF DISPERSAL-LIMITED VERTEBRATES

Metapopulation theory has been widely adopted as a paradigm of choice in planning for the conservation of wildlife in fragmented landscapes. This approach is attractive in that it accommodates important natural processes, such as recolonization of habitat patches following local extinctions. However, assuming a simple metapopulation structure that ignores the importance of matrix habitat can lead to dangerous oversimplification and ineffective planning. Due to their relatively limited mobility and patchy distribution, amphibians are used as model systems for research in spatial ecology, and will be used to illustrate the considerations critical for effective landscape-level conservation. In a simple metapopulation framework, all of the requirements for life (breeding, feeding, and year-round survival) occur within a single habitat patch, and movement is only important for dispersal among patches. For many amphibians the situation is more complicated, with different, spatially-disjunct habitats used for each of these requirements, and intervening matrix habitats of varying permeability (i.e., ranging from barriers to corridors).

Based on case study examples from published research and conservation plans in which metapopulation and landscape ecology theory have been applied, we will present a generalized decision framework that practitioners can use in planning for the preservation and recovery of spatially structured regional populations.

C31-03 TRISURAT, YONGYUT, and Anak Pattanavibool. Department of Forest Biology, Faculty of Forestry, Kasetsart University, Bangkok 10900, Thailand (fforyyt@ku.ac.th) (YT); Western Forest Complex Project, Royal Forest Department, Bangkok 10900, Thailand (AP).
ECOSYSTEM-BASED MANAGEMENT ZONES OF THE WESTERN FOREST COMPLEX IN THAILAND

The Western Forest Complex (WEFCOM) in Thailand, covering an area of 18,000 km^2 is the largest forest area in Southeast Asia. It comprises 17 protected areas, and a Natural World Heritage Site, Thung Yai-Huai Kha Khaeng, is situated in the core area of this complex. The Danish Government (DANCED) has provided technical and financial support to the Royal Forest Department through the Ecosystem Management for WEFCOM since 1999. The goal of the Project is to manage and conserve abundant biological resources through participatory and integrated management approach. An important activity of the project is to use ecological management zones as a tool to assist park managers and six Provincial Conservation Fora (PCF) to safeguard fragile and unique habitats and to manage this natural resource in a sustainable manner. The zoning processes took almost two years, and Geographic Information System (GIS) was employed to develop four spatial criteria for defining management zones, i.e. concentration of selected key wildlife species, soil erosion, habitat types, and present utilization by local community. Based on various meetings and consultation with stakeholders, four main management zones were proposed, namely Strict Preserved Zone, Natural Reserve Zone, Recreation and Nature Education Zone, and Limited Utilization Zone. Draft management zone map was validated in the field and workshops were conducted for park managers, PFC, mass media, and conservationists not only on how to prepare management zone map but also how to effectively implement it on the ground.

S08-04 TRUSH, BILL. McBain and Trush, PO Box 663, Arcata, CA 95518, USA (Bill@mcbaintrush.com).
RESTORING ENDANGERED ALLUVIAL PROCESSES AS A RECOVERY STRATEGY FOR THE TRINITY RIVER

The mainstem Trinity River in northern California was once an alluvial river capable of constantly reshaping its channelbed and banks. In 1963, the U.S. Bureau of Reclamation diverted up to 90% of the natural streamflow for power generation and water supply. Alluvial processes became endangered, and the Trinity River ceased being alluvial. With most of their primary spawning and rearing habitat upstream of an impassable dam, the mainstem channel below Lewiston became the primary habitat provider for Pacific salmon. Once altered by dam construction (blocked sediment supply) and flow regulation, the mainstem channel could never function entirely as before. But a scaled-down alluvial channel morphology could retain much of the river's original integrity provided key physical and biological processes are restored. In practice we must rely on the crucial assumption that native species, such as the Pacific salmon, have evolved with the natural flow regime. To guide a restoration program, several commonly known concepts that govern how alluvial channels work were compiled into 10 "attributes" of alluvial river integrity. Planned releases from Lewiston Dam will restore snowmelt hydrograph components to re-create physical and biological processes to meet several of the attributes. Restoration strategies focused on restoring alluvial processes, such as proposed for the Trinity River, may be the most practical and cost-effective for recovering regulated alluvial river ecosystems and the species that inhabit them.

C56-04 TUCHSCHERER, KRISTIN. Department of Zoology, University of Manitoba, Z320 Duff Roblin Building, Winnipeg, MB R3T 2N2, Canada (kristin59@hotmail.com).
BROOD ENGINEERING AS A CONSERVATION STRATEGY FOR ALTRICIAL BIRDS

Many birds regularly produce more offspring then they intend to or are able to rear to fledging. In the past, this surplus has been used in conservation efforts; managers of whooping cranes have capitalized on the value of a second insurance egg. In non-obligate brood reducers the potential value of surplus offspring has rarely been tested. By employing asynchronous hatching as a means of insurance, as well as for tailoring the brood to environmental conditions, two types of nestlings are produced. Core nestlings hatch first and almost always survive, while their younger marginal counterparts exhibit more variability in growth and survival, and are more prone to brood reduction. By engineering broods, creating nests that maximize the reproductive output for a given brood composition, these 'disposable' marginal offspring can be used in the conservation of threatened birds. Red-winged blackbirds were used as a model system for this work, and nestlings were transferred across broods to create nests of different sizes and compositions. From this population there was a net benefit of more than half of a fledgling for manipulated nests. As well, work is continuing on optimizing brood sex ratios to maximize reproductive output.

C20-05 TULL, JOHN C., and Peter F. Brussard. Program in Ecology, Evolution and Conservation Biology, University of Nevada, Reno, MS-314, Reno, NV 89557, USA (jctull@unr.edu).
THREATS TO BIODIVERSITY IN NEVADA'S RICHEST MOUNTAIN RANGE: STRATEGIES FOR SALVATION

The Carson Range is unique in Nevada because it has the highest level of biodiversity of any of the 314 mountain ranges in the state. The Carson Range serves as a transition between the western Great Basin and the east face of the Sierra Nevada, so a mix of species from two major biomes is represented. We detail the historical status of key wildlife in the Carson Range along with the current status of those animals. We also examine the landscape matrix in and around the Carson Range, with an emphasis on habitat fragmentation and loss of connectivity to the Great Basin and the Sierra Nevada. Additionally, we present recommendations for designing a system of connectivity between the Carson Range and the Sierra Nevada that should allow for some exchange of individuals between wildlife populations in each of those ecosystems. Last, we discuss our efforts with agency and non-governmental organizations to realize our goal of maintaining connectivity between the larger ecosystems of the Carson Range and the Sierra Nevada.

C10-06 TUNNICLIFFE, SUE DALE. Institute of Education, University of London, 20 Bedford Way, London WC1H 0AL, UK (ioe@sdtunnicliffe.demon.co.uk).
ELEMENTARY CHILDREN'S UNDERSTANDING OF PONDS – A STARTING POINT FOR CONSERVATION EDUCATION

Finding out what young children spontaneously know about ponds is a starting point in aspects of conservation education. Forty children, aged 6 and 10, 20 in each age group were asked individually to talk about a pond. They were cued by the word, a drawing or a coloured photograph. The interview contents were analysed according to a hierarchy of levels of organisation and counts of comments about organisms and human influences. There were no comments below that of organism level, which was the most frequent category mentioned. Population comments, community and ultimately the ecosystem of the pond followed in this order. Amphibians were the most mentioned group of organism (three quarters of all interviewees) and 38% mentioned ducks and these were mentioned equally by each age group (30% of all comments). Overall, children regarded ponds human-made and populated by frogs, ducks and pond weed with lily pads for the frogs. The results suggest that children's understanding of ponds is related to their own experiences and few pupils observe naturally occurring ponds. Moreover, myths from books and other media sources form a large part of their knowledge source. The work raises important issues for biological education.

P010 UNDERWOOD, JARED, Ronald Rodriguez, and Clayton White. Department of Integrative Biology, Brigham Young University, Provo, UT 84602, USA (jgu2@email.byu.edu) (JU, CW); USDA Forest Service, Dixie National Forest, Cedar City, UT 84720, USA (RR).
WINTER HABITAT AND DIFFERENTIAL MIGRATION OF NORTHERN GOSHAWKS (*ACCIPITER GENTILIS*)

Questions surrounding the reproductive viability of the Northern Goshawk (*Accipiter gentilis*) began in the early 1990s. In 1991 there was a petition to place the goshawk on the endangered species list. Although the petition was denied, it was listed as a species of concern. While goshawk breeding biology is well known, important questions concerning possible fall migration and wintering areas remain basically unanswered. This study looks at goshawk wintering areas and types of habitat used at those sites. Goshawks were fitted with satellite telemetry backpacks and their movements were tracked. Some goshawks migrated south during winter months while some from adjacent nesting territories did not. The wintering areas for each bird were identified and analyzed using vegetative sampling methods in order to determine correlations between habitat structure and goshawk use. We found that many goshawks wintered in habitats very different from their breeding range. These areas tended to be fairly open pinion/juniper and sagebrush ecotones. The birds generally selected areas on the borders of theses habitat types. Since the pinion/juniper habitat has been much underrated by agency personal and other scientists in general, the presence of goshawks there during winter months adds an entirely new priority to such habitat.

C34-04 UNNASCH, ROBERT, and G. David Maddox. The Nature Conservancy, 1109 Main Street #333, Boise, ID 83702, USA (bunnasch@tnc.org) (RU); 3901 Connecticut Avenue NW #304, Washington, DC 20008, USA (GDM).
CHANGE DETECTION IN ECOSYSTEMS AND NATURAL COMMUNITIES: A SIMULATION MODEL FOR SAMPLING USING THE FLORISTIC QUALITY INDEX (FQI)

Ecosystems and natural communities are increasingly important targets of conservation planning and management. Yet, there are few methods for quantifying either in ways that are effective instruments for measuring change. Here we present the Floristic Quality Index as such an instrument. FQI is a measure of species richness weighted by the average "conservatism" (CC) of the species present. CC reflects habitat identity and ranges from 0 (e.g., dandilion) to 10 (e.g., *Aralia nudicaulis* in Nebraska). Using FQI any community or ecosystem can be evaluated objectively: interannual changes in FQI reflect changes in the composition of the community. Using data from Niobrara and the Platt River (collaborators: Mike Behrens, Chris Helzer, Gerry Steinhauer) and from our simulation model (called BEE), we present sampling recommendations for the use of FQI for change detection. BEE uses

a user-supplied dominance-diversity curve and a matrix of species' spatial correlations to create replicas of plant communities. We then study sampling behavior of FQI in communities with different features (i.e., species rich vs. depauperate communities). BEE also allows for elements in communities to be individually "replaced" (say, by species whose value is 0). We suggest several things about FQI as a change detection instrument: (1) relatively small plots are best, (2) even low effort (sampling < 1% of total area) results in excellent estimates of true FQI, and (3) relatively subtle annual changes in FQI are detectable using standard ANOVA. Moreover, BEE's user-input of community features allows one to generate locally specific sampling recommendations.

S05-04 VALES, MIGUEL A., and Daysi Vilamajo. Agency of Prioritized Programs and Projects (GEPROP), Ministry of Sciences Technology and Environment, La Habana, Cuba (valvil@infomed.sld.cu or vales@geprop.cu) (MAV); Institute of Ecology and Systematic, Environment Agency, Ministry of Sciences Technology and Environment, La Habana, Cuba (DV).
ACHIEVEMENTS OF THE CUBAN NATIONAL CONSERVATION STRATEGY

During the national Biodiversity survey performed 1996-1997 and printed in 1998 were characterized 42 types of ecosystems and 23 high and medium level landscapes types; 51.4% of the 6500 species of vascular plants are endemics and more than 19600 species of animals were known with an endemism of about 50%. In this study were identified not only the threats and services but also the main lines of biodiversity to take into account for the development of the National Conservation Strategy, such as: 1) increase the studies on biodiversity at different levels, 2) assessment of the efficiency of the Protected Areas National System, 3) ecosystems restoration, 4) traditional knowledge, 5) management of the spatial an no spatial information, 6) environmental planning, 7) monitoring of biodiversity at species and ecosystems levels, 8) review of the environmental laws, and 9) communitarian participation. Cuban National Strategy developed considering the criteria of the different region and social interests of the country states that "the objectives of sustainable use and conservation of biological diversity ... should be integrating to territorial and sectorial policies ..." and establish 11 goals, 56 objectives and 134 actions, of which about 50% are today in the implementation phase.

C50-07 VALONE, THOMAS, and Michael Castellano. Department of Biology, Saint Louis University, St. Louis, MO 63103, USA (Valone@slu.edu).
EFFECTS OF LONG-TERM LIVESTOCK REMOVAL ON THE ABUNDANCE OF LIZARDS AT AN ARID GRASSLAND SITE IN SOUTHEASTERN ARIZONA

Over the past two centuries, perennial grass cover has declined and shrub density has increased in many arid grasslands. These changes in vegetation, characteristic of desertification, are thought to have occurred often following prolonged periods of intense grazing by domestic livestock. While numerous studies have examined how plants, rodents and birds respond to livestock grazing, reptiles remain poorly studied. We examined the abundance of lizards inside and outside a 44-year grazing exclosure in southeastern Arizona using pitfall traps. Lizard abundance was significantly higher inside the exclosure. Two factors may explain this pattern: perennial grass cover was significantly higher and soil compaction was significantly lower inside the exclosure. Additional work is required to tease apart the effect of these two factors, and thus the specific effect of livestock grazing, on the abundance of lizards in arid grasslands.

C08-03 VAN HOLT, TRACY, Diane Murphy, and Lauren Chapman. College of Natural Resources and Environment, University of Florida, 103 Black Hall, PO Box 116455, Gainesville, FL 32611-6455, USA (tvanholt@ufl.edu).
WATER FLOW AND HABITAT PREDICTORS OF FISH ASSEMBLAGES IN THE GREAT SWAMP, NEW YORK

Associating species presence with habitat predictors is a priority for natural resource management. This study identified predictors of fish communities and tolerance to pollution assemblages in the Great Swamp watershed in New York state. For this we predicted abundance, richness and diversity of fishes based on water flow and habitat characteristics. Water flow parameters (velocity, percent riffle, percent run, percent pool, depth and watershed area) and habitat parameters (epifaunal substrate/available cover, pool substrate, pool variability, sediment deposition, channel flow, channel alteration, channel sinuosity, bank stability, vegetative protection and riparian vegetative zone width) were analyzed with respect to fish diversity and tolerance classes. Sites with high percentage of riffle habitat supported high species richness, diversity and tolerant fish classes. Small watershed areas held more fishes intolerant to pollution. Fishes abundance, richness, and diversity were positively related to optimal epifaunal substrate/available cover, pool substrate and pool diversity conditions. Further research is needed to determine whether the difference between sites is a result of disturbance or a natural variation within the ecosystem. As development continues in the Great Swamp, habitats that offer a diverse structure within the streams are important areas to protect for the fish community.

C17-04 VANBLARICOM, GLENN R., and Melinda D. Chambers. U.S. Geological Survey, Biological Resources Division, Washington Cooperative Fish and Wildlife Research Unit, School of Aquatic and Fishery Sciences, Box 355020, University of Washington, Seattle, WA 98195-5020, USA (glennvb@u.washington.edu) (GRVB); School of Aquatic and Fishery Sciences, Box 355020, University of Washington, Seattle, WA 98195-5020, USA (MDC).
BEHAVIORAL MITIGATION OF DEPENSATION IN A POPULATION OF ABALONES DEPLETED BY EXOTIC DISEASE

Black abalones (*Haliotis cracherodii* Leach, 1814) on outer rocky coasts of California have been decimated by an exotic microbial pathogen. The pathogen causes a fatal condition termed "withering syndrome" (WS). At San Nicolas Island (SNI), abalone population data have been collected periodically since 1981, and include numbers, sizes, and microhabitat use in permanent plots at nine shoreline study sites. Abalones are dioecious broadcast spawners with limited dispersal range of gametes. Thus, individual reproductive fitness is directly linked to aggregative behavior. It follows that high rates of spatial isolation in black abalones should contribute to depensation. The periodic survey data indicate a 99% reduction in population size since WS appeared at SNI in 1992. Two indices of spatial isolation were derived from survey data. Proportions of isolated individuals were lower than expected based on the degree of population reduction. There was a trend of increasing proportionate use of crevice microhabitats following the appearance of WS. Movement into crevice habitats may have been a behavioral response to reduced density, facilitating the preservation of aggregations despite reduced population size. Microhabitat-based behaviors may allow depleted species to mitigate the depensatory effects of declining population size and reduce the risk of extinction.

C29-05 VANCE-BORLAND, KEN, and Michael Furniss. Department of Forest Science, Oregon State University, Corvallis, OR 97331, USA (ken.vance-borland@orst.edu) (KVB); USDA Forest Service, Pacific Northwest Research Station, Corvallis, OR 97331, USA (MF).
BEYOND ROAD DENSITY: A NEW METHOD FOR QUANTIFYING THE RISK OF ROAD-RELATED LANDSLIDES

Roads are a major source of disturbance in both terrestrial and aquatic ecosystems, but all roads do not have equal impacts. We used a 30-year record of road-related landslides in 38 watersheds in the Olympic National Forest, USA, to explore the influence of topographic variables (slope, slope position, and proximity to stream channel) on such road failures. Chi-squared analysis showed some landscape positions (gentler slopes, farther from streams) had fewer road-related landslides than expected from road length alone, and others (steeper slopes, higher slope positions, closer to streams) had more. Logistic regression modeling to estimate relative odds of road-related landslides found, for example, the odds of a landslide are 253 times greater (95% CI: 86, 746) for a road segment on a steep slope near a headwater stream than one on a gentle slope in a broad valley. There was no correspondence between average relative odds of road-related landslides and road density, suggesting that road density is a poor indicator of landslide risk despite its common application for this purpose. Our methods should be useful to land managers when deciding where to place new roads or decommision existing ones, and to regulators when characterizing watershed condition.

C56-05 VAUGHAN, CHRISTOPHER, Nicole Nemeth, and Leonel Marineros. Department of Wildlife Ecology, University of Wisconsin–Madison, Madison, WI 53706, USA (CV); College of Veterinary Medicine and Biomedical Sciences, Colorado State University, Ft. Collins, CO 80523, USA (NN); Regional Wildlife Management Program, Universidad Nacional, Heredia, Costa Rica (CV, LM).
ECOLOGY AND MANAGEMENT OF NATURAL AND ARTIFICIAL NEST SCARLET MACAW (*ARA MACAO*) NEST CAVITIES IN COSTA RICA

All macaw species are considered endangered and natural history information, especially concerning reproduction, is scarce. We studied Scarlet Macaw (*Ara macao*) nest cavities in the Central Pacific Conservation Area, Costa Rica from 1992 to 2000. A total of 56 natural nest cavities were found in 10 tree species. Several nests were occupied repeatedly during the study, including five nests occupied for three years and nine nests occupied for two years. Sixty-four percent (64%) of nests were considered at high poaching risk, 23% at intermediate poaching risk, and only 17% at low poaching risk. Nest cavities in dead trees were lost at a rate of 22% annually, compared to 8% annual loss rate of living trees. We mounted 38 artificial nests from 1995 to 2000. We know at least 11 broods hatched in four artificial nests made from various materials. Twenty-one (21) chicks fledged, were poached, or disappeared for unknown reasons. We suggest the following management principles: a) quantifying habitat and nest characteristics of successful nests cavities; b) eliminating snags with nest cavities so macaws cannot nest in them; c) concentrating artificial and natural nests to protect them more easily and thus increase reproductive success; d) closing high poaching risk nests; e) utilizing adaptive management to ensure nesing success; and f) coordinating visits to nests when scientists are measuring chicks by children and tourists to promote environmental education and local ecotourism.

P095 **VICTORY, ERIN,** Keith Woeste, and Olin E. Rhodes, Jr. Department of Forestry and Natural Resources, Purdue University, 1159 Forestry Building, West Lafayette, IN 47907, USA (erin@fnr.purdue.edu) (EV, OER); USDA Forest Service, North Central Research Station, Hardwood Tree Improvement and Regeneration Center, Purdue University, 240 Whistler Building, West Lafayette, IN 47907, USA (KW).
MICROSATTELITES AS INDICATORS OF GENETIC DIVERISTY IN BLACK WALNUT (*JUGLANS NIGRA* L.) ACROSS THE CENTRAL HARDWOOD REGION

Black walnut (*Juglans nigra* L.) is an important species ecologically, culturally, and economically. Its lumber is highly sought after for a variety of human uses including furniture, veneer, and gunstocks due to its coloration, and machining and wear properties. Although most populations of black walnut are currently stable, it is unlikely that this has been the case throughout history. Centuries of intense harvesting and anthropogenic use have presumably reduced overall levels of genetic diversity. Furthermore, forest fragmentation across the central hardwood region has likely increased differentiation among black walnut populations. The primary goal of this research was to determine current levels of genetic diversity and population structure in wild black walnut populations across their range. In addition, we will use these data to make inferences about the history of this species and the processes which may have contributed to current patterns of genetic diversity. We are currently genotyping individual black walnut trees from 44 populations across the central hardwood region at 12 microsatellite loci. Preliminary screening of these loci suggests high levels of polymorphism with an average of nearly 20 alleles per locus. In addition, expected heterozygosities ranged from 0.6 to 0.95, with the exception of 2 loci that showed evidence of null alleles.

C44-04 **VIGNIERI, SACHA,** and Jim Kenagy. Department of Zoology and Burke Museum, University of Washington, Seattle, WA 98195, USA (sachav@u.washington.edu).
CAN LOCAL RESULTS PREDICT REGIONAL EFFECTS: HIERARCHICAL POPULATION STRUCTURE IN A RIPARIAN ASSOCIATED SPECIES, THE PACIFIC JUMPING MOUSE

A relationship exists between sub-population demographic processes and the persistence of a species as a whole. This relationship is especially important in species that become fragmented or isolated. In such species, breeding structure and migrant success contribute directly to the stability of the sub-population. Species that exist in naturally patchy riparian habitats provide unique model systems in which to examine how processes occurring at the smallest population scale translate into population structure observed at higher levels. To reveal the connections that exist across hierarchical population levels in such a species, I am using a combination of mark-recapture methods and multiple microsatellite loci to examine the demographic processes, social structure, and genetic relatedness within a single sub-population, and the conversion of these patterns into genetic population structure at local and regional scales, within the riparian associated Pacific jumping mouse *Zapus trinotatus*. A quantitative trend may exist between population scales (sub-population, metapopulation, metapopulation groups). These data are used to construct a population model that has the potential to predict the effects that forced isolation at the small scale (i.e. fragmentation) may have on subsequently higher scales. This predictive power will be especially important for improving our ability to ameliorate such effects.

S07-04 **VILLARD, MARC-ANDRÉ,** and Pierre Drapeau. Canada Research Chair in Landscape Conservation, Université de Moncton, Moncton, NB E1A 3E9, Canada (villarm@umoncton.ca) (MAV); NSERC Industrial Chair in Sustainable Forest Management, Université du Québec à Montréal, C.P. 8888, Succursale Centre-Ville, Montréal, QC H3C 3P8, Canada (PD).
BOREAL BIRDS: HARBINGERS OF ECOSYSTEM DEGRADATION OR MODELS OF RESILIENCE?

Because they are relatively conspicuous and, thus, easy to detect and monitor, birds are often used as indicators of habitat alteration by human activities. In this paper, we will briefly review the pros and cons of using boreal birds as ecological indicators and we will compare their response to timber harvesting in contrasting settings: (1) an area recently opened to industrial forestry (the black spruce forest of northern Québec) and (2) two regions that have been deforested or harvested for over five decades (Abitibi, Québec and New Brunswick). We will also contrast bird response to agriculture and forestry in the Abitibi region. In each region, we surveyed birds at hundreds of point count stations sampling the dominant stand types and silvicultural treatments. We also measured the reproductive success of target species in managed and unmanaged stands and landscapes. Our results indicate that: (1) forest bird communities broadly reflect stand attributes and the landscape context; (2) some species are consistently sensitive to the intensity of harvesting at both spatial scales; (3) species strongly linked to natural disturbance regimes or to older seral stages and their attributes appear to be especially at risk, according to their patterns of occurrence and reproductive activity.

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RANKING THE COMPONENTS OF INVASIBILITY TO BIOLOGICAL INVASION IN A SOUTHERN APPALACHIAN RIPARIAN FOREST: AN EXPERIMENTAL MANIPULATION

In this presentation, we identify the relevant components of invasibility of a riparian forest within Jefferson National Forest in southwestern Virginia. The integration of nonindigenous species into an area (invasibility), can be affected by climate and the level of disturbance (environmental resistance), properties of native species and community structure (biotic resistance), and properties of invading species and the numbers introduced (demographic resistance). 1.5 x 1.5m experimental plots were randomly assigned low, intermediate and high recipient community richness treatments and were located within two high and two low flooding duration sites. These plots were replicated to include two invader addition treatments where various numbers of invaders were planted into the manipulated plots (across years). The purpose of these treatments was to test the relative influence of biotic, environmental and demographic resistances, respectively, to invasibility. These invaders were shorter than 0.5 m and randomly chosen from widespread native and introduced species commonly found throughout the floodplains of Big Stony Creek and with similar, forested habitat requirements. We monitored invader success and establishment for four years. Using Poisson regression analysis, we found that demographic resistance was the only factor that significantly determined invasibility into this riparian ecosystem.

P044 VONGKHAMHENG, CHANTHAVY. The Wildlife Conservation Society – Lao Program, PO Box 6712, Vientiane, Lao P.D.R. (cvongkhamheng@WCS.org).
DEVELOPING PARTICIPATORY WILDLIFE DIVERSITY MONITORING IN NAM ET-PHOU LOEY NATIONAL BIODIVERSITY CONSERVATION AREAS IN NORTHERN LAO P.D.R.

Both scientific information and local involvement are important for protected area management. A pilot project was conducted to use local knowledge and scientific study by involving local communities in assessing the status of wildlife and wildlife population trends at Nam Et-Phou Loey National Protected areas in northern Lao P.D.R. The study focused on seven villages of four different ethnic minorities, namely Hmong, Khamu, Yao and Tai Dam. Qualitative knowledge of local communities was obtained by using village-based approaches while quantitative field data was obtained by using science-based methods, which included walking transects and track-stations, for comparison with local knowledge as well as to understand local perceptions or local attitudes toward wildlife. As a result, it was found that local villagers usually overestimated the status of wildlife diversity while rigorous scientific study requires high skills of planning, technical expertise, interpretation skills, and resources input. So, to solve these problems, both scientific study and local knowledge should be combined in order to get both reliable information that is close to the real situation and also addresses the local involvement in conservation by building better local understanding.

P034 VORA, ROBIN S. Superior National Forest, 8901 Grand Avenue Place, Duluth, MN 55808, USA; Present address: USDA Forest Service, 1230 Northeast 3rd Street, Suite A262, Bend, OR 97701, USA (rvora@fs.fed.us).
POTENTIAL RESEARCH NATURAL AREAS, SUPERIOR NATIONAL FOREST, MINNESOTA, USA

Research Natural Areas (RNAs) on National Forest lands serve as sites for research, monitoring, education, and maintenance of biodiversity. The focus has expanded from unique sites to include the representation of the range of native ecosystems. In preparation for Forest Plan revision, the Superior National Forest conducted a potential RNA inventory at a coarse scale. Beginning in 1995, a list was developed and maps prepared of the highest quality sites based on existing information. Each site was ranked based on assigned points for attributes related to natural area quality and representation of common ecosystems within each site was noted. To further evaluate sites, a cooperative venture with Minnesota Department of Natural Resources, with financial support of The Nature Conservancy, provided additional analysis of 43 of these sites from the air and on the ground in 1997. Additional complimentary work on a RNA framework was completed at the regional level. In 1999, a Forest interdisciplinary team used these results and other information to develop a pool of 41 potential RNAs. The analysis report contained maps and showed ecological representation in relation to size, condition, and landscape context for each potential area. Potential management concerns were also documented.

C25-06 WAGENIUS, STUART, Claudia Neuhauser, and Eric Lonsdorf. Department of Conservation Science, Chicago Botanic Garden, 1000 Lake Cook Road, Glencoe, IL 60022, USA (swagenius@chicagobotanic.org) (SW); Department of Ecology, Evolution, and Behavior, University of Minnesota, 1987 Upper Buford Circle, St. Paul, MN 55108, USA (CN, EL).
THE EFFECT OF SELF-INCOMPATIBILITY ON POPULATION DYNAMICS IN FRAGMENTED HABITAT: EMPIRICAL AND SIMULATION STUDIES

Habitat fragmentation affects population dynamics in remnant plant populations through a variety of mechanisms such as reducing reproduction, dispersal, and survival. Ecological and genetic factors contribute to variation in all of these processes. Our study investigates, both empirically and theoretically, how self-incompatibility, an inbreeding avoidance mechanism, affects reproduction and dispersal in plants growing in fragmented patches. Our empirical study focuses on the model prairie plant, *Echinacea angustifolia* (purple coneflower), a common, long-lived, self-incompatible species that suffers from pollen-limitation and inbreeding depression in remnant populations. We combine this empirical study and an individual-based, genetically explicit patch model to demonstrate that self-incompatibility can be a major factor in the decline of population size following habitat fragmentation. We compare the results of purely ecological models versus models that include genetics with the empirical findings. Our study demonstrates that purely ecological patch models have poor predictive power when a genetic mechanism (self-incompatibility) reduces the fitness of individuals following habitat destruction. We discuss strategies that can enhance the conservation of remnant prairie populations following habitat fragmentation.

C51-05 Wainstein, Michelle, **PETER HODUM,** and Erin Hagen. School of Aquatic and Fishery Sciences, Box 355020, University of Washington, Seattle, WA 98195, USA (mwain@u.washington.edu) (MW, EH); Department of Biological Sciences, California State University, Long Beach, Long Beach, CA 90840, USA (PH).
COMPETITION VS. PREDATION: RELATIVE IMPACTS OF INTRODUCED MAMMALS ON SHEARWATERS OF THE JUAN FERNANDEZ ISLANDS, CHILE

Introduced mammals have had widespread impacts on populations of island-breeding seabirds, frequently leading to population endangerment or extirpation. Pink-footed shearwaters (*Puffinus creatopus*) on the Juan Fernandez Islands, Chile face competition for burrows with European rabbits (*Oryctolagus cuniculus*) and predation by domestic cats (*Felis catus*), Norway rats (*Rattus norvegicus*), and possibly coatimundis (*Nasua nasua*). We monitored plots at three colonies on Isla Santa Clara, where rabbits are the only mammal, and at three colonies on Isla Robinson Crusoe, inhabited by all mammals listed above. Ejected eggs and adult carcasses with predation wounds were quantified relative to estimated burrow occupancy in each colony. Egg ejection occurred in 14% of occupied burrows on Santa Clara, and in 0.2% on Robinson Crusoe. Meanwhile, predation rates were highly variable on Robinson Crusoe, ranging from 0-10% of estimated breeding adults among colonies. Relative effects of introduced mammals on pink-footed shearwaters vary dramatically between colonies and islands, but maximum mortality rates have potential to impact conservation of the species. However, further investigation of basic demography and the influence of egg versus adult mortality on population dynamics are required before we can quantify the degree of population-level effects of introduced mammals on the pink-footed shearwater.

C10-02 **WAITS, LISETTE,** Nilsa Bosque-Perez, JoEllen Force, Sanford Eigenbrode, Steve Brunsfeld, Jeffry Wulfhorst, Paul McDaniel, Jan Boll, Celia Harvey, Bryan Finegan, and Eduardo Somarriba. Department of Fish and Wildlife, University of Idaho, Moscow, ID 83844-1136, USA (lwaits@uidaho.edu) (LW); Department of Plant, Soil and Entomological Sciences, University of Idaho, Moscow, ID 83844-1136, USA (NB, SE, PM); Department of Forestry, University of Idaho, Moscow, ID 83844-1136, USA (JF, SB); Department of Biological and Agricultural Engineering, University of Idaho, Moscow, ID 83844-1136, USA (JB); Department of Agricultural Economics and Rural Sociology, University of Idaho, Moscow, ID 83844-1136, USA (JW); Tropical Agronomical Research and Higher Education Center, 7170 Turriabla Cartago, Costa Rica (CH, BF, ES).
A INTEGRATIVE MODEL OF GRADUATE EDUCATION IN CONSERVATION BIOLOGY AND SUSTAINABLE PRODUCTION

To achieve biodiversity conservation and sustainable production in anthropogenically fragmented landscapes, scientists need to be trained in a holistic fashion that emphasizes integration and interdisciplinary collaboration. Traditional graduate programs in conservation biology, forestry, and agriculture fall short of this goal as they train scientists with research skills in narrowly defined disciplines and rarely, if ever, facilitate integration across disciplines. We present an NSF funded experiment in graduate education that develops and evaluates an integrative educational model with an emphasis on developing interdisciplinary research skills and knowledge in the biological, physical and social sciences. This educational program involves researchers from 7 departments and 3 colleges at the University of Idaho plus four research areas at the Tropical Agricultural Research and Higher Education Center (CATIE) in Costa Rica. Twenty PhD students have been recruited to form 5 - 6 interdisciplinary teams that will address research questions in conservation biology and sustainability of agricultural and forestry production in temperate and tropical ecosystems. Team members representing biological, physical and social sciences work together to develop and implement interdisciplinary research projects. The structure, challenges and successes of this new graduate program will be highlighted.

C24-07 **WALKER, NATHALIE,** and Laura Rival. Queen Elizabeth House, International Development Centre, University of Oxford, Oxford OX1 3LA, UK (nathalie.walker@qeh.ox.ac.uk).
CONSERVATION STRATEGIES IN A BIODIVERSITY HOTSPOT – EFFECTS OF LARGE-SCALE CONSERVATION PLANNING ON THE THREATENED FORESTS OF THE ECUADORIAN CHOCÓ REGION

The forests of north-western Ecuador are severely threatened as they have been reduced to less than 10% of their original extent in only the last 40 years, resulting from agricultural activity, particularly oil palm and eucalyptus plantations, and from unsustainable timber extraction. The region constitutes the southernmost section of the Chocó biogeographic region, which runs along the Pacific coast of South America from northern Colombia, but the forests of the Ecuadorian Chocó can be distinguished from the Colombian section by their extremely high levels of diversity and endemism of epiphytes in forests that are relatively poor in terms of tree species diversity. In contrast to the Ecuadorian Chocó, the forests of Columbian Chocó are relatively intact. Methods of prioritization and conservation planning by international conservation organizations are targeting large areas with high levels of diversity and endemism that cross political borders, and consequently group the Chocó into one unit. This study reviews international conservation strategies for the Ecuadorian Chocó region, the level of funding and number of planned projects, and describes field studies of ongoing conservation projects. The findings reveal that large-scale conservation planning has led to increased attention and funding for the conservation of this highly threatened, species-rich region.

C04-06 WALLER, DON, Shannon Wiegmann, Dave Rogers, and Tom Rooney. Department of Botany, University of Wisconsin–Madison, 430 Lincoln Drive, Madison, WI 53706, USA (dmwaller@facstaff.wisc.edu).
FIFTY YEARS OF CHANGE IN NORTHERN WISCONSIN PLANT COMMUNITIES: SPECIES LOSSES AND BIOTIC HOMOGENIZATION

Using the baseline provided by John Curtis's surveys of Wisconsin vegetation, we examined patterns of community change across 62 sites in northern Wisconsin. Our resurveys of these northern hardwood stands reveal that northern Wisconsin forests are losing species and becoming more biologically homogenous. Curtis et al. noted 141 native understory species present (1 exotic) with 14-48 herbaceous species present at each site (in 20 m^2) while we found 123 species (7 exotic) with 6-41 species in 120 m^2. In all, 47 species disappeared and 29 new species (6 exotic) appeared. Sites lost an average of 18% of their native species with rare species declining the most (> 80% in *Mitella* and *Streptopus roseus*). In contrast, already common native species and several exotics increased greatly in abundance. Ironically, 'protected' areas without deer hunting lost the most species (65% vs. 12% elsewhere). Losses of rare species and increases in common and invading species are acting to homogenize the composition of these forest communities. These systematic changes represent a clear conservation concern by themselves as well as providing an early warning of region-wide declines in certain rare species.

C25-08 WANG, DAJUN, Hao Wang, Xiaojian Zhu, and Zhi Lu. College of Life Science, Peking University, Beijing 100871, P.R. China (djwang@pku.edu.cn).
THE FRAGMENTATION OF THE GIANT PANDA (*AILUROPODA MELANOLEUCA*) HABITAT IN MINSHAN MOUNTAINS, CHINA

This is a conservation biology study on the giant panda (*Ailuropoda melanoleuca*) habitat. The habitat fragmentation study is a spatial ecology analysis on a landscape scale, focusing on the spatial distribution of the fragmented panda habitat patches, and the relationship among these the patches. The 3S (GIS, GPS, and RS) technique was used in the study: the Landsat TM image classification provided data on the distribution of the forest, the GPS ground truthing provided data on the human activity influence, and the DEM analysis provided the potential distribution data of the bamboo. Combining all the analyses, it is found that 5,600 km^2 of panda habitat remains in Minshan mountains, but fragmented in 9 patches. Each patch is analyzed for its geographical area, shape, and connectedness with other patches. The ground truthing data combined with the historical information has showed that the road construction presented a major cause for the newly occurred fragmentation.

C01-05 WANINK, JAN, and Kees Goudswaard. Koeman en Bijkerk bv, Ecological Research and Consultancy, PO Box 14, 9750 AA Haren, The Netherlands (j.h.wanink@biol.rug.nl) (JW); Institute of Evolutionary and Ecological Sciences, University of Leiden, PO Box 9516, 2300 RA Leiden, The Netherlands (JW, KG).
INVASIVE ALIENS IN LAKE VICTORIA: NILE PERCH AND WATER HYACINTH AFFECT AQUATIC AND TERRESTRIAL BIRDS

Eutrophication, over-fishing and invasive aliens caused dramatic changes in Lake Victoria's ecosystem. Impact assessments of the Nile perch boom in the 1980s and the water hyacinth invasion in the 1990s have focused on fish. We present some effects on birds. Between 1977 and 2002 we monitored the fish community in the Mwanza Gulf (Tanzania). Occasional sampling of macrobenthos provided data on the lake-fly community. Foraging aquatic birds were observed during fish monitoring. Migrant Palearctic warblers were observed while feeding, caught in mist nets and weighed. Terns benefited from the increase in dagaa, a small pelagic fish. They used floats of Nile perch nets and hyacinth patches as safe roosts. Fish eagles benefited from the increase in Nile tilapia. Kingfishers and cormorants encountered smaller prey, but developed adaptive foraging behaviour. Hyacinth invasion was followed by an influx of little egrets, strolling the floating mats and catching fish underneath. After the collapse of the hyacinths, the birds switched to aerial feeding, exploiting dagaa. Warblers benefited from the shift from chaoborid- to larger chironomid lake-flies, reaching body weights allowing for non-stop flights to the Nile delta. The invasions of perch and hyacinth had profound effects on aquatic and terrestrial birds.

C05-04 WEBER, TED. Maryland Department of Natural Resources, 580 Taylor Avenue, E-2, Annapolis, MD 21401, USA (tweber@dnr.state.md.us).
LANDSCAPE ECOLOGICAL ASSESSMENT OF THE CHESAPEAKE BAY WATERSHED

The Chesapeake Bay Watershed, located in the mid-Atlantic region of the United States, is experiencing rapid habitat loss and fragmentation from sprawling low-density development. The bay itself is heavily stressed by excess sediment and nutrient runoff. Three states, the District of Columbia, and the federal government signed an agreement in 2000 to address these problems. The commitments included an assessment of the watershed's resource lands, and targeting the most valued lands for protection. As part of this task, the Resource Lands Assessment identified an ecological network comprised of large contiguous blocks (hubs) of forests, wetlands, and streams, interconnected by corridors to allow animal and plant propagule dispersal and migration. Hubs were prioritized by ecoregion, by analyzing a variety of ecological parameters, including: rare species presence, rarity and population viability; vegetation and vertebrate richness; habitat area, condition, and diversity; intactness and remoteness; connectivity potential; and the nature of the surrounding landscape. We found that much of the watershed was still fairly intact, although this varied dramatically by ecoregion. Current protection also varied, and an assessment of vulnerability will help focus protection efforts among the most valuable hubs and corridors.

P075 WECKWORTH, BYRON, Sandra Talbot, Kevin Sage, and Joseph Cook. Department of Biological Sciences, Idaho State University, Pocatello, ID 83209-8007, USA (weckbyro@isu.edu) (BW, JC); U.S. Geological Survey, Alaska Science Center, 1011 East Tudor Road, MS 701, Anchorage, AK 99503, USA (ST, KS).
A MOLECULAR PERSPECTIVE ON PACIFIC COASTAL WOLVES (*CANIS LUPUS LIGONI*)

Southeast Alaska is an isolated region of the Pacific Northwest that includes the Alexander Archipelago. High numbers of endemic mammals have been described from the region including a subspecies of gray wolf (*Canis lupus ligoni*). The fossil record, however, implies a recent colonization of this species into the region. Previous phylogeographic analyses of wolves elsewhere in North America indicated little geographic structure. We uncovered distinctive variation in the wolves of southeast Alaska using 11 microsatellite loci on 222 individuals from nine populations. A neighbor-joining tree based on Cavalli-Sforza distances indicated that wolves in southeast Alaska were distinctive from all others sampled (Interior Alaska, Kenai Peninsula, Copper River Delta, British Columbia, and Yukon Territories). This distinctive clade apparently reflects isolation in southeast Alaska followed by fragmentation within the Alexander Archipelago that has resulted in high levels of variation and geographic structure within the region that is comparable to that found across all other North American populations surveyed. The distinctive status of these wolves should be acknowledged in wolf harvest policies and habitat management in southeast Alaska.

C03-07 WEIR, LINDA, J. Andy Royle, Robin Jung, Priya Nanjappa, Lindsay Funk, Sara Faust, Sheera Schneider, Lori Erb, and Wayne Hildebrand. U.S. Geological Survey, Patuxent Wildlife Research Center, 12100 Beech Forest Road, Laurel, MD 20708, USA (linda_weir@usgs.gov) (LW, RJ, PN, LF, SF, SS, LE); U.S. Fish and Wildlife Service, Office of Migratory Bird Management, 11500 American Holly Drive, Laurel, MD 20708, USA (JAR); BioWhittaker, Inc., 8830 Biggs Ford Road, Walkersville, MD 21793, USA (WH).
ASSESSING SITE OCCUPANCY RATES, SPECIES DETECTABILITY AND ANURAN-HABITAT RELATIONSHIPS ALONG NORTH AMERICAN AMPHIBIAN MONITORING PROGRAM CALLING ROUTES IN MARYLAND

When modeling the occurrence of anurans from calling survey data, it is important to account for factors which influence detection and occurrence to avoid biased estimates. To examine these influences for the North American Amphibian Monitoring Program (NAAMP), we conducted nine surveys at each of the 17 NAAMP routes in Maryland. Multiple surveys allow one to disentangle sources of variation in detection probability from those of occurrence probability. We examined 9 environmental factors thought to influence species detection and used land cover and wetland data to characterize factors that may influence occurrence. We used step-wise model selection based on AIC to select models. For most species the best model contained a temperature effect. Other important factors included moon phase, cloud cover, rain, and wind speed. We found considerable variation among species in landscape factors which influence occurrence; "open water wetlands" and "forested wetlands" were important in predicting bullfrog and spring peeper occurrence, respectively. Most species showed a negative response to estuarine wetlands and developed and agricultural uplands. Models of detection/occurrence for each species can be used to evaluate sampling bias in NAAMP data, produce trend estimates adjusted for sampling bias, and to evaluate land management practices for improving anuran habitat.

C45-06 WEITZELL, ROY, Mary Khoury, Paula Gagnon, and Brian Schreurs. NatureServe, 1313 5th Street SE, Suite 314, Minneapolis, MN 55414, USA (roy_weitzell@natureserve.org) (RW); The Nature Conservancy, Freshwater Initiative, 8 South Michigan Avenue, Suite 2301, Chicago, IL 60603, USA (MK, PG); The Nature Conservancy, Midwestern Resource Office, 1313 5th Street SE, Suite 314, Minneapolis, MN 55414, USA (BS).
A COMPREHENSIVE ASSESSMENT OF FRESHWATER BIODIVERSITY IN THE UPPER MISSISSIPPI RIVER BASIN

NatureServe and The Nature Conservancy have developed a comprehensive assessment of freshwater biodiversity in the Upper Mississippi River Basin (UMRB). The goal was to identify all areas of biodiversity significance, and set priorities for the conservation of aquatic species, communities, and ecosystems across the entire basin. Building upon existing information, a standardized classification of aquatic ecosystems was completed, identifying approximately 160 aquatic system types across all size classes. Along with aquatic systems, nearly 200 imperiled or declining aquatic species were specifically addressed. The viability of species and system targets was assessed using spatial data for 10 factors known to have adverse effects on aquatic ecosystems. High quality occurrences of species and system targets, as well as areas known to harbor intact natural assemblages were designated as areas of biodiversity significance (ABS). From these ABS, additional criteria were applied to designate the highest priority areas for immediate conservation action. The presentation will include the results of the assessment, including methods used in the aquatic system classification and viability ranking, the selection and targeting of biological elements of diversity, and the criteria used in selection and prioritization of ABS.

C58-05 WENDT, KEITH M., and James Manolis. Minnesota Department of Natural Resources, 500 Lafayette Road, Box 10, St. Paul, MN 55155, USA (keith.wendt@dnr.state.mn.us).

OLD-GROWTH FOREST PROTECTION IN MINNESOTA: LESSONS FROM IMPLEMENTING A STATE AGENCY BIODIVERSITY POLICY

Historically, about half of Minnesota's forest base was old growth; today less than four percent remains. Public concern led the Minnesota Department of Natural Resources (MNDNR) to develop policy to define, inventory, evaluate and designate protected old growth on state lands. The policy addresses the fundamental question – how much and where to protect old-growth forests. In 1994, measurable targets for old-growth protection were established for 23 Minnesota ecoregions through a stakeholder roundtable involving forest industry and environmental groups. The decade-long history of policy implementation exposed the difficulties of an issue characterized by deeply held value conflicts between interest groups and disciplines; scientific uncertainty over the nature of old growth, and limited institutional resources. Following a statewide inventory, MNDNR implemented the policy by designating approximately 40,000 acres of old growth for protection in 2003. The next steps include establishment of corridors that link patches of old growth as a means to create connected landscapes of mature forest habitat. Lessons learned from policy implementation include the importance of: 1) stakeholder negotiation, 2) establishment of measurable targets, 3) a standardized and science-based old-growth evaluation method and an old growth database supported by all involved disciplines, and 4) coherent management authority with policy oversight.

C15-04 WESSELL, STEPHANIE, Deanna Olson, and Richard Schmitz. Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR 97331, USA (stephanie.wessell@orst.edu) (SW, RS); USDA Forest Service, Pacific Northwest Research Station, Corvallis, OR 97331, USA (DO).

PATCH RESERVES AS REFUGIA FOR LOW-MOBILITY SPECIES IN MANAGED FORESTS

Retaining undisturbed patches at the time of land management has emerged as an important alternative silvicultural method designed to conserve plant and animal diversity within managed forests. However, data supporting the value of patch reserves for species in intensively managed second-growth forests are few. This project evaluates the relative effectiveness of three sizes of patch reserves (0.1, 0.2, and 0.4 hectare) within a thinned forest matrix in providing refugia for low-mobility species one to five years following harvest. Specifically, we are examining differences in microhabitat and amphibian, mollusk, arthropod, and vascular plant abundance and diversity with respect to the size and placement of reserves in managed forests. By determining habitat correlates of species and functional group occurrence, we envision that this study will provide vital information regarding patch reserves in managed forest landscapes. Differences in amphibian and mollusk abundance, vascular plant diversity, and microclimate were associated with treatment (i.e. three patch reserve sizes, thinned matrix, and unharvested control). Results suggest that small patch reserves may provide short-term refugia for low-mobility, ecologically sensitive species in managed forests of the Pacific Northwest.

C43-05 WHEELER, BENJAMIN A. Northern Environmental Marine Organization, Box 1538, Iqaluit Nunavut, X0A 0H0, Canada (bwheeler@nv.sympatico.ca).

BOWHEAD WHALE (*BALAENA MYSTICETUS*) CONSERVATION CHALLENGES IN THE EASTERN CANADIAN ARCTIC

Modern management of endangered cetaceans attempts to promote population recovery through the reduction of human induced mortality, integration of population parameters (abundance, growth rate, carrying capacity) and protection of critical habitat. A review of both contemporary science and management of the endangered Baffin Bay bowhead whale suggests that such necessary measures may not be achievable under present political and budgetary conditions. The Baffin Bay bowhead group, one of only five global populations, is presently exposed to limited Aboriginal harvesting and exemplifies a population prone to extinction: it is small, relatively unknown, difficult to study, has low growth rates, large and remote distribution. Moreover, initial analyses of costly shore-based monitoring data collected from the only documented critical habitat, Isabella

Bay Baffin Island, fail to demonstrate statistically significant trends (1983 - 2002; mean = 49, stnd. dev. = 38.2, range: 2 - 147). With recent evidence of Arctic climate change and withdrawal of supporting conservation groups (which are frustrated by the lack of legal protection of critical bowhead habitat) scientists and managers alike must seek alternative methods to promote population recovery.

S10-03 WHIGHAM, DENNIS, and Mary Leck. Smithsonian Environmental Research Center, Box 28, Edgewater, MD 21037, USA (whighamd@si.edu) (DW); Rider University, 2083 Lawrenceville Road, Lawrenceville, NJ 08648, USA (ML).
PLANT SPECIES DIVERSITY IN TIDAL FRESHWATER AND TIDAL BRACKISH WETLANDS OF THE MID-ATLANTIC COAST

This presentation focuses on vegetation of tidal freshwater and brackish wetlands of the mid-Atlantic coast. The model we use to analyze and interpret habitat and species data has two elements: natural and human disturbances. In tidal freshwater wetlands, natural disturbances and dynamic hydrologic conditions maintain high levels of species diversity. Seed dispersal plays an important role in countering local extirpation. Studies of a created tidal freshwater wetland demonstrate rapid colonization in 5 yrs with 177 seed bank and 72 cover species, including rare species. Invasive species (e.g., *Phragmites australis*, *Lythrum salicaria*) have little impact on diversity in reference tidal freshwater wetlands. In contract, brackish wetlands have lower diversity and impacts of human activities in wetlands and on adjacent upland watersheds results in increased invasive species. Natural disturbance has little influence on species diversity in brackish wetlands, but the impacts of native (Muskrat) and non-native animals (Nutria) can be significant. The non-native Nutria, for example, has a negative impact on species diversity, converting habitats dominated by emergent species into open water. Although both types of wetlands are subject to various natural disturbances overlain by anthropogenic stresses, surrounding landscape uses appear to the have greatest impact on diversity in brackish wetlands.

C06-07 WHITE, MARK, George Host, David Benson, and Alan Sawyer. Natural Resources Research Institute, University of Minnesota Duluth, 5013 Miller Trunk Highway, Duluth, MN 55811, USA (mwhite@nrri.umn.edu) (MW, GH, DB); USDA OTIS Plant Protection Laboratory, Otis ANG, MA 02542, USA (AS).
EFFECTS OF TEMPERATURE AND TRAP DENSITY ON MALE GYPSY MOTH CAPTURE RATES AND FLIGHT PATTERNS

European gypsy moth in its larval form is a leaf-chewing insect that has caused significant damage to forested habitats in the eastern United States. Detection of gypsy moth populations is a key part of the strategy for both slowing the spread and for minimizing damage to forested ecosystems. At present, reproducing gypsy moth populations do not occur in northeastern Minnesota, however they are approaching from the east. Detection trap-capture methods using pheromone-baited traps were developed in climates with warmer temperatures and longer growing seasons. In order to test the utility of different pheromone based trap densities in the cooler climates of northeastern Minnesota we set up three $1mi^2$ plots in the Toimi Upland Subsection with trap densities of $36/mi^2$, $16/mi^2$ and $1/mi^2$. Two climate recorders were located in the center of each plot. Color-coded sterile male gypsy moth pupae were released on a weekly basis from July 11 to September 28. Traps were checked on a weekly basis to determine capture rates and flight distances. Pupal eclosure and capture rates varied with mean daily temperature. Capture rates were higher in the highest density plot. Results show that detection-trap capture data should be used with temperature data for accurate population prediction.

C47-04 WHITE, MICHAEL, and Keith Greer. Conservation Biology Institute, 651 Cornish Drive, Encinitas, CA 92024, USA (mdwhite@consbio.org) (MW); City of San Diego, Multiple Species Conservation Program, 202 C Street, MS 5a, San Diego, CA 92101, USA (KG).
THE EFFECTS AND CONSERVATION IMPLICATIONS OF WATERSHED URBANIZATION IN A SOUTHERN CALIFORNIA STREAM SYSTEM

We investigated the effects of watershed urbanization on the stream flow characteristics and riparian vegetation community of Los Penasquitos Creek in coastal southern California. We utilized stream gage records to assess stream flow changes and historic aerial photographs to measure land use and riparian vegetation changes in the watershed. During the period 1966-2000, the area of urban land uses in the Los Penasquitos Creek watershed increased from 9 to 37 percent. Over the same time period, median and minimum daily discharges, total annual and dry-season runoff, flood magnitudes, and flood durations in Los Penasquitos Creek significantly increased. Accompanying the changes in stream flow characteristics were altered channel geomorphology, a doubling of the area of riparian vegetation along the creek, and a shift in the distribution and composition of the riparian vegetation community. The increased area of impervious surfaces and imported municipal water supplies associated with urbanization appear to have driven changes in the historic riparian vegetation community by altering stream flow characteristics and channel geomorphology. Thus, conserved riparian habitats in urban landscapes may not be representative of historic community composition, and the regional geographic variability of these communities is diminishing with continued urbanization.

C26-08 WHITMAN, ANDREW, John Hagan, and Christina Lavertu. Manomet Center for Conservation Sciences, 14 Maine Street, Suite 404, Brunswick, ME 04011, USA (awhitman@prexar.com).
AN EVALUATION OF BIODIVERSITY INDICATORS FOR SUSTAINABILITY FORESTRY

We conducted a literature survey and a survey of forest researchers and forest resource decision makers to evaluate biodiversity indicators of sustainable forestry. We identified 763 indicators from the literature and another 150 indicators from a national survey of forest researchers (125 replies). Indicators were scored based on 41 selection criteria. Selection criteria addressed relevance to forest management, practicality of measurement, scientific merit, ecological breadth, and utility to decision makers. A national survey of researchers was used to identify the scientific importance of 41 selection criteria, the status of indicator research, scientific merits of different indicators, and communication strategies of researchers. A national survey of decision makers was used to identify the use-levels of indicators, barriers to their use, their utility, and information needs of decision makers. The perspectives of researchers and decision makers regarding biodiversity indicators were significantly disparate. The greatest barrier to the effective use of indicators may be the lack of societal participation and lack of standards that provide the societal and scientific legitimacy necessary for the widespread adoption and acceptance of indicators. Other barriers include ineffective information delivery and the lack of indicators that have established relationships with specific ecosystem stressors.

C04-05 WIEGMANN, SHANNON, Tom Rooney, Dave Rogers, and Don Waller. Department of Botany, University of Wisconsin–Madison, 430 Lincoln Drive, Madison, WI 53706 USA (smwiegmann@wisc.edu).
HISTORICAL CHANGES IN NORTHWOODS UNDERSTORY COMMUNITIES: THE EFFECTS OF EXOTIC EARTHWORM INVASION AND OVERBROWSING ON THE ABUNDANCE OF NATIVE LILIES AND EXOTIC PLANTS

In recent decades, the invasion of European earthworms in northern forest communities has dramatically increased due to the widespread use of bait for recreational fishing. With few exceptions, the impacts of these invasions on plant communities remain largely undocumented. In addition to European earthworm invasions, populations of white-tailed deer (*Odocoileus virginianus*) have also surged in the region. Both of these changes have corresponding implications for understory native diversity and composition. In order to assess the impacts of these keystone species on northwoods understory communities, we re-surveyed 51 northern upland forest understories that had been quantitatively surveyed between the years of 1948 and 1950 (Curtis 1959). In addition to the understory survey, we collected data on local deer browse levels and earthworm density at each site. Paired t-tests between the two surveys indicate a significant increase in the relative abundance of exotic plants and a significant decrease in the relative abundance of native lilies. Multivariate analyses suggest that an interaction between deer browse and worm density is an important mechanism behind these changes in relative abundance. Sites with both high browse and high worm density showed the greatest declines in lilies and the greatest increases in exotic plants.

C34-01 WILCOVE, DAVID S. Princeton University, Robertson Hall, Princeton, NJ 08544, USA (dwilcove@princeton.edu).
HOW MANY ENDANGERED SPECIES ARE THERE IN THE UNITED STATES?

The number of imperiled plants and animals that make it onto the federal endangered species list is only a fraction of the actual number of species deserving protection. Using data published by NatureServe and The Nature Conservancy, I can make a tentative estimate of the total number of endangered species in the USA. The number of endangered vertebrates and vascular plants is known with reasonable accuracy. The number of endangered invertebrates can be estimated by extrapolating from a few reasonably well-studied groups, accounting for the difference in vulnerability between fresh-water and terrestrial invertebrates. Fungi remain a black hole, with very few data on species richness or endangerment, with the posssible exception of the Pacific Northwest region. Using these and other data, I estimate that 15,000-20,000 of the 200,000+ species described to date in the USA may be at risk of extinction. This is more than an order of magnitude greater than the number of species currently on the federal endangered species list. Moreover, since many, perhaps most, species in the USA remain as yet undescribed, the true number of imperiled species may be much greater.

C16-02 WILDER, ROBERT. The Nature Conservancy, University of California, Santa Cruz, 100 Shaffer Road, Santa Cruz, CA 95060, USA (rwilder@tnc.org).
MARINE CONSERVATION THROUGH COMMUNITY-BASED RESTORATION: THE EXPERIENCE OF THE NATURE CONSERVANCY

The Nature Conservancy's work in coastal and ocean restoration utilizes tangible and science-oriented practical conservation, and it is accomplished to a significant extent through local field sites. This new Community-Based Restoration Program (CRP, a partnership with NOAA) is now producing innovative environmental action and results. The effort is also part of the new Marine Initiative at TNC, that elevates the coastal and ocean sphere to one of five cross-cutting global priority areas. Case studies of CRP work include 15 sites such as a new North Carolina Oyster Reef, Delaware Horseshoe Crab beach site where coarse aggregate is added to a formerly replenished beach, a New York Hard Clam Spawner Sanctuary, and Florida Keys Diadema Restoration which

reproduces reef sea urchin grazers Diadema on the hypothesis that restoring urchins can address algal growth that's smothering reefs in the area by reintroducing balance. Notably and looking ahead, practical lessons in marine conservation learned in diverse CRP sites may be applied to leverage greater results at locations across the U.S. and globally.

P070 WILLIAMS, LORI A., Carola A. Haas, and Patrick D. Keyser. Department of Fisheries and Wildlife Sciences, Virginia Tech, 100 Cheatham Hall, Blacksburg, VA 24061-0321, USA (lowilli4@vt.edu) (LAW, CAH); MeadWestvaco Corporation, Forestry Division, PO Box 577, Rupert, WV 25984, USA (PDK).
AMPHIBIAN SPECIES RICHNESS, RELATIVE ABUNDANCE, AND HABITAT USE IN A CENTRAL APPALACHIAN INDUSTRIAL FOREST

In 2002 our goal was to provide a second year of baseline data for the amphibian component of a long-term landscape ecology project on industrial forest in WV. This ongoing project was designed to monitor the effects of large-scale silviculture on biodiversity and ecosystem health by manipulating the distribution of forest age-classes within a landscape through replicated experiments. The current study will identify habitat features related to amphibian diversity, abundance, and distribution. In 2002 one objective was to examine relationships between terrestrial amphibian relative abundance and habitat characteristics across the landscape. To meet this objective, we turned over cover objects on 219 quadrats (10 m^2) and collected data on 11 habitat features. We identified 4 anuran species and 10 salamander species ($n = 552$). We used stepwise multiple linear regression and transformed capture data (sq-rt + 0.05) to examine relationships between habitat and amphibian abundance. Five habitat characteristics were significant at the 0.10 level in a model to predict abundance: % rock cover, % woody stem cover (< 7.5 cm DBH), soil pH, % canopy cover, and riparian vs. nonriparian classification ($R^2 = 0.3667$, $p < 0.0001$, $n = 209$).

C45-02 WILLIAMS, MARY A., and Bruce Vondracek. Conservation Biology Graduate Program and Minnesota Cooperative Fish and Wildlife Research Unit, University of Minnesota, 200 Hodson Hall, 1980 Folwell Avenue, St. Paul, MN 55108, USA (maw@fw.umn.edu).
GROUND WATER MODELING IN KARST TERRAIN: HYDROLOGICAL FLOW IN SOUTHEAST MINNESOTA

Karst terrain is characterized by an unpredictable maze of underground conduits where ground water can travel between watersheds. In southeast Minnesota, conservation and proper management of these karst terrain watersheds is critical for not only maintaining quality ground water for human consumption, but also for maintaining quality ground water flow to support and sustain viable coldwater aquatic populations. The quality of these streams is dependent on ground water to provide base flow and moderate water temperatures. To develop a better understanding of ground water flow through this karst terrain, the Soil and Water Assessment Tool (SWAT) was evaluated and parameter sensitivites were measured while modeling daily and monthly streamflows in a small watershed over a three-year period. Streamflow data from 1995 and 1996 were used to calibrate the model, and data from 1997 through 1998 were used to validate the model. Preliminary model runs adequately predict most daily and monthly streamflows. However, some peak flow values and recession rates seem poorly predicted. Parameters evaluated for sensitivity analysis included drainage area, slope length, channel length, channel width, saturated hydraulic conductivity and available water capacity. Minimization of absolute deviation between observed and simulated streamflows identified optimum values/ranges for each parameter.

S09-04 WILLIAMS, NEAL M. Department of Ecology and Evolutionary Biology, Princeton University, Princeton, NJ 08544, USA (nealw@princeton.edu).
PATCH-MATRIX MOVEMENT OF POLLINATORS DETERMINES CONNECTIVITY AT DIFFERENT LEVELS

Within mosaic landscapes, pollinator movements link natural habitat patches and the human-dominated matrix on at least two levels. First, in some systems the matrix represents habitat of variable quality that provides food, nesting, or other resources, as well as sources of mortality not found in natural habitat. The quality of matrix patches will likely affect permeability, rate and frequency of movement among patches of natural habitat and between habitat and matrix. Such movements contribute to persistence of pollinators within remnant natural habitats and the landscape as a whole. Second, pollinator foraging movements serve a functional role by determining mating patterns for animal-pollinated plants within and among patches. This second level of movement influences gene flow, effective population size and reproductive success of the affected plants. Published data on gene flow in fragmented plant populations support both positive and negative effects of isolation. Likewise fragmentation appears to affect pollinator taxa differently. I review existing studies of gene flow, pollinator movement and pollinator communities in fragmented landscapes and ask (1) whether patterns of movement for pollinators and plants are influenced by the type and quality of the intervening matrix and the focal habitat, and (2) whether gene flow in plant populations depends on the type of pollinators involved. I use the results to identify generalities that may help inform conservation planning and suggest directions for further investigation.

C58-03 WILLIS, KEVIN, and Robert J. Wiese. Minnesota Zoological Garden, 13000 Zoo Boulevard, Apple Valley, MN 55124, USA (KWillis@mail.mnzoo.state.mn.us) (KW); Fort Worth Zoo, 1989 Colonial Parkway, Fort Worth, TX 76110, USA (RJW).
HOW TO LIE WITH DEMOGRAPHY

Estimates of longevity and life expectancy are often used in the popular press to summarize the general health of peoples in different nations or how well a species is being cared for in zoos and aquariums. The concepts of longevity and life expectancy are fairly easy to understand: the longest lived individual and how long individuals live on average, respectively. What is less well understood is that there are many different methods of estimating life expectancy, and that the different methods can give widely different estimates. When selecting a method for estimating life expectancy, it is critical to ensure the method used is appropriate for the data available as well as for the life history of the species. Although there is seldom only one correct method of summarizing demographic information, it is often possible to demonstrate methods that are clearly incorrect or give unrealistic results. Examples of misuse of demographic data to advocate a policy change are presented. Studbook data for elephants and bottlenosed dolphin are used to demonstrate how much variation there can be in estimates of life expenctancy based on the method used to calculate it.

C04-02 WILMERS, CHRISTOPHER, Douglas Smith, Robert Crabtree, and Wayne Getz. Department of Environmental Science, Policy and Management, University of California, Berkeley, 201 Wellman Hall #3112, Berkeley, CA 94720, USA (cwilmers@nature.berkeley.edu) (CW, WG); Yellowstone Center for Resources, Wolf Project, PO Box 168, Yellowstone National Park, WY 82910, USA (DS); Yellowstone Ecological Research Center, 7500 Jarmen Circle, Suite 2, Bozeman, MT 59715, USA (RC).
REINTRODUCED GRAY WOLVES SUBSIDIZE SCAVENGERS IN YELLOWSTONE NATIONAL PARK

The reintroduction of gray wolves (*Canis lupus*) into Yellowstone National Park provides a natural experiment from which to study the effect of keystone predators on ecosystems. Gray wolves often only partially consume their prey, thus providing a resource subsidy to scavengers. We investigate the conditions under which partial consumption occurs and estimate flows of carrion biomass from wolf kills to the scavenger community. Wolves were tracked using radio telemetry until a kill was made. Once located, we sampled feeding activity until the carcass was fully consumed. Species-specific biomass removal was estimated weighting the number of minutes spent feeding by previously measured consumption rates. Factors affecting partial consumption by wolves were wolf pack size, prey size, winter severity and distance to road. We show that by transferring the availability of carrion from the highly productive late winter period, to the less productive early winter and from highly productive years to less productive ones, wolves provide a temporal subsidy to scavengers. In addition coyotes, grizzly bears, golden eagles, bald eagles, ravens and magpies were the principal beneficiaries of wolf-provided carrion.

C04-09 WILSEY, BRIAN, and Gray Stirling. Department of Botany, Iowa State University, 353 Bessey Hall, Ames, IA 50011, USA (bwilsey@iastate.edu) (BW); Department of Biology, McGill University, Montreal, PQ H3A 1B1, Canada (GS).
QUANTIFYING SPECIES DIVERSITY: DIFFERENT RESPONSES OF RICHNESS AND EVENNESS COMPONENTS TO CHANGES IN PLANT DENSITY SUGGEST THAT SPECIES RICHNESS ALONE IS A POOR INDEX OF DIVERSITY

Diversity has two basic components: richness, or number of species in a given area, and evenness, or how well distributed abundance is among species. In a literature review, we found that richness and evenness were positively correlated in animal communities, and that using richness alone as a diversity index accounted for 75-82% of the variation in overall diversity (H'). However, in plant communities, evenness and richness were negatively related and evenness accounted for more variation in H' (53%) than did richness (6%). We therefore seeded 60 prairie mesocosms with 22 grass and forb species under 3 densities to determine if increased competition intensity would lead to negative relationships between richness and evenness in developing communities. Diversity components responded differently to densities: evenness declined with densities on every sampling date, whereas richness increased with density early in the experiment, and was unrelated later on. This suggests that richness is measuring effects of immigration and local extinction and is a poor measure of species interactions, unlike evenness, which measures rarity and abundance. Because diversity depends on both migration and species interactions, we suggest that diversity is best estimated with a proportional index (e.g. 1/D or H') that includes both richness and evenness.

P111 WILSON, RACHEL, Linda Smith, Laura Thompson, Kristen Boccumini, Chris Kisiel, and Dave Jenkins. Bryn Mawr College, Bryn Mawr, PA 19010, USA (linda.smith@stockton.edu) (RW); The Richard Stockton College of New Jersey, Pomona, NJ 08240, USA (LS, KB); Valparaiso University, Valparaiso, IN 46383-6493, USA (LT); New Jersey Division of Fish and Wildlife, Endangered and Non-Game Species Program, PO Box 400, Trenton, NJ 08625, USA (CK, DJ).
THE EFFECTS OF HUMAN DISTURBANCE ON PIPING PLOVERS FORAGING ON NEW JERSEY BEACHES

The recovery of endangered species is difficult when foraging and breeding habitats occur in areas of human recreation. On New Jersey barriers islands, the intensity of human recreation varies from that of only pedestrians in use restricted areas to high density sun-bathing in others. Piping plovers nest and forage on beaches with these varying levels of human intensity, and quantitative data on how the birds are affected by humans is critical to the implementation of the NJ recovery plan for this bird. We examined how the density of humans affects the foraging behavior of piping plovers during the breeding period. We compared foraging of the birds on four beaches and found that foraging intensity increases with human density. Prior studies have relied on a percent foraging time to show the effects of human disturbance. Instead, we used a unique observational technique for measuring the intensity of foraging behavior and found that the intensity of foraging actually increases with increased human density and recreation. We suggest that increased foraging intensity may indicate stress and that our technique is an effective way to measure the effects of human disturbance on endangered species.

P057 WINDELS, STEVE, and David Flaspohler. School of Forest Resources and Environmental Sciences, Michigan Technological University, 1400 Townsend Drive, Houghton, MI 49931, USA (skwindel@mtu.edu).
THE DECLINE OF CANADA YEW IN THE UPPER GREAT LAKES: CAUSAL MECHANISMS AND IMPLICATIONS FOR SMALL UNDERSTORY VERTEBRATES

Canada yew (*Taxus Canadensis* Marsh.) is an evergreen shrub native to the mixed conifer-hardwood forests of northeastern North America, and was likely a major ground cover component in some presettlement forests of this region. Canada yew has been extirpated from most of its range in the U.S. as a result heavy forest disturbance and subsequent eruptions in white-tailed deer (*Odocoileus virginianus*) populations. We present a summary of research findings to date investigating: 1) deer browsing patterns on Canada yew at multiple spatial scales, and 2) potential trophic impacts related to the dramatic reduction in the importance of Canada yew within some Upper Great Lakes forests. Intensity of deer browsing on yew was negatively related to yew stem density at the forest stand level. At small spatial scales, deer browsing is concentrated on the edges of yew patches, such that large patches of yew often harbor refugia of unbrowsed stems in their interior. Preliminary analyses of vertebrate data suggests that individual species of small mammals and understory songbirds are not dependent on abundance of Canada yew in forest understories but that species richness and diversity increases as Canada yew increases in density and height. Canada yew is a unique feature of Great Lakes forests and restoration efforts are needed to prevent its extirpation from the region.

P137 WINSLOW, DONALD E. Department of Biology, Indiana University, 1001 East 3rd Street, Bloomington, IN 47405, USA (dwinslow@indiana.edu).
AN EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF LOGGING ON SUCCESS OF ACADIAN FLYCATCHER (*EMPIDONAX VIRESCENS*) NESTS IN YELLOWWOOD STATE FOREST, INDIANA

Logging generates edges and may reduce nest success, but few studies have measured success before and after timber extraction. I conducted an experiment to evaluate the effects of logging on survival and brood parasitism of Acadian Flycatcher (*Empidonax virescens*) nests in Yellowwood State Forest, Indiana. Four tracts were selectively logged between two monitored breeding seasons. Four tracts were controls. In 1995, predation was higher for nests initiated during peak nesting than for later nests. Nest survival at control sites increased from 1995 to 1996, but was similar at treatment sites before and after logging. Cowbird parasitism at control sites decreased from 1995 to 1996, but was similar at treatment sites before and after logging. If factors responsible for between-year variation operate similarly at all sites, these results suggest logging decreases nest success. Alternatively, site-specific processes at control tracts may have caused higher success in 1996. Forest managers should limit logging where productivity of late-successional birds is a priority until we better understand factors influencing variation in success. Longer-term studies before and after logging are necessary to understand how logging affects success. It is especially important to investigate how management practices affect species restricted to regenerating forest.

C16-03 WINSTON, JEFFREY, George Teachman, and Mark Zimmerman. U.S. Army Environmental Center, 5179 Hoadley Road, Aberdeen Proving Grounds, MD 21010-5401, USA (jeffrey.winston@aec.apgea.army.mil).
RAPID ASSESSMENT SCREENING OF U.S. ARMY CONSERVATION ASSETS AND LIABILITIES

Removing unexploded ordnance (UXO) and munitions constituents using today's technology frequently involves extensive site disturbance and habitat destruction that may threaten or destroy irreplaceable natural and cultural resources. The Rapid Assessment Screening of Conservation Assets and Liabilities (RASCAL) GIS-based model was developed to assist U.S. Army decision-makers with a tool to prioritize installation cleanup of UXO by identifying the potential impacts on natural and cultural resources. RASCAL ranks sites based on the occurrence and extent of threatened and endangered species (TES); migratory birds; wetlands; wild and scenic rivers; coastal zone management areas; EPA priority 1 watersheds; permeable and highly erodible soils; and cultural sites protected under the National Historic Preservation Act and Native American Grave Protection and Repatriation Act. We applied RASCAL to thirty-two active Army installations to assess the model's behavior and utility over a

wide range of site characteristics. RASCAL scores were most sensitive to variation in TES and cultural resources. The results provide a baseline for the U.S. Army leadership to make decisions on the value of ecological and cultural assets lost versus the liability of no action or the value gained by cleaning up.

C53-07 WIRES, LINDA R., and Francesca J. Cuthbert. Department of Fish, Wildlife and Conservation Biology, University of Minnesota, St. Paul, MN 55108, USA (wires001@tc.umn.edu).
MANAGEMENT AND CONSERVATION OF THE DOUBLE-CRESTED CORMORANT IN NORTH AMERICA: INSIGHTS FROM HISTORICAL RECORDS

In North America, the Double-crested Cormorant is widely distributed across five broad geographic regions. We reviewed historic and current breeding and wintering records to determine historic distribution (pre-1900), current distribution (1970-1999), and the extent of range expansion across North America. Early records suggest Double-crested Cormorants were present in large numbers throughout much of their current range, but numbers sharply declined through the late 1800s, causing extirpation in some areas. The population gradually increased through at least the mid-1900s, and again sharply declined in the 1960s-1970s. In the late 1970s, cormorant numbers began to rebound across much of the continent; the largest breeding populations (Canadian / U.S. interior, Atlantic Coast > 80% of total) went from approximately 32,000 pairs in the early 1970s to > 226,000 pairs in the late 1990s. Currently many people perceive the species as overabundant and policy makers are pressured to significantly reduce numbers. Comparison of historic and current records suggests that perception of cormorants as "overabundant" rests on socio-political rather than biological or ecological factors. Limits of human tolerance, "social carrying capacity," are narrower than those of biological carrying capacity; thus, management based on this paradigm may be opposed to conservation goals.

C27-07 WITTEMYER, GEORGE, Iain Douglas-Hamilton, and Wayne Getz. Department of Environmental Science, Policy and Management, University of California, Berkeley, 201 Wellman Hall, Berkeley, CA 94720, USA (GW, WG); Save the Elephants, PO Box 54667, Nairobi, Kenya (GW, IDH).
THE INTERACTION BETWEEN SOCIAL BEHAVIOR AND RANGE USE BY THE AFRICAN ELEPHANT

The Samburu District holds the largest free ranging population of elephants remaining primarily outside protected areas in Kenya. Land use in the region varies from group ranches, privately owned ranches, recently demarcated community conservation areas, three small national reserves, and uninhabited government holdings. We deployed Global Positioning System (GPS) radio collars on elephants using the national reserves in order to determine the spatial requirements of the population. We present information on elephant range use and movements in relation to the population social hierarchy. This information will assist the understanding of elephant spatial requirements, which is essential for their conservation and the management of the ecosystems they inhabit.

C59-03 WOLD, ANDREW P., George Host, and Larry Schwartzkopf. Fond du Lac Tribal and Community College, 2101 14th Street, Cloquet, MN 55720, USA (awold@ezigaa.fdl.cc.mn.us) (AW); Natural Resources Research Institute, University of Minnesota Duluth, 5013 Miller Trunk Highway, Duluth, MN 55811, USA (GH); Fond du Lac Natural Resources Program, 1720 Big Lake Road, Cloquet, MN 55720, USA (LS).
RESTORATION OF A WILD RICE LAKE ECOSYSTEM

Native wetland plant communities have long been important to the indigenous peoples of the Great Lakes Region. Plant communities that include wild rice (*Zizania palustris*) have been especially significant to the cultural and spiritual heritage of the Ojibwe or Annishinaabeg of the Lake Superior area. Invasive species have been reducing the aerial coverage and production of native wild rice stands in Perch Lake (Carlton County) Minnesota. The Fond du Lac Natural Resources Program has been using mechanical methods to remove pickerel weed (*Pontederia cordata*) in an effort to increase the presence of wild rice in this system. Vegetation and sediment samples are collected by canoe at fixed points before and after mechanical treatment. Changes in sediment characteristics and chemical parameters are determined and related to changes in vegetation community structure. Floristic survey results show that the community is dominated by pondweeds (*Potamogeton sp.*) and pickerel weed. Yellow water lily (*Nuphar variegate*) and wild rice are also present. Wild rice is not regenerating in mechanically manipulated areas as rapidly as hypothesized, presumably due to reduced seed stock in areas previously dominated by pickerel weed.

C38-09 WOLFE, KRISTEN, Harriet Mills, Mark Garkaklis, and Roberta Bencini. School of Animal Biology, Faculty of Natural and Agricultural Sciences, University of Western Australia, 35 Stirling Highway, Crawley, WA 6009, Australia (kwolfe@agric.uwa.edu.au) (KW, HM, RB); School of Biological Sciences and Biotechnology, Murdoch University, Murdoch, WA 6150, Australia (MG).
IS THERE LIFE AFTER SEX? INCREASED SOIL NUTRIENTS BY BREEDING SEABIRDS AFFECT MALE DIE-OFF IN A CARNIVOROUS MARSUPIAL

Large numbers of breeding seabirds may be affecting the post-mating survival, or "male die-off", of the dibbler (*Parantechinus apicalis*), a small, endangered carnivorous marsupial, which is now restricted to a few small isolated populations in Western Australia. Male die-off in dibblers only occurs in some years in some populations, and there are marked differences in die-off between two adjacent island populations. One island, Whitlock, where male die-off has never been reported, supports large numbers of breeding seabirds. The other island, Boullanger, where male die-off has occurred in some years, supports a low density of seabirds. Sea-derived nutrients, transported onto islands by seabirds significantly increase the concentration of nutrients in the soil and vegetation, which can ultimately increase the abundance of primary consumers and predators, such as the dibbler. Regular trapping of dibblers was conducted over five years to compare population density, body condition and survival of male dibblers between the islands. Concentrations of soil nutrients were also compared and were up to 18 times higher on Whitlock Island. The body condition and survival of males were also greater on Whitlock Island, suggesting that its large numbers of seabirds indirectly increase food resources and the chances of male dibblers surviving the breeding season.

P138 WONG, CARISSA. Nicholas School of the Environment and Earth Sciences, Duke University, Box 90328, Durham, NC 27708, USA (carissa.wong@utoronto.ca).
SPECIES REGENERATION RESPONSE TO CLEARING SIZE: A *SWIETENIA MACROPHYLLA* KING HARVESTED FOREST IN NORTHERN BELIZE

Swietenia macrophylla King (big-leafed mahogany) is cited as a catalytic species in the destruction of American forests. Its regeneration requires the catastrophic forest disturbance associated with hurricanes, fire, and flood, and its management may be incompatible with the preservation of overall biodiversity, or alternative economically valuable timber species. This study investigates the impact of clearing size on natural tree species regeneration in the Belizean subtropical moist forest of the Rio Bravo Conservation and Management Area. Using height-frequency distributions, I classified 32 out of 68 identified species according to light tolerance with a literature and expert verified accuracy of 91%. Analysis of Variance (ANOVA) of relative height and percent density for shade tolerant and intolerant trees does not show significant trends with increasing patchcut size. A Shannon-Wiener index of diversity varies significantly ($p = 0.047$) between only the intermediate 1000 and 2500 m^2 patch sizes. Insufficient variation in light levels between the patchcuts is a likely explanation for the lack of significant species performance and diversity responses to variations in gap size.

C10-08 WOODFORD, JAMES E., Glen Barry, and Jill Rosenberg. Wisconsin Department of Natural Resources, 107 Sutliff Avenue, Rhinelander, WI 54501, USA (james.woodford@dnr.state.wi.us) (JW); Department of Biology, University of Wisconsin–Madison, 430 Lincoln Drive, Madison, WI 53706, USA (GB); Wisconsin Department of Natural Resources, 101 South Webster Street, Madison, WI 53707, USA (JR).
CREATING AN AUTOMATED INVENTORY OF ECOLOGICAL DATA TO SUPPORT SMART DECISION MAKING

The Wisconsin Department of Natural Resources has developed a web-based application designed to inventory and provide access to biological data. The goal is to create a public and private partnership that promotes the inventory, gathering, and dissemination of data for decision-making efforts in Wisconsin, USA. To date, more than 300 data sources have been added to the inventory. Sources include tabular and spatial databases, web pages, reports, images, and summary documents. In addition to inventory efforts, the project provides grants to state and local governments, non-government organizations, private researchers, and University staff to aid in the collection of new or modernization of existing ecological databases. These partnerships have supported efforts to develop a statewide Herbaria database and methods for forest inventories, modernize multiple invertebrate databases, and complete bird, amphibian and reptile atlas projects. Other project activities include the development and dissemination of Geographical Information Systems (GIS) databases through a web-based mapping application, a complete assessment of current data collection activities and existing data gaps, and development and implementation of Department-wide biological and locational data standards. New conservation initiatives include development of Internet products to aid staff in land-use planning activities, small mammal inventories, and management of Northern Goshawk (*Accipiter gentilis*) nesting territories.

C04-01 WOODS, KERRY D. Natural Sciences, Bennington College, Bennington, VT 05201, USA (kwoods@bennington.edu).
DISTINCTIVE EFFECTS OF AN INTERMEDIATE DISTURBANCE IN OLD-GROWTH NORTHERN HARDWOOD FOREST

Research on natural disturbance in old-growth, mesic, temperate forests has focused on frequent, small gaps and catastrophic, stand-initiating wind-throw. Intermediate disturbances have been little-studied; they are rare and long-term 'signatures' are not as easily recognized as those of catastrophic blow-downs. In July 2002 an intense thunderstorm (windspeeds > 160 km/hr) caused 10-30% canopy mortality in the Dukes Research Natural Area, an old-growth hemlock-northern hardwood stand in northern Michigan. Data from permanent plots and mapped areas permit comparison of storm mortality with 'baseline' mortality over the previous decade to assess differences in spatial pattern of mortality, species and size effects on mortality, and mortality patterns with respect to site conditions.

C17-02 WOODWORTH, BETHANY L., Carter T. Atkinson, Dennis A. LaPointe, Patrick J. Hart, Erik J. Tweed, Carlene Henneman, Caleb Spiegel, Tami Denette, Jaymi LeBrun, Kelly L. Kozar, Dennis Triglia, Dan Lease, Aaron Gregor, Tom Smith, Michael Samuel, and David Duffy. U.S. Geological Survey, Biological Resources Division, Pacific Island Ecosystems Research Center, Kilauea Field Station, PO Box 44, Hawaii National Park, HI 96718, USA (Bethany_Woodworth@usgs.gov) (BLW, CTA, DAL, PJH, EJT, CH, CS, TD, JL, KLK, DT, DL, AG, TS); U.S. Geological Survey, National Wildlife Health Center, 6006 Schroeder Road, Madison, WI 53711, USA (MS); Pacific Cooperative Studies Unit (PCSU), University of Hawaii at Manoa, 3190 Maile Way, St. John 410, Honolulu, HI 96822-2279, USA (DD).
INTRODUCED PATHOGENS AND RECOVERING BIRD POPULATIONS IN HAWAII

The introduction of mosquito-borne avian malaria (*Plasmodium relictum*) and pox (*Poxvirus avium*) to Hawaii are known to have had severe detrimental impacts on the native avifauna, leading to restriction of most native birds to high elevation refugia where mosquitos are rare. Recent emergent phenomena, such as recolonization of low-elevation habitats by some native bird populations, indicate that this system is still evolving. Our studies show that native Hawaii Amakihi (*Hemignathus virens*) are resident and breeding in low-elevation forests in densities approximately 2-3 times those found at high (disease-free) elevations. Amakihi persist despite malaria prevalence rates of 60-90%, with a single host infected with up to 9 variants of *P. relictum*. Malaria-infected mosquitoes, *Culex quinquefasciatus*, occur at all three low-elevation sites, demonstrating local disease tramission. The genetic, epidemiological, immunological, and demographic basis for persistence of these populations is the subject of ongoing research. Understanding the mechanisms by which low-elevation native bird populations persist may hold the key to long-term preservation of the Hawaiian avifauna.

C23-02 WORLAND, MICHAEL, Francesca Cuthbert, and John Probst. Conservation Biology Graduate Program, University of Minnesota, 180 McNeal Hall, 1985 Buford Avenue, Minneapolis, MN 55108, USA (m_worland@hotmail.com) (MW, FC); USDA Forest Service, North Central Research Station, Forestry Sciences Lab, 5985 Highway K, Rhinelander, WI 54501, USA (JP).
DETERMINING BIRD DISTRIBUTIONS IN RIPARIAN FORESTS: EXISTING INFORMATION VERSUS FURTHER MONITORING

Planning for conservation of bird habitats across broad geographic areas requires knowledge of general distribution patterns of species and their habitat. Land managers often attain this knowledge from previous surveys and literature. Our objective is to test if this information is sufficient for predicting habitat associations of 21 species of priority songbirds in St. Croix River riparian forests of Minnesota and Wisconsin. Using an extensive review of the literature, we predicted how each species' density would vary among 7 different vegetation communities and 3 types of ecotones. We compared these predictions to data from transect surveys conducted over two breeding seasons in St. Croix riparian forests. Bird-habitat associations from the literature predicted survey results with reasonable accuracy for 8 species, while inconsistencies were evident in at least two vegetation communities or ecotones for 13 species. The literature often failed to emphasize the more subtle, natural ecotones that our surveys showed were important for understanding distribution patterns of forest birds in riparian ecosystems. Moreover, marshes and shrub swamps – habitats difficult to survey – were often neglected in the literature. Inconsistencies between literature and surveys show that effective conservation planning in dynamic riparian ecosystems requires comprehensive surveys followed by an adaptive monitoring strategy.

C38-05 WRIGHT, SAMUEL, Cynthia Lane, Matthew Fidelibus, and Jack Fisher. Fairchild Tropical Garden, 11935 Old Cutler Road, Miami, FL 33156, USA (swright@fairchildgarden.org) (SW, CL, MF, JF); Department of Viticulture and Enology, University of California, Davis, 9240 South Riverbend Avenue, Parlier, CA 93648, USA (MF); Ecological Strategies, PO Box 3, Maiden Rock, WI 54750, USA (CL).
REINTRODUCTION OF THE SOUTH FLORIDA ENDANGERED COASTAL VINE *JACQUEMONTIA RECLINATA* IN RELATION TO SALINITY, DISTANCE AND SHADE GRADIENTS

Habitat fragmentation, plant competition, and effects of large-scale natural disturbances (e.g. hurricanes) have threatened South Florida's native flora. The federally endangered beach clustervine (*Jacquemontia reclinata*) has fewer than 700 individuals

remaining. In order to establish a self-sustaining population, reintroduction is essential to recovery. To test plant survival and growth in relation to salt spray conductivity and distance from the ocean, 90 juvenile plants were outplanted at a coastal dune/strand habitat. Distance and location, significantly correlated with salt conductivity, significantly influenced survival and growth rate. Monitoring for one year showed a mean 72% survival rate. In a greenhouse experiment, we tested seedling response to various light intensities. After 6 weeks, dry weights of roots and stems showed that light levels did not affect stem growth. However roots from plants grown in full sun were shown to have 40-70% higher root mass than those grown in the shade, a condition that could favor survival in the wild. These studies provided recommendations for future reintroductions.

C42-01 Yaffee, Steven, **ELIZABETH MCCANCE,** and Sheila Schueller. School of Natural Resources and Environment, University of Michigan, 430 East University, Ann Arbor, MI 48109-1115, USA (yaffee@umich.edu).
HOW ARE WE DOING? THE CHALLENGES OF MEASURING SUCCESS IN ECOSYSTEM MANAGEMENT

As more organizations adopt an ecosystem management approach, there is an increasing need to evaluate their success. Evaluation can enhance understanding, effectiveness, and accountability. But ironically, programs rarely engage in systematic evaluation. To better understand this dilemma, we developed case studies of five collaborative ecosystem initiatives in the Midwest to understand their approaches and attitudes toward monitoring and assessing on-the-ground progress. This paper presents conclusions about the difficulty of carrying out effective evaluation programs and the types of responses needed to improve the situation. Challenges include a lack of clear, agreed-upon goals making it impossible to develop indicators of success. Project participants do not understand the benefits of evaluation, seeing it as taking time away from 'doing.' Inherent complexities in ecological and social systems make it difficult to define 'standards' against which progress can be measured, and time lags and spatial scale issues frustrate evaluators. Groups tend to measure the success of strategies, not their impact on outcomes. Solutions to these problems include: better ways to clarify goals; use of multiple metrics of success; and enhancing the capacity of sites to engage in evaluation. Evaluation should be seen as a set of activities integral throughout a project's process.

S09-01 **YODER, ANNE D.,** Link Olson, Rodin Rasoloarison, Voahangy Soarimalala, Daniel Rakotondravony, and Steve Goodman. Department of Ecology and Evolutionary Biology, Yale University, New Haven, CT 06520, USA (anne.yoder@yale.edu) (ADY); Division of Mammals, Field Museum of Natural History, Chicago, IL 60605, USA (LO, SG); University of Antananarivo, Antananarivo, Madagascar (RR, VS, DR, SG).
THE MANY WAYS IN WHICH PHYLOGENETIC ANALYSIS IS REFINING CONSERVATION PRIORITIES FOR MALAGASY MAMMALS

Phylogenetic analysis of molecular data uniquely enables investigators to decipher the evolutionary past of extant organisms. Phylogenies reveal the hierarchical nature of relationships, and can also reveal both the relative and absolute geological ages of the organisms under investigation. We illustrate the many ways in which these aspects of phylogenetic analysis are refining conservation priorities by altering our views of species-level taxonomy, and thus our understanding of geographic distributions, dispersal abilities, and fine-scale habitat use in Malagasy mammals. Specifically, we illustrate these points in mouse lemurs and long-tailed shrew tenrecs. For both groups, phylogenetic analysis has revealed the presence of numerous cryptic species, some of which are found only in fragmented and threatened microhabitats. At the most fundamental level, this clarifies the need to protect these habitats. Our work is also revising long-held views concerning the ecological elasticity and relative abundance of mouse lemur and tenrec species. We show that although some are ecological generalists and able dispersers, and thus are presumably robust to environmental degradation, others are highly constrained in their ecological requirements and should be differentially targeted for protection. These studies are being extended to include numerous groups of terrestrial vertebrates in Madagascar, and should ultimately allow us to prioritize areas for protection based on knowledge of the relative fragility and rarity of resident organisms.

W02-01 **YOUNG, JON,** and Jonathan Poppele. OWLink Media, #150, 80 North Cabrillo Highway, Suite Q, Half Moon Bay, CA 94019, USA (Attn: CyberTracker Shikari) (info@shikari.org) (JY); Conservation Biology Graduate Program, University of Minnesota, 100 Ecology, 1987 Upper Buford Circle, St. Paul, MN 55108, USA (JP).
CYBERTRACKER DATA COLLECTION TOOL

CyberTracker is a "greenware" field data collection system designed for a Palm handheld computer and GPS. It is considered by many researchers to be the most efficient way for field observers to gather large quantities of highly detailed data. CyberTracker uses icon based data entry for rapid recording of observations. The icon based interface is very intuitive and can reduce or eliminate language and terminology barriers between data collectors and researchers. Each data entry is stamped with date, time, and GPS coordinates. Upon returning from the field, data are downloaded directly to a PC where they can be viewed immediately in CyberTracker, or exported in many common formats, including Excel spreadsheets and ArcView shapefiles. The sequence of screens and prompts in CyberTracker is customizable, allowing the program to be used for a wide range of applications. CyberTracker is being successfully used for wildlife surveys, ground-truthing of remote sensing data, and even

social science research. It is being used by scientists, students at all levels, citizen volunteers, and amateur naturalists. Originally designed by Louis Liebenberg for use by illiterate Bushman trackers in the Kalahari, CyberTracker has proven its worth as a tool for engaging local communities in science and conservation.

C12-01 YOUNT, JAMES. 3073 Town Road 225, International Falls, MN 56649-8717, USA (jwyount@students.wisc.edu).
RESOURCE USE, CULTURAL IDENTITY AND CONSERVATION IN THE MIKEA FOREST OF MADAGASCAR

In the Mikea Forest region of southwestern Madagascar, human ethnicity is closely related to mode of subsistence. The Vezo specialize in marine resources and the Masikoro are inland agro-pastoralists, while the Mikea exploit the forest wilderness which lies in between. The cultural values and practices of these three groups have direct implications for conservation. The Masikoro see deforestation as an expansion of pastureland, but also rely on the forest to protect their herds from cattle raids and as a source of wood for fuel and construction. Mikea foraging practices are more sustainable than those of their neighbors, but they also clear the forest for agriculture and few perceive the forest as an exhaustible resource. Certain Vezo customs facilitate renewal of the resources they exploit, yet they recognize that over-exploitation and unrestrained use of a plant-based fish toxin by Masikoro neighbors have impaired marine ecosystem productivity along the southern coast of the Mikea Forest. The prestige of fishing skills and key game species pose special challenges and inhibit efforts to introduce algaeculture as a sustainable source of income. Conservation efforts should build on those cultural factors which favor sustainability while seeking acceptable mitigations and alternatives for destructive practices.

P008 ZABER, DAVID J., and Michael J. Wiley. University of Wisconsin–Madison Arboretum, 1207 Seminole Highway, Madison, WI 53711, USA (zaber@facstaff.wisc.edu) (DJZ); University of Michigan, School of Natural Resources, 430 East University Avenue, Ann Arbor, MI 48109, USA (MJW).
MONITORING BIODIVERSITY IN LANDSCAPE UNITS: CONTRASTING AQUATIC AND TERRESTRIAL INDICATORS

Ecosystem management depends upon accurate assessment of ecological conditions. Diversity of selected taxa is often used as an indicator of the diversity of other taxa within common landscape units. We evaluated correspondence (at multiple scales) between fish and bird species diversity within and among watersheds in the Lower Peninsula of Michigan (LPM). Correlation between the relative diversity of fish and bird communities was examined across: (1) major river basins; (2) catchments within major river basins; and (3) individual catchments within the LPM. Data were from the Michigan Breeding Bird Atlas and the Michigan River Inventory. Datasets were linked via GIS system and used to estimate the diversity of fish and birds within landscape units. Estimates of relative diversity (species-area regression residuals) were compared via simple linear regression to evaluate correspondence between the two indicator taxa. Little correspondence was seen between patterns of fish and bird diversity within and across watersheds. At some scales of analysis significant negative correlations occurred indicating catchments with exceptional fish diversity had lower than average bird diversity and vice versa. The lack of correspondence between diversity indicators suggests caution in development and application of ecological indicators for assessment of species diversity in ecosystem management programs.

PL-03 ZEDLER, JOY. Botany Department and Arboretum, University of Wisconsin–Madison, 430 Lincoln Drive, Madison, WI 53706, USA (jbzedler@wisc.edu).
WETLAND RESTORATION: IMPROVING LANDSCAPE STRATEGIES AND SITE-BASED TACTICS

The services provided by wetlands (biodiversity support, flood abatement, and water quality improvement functions) justify greater effort to increase wetland area and function in ways that are strategic. Current programs to restore wetlands provide money but not science-based planning, so applications are often accepted on first-come-first-served basis, with ponds as a common outcome. Likewise, wetland mitigation lacks strategies for restoring biological, physical, and chemical functions across landscapes. While a few well-funded projects can match objectives to specific sites or force specific sites to provide a key service, the programs that promote restoration most broadly (voluntary reserves and mitigation) need to become more strategic in providing ecosystem services. The optimal approach would: set regional goals for restoration of multiple functions, prioritize suitable sites to meet targets, offer incentives for owners to enroll high priority lands, and specify the most effective procedures for each site. Before this can happen, conservation scientists need to (1) determine how best to restore wetland functions at the landscape scale, starting from existing models, and (2) improve site-based tactics, using adaptive restoration approaches. Conservation Biology can rise to this challenge, given mandates to provide landscape strategies and funding to coordinate research and restoration.

P032 ZEIGLER, SARA, Philip Nyhus, and Ron Tilson. Franklin and Marshall College, Lancaster, PA 17604, USA (sara.zeigler@fandm.edu) (SZ, PN); Minnesota Zoo, 13000 Zoo Boulevard, Apple Valley, MN 55124, USA (RT).
GIS ANALYSIS OF VIABLE HABITAT FOR *PANTHERA TIGRIS SUMATRAE* IN SUMATRA, INDONESIA

Due to habitat degradation, the Sumatran tiger (*Panthera tigris sumatrae*), once widely distributed across the island of Sumatra, Indonesia, is now confined to small populations in sparse habitat fragments. The objective of this project was to use a geographic information system to identify the last remaining viable tiger habitat on the island with satellite imagery, existing digital data, and published materials. Data from the USGS, WWF, ORNL, GFW, IFRIS, and EU-FIMP were processed, rectified, and analyzed in ArcGIS 8.2 and ERDAS Imagine 8.5 to produce a base map of Sumatra. The resulting base map contains thematic layers for forest cover, human population density, protected areas, and land cover types. These layers, their pixels representing 0.25 km^2, were used in a suitability model incorporating elevation, conservation status, human population density, and land use. This model generated a base map of comparative habitat suitability for the Sumatran tiger, indicating that areas within national parks provide the best habitat. Beyond this distinction, the lowland areas on the eastern coastline of the island provide crucial habitat and should be looked upon as priority land for tiger conservation in the future.

C43-06 ZHANG, LI, Zhihong Li, Wei Qian, and Dafan Cao. Ministry of Education, Key Laboratory for Biodiversity Science and Ecological Engineering, Institute of Ecology, Beijing Normal University, Beijing 100875, P.R. China (azhang@ifaw.org).
IMPACTS OF HUMAN ACTIVITIES ON THE SURVIVAL OF ASIAN ELEPHANT IN CHINA

China's once widespread Asian elephant population has been reduced to remnants in the extreme southwest of Yunnan province, bordering Burma and Laos, where between 200 and 300 are thought to survive. They occur only in some fragmented evergreen forests and rain forests in three prefectures, Xishuang Banna, Simao and Lincang. Habitat alternation and reduction, poaching and human-elephant conflicts are three main threats to the elephants' survival. Most of the gullies and valleys were reclaimed to plant rubber trees or other crops since the 1970s. Many of the original forests were cut massively for commercial profits before the logging ban promulgated in 1998. But the main range of elephants is outside the protected area, where do not have enough efficient protection. From 1979 to 1999, 36 wild elephants were poached in the country for their tusks. In the communities in elephant ranges, complaints on crop raiding by elephants has increased, and elephants hurt and scared by local famers has also increased in the past 10 years. Building ecological corridors to connect the fragmented habitats, strengthening the anti-poaching enforcement, and taking measures to reduce the human-elephant conflicts are three main factors for the survial of the species in China.

C18-10 ZIELINSKI, WILLIAM J., Richard L. Truex, Fredrick V. Schlexer, and Lori A. Campbell. USDA Forest Service, Pacific Southwest Research Station, Arcata, CA 95521, USA (bzielinski@fs.fed.us) (WJZ, FVS); USDA Forest Service, Pacific Southwest Research Station, Placerville, CA 95667, USA (RLT); USDA Forest Service, Pacific Southwest Research Station, Davis, CA 95616, USA (LAC).
THE STATUS OF MESOCARNIVORES IN THE SIERRA NEVADA MOUNTAINS OF CALIFORNIA: COMPARISONS OF HISTORICAL AND CONTEMPORARY DISTRIBUTIONS

Carnivores play important roles in structuring ecosystems and are useful indices of ecosystem condition. Four species of mammalian carnivores are extirpated from forests of California and understanding the status of the remaining species has become increasingly important. We evaluated the status of 10 species of carnivores by comparing their historical and contemporary distributions. Maps of point distributions of occurrences from 1910-1930 were visually compared to the results of recent regional, systematic surveys using baited track plates. Most of the generalist mesocarnivores appear to occupy regions where they occurred in the early 1900s. The wolverine and Sierra Nevada red fox, species particularly sensitive to people and vulnerable to historical trapping, were not detected and the areas occupied by fishers and martens appear to have decreased. Fishers were not detected within the historically occupied region from Mt. Shasta south to Yosemite. The marten population in the southern Cascades/northern Sierra appears to have been fragmented from a relatively continuous historical distribution to several isolated populations. Primary hypotheses for the changes in fisher and marten distribution favor the loss, alteration, and fragmentation of habitat from timber harvest and the latent effects of historical fur trapping.

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