2002 State of Carnivore Science

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INVOLVING BALTIC AND SCANDINAVIAN HUNTERS IN LARGE CARNIVORE RESEARCH AND MANAGEMENT

In northern and eastern Europe, large carnivores are conserved through harvest management rather than protection. Species eradication campaigns are in the past in most of the countries, and sustainable hunting has a positive effect on large carnivore conservation. Because hunters are numerous (1.4% of the Latvian and 6% of the Norwegian populations) and directly manage wildlife, conservationists should consider this interest group and, if possible, involve them in conservation activities. Nordic countries have long involved hunters in carnivore monitoring and research (snow-tracking, searching for dens, etc.) and have established a system of carcass delivery to researchers. Baltic countries have also recently started involving hunters in conservation work. Since 1997, Latvian hunters have provided carcasses of hunted wolves and lynxes for further examination, and collected genetic samples. They have also been involved in a country-wide morphometrical study measuring harvested wolves according to a specially designed questionnaire, obtaining data on about 500 individuals, which would otherwise be impossible. Hunters are also involved in decision-making about wildlife management. Hunters can be effectively recruited for research and management of large carnivores, including collection of morphological data provided that measurements to be taken are simple.

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THE QERO INDIGENOUS RESOURCE MANAGEMENT SUPPORTS AN IMPORTANT ETHIOPIAN WOLF POPULATION

Enlarging our understanding of indigenous resource management systems and institutions is becoming important for conservation and development, as fortress-based approaches are increasingly questioned. This paper examines how the Qero indigenous resource management system has supported the conservation of an Afro-alpine area in the central highlands of Ethiopia, where endemic species abound. The main concern of the Qero system was to regulate the use of natural resources by the traditional community, including collection of firewood and thatch, and grazing by livestock. The system was enforced through sanctions and punishments imposed by the community. Although the conservation of biodiversity was not the main aim of the Qero system, several endemic and endangered species have benefited from this indigenous resource management system. The Qero system has declined in recent years as a result of the break down of the existing land tenure and land rights systems within Ethiopia. Furthermore, management responsibility has shifted to a non-traditional user group. Nevertheless, the Qero system has shown sufficient resilience to withstand these changes and pressures, with still defined seasons of resource use. Furthermore, the area still supports the largest population of the critically endangered Ethiopian wolf Canis simensis to remain outside a protected area.

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DISTURBANCE EFFECTS ON MALAYAN SUN BEAR (HELARCTOS MALAYANUS) ECOLOGY, LANDSCAPE USE, AND CONSERVATION

The sun bear is protected on Appendix I with C.I.T.E.S. and by Indonesian, Malaysian, and Brunei laws, but lack of information regarding sun bear ecology, population dynamics, and disturbances inhibits conservation strategy development. Disturbances can affect sun bear fitness, genetic viability, evolutionary potential, and community dynamics. Therefore, this research is focused on natural patterns of, versus disturbance effects on, sun bear ecology, landscape use, and habitats on Sumatra and Borneo. Conventional wildlife study problems and elusivity are addressed through controlled sign censuses and forage productivity and habitat surveys in disturbed and undisturbed habitats integrated with modelling and genetic analyses. A systematic remote camera Capture-Recapture study is also being conducted on relative sun bear densities and distributions. Data are being modelled in 1) Resource Selection Functions; 2) CAPTURE and DISTANCE density software packages; 3) metapopulation models; and 4) a Geographic Information System (GIS). Results indicate significant differences among sun bear distributions, preferred habitats, ecology, and landscape use across temporal and geographic extents. Biogeographic analyses attribute differences to logging, habitat fragmentation, human presence, and other disturbances. Results and critical habitat needs are being integrated with cultural, socio-economic, political, and environmental education requirements for regional sun bear and biodiversity conservation plans.

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USING PHYLOGEOGRAPHY OF A MICROPARASITE TO ASSESS SPATIAL POPULATION STRUCTURE IN ITS MAMMALIAN CARNIVORE HOST

Molecular approaches are widely used to infer spatial population structure in conservation. However, the genetic population structure of a species may reflect processes on temporal scales much larger than those of specific conservation interest, for example if populations became fragmented relatively recently. In this study we demonstrate that phylogenetic data of an endemic, rapidly-evolving, and non-pathogenic retrovirus commonly found in Rocky Mountain populations of cougars, Puma concolor, can provide recent information on population subdivision and movement of its host. Based on sequence data from two viral genes, we show that most infected cats within an area carry closely related viruses and our data indicates that many such regional virus variants circulate in Rocky Mountain cougars. Further, using serial sampling of infected individuals we estimated that the virus genes examined evolve at rates of 0.1-0.5% per year, suggesting that virus transmission that occurred among cougar populations within the last few decades should be detectable. This molecular technique thus holds the promise to provide current information about population connectivity, an issue of much interest to conservation.

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THE SCALING OF PREDATOR AND PREY POPULATION: IMPLICATIONS FOR CARNIVORE CONSERVATION

Across communities in plants and animals, there is an inverse relationship between population density and body size suggesting that resource use and availability are major factors influencing population density. While these relationships reflect processes which underlie the structure of animal communities, their predictive power for conservationists is limited. We develop and test a new model to predict variation within and between species in population density for carnivores which takes into account body mass and prey biomass. We find that 10,000kg of prey supports approximately 90kg of a given species of carnivore irrespective of body mass and that carnivore number/(unit prey biomass) scales to carnivore mass-1.0. Using mass specific equations of prey productivity, we show that carnivore number per unit prey productivity scales to carnivore mass near –3/4, and that the scaling rule can predict population density across more than three orders of magnitude. The relationship presented here provides a basis for identifying declining carnivore species that require conservation measures.

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IMPACTS OF LANDSCAPE CHANGE ON WOLF RESTORATION SUCCESS: PLANNING A REINTRODUCTION PROGRAM USING DYNAMIC SPATIAL MODELS

Mammalian carnivores are increasingly the focus of reintroduction attempts in areas from which they have been extirpated by historic persecution. We evaluated the potential success of a proposed wolf reintroduction to the southern Rocky Mountain region (USA) using a spatially-explicit population model that predicted wolf distribution and viability under current conditions and under two contrasting predictions of future landscape change. Our results suggest that the southern Rocky Mountains could support reintroduced wolves under current conditions but that development trends over 25 years may result in the loss of one of four potential regional subpopulations and increased isolation of the remaining areas. While much of the wolf population is likely to occur outside core protected areas, these areas remain the key to persistence of subpopulations. Our results suggest that social carnivores such the wolf may be more vulnerable to environmental stochasticity and landscape fragmentation than their vagility and fecundity would suggest. Techniques that integrate population viability analysis with regional-scale conservation planning and reserve design may help increase the success rates of reintroduction programs for area and connectivity-dependent species.

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ASSESSING VIABILITY AND RESILIENCE OF AN AMUR (SIBERIAN) TIGER POPULATION THROUGH POPULATION MODELS

We developed models to understand Amur tiger population dynamics. We show that tigers may not have a potential growth rate as high as previously thought, although a small tiger population (a dozen resident individuals) could persist provided relatively high reproduction and low mortality rates. It required 30 years for the tiger population in the Sikhote-Alin Zapovednik to reach an assumed carrying capacity under one of the most favorable possible trajectory. We show that resident tiger survival has the most critical impact on population persistence, and suggest that the assumption that tiger populations are inherently resilient to perturbations should be reexamined. The present tiger population in Russian Far East appears to be sensitive to yearly poaching rates as low as 10 %, suggesting that poaching may regulate the Amur tiger population, determine its trends, and ultimately its survival. Because poaching represents an unknown and highly variable mortality factor, tiger removal as part of a management regime (e.g. problem animals) should be conducted only when essential. In the absence of other threats, a small tiger population could sustain limited yearly removals based on occurrence of tiger-human conflicts, but only when its demographic trends are accurately monitored and other mortality factors are known.

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TIGER PROJECTS DATABASE – FUNDING AND ACTIVITIES ACROSS TIGER RANGE

Throughout the 1990s, the availability of funds for the implementation of tiger conservation projects has increased, as a result of concern among both the public and the conservation community. Funds intended solely or primarily for tiger conservation are now available from a variety of sources at varying scales. Since 1998, work has been underway at the Zoological Society of London, with funding support from WWF-US and active cooperation from virtually every relevant agency, to collect, compile and analyse data on both the funding for tiger conservation and the scope and focus of the projects undertaken. We now have a comprehensive dataset on the more than $15 million spent on tiger conservation work between 1998 and 2001, which is capable of analysis by project activity, country, "Tiger Conservation Unit" (Dinerstein et al. 1997), bioregion, funding source and implementing agency. Selected results of these analyses will be presented and discussed. Plans to put the database on the internet during 2002/2003, with a user-friendly data extraction interface, and to expanded it to take in other felid taxa and become the IUCN Cat Specialist Group Projects Database, will be described.

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IMPLICATIONS OF THE NATURALLY BIASED SEX RATIO OF LYCAON PICTUS FOR ITS CONSERVATION

The painted hunting dog or African wild dog, Lycaon pictus, is one of the most endangered large carnivores in Africa, with extinction predicted within a few decades if their dramatic decline is not stopped. Lycaon is an obligate cooperative breeder living in packs of up to 20 adults, in which most of the time only the alpha pair breeds; the remaining adults are reproductively suppressed and help to raise the pups. The resulting female oestrogen levels lead to a naturally biased sex ratio in the litters: primiparous litters are male biased (c. 2/3 males) and multiparous litters are female biased (c. 2/3 females). In this work, we investigate the effects of the current high level of anthropogenic mortality on painted hunting dogs: as females survive to produce fewer litters than previously, this is likely to result in a greater proportion of litters being primiparous and consequently male biased. With a mathematical model of the dynamics of a population of nine Lycaon packs, we show that lowering the survival of dominant females has an important impact on the population, not only by much diminishing its final size, but also but by disrupting the entire social structure of the population.

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POPULATION ECOLOGY OF PINNIPED HERPESVIRUS INFECTIONS AND CANCER IN CALIFORNIA SEA LIONS

Herpes virus are endemic in California sea lions (Zalophus californianus), while infection with these pathogens is by itself harmless, the presence of organic pollutants leads to aggressive carcinomas. In this talk we will present an age- and sex-structured model for California sea lions that incorporates both herpes transmission and the presence of environmental pollutant. As female sea lions forage in more polluted waters than males they carry higher doses of the pollutant and this interacts with the herpes virus to increase their risk of mortality. The model is used to examine the long-term impact of organic pollutants on the sea lion population. The expected mortalities are compared with the observed patterns along the coast of California.

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IDENTIFYING OPTIMUM HABITAT FOR THREATENED CHEETAHS: PLAINS OR WOODLANDS?

Cheetahs on the open plains in the Serengeti National Park in Tanzania have been studied for over 25 years. However, although we think of cheetahs as a plains species, they may in fact do better in woodland habitats. Research in the 1980s showed that cheetah cubs have poor survival on the plains because of predation by lions and hyenas. Cheetahs may do better in woodland areas since prey are more reliable, there are fewer hyenas and there are many places in which cubs can be hidden from predators. In this study an area in the northern woodlands within the Serengeti was used as a basis for an ecological comparison with the long term study area on the plains. Data on behaviour and hunting patterns were collected on cheetahs in both plains and woodlands habitat. Activity patterns, vigilance at kills, and the risks of kleptoparastism showed marked differences between the two habitats suggesting that cheetahs were more relaxed in woodland than in plains habitats. As cheetahs continue to decline across Africa, identifying optimum habitat is a priority for this species.

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ANCIENT DNA AND THE THYLACINE: CONSERVATION ISSUES IN THE CLONING DEBATE

The thylacine or Tasmanian tiger (Thylacinus cynocephalus) was the largest extant carnivorous marsupial in Australia at the time of European settlement. The species, the last representative of its family, went extinct on September 7, 1936 after less than 100 years of direct persecution by Europeans and a protracted decline over 4000 years following the introduction and expansion of dingoes from Asia. The blunt extermination of this species represents a nadir in the human experience of the 20th century. The Australian Museum's Thylacine Project, which ambitiously aims to clone a living thylacine, has been a hotly debated and controversial topic among the scientific and conservation communities but has captured the public's imagination since its inception in 1999. The science behind the project focusses on the use of ancient DNA in molecular methodologies with the initial, and theoretically achievable, goal of making genetic libraries encompassing the entire genome. Difficult ethical, moral, and environmental issues need to be broached and huge technological hurdles in molecular, cellular, and reproductive techniques need to be overcome if the ultimate goal is to be feasible, not least of which is determining how the (conservatively) estimated seventeen million fragments of DNA fit together to encode for a thylacine.

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NEW THREATS TO THE GIANT PANDA, ALIUROPODA MELANOLEUCA, AND PROTECTION STRATEGY IN PINGWU, CHINA

The Pingwu Nature Reserve in China is the only place where more than 180 giant pandas, Aliuropoda melanoleuca, occur. Six years of research on environmental and ecological awareness and participation of Baima Tibetan villagers residing in the Reserve indicates that the primary negative human impacts on giant panda protection have changed. Prior to 1998, the extraction of timber from the forest was the primary cause of panda habitat loss, but this activity has been successfully controlled and eliminated due to the implement of 1998 logging ban. Habitat fragmentation, the second highest impact on panda survival, has been reduced by reforestation of roads in the Reserve. Now, poaching of other animal species for wild food has emerged as the principal threat to the survival of giant pandas in the 21st century. High demands for wild food resulted in a significant increase of poaching by local residents, which causes higher probabilities of giant panda injury or death through traps and poisons. There have been recent reports of the death or injury of giant pandas due to poaching. To combat this new threat, we introduced a comprehensive panda protection strategy focusing on education, development, and monitoring (EDMP) suitable for Pingwu Nature Preserve. We will describe this programme and its successes.

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MORTALITY SENSITIVITY IN LIFE-STAGE SIMULATION ANALYSIS: A CASE STUDY OF SOUTHERN SEA OTTERS

We use life stage simulation analysis to examine 30 years of age and sex specific mortality data for Southern sea otters. Population recovery of the southern sea otter has been slow compared to other recovering otter populations and since 1995 the population has declined. We present a demographic model for examining the sensitivity of sea otter population growth to putative sources of mortality (e.g., trauma, disease, fisheries, gun shot, mating trauma, shark bites). We use resampling simulations to generate random combinations of vital rates for a large number of matrix replicates, and use these to estimate potential effects of mortality sources on l. Elasticity values obtained for Southern sea otters indicate that the population is far more sensitive to changes in survival rates than reproduction. Disease, emaciation and shark bites explained a substantial fraction of variance in l. Understanding the role of mortality sources for southern otters helps focus attention on the sources of mortality that can and cannot be controlled in recovery efforts.

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ADDRESSING PEOPLE-SPECTACLED BEAR CONFLICTS DUE TO CROP RAIDING AND LIVESTOCK DEPREDATION

Crop and livestock damage by spectacled bears are important sources of conflict between bears, park authorities and local communities near or within the national parks. In localities with a history of bear depredation of crops or cattle, bears are often blamed for losses due to other causes such as natural disease, other wildlife species , or accidents. Local residents can perceive spectacled bears as their principal enemy, and the enforcement of any conservation measures may bring conflicts between park managers and local communities. Researchers have traditionally blamed crop raiding and cattle depredation on depletion of natural resources due to loss of habitat and to lax livestock herding practices. By doing so they put all the weight of the problem on the local communities. However, little is known about the factors that contribute to crop raiding or cattle depredation. Key factors should be identified in order to develop preventive measures to reduce future conflicts. Long term conservation of the spectacled bear can only be achieved if we can find ways to minimise conflicts between the bears and the local population and change the negative perception of the spectacled bear toward a positive one.

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CONFLICT BETWEEN ENDANGERED SPECIES, EXTINCTION RISK, AND THE AGONY OF CHOICE: DHOLES AND BANTENG IN JAVA

Banteng, Bos javanicus, are an endangered bovid species whose global population is thought to number 5000—8000 animals. Alas Purwo National Park in Java, Indonesia, formerly contained 300—400 banteng, probably the world’s largest banteng population. This population, along with that in the nearby Baluran National Park, was studied from 1991 to 1999. In 1993, park staff speculated that the Alas Purwo banteng population was in decline as a result of predation by dholes, Cuon alpinus, also an endangered species. Population size, age- and sex-ratio data, as well as mortality rates for 1993—1997 are presented to show that the banteng population was rapidly declining, and that the dholes were largely responsible. Simulation models using these data indicated that without intervention the banteng population would decline to effective extinction by 1998/99, and the dholes would be threatened by the collapse of their prey base. Subsequent monitoring supported these conclusions: by January 1999 only 17 adult female banteng were known to exist in Alas Purwo and no recruitment had occurred for six years, the dholes had also apparently disappeared. The difficulties of resolving such conflicts between endangered species are discussed, as are the options that were available to the park's managers.

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AMERICAN MARTEN (MARTES AMERICANA) MOVEMENT RESPONSES TO CLEAR-CUT FOREST MANAGEMENT

American marten avoid crossing large open areas, and may be directly impacted by clear-cut forest management practices. We followed 145 marten snow-tracks over 4 winters (1994-1998), to map 308 km of path. We used fractal dimension as a measure of path complexity, and compared the mean fractal dimension of paths moving through landscapes with varying amounts of clear-cuts. Marten move increasingly more linearly as the amount of clear-cut habitat increases above 20% of the landscape. Additionally, the straight-line distance between subnivean foraging sites used by marten increases as the amount of clear-cut habitat in the landscape increases. Yet, marten may effectively reduce their travel distance by moving more linearly when travelling along a clear-cut edge compared to when they are not moving along edges. While marten use forested corridors to travel between clear-cuts, they are selective about the corridors they use, as compared to the corridors available in the landscape. There may be a length:width threshold of corridors used by marten, limiting the utility of many corridors in the region to facilitate marten movement. Marten are impacted by clear-cut forest management practices, yet show a diversity of responses that may allow them to successfully navigate landscapes that contain sufficient connectivity.

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LANDSCAPE MOVEMENTS AND CONSERVATION OF BADGERS (TAXIDEA TAXUS) IN BRITISH COLUMBIA, CANADA.

North American badgers are at the northern limit of the species distribution in British Columbia, Canada. This badger population (Taxidea taxus jeffersonii) is endangered and suffering losses due to grassland habitat degradation, prey decline, and road mortality. Here I report the results of a 2-year study on badger movement across the fragmented landscape and suggest conservation initiatives to address road mortality. Using radio-telemetry, I found striking differences in the individual badger habits. Home ranges vary between 7.6 to 257 km2 (100% MCP) and are up to 100 times that reported in studies from the United States. Using an index of aggregation and random walk model, I have illustrate that burrow locations are aggregated in core areas across each home range. These core areas consist of 2 to 6 patches and represent 20% of home range areas on average. Long-distance, nocturnal movements between core areas and other locations are common; animals move as far as 14 km in 4 hours and crossed large obstacles (e.g. highways and rivers) multiple times during one night. Fragmentation of suitable habitat and prey availability is undoubtedly affecting movement between patches, and the scale at which these animals perceive their landscape must be considered.

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THE IMPACTS OF INDIGENOUS HUNTING ON ASIATIC BLACK BEARS IN YUSHAN NATIONAL PARK, TAIWAN

Illegal hunting of Asiatic black bears has become the latest threat to the long-term persistence of this endangered species in Taiwan. Bears traditionally were taboo animals and not the targets of game for indigenous hunters. We evaluated the impact of hunting on bears in Yushan National Park (YNP) through interviews during 1998—2000. We identified 95 hunters with 174 bears taken during 1939—2000. Bears were killed with shotguns or traps opportunistically. The trend in bear harvests has declined. The simulation of a sustainable harvest shows that YNP has probably provided some protection for bears from overhunting. However, the core area of YNP acts as the population source relevant to the sink of the peripheral area where there is high hunting-caused mortality. Hunting also caused under-reported injuries of bears and deterioration of bear habitat through prey depletion. The hunters' motivations for hunting bears mainly are accidental encountering, self-protection, and commercial benefits. The harvest has been facilitated by various socio-economic changes, including traditional culture, transportation systems, commercial benefits of bears, and market demands. Hunting, along with a small population and habitat fragmentation, continues to impinge on the bears, and these factors need to be addressed to ensure the long-term survival of this species.

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USE OF MICROSATELLITE MARKERS TO STUDY DHOLE (CUON ALPINUS) POPULATIONS IN SOUTHERN INDIA AND JAVA

The Asiatic wild dog, or dhole (Cuon alpinus), an endangered canid once found throughout much of Asia, is currently thought to be at high risk of extinction in many areas. Little is known about this species except for a few studies from India and there have been no genetic studies to date. We are using microsatellite markers to carry out population genetic studies in two locations. Screening of 24 Canis microsatellite locus primers has resulted in the identification of 20 loci which are polymorphic in dholes. We have established, using quantitative PCR, that approximately 40% of DNA samples extracted from dhole faeces contain DNA of good enough quality and quantity to allow accurate genotyping. We have collected 51 scats from Baluran National Park (Java, Indonesia), thought to contain 2 packs of dholes of approximately 9 individuals each, and 135 scats from four adjoining packs consisting of 3, 4, 10 and 12 individuals each in Mudumalai National Park (Southern India). Genotyping using 12 sets of primers is being carried out and information on levels of genetic diversity, levels of gene flow and population structure in these groups is being obtained, all with implications for conservation of this species.

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CAUSES OF WOLF ATTACK ON LIVESTOCK AND CHILDREN: IMPLICATIONS FOR INDIAN WOLF CONSERVATION

India's endangered wolves primarily inhabit semi-arid agro-pastoral regions, in close proximity to people. Conflicts with human interests include predation on livestock, attacks on children, rabid wolf attacks, and damage to installations at an air base. Data on predation, food habits, ranging patterns, and wolf mortality were collected from four sites differing in wild prey abundance and species composition as well as socio-economic conditions. Wolf predation affects the economic survival of some pastoral communities. Herdsmen use guard dogs and thorn corrals, and keep stock in villages each night to mitigate predation. In areas where wolves subsist on wild prey wolf deaths were mostly natural, while in areas where wolves subsist on livestock, most of the observed wolf mortality was caused by humans. Current levels of wolf persecution, mostly limited to filling dens with smoke, are not likely to result in local extinction. However, the increasing use of poison needs to be checked. In Uttar-Pradesh in 1996, a wolf attacked 76 children (of which 50 were fatal). Our study suggests that wolves pose a threat to children in areas with high human density (> 600 per km2), high poverty, little wild prey, and livestock populations that are heavily guarded.

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HUMAN-CARNIVORE CONFLICT: STRATEGIES FOR MITIGATION AND PREVENTION

Carnivores readily come into conflict with humans because of their protein-rich diet, high fecundity, predatory behavior and social organization patterns. Such conflicts result in losses of human lives, livestock, fisheries or crops, thereby leading to elimination of carnivores through retaliatory killings. Increasing population growth, urbanization and economic development - in combination with sporadic successes in conservation efforts – are now increasing the extent of interface between human populations and those of wild carnivores. Conservationists must resolve the ensuing conflicts in a context characterized by fragmented landscapes and changing cultures. They can rely on two broad approaches: reacting to conflicts through mitigation measures or preventing conflicts through spatial separation of humans and carnivores. Conflict mitigation can occur through modification of human behavior towards carnivores as a result of economic compensation, community education, cultural tolerance and innovative crop and animal husbandry practices. Mitigation can also occur by forcing carnivores to change their behaviors using physical barriers, repellents, guarding, or, by removing or killing them. In addition, conflict prevention through voluntary, incentive-driven relocation of people away from core conservation areas is also emerging as an increasingly attractive future option for protecting viable populations of some wild carnivore species.

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PROJECT CAT (COUGARS AND TEACHING): INTEGRATING SCIENCE, SCHOOLS AND COMMUNITY IN DEVELOPMENT PLANNING

Complaint reports of cougars, Puma concolor, venturing into urban areas, killing livestock and pets, and threatening humans have increased to more than 600 reports filed annually in Washington, whereas, in the past, five years cougars have mauled two children. Increased reports are coupled with human population increases of over 1 million in the past decade and an annual loss to development of over 28,000 hectares of land. The rural Cle Elum-Roslyn community is experiencing similar growth and development with over 1,400 new homes planned, but presently with few complaints of cougars. In 2001 we began capturing and marking cougars with GPS transmitter collars to plot precise locations of cougars and predation events in relation to human residence and activity. Junior-Senior students of the Cle Elum-Roslyn School District correlate location data with GIS habitat, topographic, and human residence parameters. Elementary students learn animal track identification and report locations of carnivores and ungulate prey species. Information on ungulate habitat and cougar travel corridors is shared with community planners and incorporated into planning processes to minimise human-cougar interactions. Central Washington University trains teachers to incorporate Project CAT education objectives into other communities during this 8-year project.

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LIVESTOCK HUSBANDRY AND PROBLEM INDIVIDUALS' STUDIES OF EURASIAN LYNX IN NORWAY AND FRANCE

We studied the predation of radio-collared lynx (Lynx lynx) on domestic sheep in Norway and France. In Norway, sheep are unguarded and dispersed throughout the forest. Predation rates were high (ca. 20 sheep / 100 nights / lynx), all flocks experienced predation annually, surplus killing was widespread, and adult males had consistently higher predation rates on sheep than other classes of lynx. Male lynx move more and therefore encounter more sheep, but also kill more sheep per encounter than do females. We found no evidence for the existence of individuals that killed more sheep per encounter. Sheep flocks in habitats favoured by lynx suffered higher losses. In France, sheep graze on meadows dispersed throughout a forest landscape. Predation rates were 10% of those in Norway, <25% of flocks experienced predation annually, and some individual lynx clearly killed more sheep than others. In both Norway and France, sheep grazing in sites favoured by lynx suffered higher rates of predation, but lynx did not select for sheep grazing areas in particular. It appears that sheep are unimportant in lynx diet, sheep are usually killed simply because they are encountered, and husbandry affects the development of problem individuals.

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THE EUROPEAN MINK: BIOLOGICAL CONSERVATION OF WESTERN POPULATIONS

European Mink populations recently suffered a severe decline and the species is now among the most endangered mammals in the world. The range area of western population decreased by half, completely disappearing from north-western France. The analysis of the pattern of decline showed fragmentation resulting in sub-population isolation rather than a linear decline. Fragmentation is directly linked to bad water quality evidencing the rule of habitat alteration. However, multiple causes may be invoked for the decline of this species. Population genetic investigation revealed a low heterozygosity level and the Fis evidenced perturbations in reproductive exchanges validating fragmentation. Moreover, a capture-mark-recapture study showed that sex ratio is in favour of females (59.1%, n = 13) and, on average, only one individual was recorded each 2.27 km of river. European Mink conservation implies habitat restoration, and overall connectivity restoration. In addition, because the Western population is now very low, reproduction in captivity is urgently required.

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COMPARATIVE STATUS AND DISTRIBUTION OF TIGERS IN THAILAND AND MYANMAR

Setting range-wide, and country level priorities for saving tigers has been hampered by the lack of information on their status and distribution across remaining habitats. From 1997-2002 the Wildlife Conservation Society worked across the tiger's range to identify critical sites and to work with national governments to implement specific management actions there. In Thailand and Myanmar, 19 sites were selected using information on historical patterns of tiger occurrence and interviews. Using camera-traps and sign surveys, tigers were confirmed from 86% of Thai sites but only 17% of Myanmar sites. Relative abundance of large mammals was similar across surveys, but Myanmar forests had higher species richness. Tigers were an order of magnitude less frequently detected in camera-traps in Myanmar. Although remaining habitat is more highly fragmented, Thailand has incorporated 60% in protected areas. Camera-traps recorded 57% lower poacher activity in Thailand than in Myanmar, where < 11% of remnant forest is protected. Prescriptions for tiger conservation differ for the two countries. The expansion and addition of protected areas, and staff training will be required for the recovery of Myanmar tiger populations, with ecological monitoring and increased enforcement needed to reduce poaching and stabilise populations of tiger and prey in Thailand.

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CHEETAH REMOVAL ON NAMIBIAN FARMLANDS: REASONS, RATES AND CONSERVATION IMPLICATIONS

Cheetahs, Acinonyx jubatus, have undergone serious decline worldwide, and the largest free-ranging population is now found in Namibia. Ninety percent of Namibia's cheetahs are found outside of protected areas on commercial farms, where they come into conflict with local farmers and are often removed in large numbers. A ten-year study was conducted on the Namibian farmlands to investigate the reasons for removal, demography of the removed cheetahs, and possible solutions for alleviating the conflict. Conflict with farmers caused 91.2% of live cheetah captures and 47.6% of wild cheetah deaths reported. The majority of cheetah captures (52.7%) occurred due to a perceived threat to livestock, but in only 3% of cases was there any evidence that the cheetahs caught were indeed causing a problem. Cheetahs were often captured opportunistically rather than in direct response to stock loss. The majority of the cheetahs removed were of prime breeding age, which is likely to be particularly detrimental to the population. The level of removals dropped significantly through the study, however, from 19 cheetahs removed annually per farmer to 2.1 by the end of the study. This indicates that local attitudes and actions can be positively influenced through long-term education and conservation awareness programmes.

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A SNOW LEOPARD SURVIVAL STRATEGY

The snow leopard, Uncia uncia, is endangered throughout its 13 nation range in Asia. Due to its extremely cryptic behaviour, and the harsh and remote habitat in which it lives, the species remains poorly understood. Persecuted for trade and in retribution for livestock depredation, it faces increasing pressure, particularly in former Soviet states where the cat's human neighbours face severe economic hardship. Conservation and research efforts for this species have been limited and often poorly co-ordinated. I present here the results of an 18-month interactive process to formulate a Snow Leopard Survival Strategy (SLSS) with input from scientists, conservation NGOs and resource managers from all snow leopard range states, and around the world. The SLSS provides a comprehensive prioritised analysis of threats to snow leopards and appropriate conservation actions to address them. Similarly, information needs are described and research methodologies suggested. I discuss how consensus was reached on the SLSS by all range states, and, importantly, how it is now being implemented through local development of country-specific action plans.

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ASSESSMENT OF THREATS FACING THE RIVER OTTER IN CHILE AND THE HUMAN DIMENSION OF ITS CONSERVATION PROBLEM

Here we report on two years' research assessing the threats to southern river otters and how these are related to the knowledge and attitude of landowners, farmers, school children and State Department officials toward the water courses and otter conservation in the Lake district of South of Chile. Using an Index of Otter Field Signs (IOS) and an Index of Revisitation Rate (IRR), we assess the effect of woody debris, bank vegetation, channel morphology, river bounds, river canalisation and the presence and activity of humans on the use of water courses by otters. Otters prefer river and stream banks with a high density of riparian vegetation, woody debris and exposed roots. River canalisation and extensive removal of riparian vegetation and woody debris have an adverse impact. This research shows a limited appreciation of rivers, swamp forest and otter conservation by most landowners and some State Departments. The survival of otters in freshwater habitats in Chile may dependent on the conservation of shallow water courses, meanders, swamp forest, macrocrustaceans and the restriction of human dwellings in areas additional to the current National Parks. Therefore, there is an urgent need for an integrated and sustainable management program of floodplains and water courses by authorities.

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THE EFFECT OF DAMAGE PREVENTION METHODS ON LARGE CARNIVORE-LIVESTOCK CONFLICTS IN ROMANIA

In Romania, 5,000 bears, 3,000 wolves and 2,000 lynx live on the same range with 4.5 million sheep and 1.5 million cattle. Livestock protection methods are still very well preserved in this country: animals are not left free on pastures, they are always penned over night, and always guarded by shepherds and dogs. We investigated the amount of damage caused by large carnivores and to what extent this damage can be reduced by the use of electric fences. Every grazing season (May to October) 1.5 % of all sheep are killed by wolves and bears, with an average of 7 animals per camp. In three of the four years of our analysis the number of killed sheep was strongly correlated with the relative amount of shepherds and of guard dogs in the flocks. The camps where we installed electric fences suffered only 2.59 % of the damage suffered by camps without fences. The fences are appreciated by the livestock raisers also because they are very easy to handle and fast to be set up. Such a fence is still an expensive item in Romania but it can be profitable for livestock camp organisers over the long term.

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SPATIAL DISTRIBUTION OF FAR EASTERN LEOPARD IN SOUTHWEST PRIMORSKI KRAI, AND RECOMMENDATIONS FOR THEIR CONSERVATION

We attempt to define spatial distribution and habitat requirements for the single remaining population of endangered Far Eastern Leopards (Panthera pardus orientalis) in Southwest Primorski Krai in the Russian Far East. Using data obtained from 4 recent surveys, we developed a GIS database with 16 natural and anthropogenic parameters assigned to 1707 topographic cells that encompassed all known leopard habitat, and conducted a logistic regression and univariate analyses to assess which factors explained leopard presence/absence. Increasing distance from road and landuse status were significantly human factors that helped explain leopard distribution. Elevation, habitat type, and presence of tigers also partially explained presence/absence patterns. A habitat suitability map generated from the consequent model provides some suggestions where conservation actions are needed. Based on the results of this analysis, we recommend landuse reforms for specific components of the landscape in Southwest Primorski Krai, and closer management coordination with potential leopard habitat in adjacent lands in China.

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MANAGING TRANSBOUNDARY POPULATIONS OF AMUR TIGERS

Formerly distributed across Manchuria, the Korean Peninsula and Russian Far East, recent surveys confirm that at least 95% of the remaining Amur tigers, Panthera tigris altaica, are now found in two subpopulations concentrated in the Russian Far East. Extinction of tigers in Northeast China is apparently prevented only due to irregular immigration of tigers across the Sino-Russian border. Despite imminent extinction, recovery of tigers in Northeast China is possible via natural emigration from Russia, if steps are taken to protect habitat and increase prey populations. We propose a land use plan that manages tigers in two subpopulations — The Sikhote-Alin — Wandashan population, and the Tumen River population. We argue that long-term viability of the Tumen River population tiger population, as well as Far Eastern leopards, Panthera pardus orientalis, is dependent on steps taken on the Chinese side of the border. Creation of protected "core" areas, designation of "tiger management zones" and creation of ecological corridors can significantly increase population size, provide linkages between isolated habitat tracts, and save the last potential corridor linking Russian and Chinese habitat to potential habitat in DPR Korea. Our recommendations have already resulted in creation of the Hunchun Tiger Leopard Reserve along the Sino-Russian border.

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THE ROLE OF INCENTIVE SCHEMES IN CONSERVING THE SNOW LEOPARD (UNCIA UNCIA)

Pastoralists and their livestock share much of the habitat of the snow leopard Uncia uncia across South and Central Asia. The levels of livestock predation by the snow leopard and other carnivores are high, and retaliatory killing by the herders is a direct threat to carnivore populations. Depletion of wild prey by poaching and out-competition by livestock also poses an indirect threat to the region's carnivores. Conservationists working in these underdeveloped areas that face serious economic impacts from livestock losses have turned to incentive schemes to motivate local communities to protect carnivores. We describe a pilot incentive experiment in India that aims at enhancing wild prey density by creating livestock-free areas on common land. We also describe how income generation from handicrafts and tourism in Mongolia is helping to curtail poaching and retaliatory killing of snow leopards. However, initiatives that have tried to offset the costs of living with carnivores and to make conservation beneficial to the affected people have thus far been small, isolated, and heavily subsidized. Making these initiatives more comprehensive, expanding their coverage, and internalizing their costs are future challenges for conserving large carnivores like the snow leopard.

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THE SUCCESS OF SPECIES-ORIENTED APPROACHES IN THE REINTRODUCTION OF CANADIAN SWIFT FOXES

Human-modified landscapes are frequently associated with habitat degradation and associated alterations to ecosystem composition and processes. In extreme cases, and with increasing frequency, such perturbations result in species loss. The conversion of Canada's prairies to cropland agriculture combined with the direct killing of carnivores resulted in the extirpation of formerly abundant swift foxes (Vulpes velox) in the 1930s. The reintroduction of swift foxes to Canada since 1983 exemplifies a species approach to ecosystem restoration raising several fundamental questions: 1) Can species-specific strategies effectively restore carnivores?; 2) Does species management for reintroductions require continual human intervention?; and 3) Can species approaches serve as tools for ecosystem restoration? Translocated foxes from the United States had similar survival rates to those of recently re-established, resident foxes in Canada from 1994 – 1997. Subsequent monitoring from 1997-2001, when releases were not conducted, documented significant increases in population size and population distribution, changes in sex ratio, and increases in the proportion of wild individuals within the population. Hence species approaches can be effective in restoring small carnivores. Moreover, concurrent radio-tracking of swift foxes and coyotes in Canada and Mexico from 1994-1997, served to detect Canadian prairie ecosystem deficiencies in small mammal prey productivity and badger abundance.

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BOBCAT RESTORATION, DEER HERD TRENDS, AND OAK REGENERATION ON CUMBERLAND ISLAND, GEORGIA, USA

We evaluated bobcat, Lynx rufus, food habits, white-tailed deer, Odocoileus virginianus, herd trends, and vegetation change over 18 years on Cumberland Island National Seashore, Georgia, before and after bobcat restoration. Bobcats were released on the island during 1988-1989 to restore an extirpated predator to this protected area. We determined abundance of deer and prey use by bobcat during 1988-1990 and 1997-1998. We also analysed annual deer harvest data from 1980 - 1997, and used permanent plots to compare live oak, Quercus virginiana, regeneration in 1985 - 1997. During 1988-1990, deer comprised 20-38% of the diet of bobcats, compared to 7-31% in 1997-1998. Deer abundance decreased after restoration of bobcats, and eviscerated body weights of deer harvested by hunters increased significantly for most age-sex classes. After no significant change in height during 1986-1989, mean oak sprout height doubled between 1989 and 1997; oak sprout and seedling density also increased during this time. Our results are consistent with the hypothesis that predation by bobcats on deer caused a decline in deer abundance, which resulted in improved deer condition and a release of vegetation from browsing pressure that enhanced oak regeneration.

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LARGE CARNIVORE PREDATION ON LIVESTOCK VARIES WITH HUSBANDRY PRACTICES IN LAIKIPIA, KENYA

Livestock predation is a serious challenge to the conservation of carnivores outside protected areas in Kenya, and other parts of Africa. It also has an adverse impact on livestock production, particularly in Laikipia District, Kenya, where ranches lose up to US$ 12,600 annually. These losses are even more damaging to pastoralists with small herds. This study examined how effectively various stockade designs and management practices protected livestock from lions, leopards, and hyenas (both spotted and striped). We found that predator species and predation style varied by the type of livestock attacked, but that some stockades were particularly prone to attack by all predators. High levels of human activity around stockades (measured as the number of houses) were most effective in protecting cattle, sheep and goats from attack. Traditional solid stockades were more effective than wire enclosures in protecting livestock. We also investigated the effectiveness of two new designs. Effectiveness of watchdogs varied greatly in different situations. We identified optimal designs and management statistically and conclude that modification of livestock housing and management can reduce depredation. This reduction would serve both the causes of livestock production and wildlife conservation.

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THE SPECTACLED BEAR IN APOLOBAMBA, BOLIVIA: THE CONSERVATION OF A CULTURALLY SALIENT SPECIES

Tremarctos ornatus is South America's only ursid, its largest carnivore and a key conservation priority. However, many aspects of its basic natural history and complex role in human culture have never been studied. In 1996, qualitative and quantitative research was initiated into the interaction between Andean bears and people, both in and outside a protected area, in Apolobamba, Bolivia. This mountain range is an important stronghold for bears and for traditional attitudes and beliefs towards them. Key informants and 137 semi-structured open-ended interviews revealed a wide range of bear-related beliefs and attitudes, ranging from intense veneration to vilification. Despite their important role in myth and ritual, the majority of interviewees would be glad if there were no more bears in the future. Perceived depredation of crops and livestock was high, although this was not corroborated by investigations on the ground. Frustration about living inside the protected area focused on the prohibition against killing problem animals. Using factor analysis and generalised linear models, tolerance of bears was found to be higher in certain valleys, amongst older people and those who did not keep livestock. Spectacled bears are highly culturally salient animals. As a result, their conservation necessitates tackling complex issues of interaction and perception.

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EVALUATING TIGER CONSERVATION: WHAT SOCIAL CONDITIONS ALLOW FOR SUCCESS IN CONSERVATION?

While tigers receive considerable research attention and substantial funding is directed toward their conservation, their populations continue to decline. The results of preliminary doctoral research are discussed here, followed by future research plans. To identify possible causes for this seeming disconnect, a literature review of social conditions in conservation was conducted, followed by preliminary evaluations of in situ case projects in Cambodia. The preliminary evaluation was conducted through literature review, project document review, and correspondence with project contacts. The results of the literature review suggest that there are four major social conditions involved in effective conservation: positive government involvement, effective interagency cooperation, community involvement, and cultural appropriateness of the conservation methods. Preliminary evaluation results suggest that the first three conditions are essential in successful conservation. Next, extensive field evaluation of the case projects will allow for verification of and expansion upon these findings, and will also illuminate the role of culture in conservation. After these data are analyzed, a written survey of tiger projects across Asia will be conducted to determine whether the results are generalizable across tiger conservation. In the future it is hoped that this theoretical model will contribute to the success of future conservation initiatives.

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ARMY CUTWORM MOTH MIGRATION AND GRIZZLY BEAR CONSERVATION

The army cutworm moth (Euxoa auxiliaris) (ACM) is native to North America and migrates from the Great Plains to high elevations in the Greater Yellowstone Ecosystem (GYE), USA. ACM larvae are crop pests in many Great Plains states, while ACM adults are the richest grizzly bear (Ursus arctos horribilis) food in the GYE. While foraging on ACMs, bears geographically separate themselves from human use areas, and fewer human-caused bear mortalities occur than when ACMs are not available to bears. We collected ACMs from ten high elevation sites and from 39 surrounding agricultural areas. We found ACMs begin mating in high elevation and continue to mate enroute to and in agricultural areas. We developed microsatellites for the ACM to elucidate their migration patterns, determine their Great Plains origins, determine if they show site fidelity to Great Plains and GYE sites between years, and discern the scale at which environmental factors (e.g., weather, habitat loss, and pesticides) may influence ACM abundance and availability to bears. By foraging on ACMs, bears gain pre-hibernation fat stores and incidentally minimize conflicts with humans; hence, determining ACM origins and the scale at which environmental factors influence their availability to bears is important to grizzly bear conservation.

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USING MTDNA SEQUENCING TO REVEAL FINE SCALE SPATIAL POPULATION STRUCTURE FOR VAGILE SPECIES (URSUS ARCTOS) IN GLACIER NATIONAL PARK

Distributions of mitochondrial DNA haplotypes have been effectively used in identifying broad phylogeographic patterns, but have rarely been applied in assessing fine-scale, intra-population structure. In 1998 and 1999, we used barbed-wire snags to collect hair samples from two bear species, Ursus arctos and U. americanus, across 8000 km2 of Glacier Park (USA). UTM coordinates were recorded for every sample collection site. After genotyping all U. arctos samples for species, sex, and individual, we selected 73 females and 77 males using a randomized block approach, and sequenced a 300bp section of the MtDNA control region. Haplotypes were plotted using GIS, and spatial distribution assessed using geostatistics. We identified eight haplotypes; one of which was female-specific, and three of which were male-specific. One haplotype (37a) occurred in 65 females and 59 males. The only other haplotype appearing in multiple females (37b) had a geographically random distribution. Three male haplotypes (40a, N=4, 39b, N=3, 37b, N=6) clustered into geographically discrete regions. ($p << 0.001$). We propose several explanations for this pattern, including anthropogenic and/or geographic barriers to dispersal, disproportionate sampling of kin groups, and pre-existing, broad scale spatial patchiness. We discuss the relative merits of these hypotheses in light of individual microsatellite data.

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MHC DIVERSITY IN A SPECIES WITH LIMITED GENETIC VARIATION: THE ISLAND FOX (UROCYON LITTORALIS)

The Channel Island Fox (Urocyon littoralis), a threatened species, inhabits six of the California Channel Islands (Santa Catalina, San Nicolas, Santa Rosa, San Miguel, Santa Cruz and San Clemente). Major histocompatibility complex (MHC) variation at specific loci may confer parasite resistance to the foxes and therefore affect individual fitness. MHC was assessed in U. littoralis populations from all six Channel Islands via SSCP-PCR and sequencing analysis with primers specific to domestic dog MHC DRB, DQA and DLA88 loci. Three different alleles were identified at the DRB locus, four alleles at the DLA88 and only one allele at the DQA locus. The polymorphism at the DRB and DLA88 locus indicates balancing selection acts on the U. littoralis populations. Future work correlating allelic frequency with parasite prevalence may identify alleles advantageous to the populations survival. This information can be incorporated in current captive breeding programmes.

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CONSERVATION BIOLOGY IN THE REAL WORLD: NON-LETHAL TECHNIQUES FOR MANAGING PREDATION

Conservation biology is not only a science of scarcity and diversity, but one of interface between theory and practice. It requires the development of practical tools and techniques to mitigate conflicts arising from human modification of ecosystems. I have applied behavioral theory to predator management by using aversive stimulus devices (electronic training collars) and disruptive stimulus devices (behavior-contingent audio and visual repellents) in bear (Ursus spp.) and wolf (Canis lupus) conflict situations in the United States. A program using aversive training collars and two packs of wild wolves was not successful after nearly two years of effort, and I conclude that temporarily holding wild wolves in captivity for aversive conditioning is unlikely to be an effective predation management technique. Newly developed disruptive stimulus devices, however, are a promising new management tool that have helped to encourage public acceptance of wolf populations. No livestock were killed by wolves wearing these devices (n=17) during 3 years of research in Idaho. Ongoing studies in Minnesota and Wisconsin indicate the need to understand variation in technology and animal behavior that may hinder the effectiveness and application of non-lethal management techniques, and thus affect local support for conservation efforts.

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LANDSCAPE ANALYSIS OF TIGER AND ITS PREY BASE DISTRIBUTION IN LOWLANDS OF NEPAL

Tiger distribution in Nepal is restricted to small and isolated protected areas attributed to extensive loss of habitat. Existing reserves are not large enough to maintain viable tiger populations. Restoration of degraded forestlands outside reserves is critical. We report on the distribution of tigers in Nepal in relation to prey abundance and habitat quality. We have identified gaps and potential habitats to preserve and expand effective land base that supports tiger. Tiger distribution (presence/absence) was determined by pug marks or any other sign in potential tiger habitats supplemented by information from local people. A total of 700, 625 m long transect lines, each consisting of 25, 10 m2 circular plots were examined for pellet groups of tiger prey species. Human disturbance level and habitat quality was estimated visually during the transect studies. Adjacency to reserve, forest patch size, prey abundance, habitat quality, and human disturbance were determining factors for the occurrence of tiger. Connecting link to a reserve (source) was the key for occurrence of tiger in other areas (sink). Estimates of potential tiger habitats and tiger occurrence outside reserves call for expanding the current management beyond protected areas focusing on dispersal corridors for metapopulation management.

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THE USE OF CAMERA TRAPS TO ESTIMATE JAGUAR POPULATIONS

A major obstacle to developing an effective, range-wide conservation strategy to protect jaguars (Panthera onca) is an absence of robust, reproducible population estimates. Occurring at low densities and being shy and secretive, jaguar populations have been historically very difficult to assess. Using a technique originally developed for tiger populations, we installed 20 camera trap stations sample an area of approximately 145 square kilometers of tropical forest in the Cockscomb Basin Wildlife Sanctuary, Belize. Using the distinctive markings to identify individuals, we concluded that 11 jaguar were photographed over the 59 day sampling period. Using mark/recapture models for closed populations analyzed by the CAPTURE program, we were able to estimate the abundance of jaguar in the sampled area. The results of this study indicate the photographic mark/recapture technique designed for tigers can be adapted for other felids. The technique enables biologists studying jaguar to estimate population abundances and provide them with information they need to promote conservation actions based upon sound population information.

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DYNAMICS OF A SMALL CARNIVORE COMMUNITY IN MYANMAR: SOME PRELIMINARY FINDINGS

The study investigates the dynamics of a typical small carnivore community in a reserve in lower Myanmar, identifying any threats to survival of the five species, namely Palm Civet (Paradoxurus hermaphroditus), Small Indian Civet (Viverricula indica), Crab-eating Mongoose (Herpestes urva), Jungle Cat (Felis chaus) and Leopard cat (F. bengalensis). In addition to observation of individuals and sign (tracks, scats), methodology includes camera trapping and radio-tracking. Food availability is determined by phenology studies, observation and trapping of potential prey species. Scat analysis provides quantitative data on actual diets. Results show Palm Civets as being very common and Small Indian Civets as relatively common (ratio of respective numbers 7.8:1). Sparse data indicate that Mongooses, Jungle Cats and Leopard Cats are uncommon. While the two civets eat mainly fruit and insects, the three rarer species are primarily predators on small vertebrates and, as such, occasionally attack domestic poultry, resulting in their persecution by people residing near the reserve. Greater protection is essential for mongooses and small cats if these species are to survive in populated areas of the country.

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CONSERVING CARNIVORES IN HUMAN-MODIFIED ECOSYSTEMS: STRATEGIES FOR THE NEW MILLENNIUM

All large carnivore species inhabit regions of multiple use wherein human-carnivore conflicts arise. Sociopolitical changes have allowed some carnivore populations to recover, but public tolerance erodes quickly when domestic animals or humans are threatened. Therefore, effective management of human-carnivore conflict is critical to long-term conservation of carnivores. I describe a goal of self-sustaining carnivore populations existing in minimal conflict with humans and managed with public input. This goal depends on managing both humans and carnivores in areas of repeated conflict. Within such areas, managers must use a mix of public participation in management, law enforcement, environmental education and incentive systems, coupled with the full range of non-lethal deterrents and removal techniques to minimize threats to lives and livelihoods. Researchers can advance this goal by identifying risk factors among all individuals involved in conflict, as well as the landscape attributes of sites of conflict. Together, managers and researchers must focus scarce time and resources in those areas facing the highest future risk. By preempting carnivore predation on humans and domestic animals, we may reduce non-selective, retaliatory killing of carnivores and improve public tolerance for conservation programs. Carnivore conservation therefore requires interdisciplinary collaboration among social scientists, biologists and managers.

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ANTI-WOLF BARRIERS TO MANAGE CAPTIVE AND WILD WOLVES AND PROTECT LIVESTOCK

Traditionally Russian hunters kill wolves at bottlenecks formed by flags hanging from ropes. We tested such anti-wolf barriers to impede wolves' access to food, livestock and other wolves. We conducted 13 experiments in three enclosures containing six European and two Siberian wolves. Barriers were used for increasing time periods (45 min - 120 hours). In all cases, wolves did not cross the anti-wolf barrier. Barriers also allowed daily separation of two wolves to administer a food/contraceptive pills mixture to the female. In Canada, we set anti-wolf barriers around a 500 x 500 m enclosure containing 100 cows. During the 60-day experiment, we detected 17 wolf approaches to within 50 cm of the barriers, but no crossings and no killings. Instead, wolves killed livestock in neighboring ranches as wel as before and after the experiment in the tested ranch. Finally, anti-wolf barriers also impeded wild wolves' access to baited sites during two one-month tests. Our results suggest that anti-wolf barriers are effective on captive and wild wolves for >5 and >60 days respectively, and that wild wolves might switch to alternative food sources. Anti-wolf barriers might offer a cost-effective solution to wolf predation on livestock and to exclude wolves from human areas.

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RECOVERING THE ENDANGERED REDWOLF (CANIS RUFUS): ADDRESSING THE CHALLENGE OF HYBRIDIZATION

Preventing hybridization is becoming increasingly important in the conservation of endangered species. The recovery program for the re-introduced red wolf (Canis rufus) population of North Carolina is facing the challenge of preventing hybridization with coyotes (Canis latrans). An adaptive management plan was developed to prevent hybridization while also studying the interactions of red wolves, hybrids and coyotes. This plan utilizes a combination of approaches including culling hybrids and sterilizing hybrids. Managers face the challenge of monitoring for hybridization across 1.7 million acre s and need a reliable and sensitive genetic test . We have addressed these challenges by collecting genetic samples from as many adults and offspring as possible and augmenting trapping efforts with non-invasive genetic sampling of feces. We also collected 19 loci of microsatellite data from coyote populations in North Carolina and Virginia, 14 founders of the captive population, and 50 captive red wolves. Three different analytical approaches to detecting introgression have been evaluated. These approaches are very successful in detecting F1 hybrids (50% introgression) but had low power or conflicting results when identifying red wolves with low levels (25 — 10%) of introgression. This presentation will evaluate the effectiveness of the field and genetic efforts to curb hybridization.

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THE TIGER IN THE TERAI: USING THE ECOLOGY OF UMBRELLA SPECIES TO PLAN CONSERVATION LANDSCAPES

Large, wide-ranging species are considered to be suitable surrogates and 'umbrellas' for conservation planning. We used the ecological requirements of Asia's largest predator, the tiger, Panthera tigris, to design a conservation landscape–known as the Terai Arc–along the Himalayan foothills in Nepal and India. We modelled habitat linkages among the 12 protected areas in the landscape using remote sensing and GIS analysis. Broad habitat types and block size, and elevation were combined to create a cost grid of likelihood of tiger use. The best possible system of corridors between core refuges that harbour tiger populations were identified using a cost-distance analysis. We then conducted finer-scale modelling to locate strategic dispersal nodes that improve the potential of corridors for use by distantly separated tiger subpopulations. We identified 11 potential corridors for tiger dispersal. Among these, 6 corridors had high potential for tiger dispersal, and tiger presence has been confirmed by field observations. Five corridors that connected the most distant subpopulations had greater dispersal costs, but strategically placed dispersal nodes greatly improved the quality of these corridors for dispersal potential. This analysis shows how the ecology and metapopulation management of wide-ranging species can be used to design large conservation landscapes.

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HUMAN-WILDLIFE CONFLICT AS A CAUSE OF GLOBAL CARNIVORE DECLINE

Virtually all large carnivores are undergoing global decline, often despite legal protection inside and outside reserves. Three empirical measures of vulnerability to extinction – the area needed for a population to persist, extinction date relative to sympatric species, and red book status – all indicate that wide-ranging carnivore species are particularly extinction-prone. The available data suggest that ranging widely leads to high mortality because it brings animals into contact – and, hence, conflict – with people and human activity. The endangered African wild dog (Lycaon pictus) follows this pattern precisely, having extremely large home ranges and being threatened principally by conflict with people. However, new data suggest that wild dogs may range preferentially in areas of comparatively high human density, potentially accentuating conflict. This behaviour appears to be a response to the distribution of lions, wild dogs' principal natural enemy. This raises new challenges for the conservation of wild dogs and other large carnivores suffering predation from still larger competitors.

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PUBLIC ATTITUDES TOWARD MANAGING PROBLEM WOLVES.

Compensation programs are intended to improve rural citizens' tolerance for large carnivores. I surveyed tolerance for wolves among 533 livestock producers, bear hunters and other citizens living in areas of Wisconsin recently colonized by wolves. While there was general support for wolf recovery, most respondents wanted wolf numbers capped or reduced. Bear hunters were the least tolerant of the surveyed groups. I found no difference in tolerance for wolves between compensated and non-compensated individuals. Rather, respondents, identity as a bear hunter or livestock producer proved most predictive. Education, gender, and size of childhood community were also significant predictors. The Wisconsin compensation program does not seem to improve individual tolerance for large carnivores but may be critical to building broader political support for wolf conservation. I also discuss public opinion of lethal and non-lethal control methods.

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TIGER PREDATION ON LIVESTOCK IN GEDANG, MEDOG, SOUTHEAST TIBET, CHINA

Medog County holds the last remnant tiger population in Tibet. From May to June, 2000, we conducted a survey in Gedang Xiang, the only place where losses of livestock to tigers are high. The xiang’s cattle population dropped by 11% in 1990s. In 1999, the xiang lost 7.8% of its cattle and 1.9% of its horses to tiger predation. A total of 21 households were interviewed. Of these a household lost on average 0.8 cattle and 0.2 horses during the previous 12 months; nine households had no losses. One reason that tigers are tempted by livestock is lack of sufficient wild prey. Widespread illegal hunting has greatly reduced tiger’s principal prey populations. Until recovery of wildlife populations, an effort must be made to reduce tiger predation on livestock. Conservation recommendations were as follows: 1) villagers should herd and guard their animals cooperatively instead of permitting livestock to wander untended, 2) overgrown abandoned fields, slopes covered with tall bracken fern, and thickets near villages should be cleared and converted to open pastures to remove cover in which tigers can hide, and 3) Some animals could also be housed in stalls, especially in winter when much of the predation occurs.

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ATTITUDES OF RANCHERS IN BRAZIL'S PANTANAL TO CONFLICTS WITH JAGUARS

In many parts of the world, human-wildlife conflict is an economic, social and conservation problem for which solutions are difficult to find. The jaguar, Panthera onca, is threatened by habitat loss and persecution throughout its range in Latin America. The Pantanal of Brazil is a region of widespread traditional cattle raising where jaguar-rancher conflict is common and presents a serious threat to both jaguars and the well being of the human community. This study used a questionnaire survey to determine ranchers' attitudes to jaguar depredation patterns, to conservation and protected areas, including sustainable use, tourism, education and incentive measures. The results showed the potential of ranchers as advocates and facilitators of regional conservation programmes, and indicate that ranchers share a strong inherent appreciation of their local natural heritage. Hence, a strategy for jaguar-rancher conflict resolution needs to be based on incentive measures and rewarding schemes. Compensation, translocation and similar approaches are not recommended, while trophy hunting may prove a useful tool in the future but requires further investigation.