Weasels, Civets, Mongooses, and their Relatives

An Action Plan for the Conservation of Mustelids and Viverrids

A. Schreiber, R. Wirth, M. Riffel, and H. Van Rompaey

IUCN/SSC Mustelid and Viverrid Specialist Group

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Foreword

The IUCN Species Survival Commission plays an important role, through its Specialist Groups, in encouraging professional biologists and naturalists to focus on the conservation needs of many groups of organisms, many of which are threatened or endangered. This Action Plan for the conservation of mustelids and viverrids (including mongooses) is a plan developed by one of the Specialist Groups of the Species Survival Commision. It summarizes the state of existing knowledge, including an assessment of threats and strategies for dealing with those threats. As such, the Action Plan will need to be updated regularly. Action Plans review information about classification, distribution, and ecology in the detail required to focus on the conservation needs. They represent a most important means by which the talents of biologists and conservationists can be coordinated to develop priorities and plans for the conservation of organisms.

I wish to thank the four authors for preparing this Action Plan, and the members of the IUCN/SSC Mustelid and Viverrid Specialist Group, and other people, who contributed information and support. I hope that the Action Plan will prove successful in catalyzing the necessary measure for the conservation of these fascinating animals.

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We take the responsibility for any errors, omissions or biases still present in this document, particularly in the few cases where conflicting views of experts could not be resolved, and decisions had to be made as to which perspective to follow.

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Introduction

The aim of this document is to improve the survival chances of threatened species and subspecies of mustelids (excluding otters) and viverrids, as well as their natural habitats. It identifies taxa of conservation concern, and presents information about their status and conservation requirements. Furthermore, it discusses the general strategies which are necessary for the long-term preservation of these carnivores, and the specific approaches which are essential in the cases of single taxa.

This Action Plan should be viewed against the background of an alarming loss of biological diversity resulting from the rapid increase in the world's human population, from mankind's short-sighted use of natural resources, and from a system of ethical values which places our own species outside the context of living nature. Many people are aware of the fact that the most dramatic wave of extinction ever is currently taking place. It is also known that many animal and plant species, possibly in the order of magnitude of hundreds of thousands, are threatened, this being too many to count or list in red data books. Most of them are tropical species, consisting mainly of organisms of taxonomic groups which are not yet well studied. Such horrific numbers run the risk of being discouraging, rather than being a motivation to act.

This conservation Action Plan aims to be different. In addition to demonstrating what we would lose in terms of beauty, cultural, scientific, and also economic values if mustelids and viverrids disappeared, we emphasize what can be done to reverse the present negative trend. Conservation action cannot be left to one or two international conservation organizations. This would be an impossible task, in view of the large number of threatened species. It is therefore our hope that many individuals interested in nature will recognize from this publication that their personal active contribution can be of decisive help towards achieving, and implementing, a sound conservation strategy. This Action Plan is addressed to anybody who is concerned about the future of the earth's natural heritage. It is aimed to reach the following groups of persons and institutions in particular:

- Relevant governmental authorities, development agencies and planning institutions, who need to take into account the far-reaching ecological implications of their decisions.
- The various national and regional conservation groups who are asked to support this work by providing information, and by the occasional funding of selected high priority conservation projects. In particular, we appeal to the wealthy conservation groups of the industrialized nations to become more involved in projects in the centres of diversity and endemism in the tropics, where the highest rates of extinction are currently taking place.
- Field zoologists, taxonomists, and geneticists, whom we ask to provide the data to close gaps in our understanding of how to promote survival of some of the most highly endangered taxa.
- Universities and associated institutes which can be of key importance by stimulating Ph.D. and postgraduate research relevant to conservation.
- The zoological gardens community, who we ask to take more account of neglected taxonomic groups (such as mustelids and viverrids) in their breeding programmes.

In addition, this publication defines the tasks, and the philosophy of the Mustelid and Viverrid Specialist Group. This specialist group of IUCN's Species Survival Commission includes some 30 members with an interest in mustelid and viverrid conservation, among them small carnivore biologists, ecologists, scientists working in university institutes, governmental organizations, zoological gardens, and natural history museums, as well as interested amateur naturalists. Those that want to contribute their expertise, energy, and time towards the common aim of the group should contact the Chairman.

Chapter 1. Why Should We Conserve Mustelids and Viverrids?

1.1 Overview of the Two Families

Both Mustelidae and Viverridae are extraordinarily diverse families of mammals, and include species adapted to terrestrial, aquatic, fossorial, and arboreal life. They have diversified into a variety of biological roles: some, such as the fossa (*Cryptoprocta ferox*), are carnivores; others, such as the fanalouc (*Eupleres*), are specialized earthworm feeders; and still others, such as most palm civets (*Paradoxurinae*), are chiefly frugivores, or are partly insectivorous, such as the meerkat (*Suricata suricatta*). At least 36 genera and 70 species of viverrids (totalling approximately 350 subspecies) are recognized at the present time. There are 19 genera of mustelids with 53 species including some 420 subspecies (if we ignore the otters, which will be covered by a separate conservation action plan). New subspecies and species continue to be described.

Except for a few species which have extended their ranges into the Palearctic region of Europe and Asia, Viverridae are confined to the Old World tropics. They were the only carnivores to reach Madagascar. They do not occur, even as fossils, in the New World, but some procyonids occupy comparable ecological niches. Mustelids are distributed on all continents except Australia and Antarctica.

Viverrid meat is locally of economic value, particularly in Africa. However, viverrids never acquired such prime economic importance as the mustelids, which contain several valuable fur-bearers. This economic significance, as well as the scientific and cultural importance of both families, are outlined in more detail in the next two sections, but one aspect of relevance to conservation in general should be emphasized: carefully controlled culling of wild fur-bearers can be a viable alternative to other forms of land use, as is demonstrated by the profits of sable (*Martes zibellina*) trapping in the Siberian taiga forests, and of marten (*Martes americana*) and fisher (*Martes pennanti*) trapping in North America. Carefully controlled hunting renders these forests economically productive to man without destroying them, and the value of the pelts ensures protection of the habitat of a large number of other species.

Mustelids are the most diverse group of carnivores practically everywhere in the Palearctic realm, and the same is true of viverrids in the Old World tropics. In and around Gunung Kinabalu National Park in Sabah (Malaysia), for example, one can find at least 7 species of viverrids and 4 of mustelids. Little precise knowledge is available on the ecological role of this diverse carnivore fauna, but it is certain to be significant. For the state of New York, it was calculated that weasels alone catch around 60 million mice and several million rats annually. The 8000 weasels living in the 10,000 km^2 of Gunnison County, Colorado, consume 30,000 small mammals a day.

Species in both families retain a number of phylogenetically primitive characteristics which are of great scientific interest.

But it is not only for this scientific significance, ecological importance or economic value that these small carnivores should be conserved. Many mustelids and viverrids are among the most appealing mammals. With their frequently amazing combinations of colours and patterns, the texture of their fur, and their elegance of locomotion, they are a source of human curiosity and emotional satisfaction. The survival of all species and subspecies of mustelids and viverrids would, without doubt, give much pleasure and intellectual stimulus to all people able to perceive such subtleties.

Unfortunately, four or five adaptable mongoose and weasel species have acquired a bad reputation as constituting a conservation problem to other organisms rather than being in need of conservation action themselves. These species have been dispersed by man and introduced into foreign—often fragile—island ecosystems, where in some cases they now threaten the survival of endemic species and act as a warning of the ecological disasters associated with species introductions. However, generalization of this negative image would be misleading, because many mustelids and viverrids are ecologically specialized and susceptible to habitat changes themselves.

1.2 Pelts, Pets, and Pest Killers—the Cultural and Economic Significance of Mustelids and Viverrids

Although neither mustelids nor viverrids played as prominent a role in man's culture and economy as did canids or felids, they have, from early times, been featured in religious myths and legends. Even today, some species are significant in economic terms.

Characteristics which have been attributed in folklore to species of both families include courage and cunning, strength and ferocity, and sometimes even bloodthirstiness. Badgers must be partly excepted from this, as in various parts of the world tradition regards them as being handsome and kind. Examples for this are the Japanese figure *Tamuki*, the "god of wine," and the German "*Meister Grimbart*." Badgers serve as emblems, such as the state symbol of Wisconsin, and badger watching is popular in some parts of Europe. However, until recently, even the badger was used in Europe in cruel "badger fights," where the animal was teased, enclosed in a pit, and forced to fight for its life for the pleasure of man. Occasionally, badger fighting against dogs is still practiced illegally in the United Kingdom.

In view of the general ferocious picture of the two families, which prevails world-wide, it is not surprising that magical powers have been attributed to internal organs, fat, and other body parts of a wide variety of species. These parts are used as medicine or as amulets to influence positively personal fate in conflict situations.

Hunters have used the abilities of a range of mustelid and viverrid species. In South America, the grison (*Galictis*) was trained to catch chinchillas. In some regions of tropical America, the tayra (*Eira barbara*) was kept to protect houses and belongings from rodents. Weasels (*Mustela erminea* and *M. nivalis*), polecats (*Putorius*), and genets (*Genetta*) are occasionally still kept in the Old World for hunting purposes. Although the cat largely replaced

these species, the polecat became domesticated and as the "ferret" was, and still is, an appreciated partner in hunting rabbits in parts of Europe and northwest Africa. No mustelid, however, became as well known in this role as did various mongooses of the genus *Herpestes*, which, apart from catching rodents, have been famous for millennia for killing reptiles, particularly venomous snakes. Mongooses were introduced to a variety of islands which lacked suitable predators to control agricultural pests or snakes; in several cases, especially on some Caribbean islands, they demonstrated the risks of biological pest control by not only killing selected pest targets, but also devastating native endemic species not adapted to coping with efficient predators.

Ancient Egyptians kept the ichneumon (*Herpestes ichneumon*) to kill snakes. They believed that mongooses would break crocodile eggs and that without the mongoose, the number of crocodiles would be so great that no one would be able to approach the Nile. It is not surprising, therefore, that the mongoose was a sacred animal and that a great number of ichneumon mummies have been found, mainly at Tanis. Mongooses were also the objects of artwork, and they appear as bronze figures, on coins, or as figurines of human beings with mongoose-like heads. The sun-god *Re* once transformed himself into a mongoose to fight *Apophis*, the serpent of the netherworld. On the other hand, the ichneumon god in the mortuary temple of *Amenemhet III* (Dynasty XII: 1991-1786 B.C.) represented the spirits of the netherworld. In Letopolis, the mongoose was equated with the falcon-god *Horus*, and in Heliopolis with the creator-god *Atum*.

These few remarks should suffice to show the important impact *Herpestes* had on ancient Egyptian thinking. The advent of poultry breeding—to which mongooses were detrimental—is thought to be the cause for the decrease in the numbers of ichneumons kept in the houses of north Africa.

Mongooses also feature prominently in the Middle and Far Eastern religions, frequently as guardians of wealth. According to Hindu mythology, *Kubera*, the son of a sage having performed austerities for a thousand years, was given immortality by *Brahma* and made god of wealth and guardian of all the treasures of the earth. Already in the first century B.C., *Kubera* is sculptured as pot-bellied and holds in his left hand a mongoose-shaped purse (*nakulata*), probably made from mongoose skin. The mongoose is the natural foe of the *nagas* (serpents), regarded as the guardians of the jewels and treasures lying under the earth. It may therefore be conceived of as having wrested the wealth from the possession of the serpents; hiding the treasures in its stomach was considered a repository of riches and a suitable attribute to the god of wealth. Later *Kubera* is also depicted holding a mongoose in his hands.

In Buddhist mythology *Kubera* is known as *Jambhala* and is sculptured most often with a mongoose (*nakula*) in his left and a lemon (*jambhara*) in his right hand. The mongoose, when pressed, disgorges streaks of wealth or rounded coins from its mouth. Similar artwork has been found in the Greco-Buddhist art of Gandhara (now chiefly lying in Afghanistan), in Tibet (*Hariti*, the "giver of children" feeding a child at her right and as "bestower of wealth" pressing a mongoose at her left breast), Nepal (god *Mahakala*), and China (*To-wen* holding a mongoose).

Today, mongooses are still kept as pets (as are many species of viverrids and some mustelids), particularly in tropical Asia. A mongoose fighting a cobra is a spectacle in many Eastern towns. Through the famous *Rikki-Tikki-Tavi*, one of the hero characters of Kipling's *Jungle Book*, the genus was accorded an everlasting place in literature.

These cultural aspects should not lead us to forget, however, that viverrids are hunted throughout the tropics and locally are of importance for man's protein supply. This aspect is not important in a world-wide view, but may be crucial for local village communities in tropical countries, especially in wide areas of the African moist tropics, where cattle breeding is problematic due to trypanosomiasis. Although antelopes and primates are the most sought after prey, the usual hunting and trapping methods are not very selective, and most mammals are caught according to their frequency of occurrence. Whereas the most valuable game meat is often sold at local market centres, carnivore meat tends to be consumed at home, and is therefore significant to poor subsistence families. In a recent study of the economy of the Bakumu people, who live near Kisangani, Zaire, in an area where cattle are almost entirely absent, and where hunting and fishing provide almost all protein, carnivore meat was found to make up 15% of all "bush meat" consumed. Whereas mustelids and felids are quite insignificant in this respect, the genets (*Genetta*) and cusimanses (*Crossarchus*) feature prominently, as do civets and other mongooses to a slightly lesser degree. Cusimanses alone constitute 52% of consumed carnivore meat—about 7% of all animal protein eaten by the Bakumu (Colyn et al. 1988). It is therefore no wonder that viverrids play a prominent role in Bakumu myths and culture and that their skins are used for tailoring spiritual dancers' adornments and hats of village chiefs. Skins of the African striped weasel (*Poecilogale albinucha*) are similarly used in traditional African ceremonies.

The African civet (*Civettictis civetta*) is a valuable source of a musk-like substance called "civet". This yellowish secretion has the consistency of butter and is a product from scent glands located near the civet's anus. Civet musk mainly comes from Ethiopia, where "civet farmers" keep up to 60 wild-caught male civets in cylindrical cages made of branches. Musk is collected every 9-12 days with a horn spatula, each collection amounting to 10-15 grams per animal. There are an estimated 180 civet farmers in Ethiopia, holding a total of over 2,700 animals (Hillman in litt. 1988). An animal produces about 800 gram civet per year, representing a value of 350 U.S. dollars (in early 1988). During 1975-1978, Ethiopia exported a total of 5,830 tons of musk, mainly to France, where it is used as a raw substance in the perfume industry. As the animals are not captive-bred, the possibilities for vast increases in production of this valuable substance appear limited. The secretions of various other species are also used for producing perfumes; the old Javanese sultans favoured a perfume based on the fluid of the Malayan stink badger (*Mydaus javanensis*).

The major economic value of mustelids and viverrids, however, is derived from their fur. Mustelids from climatically cold or arctic regions dominate. Fur trapping is a historically old economic activity in northern latitudes, and the colonization of the vast boreal forests of Siberia, Canada, and Alaska by the white man was largely influenced by the search for better trapping grounds. Fears of losing the monopoly or dominance in the trade of certain fur

species, or pelt qualities, influenced political decisions in a number of countries. The economic implications of the fur trade were in no small part responsible for the United States' decision to buy Alaska from Czarist Russia for 7.2 million dollars in 1867. This amount was recouped very soon afterwards by the new state's pelt production. Trims made of ermine pelts (*Mustela erminea*) on ceremonial clothing were widespread signs of royal dignity, and sable (*Martes zibellina*), mink (*Mustela vison* and *M. lutreola*), and marten (*Martes* spec.) furs are still among the most valuable products of large areas of the North. Prices depend on size, colour, texture and fur density, but in the seventies, single prime quality pelts reached $14 (American mink), $410 (female fisher or martens), $126 (male American martens) and $182 (wolverine) on the U.S. market. With an average annual harvest of 256,000-373,000 wild mink and 10,000-15,000 fisher martens in North America alone, the economic impact of these species is evident (Chapman and Feldhamer 1982; Powell 1982).

Captive breeding of fur-bearers has been attempted with a number of mustelids, particularly with minks, martens, sable, and wolverine. At present, the American mink (*Mustela vison*) is the most important farm-bred species. Only since the last decades of the nineteenth century were mink pelts produced in captivity. At first, they were used to substitute and augment the harvest from the wild, but later, by selection and breeding of various races, furs of desired qualities, densities, and colours were produced. The American mink has become the only domesticated mustelid or viverrid apart from the ferret, with domestic races such as Black Cross, Platinum, and Silver. Today, the majority of mink pelts come from captive stock. From 1953 to 1966, world mink pelt production rose from 2,500,000 to 22,000,000 skins. The main producing countries in 1977 were the U.S.S.R. (8,700,000 pelts annually), Finland (3,200,000), the U.S.A. (3,000,000), and Denmark (2,960,000). This tremendous development has caused a drop in the fur price, and mink pelts can now be afforded by a larger number of people than before.

Although trapping of fur-bearers has caused the decline of several species and the extinction of the sea mink (*Mustela macrodon*) which had occurred along the New England coast, the main trapping countries today have a balanced system of regulations protecting the species and permitting a sustainable yield. The valuable sable, for example, was once seriously overhunted and declined markedly throughout its vast range in the U.S.S.R.; but since 1929, fur farms have raised large numbers of sable and captive-bred animals were released to strengthen or rebuild wild populations. In 1956, the U.S.S.R. was again able to export 68,500 of these valuable pelts.

From this short glimpse at man's relationship with mustelids and viverrids, it is obvious that unresolvable conflicts between exploitation and conservation need not occur. Only one species, the wolverine (*Gulo gulo*), sometimes preys on larger domestic species, but this problem is confined to countries which should be able to reimburse losses to private people. Poultry raiding, which is a problem with several mustelid and viverrid species, may be minimized by predator-proof fencing or selective culling of raiding individuals.

1.3 What Science Stands to Lose from the Extinction of Mustelid and Viverrid Species

Scientifically, most viverrids and many mustelids, particularly the tropical forms, are among the least known carnivores. As described in the individual data sheets of this action plan (Chapter 4, section 4.2), an appreciable number of species is only known from a few museum skulls or skins, and even such distinctive monotypic genera as the Liberian mongoose (*Liberiictis*), the aquatic genet (*Osbornictis*), Owston's palm civet (*Chrotogale*) or Hose's palm civet (*Diplogale*) have never or rarely been observed alive by biologists. In view of this, it is not surprising that new subspecies and even species continue to be described. The most recent discovery, in 1986, was the giant striped mongoose (*Galidictis grandidieri*) from southwest Madagascar. Even the taxonomy and geographic variability of the European species is far from clear, as is shown by the still doubtful validity of Mediterranean subspecies of the popular badger (*Meles meles*) or the debate as to how many species of weasels form the *Mustela nivalis/M. erminea* complex. The spectacular geographical and individual variability of a number of species does not facilitate a solution of the many taxonomic problems still associated with these families. The genets (*Genetta*) are notorious for the taxonomic difficulties they present at the species level, and a great number of subspecies have been described in other species, for example at least 30 in the common palm civet (*Paradoxurus hermaphroditus*).

However, the scientific interest in mustelids and viverrids is not confined to a better understanding of the natural history of a diverse and insufficiently known group of carnivorous mammals. The phylogenetic significance also makes both families so intriguing (particularly the assemblage of evolutionary lines presently called "viverrids"). Since the miacids—the stem group of modern Carnivora—appeared in an early tertiary radiation, this mammalian order evolved into such spectacular forms as bears, cats, dogs, hyaenas, and probably seals. These evolutionary lineages are characterized by an increase in size, general progress in cerebralization, and by specializations in the organs of locomotion and of catching and handling prey. To understand these evolutionary processes, an analysis of the phylogenetically primitive characters which survive in some mustelids and several viverrids is necessary. Their scientific importance is therefore comparable to that of the prosimians in understanding primate evolution. As the concepts of mammalian behavioural and social evolution have mainly been influenced by knowledge of the primate and ungulate lineages, an appraisal of the situation in a third main order of higher mammals seems worthwile.

While a few European and North American mustelids have been studied in some detail, there have been only a few field studies of viverrids, and these, for obvious reasons, have concentrated mainly on diurnal mongooses. What still can be discovered is exemplified by detailed studies in the dwarf mongoose (*Helogale parvula*). This species demonstrates such behavioural traits as an unusually cohesive group structure, common defence of group resources against foreign rivalling groups, and even attending of

an injured or dying group member. Mongooses and some mustelids are also among the few non-simian mammals to use "tools" to open hard-shelled food such as eggs by skillfully throwing them against stones. Unusual as this appears, it is all the more so considering the primitive state of these animals' brain structures. Scientists have hardly begun to apply the concepts of comparative behavioural ecology to these "primitive" but ethologically highly diverse families.

In recent decades, research—apart from general natural history work—has mainly been conducted on aspects such as parasitology and chemical communication. Only the easily available American mink (*Mustela vison*) and ferret (*Mustela putorius* forma furo) have frequently been the objects of research involving modern scientific methods and techniques. Both families are hosts to a variety of peculiar parasites, and while the parasite fauna is still little known, one can assume that some parasitic species will prove to be host-specific. It is highly probable that those parasitic invertebrates with a narrow host range will follow their host species into extinction. The flukes (*Trematoda*) exhibit unique life cycles: after passing one or several larval stages in an intermediate host, frequently a mollusc or crustacean, they reach sexual maturity only if they are swallowed by an appropriate host species, e.g. a mustelid or viverrid. Eggs are then produced and shed, often in astronomically high numbers, again to be taken up by invertebrate intermediate hosts.

Scent glands, which are a characteristic feature of most mammals, are especially well developed in mustelids and viverrids. Histological analysis and recent behavioural studies have revealed peculiar details. Dwarf mongooses (*Helogale parvula*), for example, are able to recognize the scent marks of individual group members, even several days after the pheromone has been secreted. The small carnivores may well become suitable model animals to understand chemical communication in mammals more effectively.

There is evidence that some species, such as snake-killing mongooses, are less sensitive to snake venoms than other mammals, even to the strong neurotoxins that are contained in cobra venom. Hog-nosed skunks are reported to sustain a dose of rattlesnake poison per kilo of body weight ten times higher than rabbits do. The lack of comprehensive studies notwithstanding, this may be of interest for immunologists, neurologists, or even pharmacologists.

Although the basic biological and biomedical sciences still largely concentrate on a handful of laboratory-bred rodent and rabbit species, understanding basic biological processes requires an analysis of the multitude of solutions evolution offers in the diversity of species. For comparative biology, and equally for the expanding field of molecular disciplines, a rich pool of species is essential, as each animal group may be best suited to tackle a certain problem of life science. The prime ecological series of species differently adapted to living in swampy habitats or near or in water, are good examples, from the polecat (*Mustela putorius*) to minks (*Mustela lutreola* and *M. vison*), otters (Lutrinae) and, on a larger scale, even seals (Pinnipedia) in the arctoid lineage of carnivoran phylogeny; or from the marsh mongoose (*Atilax paludinosus*) and aquatic genet (*Osbornictis piscivora*) to otter civets (*Cynogale bennettii* and *C. lowei*) among the viverrids. These series offer prime opportunities to investigate the adaptation of mammals to aquatic life on all levels of biological organization, be it comparative anatomy, physiology, behaviour, or the molecular dimension.

As the data sheets in this Action Plan show, time is running short for gaining these insights, as important links in the species series cited above are already disappearing rapidly.

Chapter 2. Classification and Diversity of Mustelids and Viverrids

The principal goal of this document is to provide the basis for conservation action targeted to maintain the biological diversity represented in the mustelids and viverrids.

To provide a rational means for presenting an overview of the diversity found in these groups, we have chosen to follow the classification and nomenclature of Honacki et al. (1982) with three principal exceptions. First, some additions and departures are due to recently described taxa. In such cases we have added the taxon name as appropriate within the taxonomic hierarchy. Second, where systematists disagree as to whether a taxon should be recognized as a species or subspecies, we have chosen to list it as a species (see footnote[1]). This approach has been adopted to ensure that no taxon is overlooked or neglected when conservation action is called for. Third, because most books on wildlife ecology, behaviour, and conservation do not separate the mongooses from the other viverrids, we have elected to retain these animals as a subfamily (Herpestinae) in the family Viverridae. Adoption of a cladistic approach has not been followed because our primary focus is on the conservation, and not on the phylogeny, of these organisms. The rationale employed for accepting species and subspecies is presented in Appendix 4.

The species referenced in this Action Plan are presented below in the order used in Honacki et al. (1982). Common names are provided. Where appropriate, a few introductory comments are included. From this list the diversity exhibited in these groups is quite clear. As a further reflection of the level of intraspecific diversity and geographic variation found in these families, the approximate number of subspecies is cited in parentheses after the species names.

[1] The departures from Honacki et al. (1982) are as follows (authors whom we follow are added after the scientific name): Nilgiri marten (*Martes gwatkinsi;* see Pocock 1936a; Anderson, 1970; Prater 1980; Nowak and Paradiso 1983; Powell 1984), Javan ferret-badger (*Melogale orientalis;* see Everts 1968), Malabar civet (*Viverra civettina;* see Pocock 1941), Mentawai palm civet (*Paradoxurus lignicolor;* Groves in litt. 1986); Lowe's otter civet (*Cynogale lowei;* see Pocock 1933; Wemmer and Wozencraft 1984), Bengal mongoose (*Herpestes palustris;* see Ghose 1965), and black slender mongoose (*Herpestes nigratus;* see Thomas 1928; Watson and Dippenaar 1987). We do not recognize Hose's mongoose (*Herpestes hosei*) which is listed by Honacki et al. (1982) as a valid species because the type and only known specimen seems to be an aberrant individual of the short-tailed mongoose (*Herpestes brachyurus;* see Bechtold 1939; Van Rompaey, unpubl.). Hose's palm civet (*Diplogale hosei*) is retained here in a separate monotypic genus.

2.1 Mustelidae

Numbers of mustelid subspecies have been taken from Heptner and Naumov (1974; Palearctic species), Hall (1981; Nearctic species), Haltenorth and Diller (1977; Afrotropical species), Long and Killingley (1983; subfamily Melinae), Krumbiegel (1942; for the genus *Eira*) and Cabrera (1957; for *Galictis* and *Conepatus*).

So far, approximately 420 mustelid taxa have been described. Without doubt, further revisions will change this number, since some subspecies may not merit recognition. On the other hand, new subspecies continue to be described, such as the Hainan small-toothed ferret-badger (*Melogale moschata hainanensis*) in 1983.

The least weasel (*Mustela nivalis*) is the smallest living carnivore. (Photo by Reinhard-Tierfoto)

Subfamily Mustelinae

The Mustelinae include mainly small and slender mustelids. They are terrestrial hunters of small vertebrates but several, such as some martens (*Martes*), are excellent climbers. The smallest recent species of the order Carnivora, the least weasel (*Mustela nivalis*), belongs to this subfamily, as well as one of the largest mustelids, the wolverine (*Gulo gulo*).

Genus *Mustela*

Tropical weasel (*Mustela africana*) (Desmarest 1818) (2)
Colombian weasel (*Mustela felipei*) (Izor and de la Torre 1978)
Mountain weasel (*Mustela altaica*) (Pallas 1811) (4)
Stoat (*Mustela erminea*) (Linnaeus 1758) (37)
Long-tailed weasel (*Mustela frenata*) (Lichtenstein 1831) (42)
Yellow-bellied weasel (*Mustela kathiah*) (Hodgson 1835) (2)
Indonesian mountain weasel (*Mustela lutreolina*) (Robinson and Thomas 1917)
Least weasel (*Mustela nivalis*) (Linnaeus 1766) (20)
Malayan weasel (*Mustela nudipes*) (Desmarest 1822)
Siberian weasel (*Mustela sibirica*) (Pallas 1773) (15)
Back-striped weasel (*Mustela strigidorsa*) (Gray 1853)
European mink (*Mustela lutreola*) (Linnaeus 1761) (6)
Sea mink (*Mustela macrodon*) (Prentiss 1903) (extinct species)
American mink (*Mustela vison*) (Schreber 1777) (15)
Steppe polecat (*Mustela eversmanni*) (Lesson 1827) (8)
Black-footed ferret (*Mustela nigripes*) (Audubon and Bachmann 1851)
European polecat (*Mustela putorius*) (Linnaeus 1758) (15)

The beech marten (*Martes foina*) is a follower of man in large parts of its Eurasian range. Nevertheless, the population of Ibiza Island (Spain) probably disappeared recently and other island subspecies may be threatened. (Photo by Reinhard-Tierfoto)

The European mink (*Mustela lutreola*) is a globally threatened species with a small population surviving within the territory of the European Community, yet its precarious status has received very little attention. (Photo by Väino Silm and Tiit Maran/Tallinn Zoo)

Genus *Vormela*
Marbled polecat (*Vormela peregusna*) (Güldenstaedt 1770) (5)

Genus *Martes*
European pine marten (*Martes martes*) (Linnaeus 1758) (7)
Sable (*Martes zibellina*) (Linnaeus 1758) (19)
Japanese marten (*Martes melampus*) (Wagner 1841) (3)
American pine marten (*Martes americana*) (Turton 1806) (14)
Beech marten (*Martes foina*) (Erxleben 1777) (11)
Fisher (*Martes pennanti*) (Erxleben 1777) (3)
Yellow-throated marten (*Martes flavigula*) (Boddaert 1758) (9)
Nilgiri marten (*Martes gwatkinsi*) (Horsfield 1851)

Genus *Eira*
Tayra (*Eira barbara*) (Linnaeus 1758) (8)

Genus *Galictis*
Lesser grison (*Galictis cuja*) (Molina 1782) (4)
Greater grison (*Galictis vittata*) (Schreber 1776) (4)

Genus *Lyncodon*
Patagonian weasel (*Lyncodon patagonicus*) (Blainville 1842) (2)

Genus *Ictonyx*
Zorilla (*Ictonyx striatus*) (Perry 1810) (21)

Genus *Poecilictis*
North African striped weasel (*Poecilictis libyca*) (Hemprich and Ehrenberg 1833) (7)

Genus *Poecilogale*
African striped weasel (*Poecilogale albinucha*) (Gray 1864) (6)

Genus *Gulo*
Wolverine (*Gulo gulo*) (Linnaeus 1758) (7)

The colour patterns in the pelage of the elusive marbled polecat (*Vormela peregusna*) is subject to geographical variation. (Photo by Väino Silm and Tiit Maran/Tallinn Zoo)

Subfamily Mellivorinae

The honey-badger (*Mellivora*), the only species of this subfamily, is of special interest because of its symbiosis with honey-guides (*Indicator* spp.). These small birds lead their partner to the nest of bees. The strong honey-badger digs the bees nest out, and the larvae, honey, and wax are shared by both partners.

Genus *Mellivora*

Honey-badger (*Mellivora capensis*) (Schreber 1776) (15)

Subfamily Melinae

Whereas the outward appearance of ferret-badgers (*Melogale*) is reminiscent of some Mustelinae species, most badgers of this subfamily are stoutly built mustelids. They exhibit a tendency towards fossorial life and an omnivorous diet. The stink badgers (*Mydaus*) are notorious for secreting an evil-smelling fluid from special skin glands.

The Eurasian badger (*Meles meles*) is a very popular animal. However, we do not even know how many subspecies live in Europe. (Photo by Reinhard-Tierfoto)

Genus *Melogale*

Small-toothed ferret-badger (*Melogale moschata*) (Gray 1831) (6)
Large-toothed ferret-badger (*Melogale personata*) (I. Geoffroy St. Hilaire 1831) (5)
Javan ferret-badger (*Melogale orientalis*) (Horsfield 1821) (2)
Kinabalu ferret-badger (*Melogale everetti*) (Thomas 1895)

The American badger (*Taxidea taxus*) is widely distributed and not threatened as a species. However, it has disappeared from certain areas, and some populations, particularly in Mexico, are at risk. (Photo by Roland Wirth)

Genus *Meles*

Badger (*Meles meles*) (Linnaeus 1758) (19)

Genus *Arctonyx*

Hog badger (*Arctonyx collaris*) (F. Cuvier 1825) (6)

Genus *Taxidea*

American badger (*Taxidea taxus*) (Waterhouse 1839) (4)

Genus *Mydaus*

Malayan stink badger (*Mydaus javanensis*) (Desmarest 1820) (2)
Palawan stink badger (*Mydaus marchei*) (Huet 1887) (2)

Subfamily Mephitinae

The subfamily Mephitinae contains the skunks, which are well-known for their conspicuous black and white pelage and the evil odour they can emit when molested or menaced. Skunks are terrestrial hunters inhabiting a wide range of habitats.

Genus *Mephitis*

Striped skunk (*Mephitis mephitis*) (Schreber 1776) (13)
Hooded skunk (*Mephitis macroura*) (Lichtenstein 1832) (4)

Scent glands emitting an evil-smelling secretion are found in a number of small carnivores, such as this striped skunk (*Mephitis mephitis*). (Photo by Klaus Rudloff)

Genus *Spilogale*

Spotted skunk (*Spilogale putorius*) (Linnaeus 1758) (17)
Pygmy spotted skunk (*Spilogale pygmaea*) (Thomas 1898) (3)

Genus *Conepatus* (taxonomy to be considered preliminary)

Common hog-nosed skunk (*Conepatus mesoleucus*) (Lichtenstein 1832) (10)
Molina's hog-nosed skunk (*Conepatus chinga*) (Molina 1782) (7)
Patagonian hog-nosed skunk (*Conepatus humboldtii*) (Gray 1837) (3)
Eastern hog-nosed skunk (*Conepatus leuconotus*) (Lichtenstein 1832) (2)
Amazonian hog-nosed skunk (*Conepatus semistriatus*) (Boddaert 1784) (5)

Subfamily Lutrinae

The otters will be the subject of a separate conservation Action Plan to be compiled by the IUCN/SSC Otter Specialist Group.

2.2 Viverridae

The exact number of viverrid species, or even subspecies, is not yet known, and the systematic arrangement of the seven main viverrid groups differs in recent publications. The classification upon which this action plan is based comprises approximately 350 taxa (including the mongooses which are frequently treated as a separate family Herpestidae, see above). The subspecies numbers were taken from Wenzel and Haltenorth (1972), complemented by the subspecies described since (Crawford-Cabral 1971; Delibes 1977; Goldman 1984).

New species continue to be identified, the most recent ones being the flat-headed cusimanse (*Crossarchus platycephalus*) in 1984 and the giant striped mongoose (*Galidictis grandidieri*) in 1986.

Subfamily Viverrinae

The subfamily Viverrinae includes some medium-sized ground-living species, such as civets (*Viverra*), but also genera adapted to an arboreal life (especially the linsangs of the genera *Prionodon* and *Poiana*). *Osbornictis* is a monotypic aquatic genus.

The Malayan civet (*Viverra tangalunga*) is still common in southeast Asia. Two other civets of the Indomalayan genus *Viverra*, however, the Malabar civet (*V. civettina*) and the large-spotted civet (*V. megaspila*), occur in very low numbers, and are threatened. (Photo by Roland Wirth)

Genus *Viverra*

Large Indian civet (*Viverra zibetha*) (Linnaeus 1758) (4)
Malayan civet (*Viverra tangalunga*) (Gray 1832)
Malabar civet (*Viverra civettina*) (Blyth 1862)
Large-spotted civet (*Viverra megaspila*) (Blyth 1862)

Genus *Civettictis*

African civet (*Civettictis civetta*) (Schreber 1776) (4)

Genus *Viverricula*

Small Indian civet (*Viverricula indica*) (Desmarest 1817) (11)

Genus *Genetta* (taxonomy to be considered as preliminary)

Haussa genet (*Genetta thierryi*) (Matschie 1902)
Abyssinian genet (*Genetta abyssinica*) (Rüppell 1836)
Johnston's genet (*Genetta johnstoni*) (Pocock 1907)
Angolan genet (*Genetta angolensis*) (Bocage 1882) (3)
Southern genet (*Genetta felina*) (Thunberg 1811) (6)
Small-spotted genet (*Genetta genetta*) (Linnaeus 1758) (5)
Panther genet (*Genetta maculata*) (Gray 1830) (12)
Cape large-spotted genet (*Genetta tigrina*) (Schreber 1776) (2)
Servaline genet (*Genetta servalina*) (Pucheran 1855) (5)
Giant genet (*Genetta victoriae*) (Thomas 1901)

Genus *Osbornictis*

Aquatic genet (*Osbornictis piscivora*) (J.A. Allen 1919)

Genus *Poiana*

African linsang (*Poiana richardsoni*) (Thomson 1842) (3)

Genus *Prionodon*

Spotted linsang (*Prionodon pardicolor*) (Hodgson 1842) (2)
Banded linsang (*Prionodon linsang*) (Hardwicke 1821) (4)

The spotted linsang (*Prionodon pardicolor*) is one of several tropical species which, in spite of a large range, remains virtually unknown and could disappear without anybody noticing. (Photo by Roland Wirth)

The aquatic genet (*Osbornictis piscivora*) is one of Africa's least known mammals and has never been observed in the wild by a scientist. (Photo by Marc Colyn)

Subfamily Paradoxurinae

The palm civets and their allies form a subfamily which is, with the exception of the Afrotropical genus *Nandinia*, confined to the rain forests of tropical Asia. Most species are arboreal and largely frugivoruous.

Genus *Nandinia*

African palm civet (*Nandinia binotata*) (Gray 1830) (4)

Genus *Arctogalidia*

Small-toothed palm civet (*Arctogalidia trivirgata*) (Gray 1832) (12)

Genus *Paradoxurus*

Common palm civet (*Paradoxurus hermaphroditus*) (Pallas in Schreber 1777) (more than 30)
Brown palm civet (*Paradoxurus jerdoni*) (Blanford 1885) (2)
Golden palm civet (*Paradoxurus zeylonensis*) (Pallas in Schreber 1777)
Mentawai palm civet (*Paradoxurus lignicolor*) (Miller 1903) (2)

Genus *Paguma*

Masked palm civet (*Paguma larvata*) (Hamilton-Smith 1827) (13)

Genus *Macrogalidia*

Sulawesi palm civet (*Macrogalidia musschenbroekii*) (Schlegel 1877)

The African palm civet (*Nandinia binotata*) is the only African representative of an otherwise Asian subfamily of chiefly frugivorous viverrids. (Photo by Klaus Rudloff)

Genus *Arctictis*
Binturong (*Arctictis binturong*) (Raffles 1821) (7)

Subfamily Hemigalinae

The four genera classified as Hemigalinae contain some of the most elusive viverrids. All are inhabitants of southeast Asian rain forests. The otter civets (*Cynogale*) dwell near rivers and are to a large extent aquatic.

Genus *Hemigalus*
Banded palm civet (*Hemigalus derbyanus*) (Gray 1837) (4)

Genus *Chrotogale*
Owston's palm civet (*Chrotogale owstoni*) (Thomas 1912)

Genus *Diplogale*
Hose's palm civet (*Diplogale hosei*) (Thomas 1892)

Genus *Cynogale*
Otter civet (*Cynogale bennettii*) (Gray 1837)
Lowe's otter civet (*Cynogale lowei*) (Pocock 1933)

Subfamily Fossinae

The subfamily Fossinae is confined to Madagascar. Its only species exhibits several phylogenetically primitive characteristics and may show some affinities to the Hemigalinae. Sometimes, the fanalouc (*Eupleres;* see next subfamily) is also included in the Fossinae.

Genus *Fossa*
Malagasy civet (*Fossa fossana*) (P.L.S. Müller 1776)

Subfamily Euplerinae

The fanalouc has a specialized way of life, feeding predominantly on earthworms.

Genus *Eupleres*
Fanalouc (*Eupleres goudotii*) (Doyère 1835) (2)

Subfamily Cryptoproctinae

The fossa is the largest predator in Madagascar. Some aspects of its morphology are reminiscent of a cat species, a phenomenon which has elicited much debate among taxonomists.

Genus *Cryptoprocta*
Fossa (*Cryptoprocta ferox*) (Bennett 1833)

The fossa (*Cryptoprocta ferox*) is the largest predator in Madagascar. (Photo by Roland Wirth)

The yellow mongoose (*Cynictis penicillata*) from southern Africa lives in colonies of up to 50 or more individuals. Its underground tunnels and chambers have many entrances and exits, and definite areas within the colony are used for the deposit of body wastes. (Photo by Klaus Rudloff)

Subfamily Herpestinae

The mongooses form a distinctive and species-rich subfamily. They are small terrestrial carnivores and include the smallest viverrid, the dwarf mongoose (*Helogale*). Several species are exceptional among viverrids in being diurnal. Their social structures can be quite complex, ranging from temporary foraging aggregations to complex colonies. The meerkat (*Suricata*) lives in stable colonies and burrow systems similar to the colonies of some rodents such as prairie-dogs (*Cynomys*) or marmots (*Marmota*). The Malagasy mongooses (the first four genera listed below) are frequently separated as their own subfamily, the Galidiinae.

Genus *Galidia*

Malagasy ring-tailed mongoose (*Galidia elegans*) (I. Geoffroy Saint-Hilaire 1837) (3)

Genus *Galidictis*

Malagasy broad-striped mongoose (*Galidictis fasciata*) (Gmelin 1788) (2)

Giant striped mongoose (*Galidictis grandidieri*) (Wozencraft 1986)

Genus *Mungotictis*
Malagasy narrow-striped mongoose (*Mungotictis decemlineata*) (A. Grandidier 1867) (2)

Genus *Salanoia*
Malagasy brown-tailed mongoose (*Salanoia concolor*) (I. Geoffroy Saint-Hilaire 1839)

Genus *Herpestes*
Ichneumon (*Herpestes ichneumon*) (Linnaeus 1758) (9)
Indian grey mongoose (*Herpestes edwardsi*) (E. Geoffroy 1818) (5)
Javan mongoose (*Herpestes javanicus*) (E. Geoffroy 1818) (7)
Small Indian mongoose (*Herpestes auropunctatus*) (Hodgson 1836) (5)
Ruddy mongoose (*Herpestes smithii*) (Gray 1837) (2)
Bengal mongoose (*Herpestes palustris*) (Ghose 1965)
Short-tailed mongoose (*Herpestes brachyurus*) (Gray 1836) (6)
Indian brown mongoose (*Herpestes fuscus*) (Waterhouse 1838) (2)
Collared mongoose (*Herpestes semitorquatus*) (Gray 1846) (2)
Crab-eating mongoose (*Herpestes urva*) (Hodgson 1836) (4)
Stripe-necked mongoose (*Herpestes vitticollis*) (Bennett 1835) (2)
Slender mongoose (*Herpestes sanguineus*) (Rüppell 1835) (42)
Cape grey mongoose (*Herpestes pulverulentus*) (Wagner 1839) (5)
Black slender mongoose (*Herpestes nigratus*) (Thomas 1928)
Long-nosed mongoose (*Herpestes naso*) (de Winton 1901) (3)

Genus *Mungos*
Banded mongoose (*Mungos mungo*) (Gmelin 1788) (17)
Gambian mongoose (*Mungos gambianus*) (Ogilby 1835)

Genus *Crossarchus*
Cusimanse (*Crossarchus obscurus*) (F. Cuvier 1825)
Flat-headed cusimanse (*Crossarchus platycephalus*) (Goldman 1984)
Alexander's cusimanse (*Crossarchus alexandri*) (Thomas and Wroughton 1907) (2)
Ansorge's cusimanse (*Crossarchus ansorgei*) (Thomas 1910) (2)

Genus *Liberiictis*
Liberian mongoose (*Liberiictis kuhni*) (Hayman 1958)

Genus *Helogale*
Dwarf mongoose (*Helogale parvula*) (Sundevall 1846) (16)
Desert dwarf mongoose (*Helogale hirtula*) (Thomas 1904) (5)

Genus *Dologale*
Pousargues' mongoose (*Dologale dybowskii*) (Pousargues 1893)

Genus *Bdeogale*
Bushy-tailed mongoose (*Bdeogale crassicauda*) (Peters 1850) (5)
Jackson's mongoose (*Bdeogale jacksoni*) (Thomas 1894)
Black-footed mongoose (*Bdeogale nigripes*) (Pucheran 1855)

Genus *Rhynchogale*
Meller's mongoose (*Rhynchogale melleri*) (Gray 1865) (3)

Genus *Ichneumia*
White-tailed mongoose (*Ichneumia albicauda*) (G. Cuvier 1829) (5)

Genus *Atilax*
Marsh mongoose (*Atilax paludinosus*) (G. Cuvier 1829) (10)

Genus *Cynictis*
Yellow mongoose (*Cynictis penicillata*) (G. Cuvier 1829) (12)

Genus *Paracynictis*
Selous' mongoose (*Paracynictis selousi*) (de Winton 1896) (4)

Genus *Suricata*
Slender-tailed meerkat (*Suricata suricatta*) (Erxleben 1777) (7)

Chapter 3. The Threats Facing Mustelids and Viverrids

Although several species of mustelids and a few viverrids continue to be hunted for their valuable fur, and some viverrids for their meat, the most important single reason for the decline of whole species and genera is habitat destruction, mainly by encroachment into tropical forest habitats and wetland ecosystems. Moreover, this process leads to a fragmentation of populations which can prove detrimental to long-term survival. Another threat is posed by introduction of closely related subspecies or species, leading to competition or genetic introgression. In several species of concern, these threats cannot yet be evaluated for a severe lack of data (see Chapter 5, sections 5.2 and 5.3).

3.1 Habitat Destruction

Most of the mustelids and viverrids of conservation concern live in the tropical and subtropical regions of the earth. Even in the case of the Mustelidae, a predominantly temperate-zone family, most of the threatened species occur in the tropics. The destruction of tropical moist forests, hitherto used only to a small degree by man, is by far the most important single threat to both families. It is not known if selective logging alone will render a tropical rain forest habitat useless for arboreal viverrids or those hunting along or in shadowy, clear rain forest streams and rivers. However, it seems certain that the replacement of highly structured and species-rich forest systems by monotonous plantations of cash crops or badly managed subsistence agriculture with little cover will exclude the survival of most species. Only a few species are known to adapt easily to life in orchards and peasant estates, e.g. the common palm civet (*Paradoxurus hermaphroditus*) and several mongoose (*Herpestes*) species. It must not be forgotten that several species, although belonging to the order Carnivora, are frugivorous, perhaps depending on wild fruit-bearing trees (with the possibility of becoming pests in plantations).

Details of rain forest destruction need not be repeated here—they are well-known to conservationists. However, the uneven distribution of viverrid diversity within the rain forest belt must be emphasized. There are centres of diversity, often coinciding with similar distributional foci of other animal and plant groups. Unfortunately, these include some of the most endangered forests on earth. Whereas the species concentration in northeastern Zaire is perhaps not immediately threatened, the concentration in the Upper Guinea forests (centred on Liberia and Ivory Coast) and in the East African forest patches (remaining there as refuges from moister climatic periods in the past) are disappearing rapidly. This habitat fragmentation and loss means that conservation action is urgent. Comparable situations exist in the Malagasy forest belt along the eastern escarpment, in the forests of the Western Ghats in southwest India, in northern Vietnam, and in humid west Java. These few regions alone contain about two fifths of the mustelid and viverrid species presently thought to be threatened (see Chapter 6, section 6.3). The situation in these areas is particularly serious, as the conflict between man and forest is not simply one of the degree and modalities of logging, but also the need for more arable land. All conservation actions notwithstanding, the only long-term hope for mustelids and viverrids in these areas can come from development activities aimed at enabling people to live in harmony with their environment.

3.2 Fragmentation of Populations

The decline of a species, be it caused by habitat destruction or direct persecution, is usually associated with the fragmentation of once contiguous populations. Former centres of occurrence persist as isolated ranges, separated from each other by areas which have become unsuitable for the species.

One of the risks of such a distribution pattern arises from the fact that population numbers are never completely stable. The number of predators cycles along with the abundance of their prey species, and the population size of a species must be large enough to buffer such changes. Declines in populations may also be caused by fire, temporary climatic changes, or the outbreak of disease. It is worth mentioning here that mustelids and viverrids are susceptible to a number of diseases common to domestic dogs and cats. The outbreak of canine distemper brought the only known wild population of the black-footed ferret to the edge of extinction, with less than 20 animals surviving from a former remnant population of approximately 130. The minimum population size needed to guard against extinction by such factors depends on a large number of specific parameters, and is very difficult to estimate. However, it is clear that in animals such as the wolverine (*Gulo gulo*), with home ranges of individual animals of several hundred square kilometers, huge areas of suitable habitat are needed to ensure the long-term survival of a population.

Another risk resulting from population fragmentation is the interruption of gene flow between isolated groups. Animals within small populations will tend to become genetically similar. Among the several implied dangers, the animals will become more uniform in the genes contributing to resistance against various infectious diseases. If inbreeding results in the loss of important alleles conferring such resistance, the risk of a whole population succumbing to a single infection increases. This perspective should be seen against the background of increasing contact between mustelids and viverrids and domestic carnivores in developed areas. Moreover, in the long term, the possibility of evolutionary adaptations to changing environments will probably diminish if the genetic variability decreases. Our limited knowledge of the social structure of most threatened mustelids and viverrids prohibits conclusions on the population numbers required for conserva-

tion of the species' present genetic variability. However, it is obvious that in several cases, such as the wolverine (*Gulo gulo*), the European mink (*Mustela lutreola*), or the otter civet (*Cynogale bennettii*), the populations presently being protected by existing reserves may not be sufficient for this essential conservation aim.

3.3 Hunting and Trapping

As is outlined in the chapter on the cultural and economic significance of mustelids and viverrids, a number of species are hunted in considerable quantities, either for their fur or as food. Trapping of fur-bearing mustelids in the major producing countries in the Palearctic and Nearctic presently appears to be sustainable and does not threaten the survival of the harvested species. The ineffectively controlled trade in pelts of South American hog-nosed skunks (*Conepatus*) is of concern, however, and it might well endanger certain populations.

Hunting of viverrids for food is widespread in parts of Africa, but has not jeopardized the survival of species, as long as the density of hunters remains low and the habitats remain intact. However, the impact of hunting is growing with the rapid increase of the human population, and this results in a decrease in habitat quality, and the fragmentation of viverrid populations. This problem seems to be greatest in the Upper Guinea rain forests, but also in parts of Asia, such as China, Taiwan, and Vietnam. In these areas, hunting must be considered to pose a threat to several species.

"Accidental" killing of animals in traps that are directed to other species is of concern, if the target species is common and a rare mustelid or viverrid is taken. For example, accidental killing in traps set for muskrats (*Ondatra zibetha*), coypus (*Myocastor coypu*) or feral American minks (*Mustela vison*) is one of the major threats to the survival of the European mink (*Mustela lutreola*) in France.

A comparable problem arises from the persecution of prey species of mustelids and viverrids. Not surprisingly, the extermination or great reduction in numbers of key prey species can lead to the extinction of a specialized carnivore, as is demonstrated by the decline of the black-footed ferret (*Mustela nigripes*), which is thought to have resulted from the persecution of prairie dogs (*Cynomys*).

3.4 Genetic Introgression

Genetic introgression results from the introduction of animals within the range of closely related species or subspecies, which are capable of hybridization with the introduced form. Depending on the success of the colonizing species, this process can rapidly have a significant impact on the gene pool of the original population.

Although not yet widely recognized as a conservation problem, genetic introgression should be taken seriously, since even a small degree of genetic introgression can lead to the loss of the distinctiveness of a taxon (or contribute to its extinction by changing genetically determined characters which are the result of a population's adaptation to its environment). Although no data about this far-reaching consequence of introgression are available for mustelids and viverrids, Greig (1979) gives a popular discussion of this problem in mammals.

Genetic introgression is a real or potential threat to several mustelid and viverrid populations. Surprisingly, some of the most common species are affected. The common palm civet (*Paradoxurus hermaphroditus*) is a widespread follower of man in tropical Asia. It is an esteemed pet and has been introduced to a number of islands. There exist a number of subspecies endemic to tiny islands in Indonesia and Malaysia, but the extent to which these might already have been affected by hybridization is unknown.

Genetic introgression might also be caused by conservation activities, a fact that tends to be overlooked. The restocking of depleted populations with captive-bred animals, or the release of confiscated individuals, is often carried out without knowing the exact geographic origin of the released animals. The restocking of sable (*Martes zibellina*) in many parts of the U.S.S.R., which was very successful in terms of rescuing this species after a long period of excessive trapping, probably resulted in the extinction of some subspecies through hybridization with released exotic stock. It is obvious that this problem needs very careful evaluation in the context of IUCN's policy in relation to sustainable utilization of wildlife. This approach often coincides with the establishment of game farms with animals originating from populations other than the local ones, or the introduction of animals from populations which are economically the most desirable ones, to the range of other subspecies. Guidelines need to be drawn up in order to minimize associated conservation problems.

Chapter 4. Accounts of Mustelids and Viverrids Known or Likely to be Threatened

4.1 List of Species and Subspecies of Conservation Concern

The following is the list of species and subspecies of conservation concern, each of which is discussed in detail in section 4.2.[1]

Palearctic Realm

Mustelids

European mink (*Mustela lutreola*)
European marbled polecat (*Vormela peregusna peregusna*)
Tsushima marten (*Martes melampus tsuensis*)
Wolverine (*Gulo gulo* ssp.)

Viverrids

Ibiza small-spotted genet (*Genetta genetta isabelae*)

Nearctic Realm

Mustelids

Black-footed ferret (*Mustela nigripes*)
Wolverine (*Gulo gulo* ssp.)
Big-Thicket hog-nosed skunk (*Conepatus mesoleucus telmalestes*)

Indomalayan Realm

Mustelids

Indonesian mountain weasel (*Mustela lutreolina*)
Back-striped weasel (*Mustela strigidorsa*)
Taiwan yellow-throated marten (*Martes flavigula chrysospila*)
Javan yellow-throated marten (*Martes flavigula robinsoni*)
Nilgiri marten (*Martes gwatkinsi*)
Javan ferret badger (*Melogale orientalis* ssp.)
Kinabalu ferret badger (*Melogale everetti*)

Viverrids

Malabar civet (*Viverra civettina*)
Large-spotted civet (*Viverra megaspila*)
Spotted linsang (*Prionodon pardicolor*)
Javan small-toothed palm civet (*Arctogalidia trivirgata trilineata*)
Kangean common palm civet (*Paradoxurus hermaphroditus kangeanus*)
Mentawai palm civet (*Paradoxurus lignicolor*)
Golden palm civet (*Paradoxurus zeylonensis*)
Brown palm civet (*Paradoxurus jerdoni* ssp.)
Sulawesi palm civet (*Macrogalidia musschenbroekii*)
Mentawai banded palm civets (*Hemigalus derbyanus minor* and *H. d. sipora*)
Hose's palm civet (*Diplogale hosei*)
Owston's palm civet (*Chrotogale owstoni*)
Otter civet (*Cynogale bennettii*)
Lowe's otter civet (*Cynogale lowei*)
Sumatran collared mongoose (*Herpestes semitorquatus uniformis*)

Malagasy Realm

Viverrids

Malagasy civet (*Fossa fossana*)
Fanaloue (*Eupleres goudotii* ssp.)
Malagasy broad-striped mongoose (*Galidictis fasciata* ssp.)
Giant striped mongoose (*Galidictis grandidieri*)
Malagasy narrow-striped mongoose (*Mungotictis decemlineata* ssp.)
Malagasy brown-tailed mongoose (*Salanoia concolor*)
Fossa (*Cryptoprocta ferox*)

Afrotropical Realm

Viverrids

Abyssinian genet (*Genetta abyssinica*)
Johnston's genet (*Genetta johnstoni*)
Giant genet (*Genetta victoriae*)
Aquatic genet (*Osbornictis piscivora*)
Leighton's linsang (*Poiana richardsoni liberiensis*)
Ansorge's cusimanse (*Crossarchus ansorgei* ssp.)
Liberian mongoose (*Liberiictis kuhni*)
Pousargues' mongoose (*Dologale dybowskii*)
Sokoke bushy-tailed mongoose (*Bdeogale crassicauda omnivora*)
Jackson's mongoose (*Bdeogale jacksoni*)

Neotropical Realm

Mustelids

Colombian weasel (*Mustela felipei*)
Tropical weasel (*Mustela africana* ssp.)
Grey-headed tayra (*Eira barbara senex*)
Pygmy spotted skunk (*Spilogale pygmaea* ssp.)

[1] The biogeographical classification and nomenclature adopted in this conservation action plan follows the system of Udvardy (1975) which is generally applied by IUCN.

4.2 Data Sheets of Mustelids and Viverrids of Conservation Concern

Palearctic Realm

Mustelidae

European mink (*Mustela lutreola*). (Photo by Väino Silm and Tiit Maran/ Tallinn Zoo)

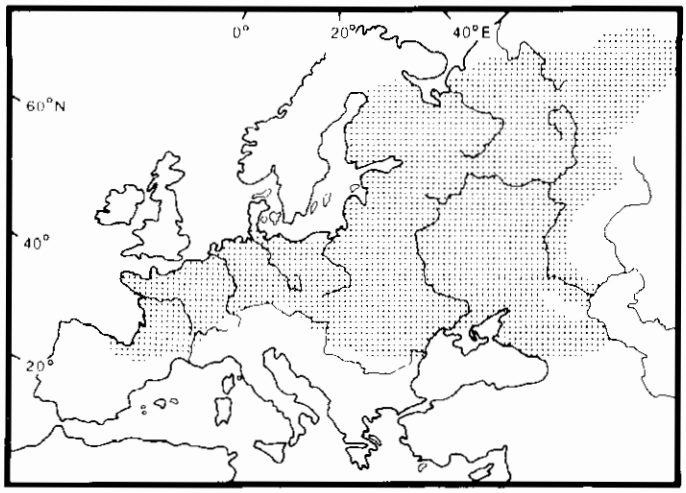
European mink (*Mustela lutreola*)

The European mink (*Mustela lutreola*) is the only native European mustelid, apart from the otter (*Lutra lutra*), that is adapted to a semiaquatic life. Heptner and Naumov (1974) list five subspecies (*M. l. lutreola, M. l. novikovi, M. l. turovi, M. l. cyclipena*, and *M. l. transsylvania*) for the U.S.S.R. and neighbouring countries but state that the last two, at least, are of doubtful validity. The minks of western France are also sometimes treated as a separate subspecies, *M. l. biedermanni*. Youngman (1982) denies the validity of any subspecies.

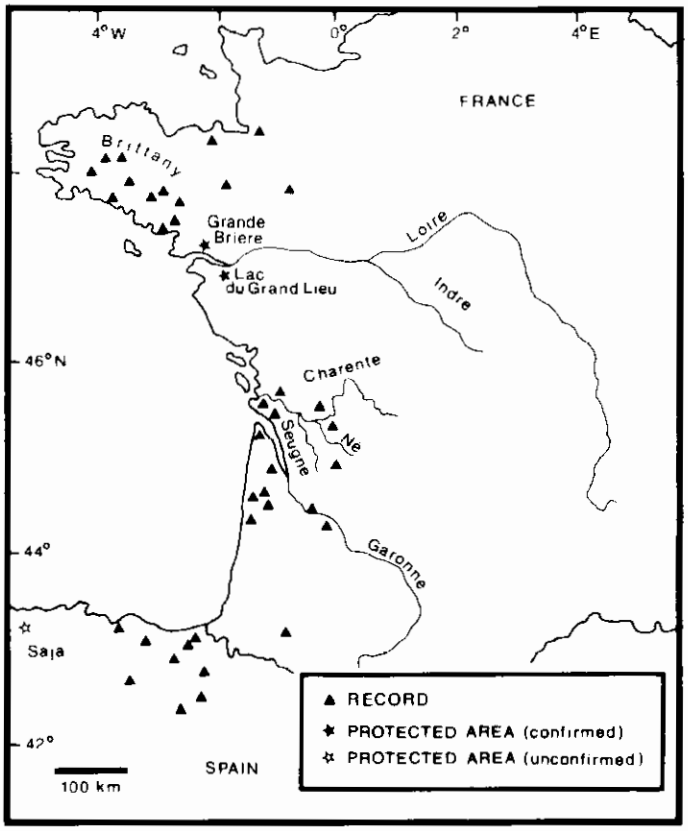
The American mink (*M. vison*) is among the most valuable fur animals and is bred in many commercial farms. The possible value of its European congener for breeding purposes should not be discounted.

Distribution: Before the present decline, *M. lutreola* occurred in non-Mediterranean France and in adjacent provinces of northwestern Spain, in northern and eastern Germany, Poland, eastern Austria, Czechoslovakia, the east of Yugoslavia, Hungary, Bulgaria, northern Romania, central and southern Finland and the western parts of the U.S.S.R., ranging to the east to about 75° E in west Siberia and south to the Caucasus (see Map 1a). The European mink is now extinct or greatly reduced over a considerable part of the original range, with confirmed records only from the following countries: U.S.S.R., Romania, France, Spain, and possibly Finland.

Status: In many parts of the European mink's range, the feral American mink (*Mustela vison*) also occurs, having escaped from fur farms. Both species look similar, and in the following sections,



Map 1a. Original distribution of the European mink (*Mustela lutreola*) following Youngman (1982).



Map 1b. Recent records of European mink in France and Spain according to data from Braun (in litt. 1988) and Garcia and Sancho (1983). There are additional reserves adjacent to Saja National Reserve which may protect the species.

the only records that have been incorporated are those by zoologists who are confident that the possibility of misidentification has been excluded (or at least rendered very unlikely).

France: The range of the mink in France includes the western part from Normandy in the north to the Spanish border. Van Bree and Saint Girons (1966) give a detailed account of the mink's French range prior to 1966. Recent records (the years of the last records are given in brackets)

come from the following departments (Braun in litt. 1986; see Map 1b): Morhiban (1982, 1984, and 1986), Ille et Villaine (1984, 1986), Loire-Atlantique (1984), Manche (1976, 1977), Charente (1983) and Charente-Maritime (1978), Mayenne (1977), Dordogne (1984), Gironde (1983), Lot et Garonne (1984), and Pyrénées Atlantiques (1984). Only two regions are reported to still contain significant populations of the European mink: Brittany and southwestern France. In Brittany (Braun in litt. 1987), the northeast, central, and southern parts of the department of Morhiban are thought to be the species' stronghold (particularly the marsh of Noyalo), with about 10 sightings or records of captured or road-killed individuals during the 1980s. The last record from the partly protected Brière marshes (Loire-Atlantique) dates back to 1984, when two or three minks drowned in eel traps. A single specimen was seen south of Rennes (district of Saint-Erblon) in the department of Ille et Villaine in 1984, and another one was trapped in this department in 1986. Smaller but unconfirmed populations are suspected to persist in other parts of Brittany. One mink was killed in Côtes du Nord in 1971, the only recent record from this department which may have contained the largest Brittanic population, as around 50 minks were killed annually there from 1930-1970. In the southwest, Chanudet (in litt. to Braun) reports the species as being "quite common" in Charente-Maritime (on the rivers Charente and Caran, and in the valleys of Soute and of Seugne) and in Charente (on the rivers Beau and Né). Most records are of animals which had been accidentally trapped, thus demonstrating an obvious threat. Gironde is another department with a high number of records, the most recent one from 1983.

In many parts of the French range of *M. lutreola*, the introduced American mink also occurs. Although a direct impact of the feral *M. vison* on the European species through competition is controversial, and hybridization has not yet been confirmed, the damage that this introduced species has caused in fish ponds and poultry farms has led to increased trapping, shooting, and poisoning efforts. In Brittany alone, 1,000-1,500 American minks are killed annually (Braun in litt. 1987). In the department of Morhiban, feral American minks are classified as pests. The most serious problem is the widespread use of unselective trapping methods for the control of feral minks, muskrats, and coypus; cage-traps which would allow the release of unintentionally caught *M. lutreola* are used by a minority of trappers. Traps of the steel-jaw type are most commonly set. Frequently these do not even have rubber covers on the trap jaws, which means that the leg of the captured animal is severely wounded. Muskrats and coypus with a missing foot have been found. Drowning in fish traps and collision with vehicles are further causes of unintentional kills. Drainage of marshlands is another negative factor. In France, the European mink is protected by law (Article I of the decrete of 25th November 1977). The European mink is included in Appendix II of the Convention on the Conservation of European Wildlife and Natural Habitats, to which France is a party.

Spain: The first record of the mink in Spain was published only in 1955 (Youngman 1982; Alvarez et al.). It is confined to a comparatively small area in the north, ranging from Navarra in the east to Asturias in the west (see Map 1b). Garcia and Sancho (1983), Delibes (1983), Noval (1985), and Nores and Vásquez (1987) provide further information. Specimens have been captured inside towns and in heavily polluted rivers. In Spain, the European mink is protected by law (Real Decreto 3181/1980).

European Community apart from France and Spain: Extinct. The last west German minks are said to have persisted along the Aller River near Wolfsburg (Lower Saxony) until at least 1948.

German Democratic Republic: Extinct.

Poland: The last specimens were collected in 1915 and there is a record from northern Poland from 1926. Ratajszczak (in litt. 1987) writes that although the mink is generally considered extinct in Poland since the second world war, it possibly survives in small numbers. A good deal of suitable habitat is available in the country and there is no apparent reason why the species should be extinct; it still occurs in neighbouring Bialorusia (Tumanov and Zverev 1986).

Austria: No recent records.

Hungary: The most recent specimen was collected in 1952 near Lake Balaton (Youngman 1982).

Bulgaria: The last two records date back to 1938 and 1951 and the species is listed as extinct in the Bulgarian National Red Data Book (Romanowski in litt. 1987).

Romania: A large population is reported from the Danube delta where the mink is still captured by trappers.

Czechoslovakia: Several reports of mink were made in the 1950s but were not supported by specimens.

Yugoslavia: The only record came from Vojvodina, eastern Yugoslavia, in 1941 (Krystufek in litt. 1987).

Finland: Unpublished surveys of the Finnish Game and Fisheries Research Institute recorded the European mink from numerous localities in Finland as recently as 1981 (Youngman 1982). Pulliainen (in litt. 1987) considers the mink to be extinct in Finland.

U.S.S.R.: Although this is the major stronghold of the species, even here a decrease, which began in the 1950s, is apparent (Tumanov and Zverev 1986; Kaal and Maran in litt. 1988). Heptner and Naumov (1974) report that the European otter (*Lutra lutra*) greatly affects *M. lutreola* and in areas where the otter increases, European mink populations decrease. They also indicate that the introduced American mink (*Mustela vison*) outcompetes *M. lutreola*. In contrast, Tumanov and Zverev (1986) could not find any evidence of a negative impact of American minks on *M. lutreola* populations. Tumanov and Zverev (1986) collected their data with the help of a questionnaire from hunters, and it is therefore unknown if the two species of mink (which frequently occur side by side in the same localities) were correctly identified. Recognizing these shortcomings, these authors calculate that about 40,000-45,000 European minks

still survive in the U.S.S.R. Considering the continuing downward trend and the fragmentation of the remnant populations, this number is no reason for complacency. The major remaining stronghold of the mink is the region of the rivers Wasuwa, Ugra, Sosh, Oster, Chmara, Wolga, and western Dwina in the districts of Kalinin, Smolensk, Kostroma and Jaroslawe, lying northwest of Moscow. This area is supposed to contain about half of all European minks in the U.S.S.R. The population density varies from 0.2 to 0.7 specimens per kilometer of river bank, or between 2.45 and 2.48 per 1,000 ha. In all other districts and autonomous republics west of the Urals, the numbers of *M. lutreola* have declined to densities below 0.1 specimens per 1,000 ha. The possibly distinctive populations of the Caucasus are reported as being close to extinction. The species is believed to be extinct in western Siberia, northern Kazakhstan, and the Moldowian, Baschkirsic, and Tartaric autonomous republics. It has occasionally been suggested that *M. lutreola* has recently extended its range into Siberia (i.e. Heptner and Naumov 1974), but this hypothesis is doubted (Maran in litt. 1988). In 1983, European minks were released on Kunaschir Island and later also on Urup Island, by the Biological Institute of the Siberian Department in the U.S.S.R. Academy of Sciences. The Kuriles are outside the natural range of *M. lutreola* but the species has adapted well to the local conditions. The introduction of this alien predator is thought to threaten the local herpetofauna, which includes some species listed in the U.S.S.R. Red Data Book (Maran in litt. 1988).

The main reason for the European mink's decline in the U.S.S.R. (and probably elsewhere) is the alteration of its habitat, namely densely vegetated river courses and other wetlands. The American mink is known to suffer from environmental pollution caused by chlorinated hydrocarbons (PCBs) which may even cause infertility.

Status in captivity: Two European minks are currently kept in Leningrad Zoo, U.S.S.R. (Maran in litt. 1988), and in 1987, 12 European minks were kept at Talinn Zoo, also U.S.S.R., four of which had been born in that zoo (Spitsin and Kaal in litt. 1987). In another breeding colony in Novosibisrk (Siberian Academy of Sciences), 17 litters were bred from two males and two females, consisting of 32 male and 28 female offspring. One case of unsuccessful hybridization with the American mink is reported: copulation took place, but the embryos were absorbed (Ternovskij 1977, as translated by Romanowski in litt. 1988). A few *M. lutreola* have been held and bred by a private breeder in Brière, France (Braun in litt. 1987), and hybrids with *M. vison* were reported to have been born there, although this requires confirmation. Zoo records indicate that European minks were kept at Lisbon (Portugal) in 1958, Berlin (Germany) from 1931-1935, and Frankfurt (West Germany) from 1953-1956 (Jones in litt. 1987).

Occurrence in protected areas: There are numerous reserves in the U.S.S.R. which are likely to contain mink populations (Wirth 1981; IUCN 1971 and 1982; Harroy 1972; Dupont 1976). Records are known from Lahemaa National Park (64,911 ha) in Estonia and the Nature Reserves of Tsentralno-Lesnoi (21,348 ha), Karpatskii (18,544 ha), Dunaiskie Plavni (14,851 ha), and Kanevskii (1,800 ha). In Cernomora Nature Reserve (9,695 ha), the most recent European mink was seen in 1983 (Maran in litt. 1988). Ritsa-Avakhar (15,923 ha) and Adzhametsky (4,868 ha) Nature Reserves in the Georgian S.S.R. are further protected areas with published records of *M. lutreola*. A large population is recorded from the Danube delta (Romania), where some areas totalling about 40,000 ha have been gazetted as reserves. In 1984, two or three minks drowned in fish traps within the Parc Naturel Régional de Grande Brière (40,000 ha), a semi-protected area in western France, and they also occur in the Lake of Grand Lieu Nature Reserve (2,700 ha) in Brittany (Braun in litt. 1988) and presumably in the Réserve Naturelle de la Domaine de Chérine (145 ha), where one specimen was observed in 1982 (Reille and Bonnin Luquot 1987). The Reserva Nacional de Caza de Saja (16,000 ha), southwest of Santander, Spain, and adjacent protected areas such as Covadonga National Park (16,925 ha) possibly also protect this species (Blas Aritio in Youngman 1982; Duffey 1982).

Recommended action:

- Protection of sufficiently large areas of suitable habitat, especially in the three known remaining distribution centres: western France, the Danube delta in Romania, and the area northwest of Moscow.
- Of particular importance is the clarification of whether the European and the American mink species successfully hybridize,[1] and whether they compete for essential resources.
- Research into a possible role of pesticide pollution in the European mink's decrease.
- The managers of *Mustela vison* farms within the range of the European mink should be asked to minimize the risk of creating new unintended feral populations of escaped American minks.
- Surveys are recommended to define more accurately the distribution of mink populations and remaining habitats, particularly of the presumably distinctive Caucasian mink population (*M. l. turovi*).
- Only cage traps should be used for capturing feral American minks, as they allow the release of accidentally trapped *M. lutreola* (and otters). Indiscriminate ways of killing, such as gin traps or shooting, should be banned.
- A more embracing study of mink taxonomy is desirable in order to obtain a more unambiguous understanding of the species's geographic variation.
- In France, a better state of information allows the recommendation of special activities to increase public awareness of the European mink's fate: these are listed in detail in Chapter 6 (Section 6.4).

[1] It has been suggested that American mink males come into breeding condition earlier than males of *M. lutreola*. It is hypothesized that they can fertilize European mink females, and although the hybrid embryo always dies before birth, it develops long enough to prevent fertilization of the females by males of their own species (Maran in litt. 1988).

European marbled polecat (*Vormela peregusna peregusna*). (Photo by Väino Silm and Tiit Maran/Tallinn Zoo)

European marbled polecat (*Vormela peregusna peregusna*)

Vormela p. peregusna is the subspecies of the marbled polecat with the most westerly distribution, and the only one occurring in Europe. This species is closely associated with the rapidly retreating European continental steppes.

Distribution: The historical range included the southern steppe regions of the European parts of the U.S.S.R. (from the Black Sea to the pre-war Polish border) and Ciscaucasia, Bulgaria, the Dobrudja area of Romania, the Thrace and Macedonia provinces of Greece, European Turkey, and eastern and southern Yugoslavia. The taxonomic status of *Vormela* populations in Transcaucasia is uncertain (see Map 2).

Status:

U.S.S.R.: Extinct over the western part of its original Soviet range. Atanassov (1966) gives the easternmost periphery of Ukraine as the western range limit, together with the Poltava, Woroschilovgrad, and Wolgrad regions. According to Maran (in litt. 1988), the western range limit has retreated eastwards to a line from Odessa, Kirovograd, and Tsirigin in the province of Tsherkassy to the town of Bogodukhor in Harkov province. The shores of the eastern Black and Azov Seas delimit the range in the south. The northern limit of this subspecies' distribution is now 350-600 km further to the south of what it used to be one or two centuries ago (Heptner and Naumov 1974). There is now a gap of at least 800 km between remaining populations of *V. p. peregusna* in the U.S.S.R. and surviving populations in Bulgaria and Romania.

Romania: No status information exists for Romania, where the species occurs in North Dobruja in the south-east of the country; it used to be hunted throughout the year without restriction (Atanassov 1966).

Bulgaria: The marbled polecat occurs locally all over Bulgaria, but is more numerous in Dobruja in the east. It is protected by law, but illegal hunting is known to occur (Romanowski in litt. 1987).

Yugoslavia: In Yugoslavia, where the marbled polecat has always been rare, the Danube forms the northernmost boundary of its range. There is no evidence of a decline in this country (Krystufek in litt. 1987).

Albania: Records are lacking from Albania.

European Turkey: *Vormela* occurs in some parts of European Turkey, as detailed by Atanassov (1966).

Greece: In Greece the status was described as "insufficiently known" in 1982 (Antipas in litt. to IUCN 1982).

The species is listed in the Red Data Books of the U.S.S.R., Ukrainia S.S.R., Kazakh S.S.R. and Bulgaria.

The cause of the European marbled polecat's decline is not known with certainty. Atanassov (1966) includes steppe areas, but also orchards, fields and vineyards among the Bulgarian habitats, and stresses the species's preference for dry and open biotopes. Most steppe areas in the Balkans and Ukraine are now occupied by intensive agriculture. One is tempted to compare *Vormela's* fate with the situation of the Nearctic black-footed ferret (*Mustela nigripes*), which is now extinct in the wild due to conversion of its prairie habitat and by a reduction of the number of prairie dog colonies, which provided food and shelter for the species. Maran (in litt., 1988) believes the decrease of steppe rodents and extensive agricultural activities to be the main causes for the species' decline

Map 2. Historic records (black triangles) of the European marbled polecat (*Vormela p. peregusna*) following Miric et al. (1983) for Yugoslavia, Atanassov (1967) for the rest of the Balkans, and Heptner and Naumov (1974) for the U.S.S.R. The dotted line denotes the original northern edge of the marbled polecat's range. Anatolia and the Near East are inhabited by a different subspecies (*V. peregusna syriaca*). It is not known which race occurs in Transcaucasia. Only four protected areas are known to include the European subspecies (black stars), though it could also survive in Cernomora Nature Reserve (open star). There are additional reserves in Transcaucasia.

in the U.S.S.R. Of the various marbled polecat subspecies, only *V. p. syriaca* in Israel has been studied relatively well. Ben-David (pers. comm. 1987) found that the animals' main food in summer are large insects, particularly mole crickets (*Gryllotalpa*), whereas during the winter they depend on small rodents such as voles and mice. In Israel, *V. p. syriaca* is quite common in irrigated areas and citrus plantations (Mendelssohn in litt. 1987). In central Asia, *Vormela* lives in the subterranean tunnel systems of the great gerbil *Rhombomys opinus* (Heptner and Naumov 1974).

Status in captivity: Marbled polecats have infrequently been kept in captivity, including recently at Tel Aviv University (Israel), Ankara Zoo (Turkey), Tallinn Zoo (U.S.S.R.), and Wielkopolski Zoo Park, Poznan (Poland). Successful breeding of *V. p. syriaca* was achieved by Mendelssohn (in litt. 1987) 15 years ago and in 1987. At Novosibirsk Zoo (U.S.S.R.), seven animals of unknown subspecies were raised in 1982. Among older records are those from Frankfurt (West Germany) from the 1960s and 1970s and Antwerp (Belgium) from 1952-1953. Berlin (West Germany) has kept several specimens over the years (Jones in litt. 1987).

Occurrence in protected areas: In the U.S.S.R., the species is protected in the Ukrainski Stepni (1,634 ha) and Lugansky (1,580 ha) Nature Reserves in Ukraine. The last record from Cernomora Nature Reserve (9,695 ha), Ukraine, dates from 1964 (Maran in litt. 1988). There are additional records from Sevan National Park (150,000 ha) and Ag-Helsk Nature Reserve (9,100 ha). However, we do not know which subspecies of the marbled polecat occurs there (Sokolov and Bannikov 1985). In Bulgaria, *V. p. peregusna* has been observed in the Ropotamo River National Park (847 ha) and in Srebarna Pelican Reserve (600 ha). Other reserves within the marbled polecat's range lack records.

Remarks: The species as a whole ranges through the steppe and subdesert zones from southeast Europe to western China, south to Palestine and Baluchistan. A second subspecies, *V. p. pallidior*, is also listed in the Soviet Red Data Book, but as the range of this subspecies extends into Dsungaria and Mongolia—areas with a low human population—this form is probably not threatened outside the U.S.S.R. The same may apply to the Pakistan population, which has been considered for inclusion in the CITES appendices due to a presumed threat from the fur trade.

Vormela is variable, and a large number of subspecies have been described. The western populations, here included in the nominate subspecies following Heptner and Naumov (1974), were separated as *V. p. euxina* by Pocock (1936c), on the basis of colouration peculiarities. *V. p. euxina* inhabited the Balkans, the Ukraine and the southern Russian S.S.R. Of its former range, only the populations in the Balkans, and (possibly, if this is still *euxina*) in eastern Ukraine remain.

Recommended action:

- Investigations to understand better the European marbled polecat's present distribution and the reasons for its decline, as well as research into its natural history, particularly the supposed close association with social rodents in some regions.
- Conservation of representative samples of the remaining eastern European steppe habitats.

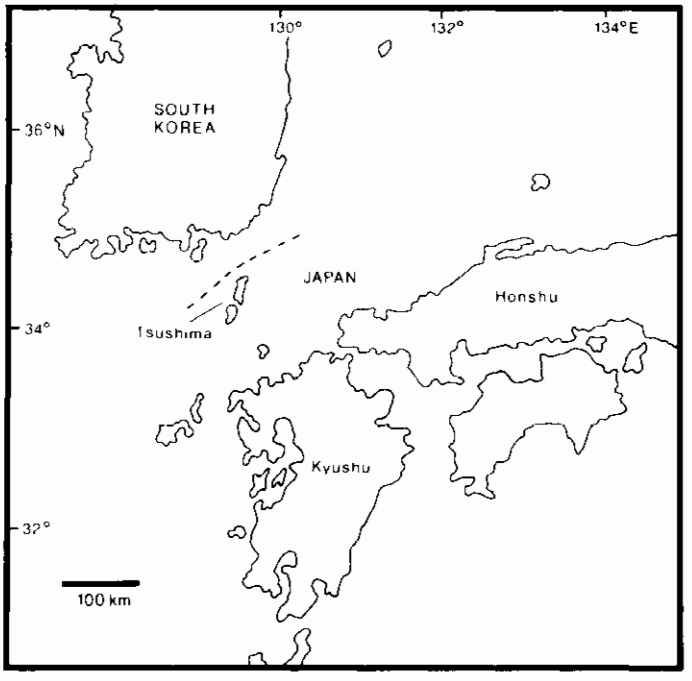
Tsushima marten (*Martes melampus tsuensis*)

The Japanese marten (*Martes melampus*) is endemic to a number of Japanese islands. It is also reported in Korea, but there is disagreement as to whether or not the populations on the Asian mainland are human introductions.

Several subspecies have been described, but the actual geographic variation of *M. melampus* is far from clear. The small number of museum specimens renders any final taxonomic decision difficult, but two of us have had the opportunity to compare a small series of skins from Tsushima Island in the British Museum of Natural History with *M. melampus* from other islands. The animals from Tsushima (*M. m. tsuensis*) were consistently different from conspecifics with a whitish rather than yellowish throat patch, which also differs in showing an infusion of large grey blotches from the belly. Obara (in litt. 1988) confirms the distinctiveness of this form from any other marten population in Japan.

Distribution: Endemic to Tsushima Island (702,900 ha), Japan (see Map 3).

Status: *Martes melampus tsuensis* is included here due to its restricted distribution. Judging from faeces, the marten is still distributed throughout most of Tsushima Island, albeit sparsely. It is thought to prefer broad-leaved deciduous forests and includes relatively more plant matter in its food than other martens (Tatara in litt. 1988). Tsushima Island used to be covered by deciduous forests, dominated by oaks (*Quercus*), and although most of the island is still forested (about 90% forest cover), a third now consists of coniferous plantations. Nowak and Paradiso (1983)



Map 3. Location of Tsushima Island, home of the endemic Tsushima marten (*Martes melampus tsuensis*).

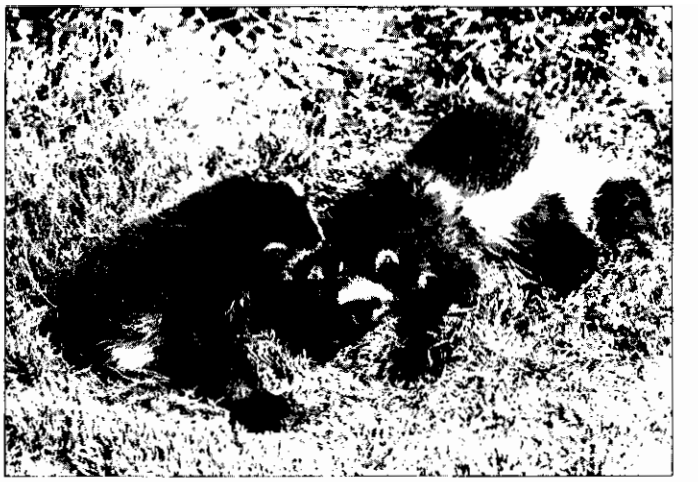
mention that *Martes melampus* is affected by excessive fur trapping and the harmful influence of pesticides. According to Tatara (in litt. 1988), however, the Tsushima marten is not hunted, because it has been granted official protection by its designation as a "precarious natural product" by the Agency of Cultural Affairs in 1971.

Status in captivity: No records.

Occurrence in protected areas: Not known.

Recommended action:

- An assessment of the marten's status and Tsushima Island's ecosystems is needed for conservation planning.



Young Scandinavian wolverines (*Gulo gulo gulo*). (Photo by Hans-Ove Larsson)

Wolverine (*Gulo gulo*)

The natural history of the wolverine (*Gulo gulo*), one of the largest mustelids, is in several aspects akin to that of a bear, and an old tale says that if a female bear gives birth to four cubs, the fourth will be a wolverine. Its strength, ferocity, and cunning, as well as its often exaggerated "gluttonous behaviour" have impressed the human inhabitants of its range since early history.

Heptner and Naumov (1974) distinguish three different Eurasian subspecies. They are, from west to east, *G. g. gulo, G. gulo sibiricus*, and *G. gulo albus* (variation is essentially clinal with a tendency for lighter coloured individuals to become more common towards the east). The Kamchatka wolverine (*G. gulo albus*) is a relatively well-marked subspecies. The four American subspecies, *G. gulo luscus, G. gulo katschemakensis, G. gulo luteus*, and *G. gulo vancouverensis* are well separated in craniological characters from the Eurasian populations.

Distribution: The enormous range of the wolverine reaches from Scandinavia through the European U.S.S.R. and Siberia to Alaska, Canada and the western lower states of the U.S.A. south to California (see Maps 4b and 4c). The present range includes territory of the following countries: Norway, Sweden, Finland, U.S.S.R., Mongolia, China, Canada, and U.S.A. The following paragraphs present a more detailed account of the distribution.

Norway: Widespread in the northern mountain chains, with isolated populations in the southern mountains (for example Rondane and Hardangervidda; see Map 4a, and Kvam et al. 1988).

Sweden: Mountain areas from Jämtland northwards (with some individuals wandering further south). Most wolverines live in the national parks of Lapland.

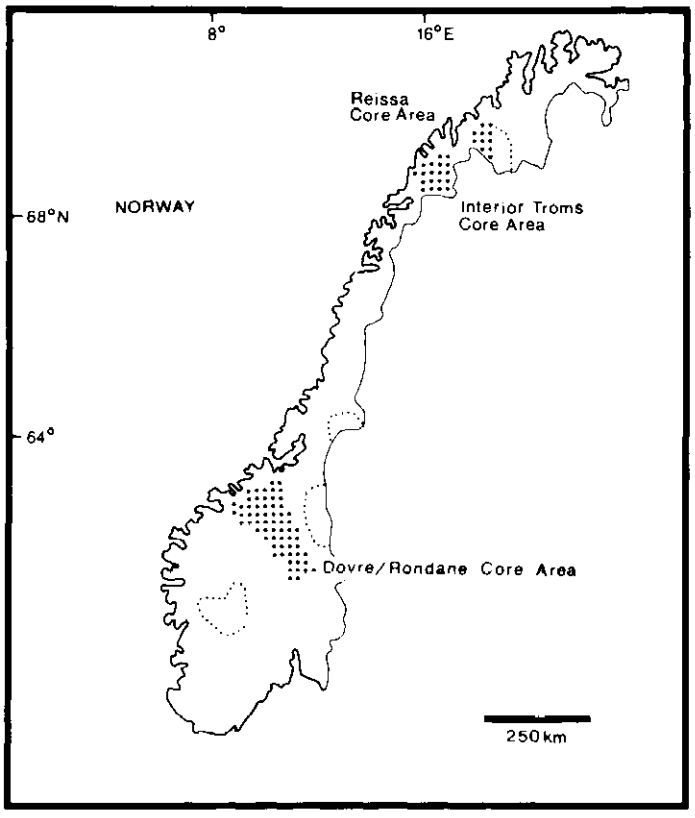
Finland: Found in the frontier districts with the U.S.S.R. and Norway, and in the area where the three Scandinavian countries meet (Pulliainen 1988).

U.S.S.R.: The generalized range includes the entire taiga zone and the southern fringe of the tundra. Also found on the island of Sakhalin and two of the Schantar Islands (Bolschojschantar and Medweshi). The southern boundary is thought to run along a line from Leningrad, Vologda, Kirov, and Molotov to the north of Sverdlovsk. During the last decade, one or two records of wolverines could still be obtained annually from Estonia, probably of wandering specimens coming from the Leningrad region (Maran in litt. 1988). In the Ussuri region the distribution of the wolverine includes the Sichote-Alin mountain range and reaches 44° N, which is the southernmost record in Eurasia (Heptner and Naumov 1974).

Mongolia: Along the northern border regions. There are records from Urga district (in 1923) and from the Altai mountains.

China: Heilongjiang province, particularly the Daxingan mountains, Xinjiang and Inner Mongolia (Xu Xue-Liang 1983). At least formerly the species occurred in northern Manchuria.

Canada (Kelsall 1981; Banci 1982 and 1987): British Columbia, the Yukon, and the Northwestern Territories are the stronghold of the wolverine in Canada. In Ontario, a small population may survive north of 50° N, and west of James Bay and Hudson Bay towards the border of Manitoba. In the northern Labrador peninsula, very few definite recent records are known, and the local status is given as very rare but not yet extinct; indeed, concomitant with an increase in the Ungava caribou population, numbers may be building up again (from a very low level). Apart from Vancouver Island, where an endemic subspecies, *G. gulo vancouverensis*, may exist (treated in a separate data sheet), the following Canadian areas contain isolated populations: northern Labrador (Quebec), northeastern Ontario, and perhaps Baffin Island and other high arctic islands. The large range of *Gulo* in the Canadian arctic archipelago may be misleading because records from this area are so scarce that they are possibly due to wandering animals (wolverines are known to migrate on sea ice in search of food, such as seal pups). The species has never occurred on Nova Scotia, on the Queen Charlotte Islands, or on Prince Edward Island, and it is debatable whether wolverines ever lived on Newfoundland.



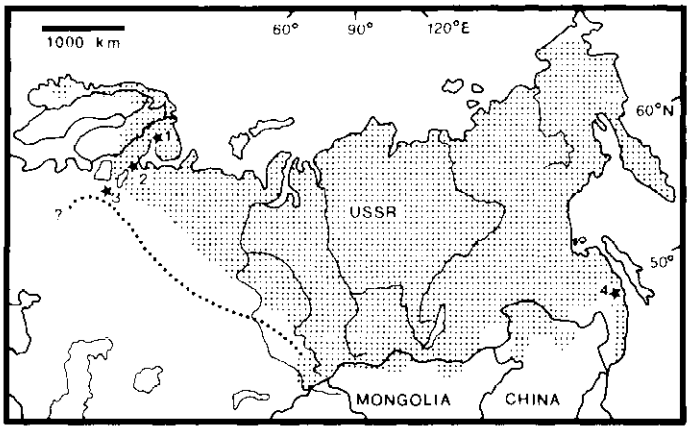
Map 4a. In Norway, core areas for the conservation of the wolverine (*Gulo gulo*) have been defined (hatched areas). Additional regions where wolverines live and reproduce are delimited by dotted lines (after Kvam et al. 1988).

U.S.A.: Wolverines are found throughout Alaska (except some southern coastal areas and the Aleutians), in the Pacific lower states, and in parts of the Rocky Mountains (see the separate data sheets for *G. gulo katschemakensis* and *G. gulo luteus*).

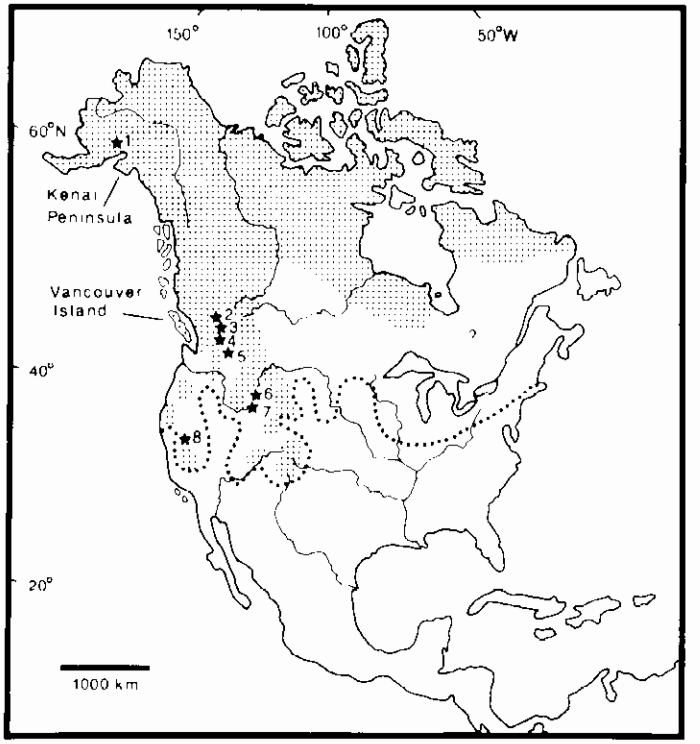
Status: Summarizing the insufficient state of knowledge on the wolverine's status, it appears that the species is not yet threatened in large parts of its range. However, this species is obviously very susceptible to human activities within its habitats. Without a better understanding of its natural history, and a policy which tries to achieve the difficult integration of wolverine conservation and economic demands, the long-term survival of the genus *Gulo* is open to doubt.

Among the aspects of wolverine biology which render this mustelid prone to conservation problems, the requirement of huge home ranges (approximately 100-900 km^2 in summer, and sometimes even more in winter) is of particular importance. Kelsall (1981) cites migration records of up to ca. 100 km a day. Indeed, it may be difficult to decide if records from any area are due to a thinly-spread resident population or only due to straggling individuals. With the increasing development of the taiga and tundra zones, such spatial requirements will become critical. Canadian long-term fur trade statistics, going back to the 16th century, suggest that numbers fluctuate with amplitudes of several hundred percent. Although the species is capable of killing large mammals, it is chiefly a scavenger of herbivore carcasses, mostly reindeer (caribou) and other deer. The numbers and migration patterns seem to be influenced to a large degree by the food supply during the winter. Banci (1987) found that in the Yukon (Canada), the summer is the worst time in terms of food availability. In this season, females raising young are especially affected. The availability of carcasses can have an influence on reproduction. Food shortage can even lead to starvation (Pulliainen 1988). The wolverine is traditionally hunted for its fur, which is said to be appreciated because frost can be easily brushed from it (Krott 1960). In 1971-72, about 6,000 wolverine pelts were traded (Dathe and Schöps 1986). Banci (1987) provided much data on the influence of trapping on wolverine populations in northwest Canada. However, there exists a conflict with the trapper community. Feeding to a large extent on carcasses, wolverines frequently empty traps of their baits or of the trapped fur animals. Sometimes they follow trap-lines systematically and devour the baits. Consequently, they are often either accidentally trapped or deliberately persecuted by trappers. In Scandinavia, preying on reindeer led to the wolverine being declared a nuisance, and it used to be hunted under a bounty system. Another conflict with human interests arises if, in search of food, it breaks into huts and cabins containing hunters' provisions, leaving not only damage but also its strong scent. In Scandinavia and some parts of North America, increased mobility of the human population using snowmobiles is reported to heavily disturb wolverines in their winter refuges. Easy access to remote regions by snow-scooters has also led to an increase in illegal hunting. Another threat emerges from scavenging poisoned baits laid out to kill wolves. Some wolverines, however, seem able to learn to avoid strychnine in baits or even in the stomachs of poisoned wolves. Kelsall (1981) provides evidence of wolverines feeding on a number of poisoned wolves while apparently not becoming poisoned themselves.

The vulnerability of the wolverine is well illustrated by the decrease of its range. The species used to occur further to the south, in Sweden prior to the 1850s in Värmland, and a century ago in all parts of Finland (Pulliainen 1988). Harper (1945) includes northern Germany in the historic range, although he states that two specimens reported from this country in the 17th century were



Map 4b. Generalized range of the wolverine in Eurasia (after Heptner and Naumov 1974). The dotted line shows the historic range in European U.S.S.R. Some Soviet reserves protecting the species are indicated by numbers: 1: Kandalakshsky and Laplandsky Nature Reserves (58,100 ha and 161,254 ha). 2: Kivach Nature Reserve (10,460 ha). 3: Darvinsky Nature Reserve (112,630 ha). 4: Sikhote-Alinsky Nature Reserve (347,052 ha).



Map 4c. Wolverines once occurred all over the northern Nearctic Realm, south to the dotted line. Today, only the hatched areas are inhabited (after Kelsall 1981; Chapman and Feldhamer 1982; Harestad pers. comm. 1988). The species's continued survival in the southern Rocky Mountains is uncertain, as is the situation in Ontario. National parks with wolverines include: 1: Denali (2,356,900 ha). 2: Jasper (1,087,800 ha). 3: Banff (664,076 ha). 4: Kootenay (137,788 ha). 5: Glacier (405,251 ha). 6: Yellowstone (899,139 ha). 7: Grand Teton (124,140 ha). 8: Yosemite (308,300 ha).

probably escapes from captivity. Its former occurrence in Czechoslovakia is also thought possible. It occurred until the 19th century in eastern Poland.

U.S.S.R.: In the U.S.S.R., the historic range generally extended further to the south, including western Ukraine, White Russia, Latvia, and possibly Lithuania, while in the Urals it extended south to 55° N. An isolated population occurred to the southwest of Kiev. In the westernmost parts of the U.S.S.R., the wolverine ranged at least 1,000 km further south than today. The shrinking of the species's range in this part of the world has occurred largely in the last 100 to 150 years. In Siberia, it ranged south to the Baikal region and from there almost to Vladivostok. In the Soviet Far East, the southern border of wolverine distribution did not change considerably until the late 1960s (Heptner and Naumov, 1974). We have no more recent status information from the Soviet Far East.

Canada: In the three prairie provinces of Manitoba, Saskatchewan, and Alberta, *Gulo* has retreated from the southern aspen parklands and is confined today to the boreal forests, or, in Alberta, to the Rocky Mountains. In the eastern provinces, the species disappeared from New Brunswick, possibly in the last half of the 19th century. They are also no longer found in southern Quebec.

U.S.A.: The range in the lower states has contracted considerably. Wolverines no longer occur in the states of Minnesota, Nebraska, North and South Dakota, Utah, Nevada, Indiana, Iowa, Wisconsin, Ohio, Maine, Vermont, New Hampshire, New York, Pennsylvania, New Mexico, or Michigan, although in the latter two states a historical occurrence is doubtful (Chapman and Feldhamer 1982).

Population sizes:

Norway: For 1978-1983, 118-183 wolverines were estimated as a minimum size of the Norwegian population (Kvam et al. 1988). Six viable populations have been defined, the largest containing some 70 animals. The numbers appear to have been stable since 1970 (Kvam et al. 1988). The wolverine is listed on Annex II of the Bern Convention, which means that contracting parties should confer special protection on it; Norway has signed this convention. Two wolverine core areas have been defined (in the Dovrefjell-Rondane mountains in the south, and in interior Troms in the north), and a third (Reissa in northern Norway) has been proposed (see Map 4a). In these areas, wolverines will be managed to number 25, 40, and 15, respectively. Wolverine management outside the core areas will depend on cooperation with neighbouring countries, and wolverine hunting in sheep breeding areas will not take minimum population numbers into account.

Sweden: In 1975, about 75 animals were estimated to live in Sweden, based on a survey made in 1972. Curry-Lindahl (in litt. 1987) put the Swedish population at 100 in 1981. The species is protected in Sweden.

Finland: The population is declining, mainly due to excessive persecution by hunters using snowmobiles. In January 1988, a maximum of 33 wolverines was estimated to occur in the Finnish border regions (particularly in the east), with an additional 5-10 individuals wandering in inland areas (Pulliainen 1988). Many of these animals are moving to and fro between Finland and the U.S.S.R., even daily. The species is protected in Finland but special killing licenses are easily granted, even though losses to reindeer herders are compensated (Pulliainen in litt. 1987; Pulliainen 1988).

Since wolverines have been observed to cross the Norwegian, Swedish, Finnish, and Soviet borders, the Scandinavian and neighbouring Soviet populations should be considered as one in national management decisions. In general, the Scandinavian population may have held its own or increased slightly during recent years, with the exception of Finland (Pulliainen in litt. 1987).

U.S.S.R.: No exact population numbers are available, but most sources describe this species as rare. Heptner and Naumov (1974) gave a density of 0.007 to 0.22 animals per 1,000 ha and calculated that the total number of wolverines in the U.S.S.R. may be 7,000 to 7,500 individuals. This appears to be a very pessimistic estimation. Recent Russian papers, summarized by Maran (in litt. 1988), state that wolverines are numerous in the northern parts of the Jenissei region. The population in Kamchatka (subspecies *G. gulo albus*) is estimated to number 600-1,000 animals.

China: According to Xu Xue-Liang (1983) this animal is very rare in northern China. In 1937-1938, 23 furs were recorded in the hunting statistics of Heilongjiang province, but only 17 since 1949.

Canada: The wolverine is one of Canada's rarest mammals, particularly in the east. The populations in British Columbia (approximately 5,000-8,000 animals) and Yukon (an estimated 4,380 specimens) appear to be stable (Banci 1982, 1987). It may be of interest that in these provinces wolverine numbers are approximately one eighth to one-tenth the population numbers of wolves. The species possibly maintains its population in Ontario, where, however, only about 70-100 animals remain. The number of trapped wolverine pelts increased only until 1974; thereafter, trade dropped in spite of continued increases in prices (Kelsall, 1981). This could be partly due to trapping, but declining caribou populations may also be a significant factor.

U.S.A. (Chapman and Feldhamer, 1982): In Alaska, the wolverine's U.S. stronghold, between 548 and 1,037 wolverines were hunted annually from 1971 to 1977. In the lower states, wolverines are scarce everywhere, the largest population occurring in Montana, where around 200 were taken annually in the 1960s after near extirpation by around 1920. Smaller populations survive in Wyoming, Washington, Oregon, and possibly Idaho and Colorado. With the exception of Montana, all other records are based on a few sightings, mostly some years ago, although in recent years records have tended to increase, though still at very low levels, in Washington and Oregon. This possible increase also holds true for California (see separate section on *G. gulo luteus*).

In some parts of its range, the wolverine is protected by law. However, enforcement of these regulations is often difficult in the remote habitats and because of the conflicts arising between the species and some human interests.

Status in captivity: A cooperative breeding programme is under way in several zoos in Finland and Sweden with animals originating from Scandinavia (Larsson pers. comm. 1987). Five Swedish zoos (Lycksele, Boras, Skansen, Kolmarden, and Höör) and three Finnish zoos (Högholmen, Ranua, and Ähteri) presently have 27 wolverines, 12 of which have been wild-caught, and 15 are zoo-born. In autumn 1988, there were eight potential breeding pairs. Three wild-caught males and three zoo-born females are known breeders (Larsson in litt. 1988). Maran (in litt. 1988) reports an additional case of successful captive breeding in Finland, at Korkeansaare Zoo, Helsinki, in 1988. Investigations into the wolverine's reproductive biology are being carried out at the Northwest Trek Wildlife Park near Tacoma, Washington (U.S.A.), where 14 individuals are kept (Mead in litt. 1987).

Occurrence in protected areas: The wolverine is recorded from a number of protected areas. However, due to its spatial requirements, very few reserves will contain the full home ranges of more than a small number of individuals. These small populations are heavily dependent on surrounding unprotected areas. Some larger and better known reserves where *Gulo* occurs are (Wirth 1981; Dupont 1976; IUCN 1971; Kvam et al. 1988): Rondane (57,500 ha), Dovrefjell (26,500 ha), Hardangervidda (340,000 ha), Övre Pasvik (6,300 ha), Övre Dividal (75,000 ha), and Börgefjell National Parks (106,500 ha) in Norway; Padjelanta (201,000 ha), Sarek (194,000 ha), and Stora Sjöfallet National Parks (138,000 ha) in Sweden; Lemmenjoki National Park (172,197 ha) and Malla Nature Reserve (3,000 ha) in Finland. In the U.S.S.R., the Kandalakshky (58,100 ha) and Laplandsky Nature Reserves (161,254 ha) in the Murmansk region, Kivach Reserve (10,460 ha) in Karelia, and Darvinsky Reserve (112,630 ha) on the Rybinsk Reservoir protect the nominate subspecies (*G. g. gulo*), whereas the Sikhote-Alinsky (347,052 ha), the Kronotskii (1,099,000 ha), the Zeiskii (82,567 ha), and the Magadan (8,692 ha) Nature Reserves in the Soviet Far East have Siberian wolverines (*G. gulo sibiricus;* Maran in litt., 1988); Jasper (1,087,800 ha), Banff (664,076 ha), Kootenay (137,788 ha), Yoho (131,313 ha), and Waterton Lakes National Parks (52,577 ha) in Canada; and Denali (2,356,900 ha), Grand Teton (124,140 ha), and Yellowstone (899,139 ha) National Parks in the U.S.A. have populations of the American wolverine (*G. gulo luscus*); Yosemite (308,300 ha) and Mount Rainier National Parks (96,712 ha) include the west coast subspecies (*G. gulo luteus*). In some parks, traditional hunting and trapping by native people is allowed.

Recommended action:

- Since a long-term conflict between human needs, economic development and wolverine survival can be foreseen, basic research into the biology of *Gulo* is a priority. Factors limiting population densities, migration patterns and habitat requirements should be better understood in order to formulate survival strategies.
- As reserves of sufficient size to protect whole wolverine populations will usually not be feasible, an integration of human interests and wolverine protection must be reached. In regions which are to be selected and defined as wolverine core areas, actual losses to private persons due to wolverine predation should be financially compensated by the authorities. This has to occur with respect for the local people who are frequently themselves at the margin of their nation's economy. The Norwegian government pays about 10,000,000 Kroner annually to compensate for damages caused by carnivores. "Large carnivore consultants" are employed by Norwegian county authorities to inspect the wounds and marks on sheep and reindeer reported to have been killed by wild carnivores, and to register tracks and other signs of wild carnivore presence. This system permits an evaluation of the population trends of large carnivores, and minimizes any possible misuse of the reimbursement system. It also contributes to the maintenance of a good atmosphere between animal breeders and the authorities (Kvam in litt. 1988).
- A closed season should be declared or extended to include the breeding season, (which for example in Finland lasts from February to April) because the death of a nursing female is thought to have significant adverse effect on the population of such a thinly-spread and slowly breeding species.

Threatened wolverine subspecies

In addition to the wolverine in general, conservation attention must be turned to a number of described subspecies, which are even more at risk. They are treated in separate sections below, although taxonomically they are based on insufficient material.

Kenai peninsula wolverine (*Gulo gulo katschemakensis*)

Kenai peninsula is situated in southern Alaska and is separated from the mainland by glaciers. This isolation is not complete for terrestrial mammals. Nevertheless, apart from the wolverine, separate subspecies have been described for the red fox, wolf, black bear, and brown bear. The peninsula became ice-free about 14,000 years ago, and may have been colonized this long ago by wolverines, although nothing is known about exchange with the mainland *G. gulo luscus*. The validity of the Kenai peninsula wolverine (*G. gulo katschemakensis*) is not without doubt. Bailey (in litt. 1987) thinks (after the observation of some live specimens) that it may be smaller and darker than mainland Alaska specimens. A few skulls are available at the Kenai National Wildlife Refuge (N.W.R.) for morphometric analysis.

Status: Bailey estimates the wolverine number in the Kenai N.W.R., which comprises 781,700 ha (or 31% of the Kenai peninsula), at about 14-25 individuals, with 2-3 times this number on the peninsula as a whole. Only 5% of the refuge is prime *Gulo* habitat, as the species avoids the lowlands. The number of trapped wolverines on Kenai has been declining since 1960. Current hunting seasons are long, from November 10th to March 15th, and so include the nursing period. Access to remote areas is increasing by snowmobiles and new roads.

Recommended action:

- A taxonomic study to clarify the distinctiveness of the Kenai subspecies. With so many endemic subspecies described from the peninsula (see above), and such a small population, probably characterized by a noticeable founder effect and continued inbreeding, a study of the genetic distance to mainland populations would be worthwhile, using tissues from trapped wolverines.
- A forthcoming Kenai N.W.R. fur-bearer management plan recommends to close the trapping season in the north of the refuge, and to limit it to 60 days in the remainder of the reserve, in order to avoid killing nursing females. This plan needs to be implemented.

Vancouver Island wolverine (*Gulo gulo vancouverensis*)

The wolverine population of Vancouver Island has been described as a separate subspecies (*G. gulo vancouverensis*) on the basis of only two specimens. Banci (1982) compared eight skulls of Vancouver Island wolverines with some from the mainland, and found a weak differentiation from mainland wolverines in several craniometric parameters. This, however, was not sufficient to justify a separate subspecific rank. However, Vancouver Island is faunistically quite distinct from the adjacent Canadian mainland, having at least nine endemic mammalian subspecies, and one endemic species. In this context, we are drawing attention to the critical status of this highly endangered island population.

Status: Banci (1982) gives a detailed report on the status of the Vancouver Island wolverine. The size of the population cannot be estimated, but the very few records suggest that it is extremely rare on Vancouver Island. It ranges mainly in the central mountains. With the large home ranges typical of *Gulo*, few animals could live on Vancouver Island even if there were no adverse human influences. Kelsall (1981) stated that the prolific deer population on Vancouver Island might provide a very good food supply. However, the deer populations have declined markedly since the mid-seventies (Harestad pers. comm. 1988).

Recommended action:

- Evaluation of the number, population trends, and conservation needs of the Vancouver Island wolverine.

Western wolverine (*Gulo gulo luteus*)

The western wolverine (*G. gulo luteus*) occurs in the southwestern border regions of British Columbia, in Washington state (apart from its south-eastern corner), the western half of Oregon, and parts of California. In California, the wolverine ranges from Del Norte and Trinity counties eastward through Siskiyiou and Shasta counties and southward through the Sierra Nevada to Tulare county. It lives from an altitude of around 500 m to 2,000 m in the coast range, and above 1,300 m in the Sierra Nevada. The California Fish and Game Commission (in litt. 1987) knows of only 87 sight records of wolverines in California since 1950, 27 of which have been reported since 1970. The very little evidence available suggests a small increase of population numbers in that state.

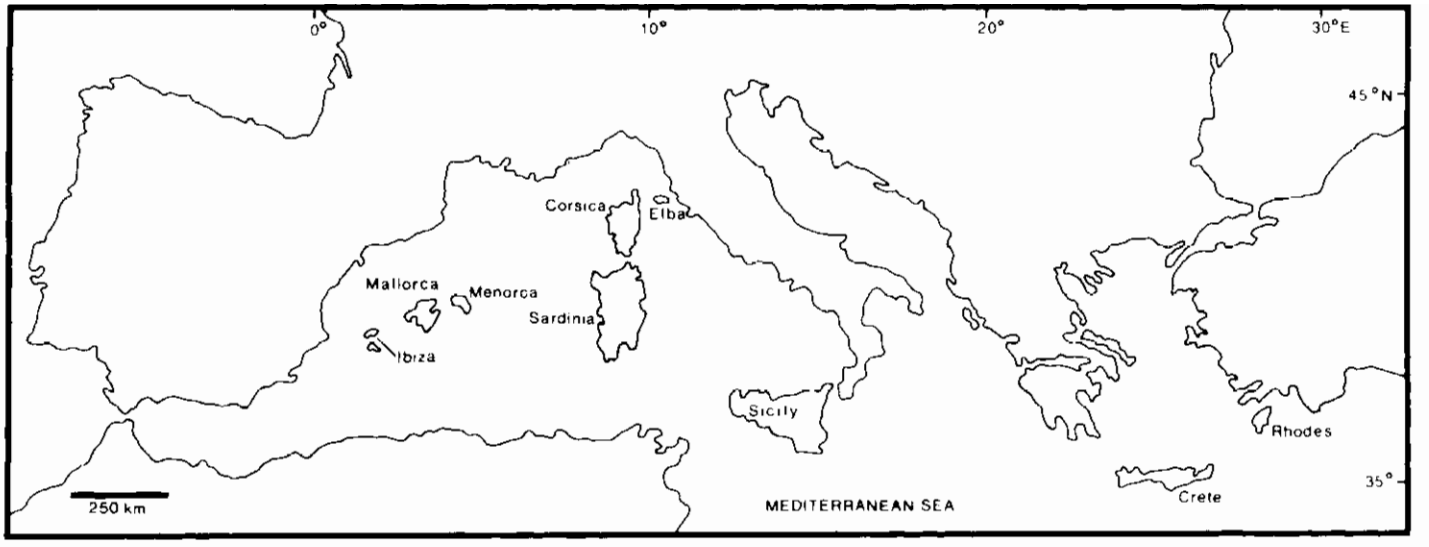
Recommended action:

- A taxonomic revision of North American wolverines is needed.
- Continued research to determine the conservation requirements of the West Coast wolverine populations.

Viverridae

Ibiza small-spotted genet (*Genetta genetta isabelae*)

The systematics of the genets (*Genetta*) are still a matter of scientific debate. An unusually high degree of variation contributes to this unsatisfactory situation (see Chapter 6, section 6.4). From several described taxa with small ranges which are presumably in need of conservation action, we only include the Ibizan subspecies (*G. genetta isabelae*) of the small-spotted genet. This



Map 5. Islands in the Mediterranean Sea with endemic mustelids and viverrids of conservation concern: Ibiza (*G. genetta isabelae, Martes foina* ssp.), Menorca (*M. martes minoricensis*), Sardinia and Corsica (*M. martes latinorum*), Elba (*M. martes* ssp.), Crete (*M. meles arcalus*), and Rhodes (*M. meles rhodius*). The status of all these forms needs clarification.

endemic island form, although supposedly an old human introduction, can be unambiguously separated from the other Iberian and North African populations of the species using several craniological parameters (Delibes 1977).

The relatively small body size of this subspecies falls outside the general cline from the larger North African to the smaller French populations. Differences in diet have also been recorded: *G. genetta isabelae* is the most herpetophagous of the known Palearctic populations. Morphological similarities with *G. genetta senegalensis* from West Africa and *G. genetta granti* from Arabia have been noted.

Distribution: Ibiza Island, Spain (see Map 5).

Status: This subspecies inhabits pine forests (*Pinus halepensis*) and was once common. Nothing is known about the present population size. However, its small range renders this subspecies vulnerable to habitat alterations. The Ibiza genet is classified as "Rare" by ICONA (1986). Another small carnivore, a distinctive but undescribed form of the beech marten (*Martes foina* ssp.), has probably disappeared from Ibiza during the last few years (Delibes in litt. 1987; Delibes et al. 1979).

Status in captivity: No records.

Occurrence in protected areas: Unknown.

Recommended action:

- A survey to establish the present status of the Ibiza genet and to propose appropriate conservation action.
- Ibiza is rich in endemic species and subspecies. Reserves are important to safeguard their survival. Protected area planners should take into account the conservation needs of the endemic genet.

Nearctic Realm

Mustelidae

Black-footed ferret (*Mustela nigripes*). (Photo by Wyoming Game and Fish Department)

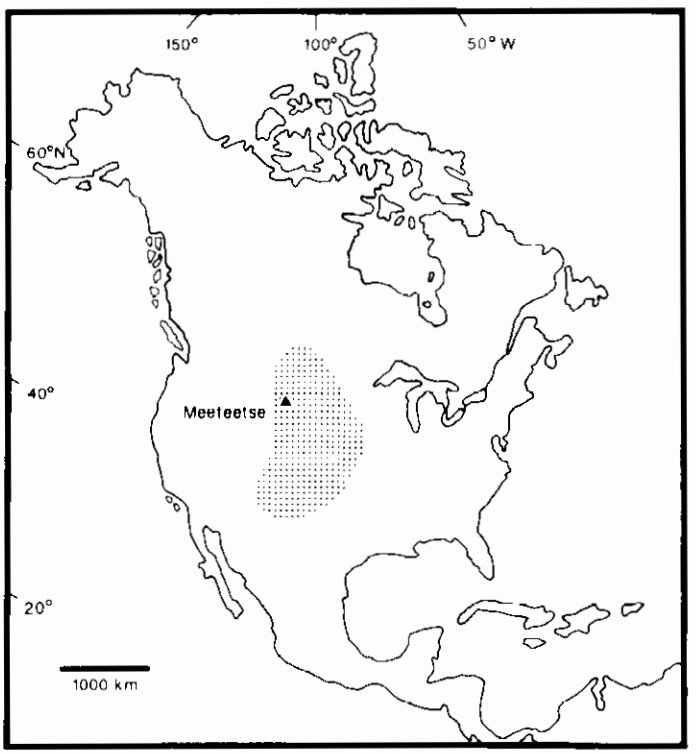
Black-footed ferret (*Mustela nigripes*)

The black-footed ferret (*Mustela nigripes*) is an inhabitant of the North American prairie belt. Although it has been found to live occasionally in association with ground squirrels, prairie dogs

(*Cynomys*) constitute its principal food item, and prairie dog burrows its favourite shelter. The species formerly played a role in the ceremonies of several Indian tribes, and its pelt was used to manufacture head-dresses.

Distribution: Before the colonization of the prairies by western man, the black-footed ferret occurred throughout the Great Plains, from Alberta and Saskatchewan in southern Canada to Texas and Arizona in the U.S.A. (see Map 6). A former occurrence in Mexico is uncertain. In 1970, an estimated 40 million hectares of habitat remained (Clark in litt. 1988).

Status: During the last 100 years, many prairie dog colonies have been wiped out or greatly reduced by poisoning, and this is generally thought to be the main reason that the black-footed ferret became extinct or nearly so over most of its range. However, diseases such as distemper have also been suspected as an important cause (Powell in litt. 1988). In Canada, the species has not been recorded since 1937, and by the 1950s some people feared it had become extinct in the United States as well. In 1964, a ferret population was discovered in a series of prairie dog colonies in South Dakota. For unknown reasons, this population had disappeared by 1974. It was not until September 1981 that another population of *Mustela nigripes* was located on a ranch near Meeteetse, in northwestern Wyoming. The ferrets were confined to an area of approximately 3,000 ha, scattered over about 130 km². Historical records indicate that the population probably has been both small (around 100 animals or less) and isolated since the 1930s. This population was at its maximum in the summer of 1984

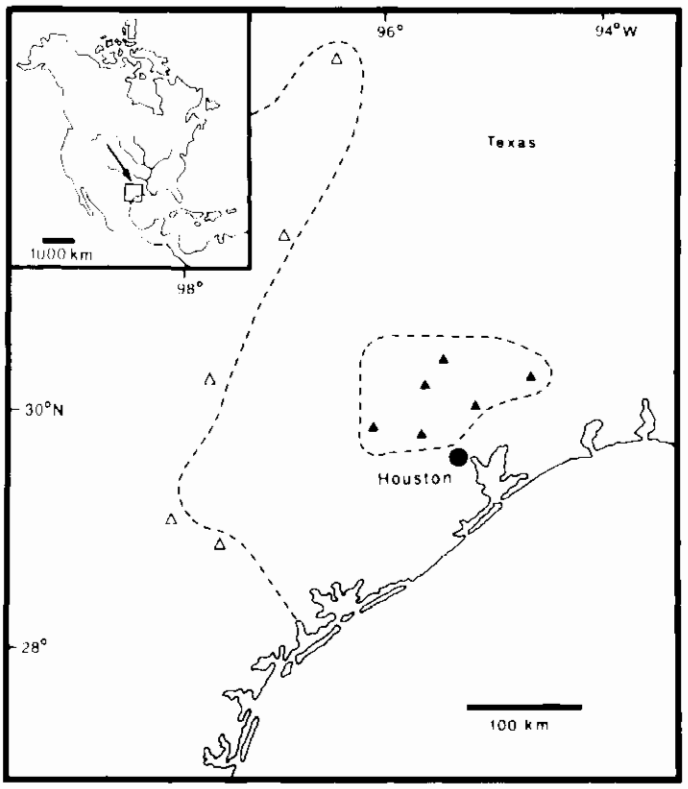


Map 6. The approximate former occurrence of the black-footed ferret (*Mustela nigripes*) in the North American prairie belt (after Hall 1981; Chapman and Feldhamer 1982).

The first offspring born during the captive breeding programme to save the black-footed ferret (*Mustela nigripes*). (Photo by Wyoming Game and Fish Department)

with 129 individuals, but an outbreak of canine distemper reduced it to 12 animals in late 1985. Captive breeding constitutes the only hope for the survival of the species, and 24 black-footed ferrets were captured for this purpose between 1985 and 1987. No ferrets remain now in the wild around Meeteetse. There is a fear that the species may now be extinct in the wild, although a slight hope remains that some unknown small populations may survive. An Interstate Coordinating Committee (I.C.C.) has been formed by the U.S. Fish and Wildlife Service, consisting of representatives of the wildlife management departments from the states within the historical range of the black-footed ferret (Mexico and Canada will also participate). The I.C.C. will coordinate the formulation of contingency plans to be followed if further ferret populations are discovered, and is also developing criteria to identify reintroduction sites for captive-bred ferrets (Thorne in litt. 1988). The black-footed ferret is listed on CITES Appendix I.

Status in captivity: Twenty-four *Mustela nigripes* have been captured as a founder population for the captive breeding programme. The first six ferrets, captured in October 1985, all died from canine distemper. However, the other 18 animals (7 males and 11 females) obtained from the wild between October 1985 and March 1987, were not affected by the disease. At the time of writing, 17 of them are still alive, while one ferret, suffering from an inoperable nasal carcinoma, died in January 1988 (Thorne in litt. 1988). The animals are housed in a special breeding facility at the Wyoming Game and Fish Department's Sybille Wildlife Research and Conservation Education Unit, Wheatland, Wyoming, U.S.A.. The first two litters, totalling eight animals, were born in June 1987; seven of the young ferrets survived. Six of the young born in 1987 were still alive in spring 1988 (Powell in litt. 1988). In 1988, 12 litters totalling 42 ferrets were produced, of which 34 have survived (Foose 1988). One female which would not accept any of the males was artificially inseminated (Thorne in litt. 1988).



Map 7. The subspecies *Conepatus mesoleucus telmalestes* of the hog-nosed skunk is confined to the Big-Thicket area of Texas (locality data from Schmidley 1983). The open triangles show the easternmost outposts of the disjunct main range of this skunk species (subspecies *C. mesoleucus mearnsi*).

Remarks: Gao Yaoting (pers. comm. 1988; in litt. 1988) has drawn attention to the close morphological resemblance of the smooth-coated polecat (*Mustela eversmanni amurensis*) to *Mustela nigripes*. He suggested that *amurensis* is not a subspecies of the steppe polecat (*M. eversmanni*) but that it may either be a distinct species or an Asian subspecies of the black-footed ferret. The smooth-coated polecat is rare and probably endangered. Its taxonomy and conservation status need study.

Recommended action:

- Continuation of the captive breeding programme, applying all necessary genetic and demographic considerations.
- Establishment of captive breeding colonies at other localities as soon as possible to reduce the risk of one disease wiping out the total known population of the species. Disease susceptibility should also be taken into account in any reintroduction projects.
- Surveys to locate any wild population that may still exist and to select reintroduction sites.

Wolverine (*Gulo gulo*)

Since the wolverine's range spans northern Eurasia as well as Canada and the western half of the U.S.A., the data sheet of this threatened species (and its Nearctic subspecies) is included among the Palearctic mustelids.

Big-Thicket hog-nosed skunk (*Conepatus mesoleucus telmalestes*)

The Big-Thicket hog-nosed skunk (*Conepatus mesoleucus telmalestes*) occurs at the eastern periphery of its species' main range, from which the Big-Thicket area is isolated by about 200 km. It differs in skull form and in the smaller size of the carnassials, possibly indicating a different diet. Outlying isolated populations are considered to be important in the process of species formation. In this context it appears interesting that *C. m. telmalestes* lives in a moister and more densely vegetated region than other hog-nosed skunk subspecies.

Distribution: *Conepatus mesoleucus telmalestes* is confined to the Big-Thicket area in eastern Texas, U.S.A. (see Map 7).

Status: The species is extremely rare in eastern Texas, or even extinct (Schmidly 1983). The Big-Thicket hog-nosed skunk population was considered to be extinct already in 1945, and Schmidly did not encounter any during three years of field work in the Big-Thicket National Preserve. However, one third of the licensed trappers of the area responding to a questionnaire reported to have taken a total of 38 specimens, which would be a higher figure than for the trapped striped skunks (*M. mephitis*). If the trappers did not confuse the hog-nose skunk with striped skunks, the population may still survive.

Status in captivity: There are no records of this subspecies in captivity, and for the species as a whole there are only two (Jones pers. comm. 1988): one *C. m. mesoleucus* was held in Cincinnati Zoo (U.S.A.) from 1965-1968, and the New York Bronx Zoo exhibited a pair which produced several offspring in 1968 (of which one survived). This birth represents the only known case of captive breeding of the species and one of only two for the whole genus *Conepatus*. No hog-nosed skunk of any species seems to be in captivity at present.

Occurrence in protected areas: As cited above, Schmidly (1983) did not find the subspecies in the Big-Thicket National Preserve (34,243 ha), which lies within its range.

Recommended action:

- Surveys to locate surviving populations, possibly with the help of local trappers.
- The cooperation of these trappers should be sought in order to minimize killing. Other conservation requirements should be elucidated and acted upon.

Indomalayan realm

Mustelidae

Indonesian mountain weasel (*Mustela lutreolina*)

The Indonesian mountain weasel (*Mustela lutreolina*) is a poorly known mustelid, endemic to the islands of Sumatra and Java. Van Bree and Boeadi (1978) suggest that it immigrated to the Sunda islands when they formed a part of the Asian mainland during the

Quaternary. The species is adapted to cooler climates and is restricted to elevations above 1,000 m. Hardly anything is known of its natural history, apart from Robinson and Thomas' 1917 observation of one killing a three-striped ground squirrel (*Lariscus insignis*).

Distribution: Southern Sumatra and Java, Indonesia (see Map 8). Specimens are known from the following highland areas: the mountains near Bengkulu and Gunung Dempo in south Sumatra; Gunung Gede, Gunung Tangkuban Prahu and Tjibuni near Bandung in west Java; Gunung Slamat in central Java and Ijang Highlands, east Java (Van Bree and Boeadi 1978).

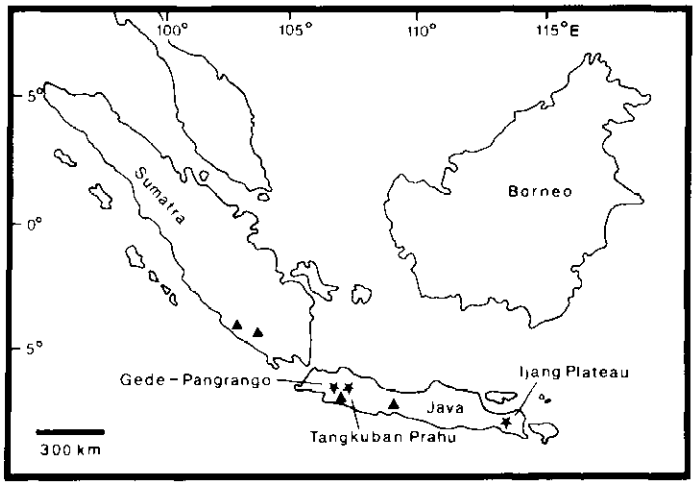
Status: Only two specimens are known from Sumatra, and nine from Java (Van Bree and Boeadi 1978). The higher mountains of Java still have forest cover, so it is possible that *Mustela lutreolina* survives in several populations.

Status in captivity: Two mountain weasels were kept at Ragunan Zoo (Jakarta) until 1977. Another specimen, which has since died, had been kept at the Centre for Tropical Biology (BIOTROP) of the Southeast Asian Ministry of Education Organization (SEAMEO) near Bogor (Boeadi pers. comm. 1987; Santiapillai in litt. 1988).

Occurrence in protected areas: According to Boeadi (pers. comm. 1986), the species occurs in Gunung Gede-Pangrango National Park (15,000 ha) near Bogor, west Java. Old records are known from the Ijang Highlands in east Java, where today a wildlife reserve is situated. Gunung Tangkuban Prahu and Gunung Slamat are other protected areas in Java with old records.

Recommended action:

- Field work in the mountains of southern Sumatra and Java to locate populations of the mountain weasel and to assess their conservation status and requirements.
- Continuation of conservation efforts on Gunung Slamat in central Java is desirable and would also benefit the survival of Frederica's leaf monkey (*Presbytis comata fredericae*).

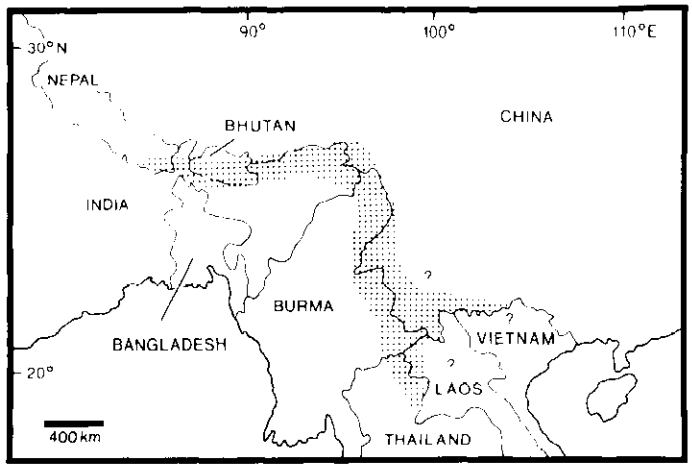


Map 8. Localities (black triangles) of the few known museum specimens of the Indonesian mountain weasel (*Mustela lutreolina*). The protected areas which are known to include this weasel are indicated by black stars (after Van Bree and Boeadi 1978).

Back-striped weasel (*Mustela strigidorsa*)

Hardly anything is known of the life history of the back-striped weasel (*Mustela strigidorsa*). In 1922, Hutton (in Lekagul and McNeely 1977) saw a single specimen, which was attacking a bandicoot rat three times as big as itself.

Distribution: Museum specimens have been collected in easternmost Nepal, Sikkim, Burma, eastern India, the Nan province of Thailand, Laos, and western and southern Yunnan in China (see Map 9). According to Wang Ying-Xiang (in litt. 1986; pers. comm. 1988), the back-striped weasel is also reported from southern Guangxi in China. Although not confirmed, it may also occur in northern Vietnam.



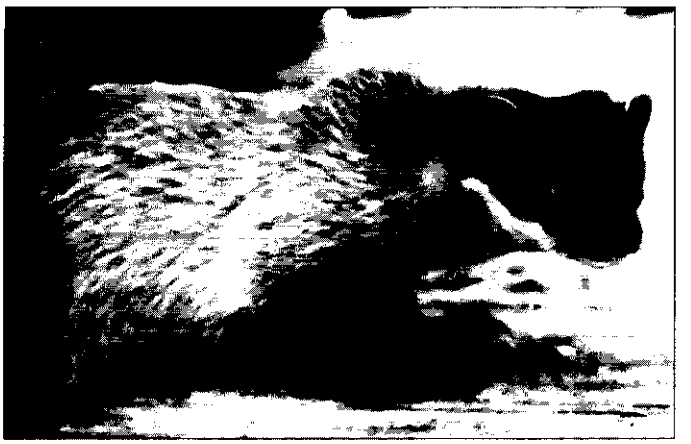
Map 9. Presumed range (hatched area) of the back-striped weasel (*Mustela strigidorsa;* after Lekagul and McNeely 1977; Wang Ying-Xiang pers. comm. 1988).

Status: Unknown, but probably rare. Lekagul and McNeely (1977) state that there are only 8 museum specimens of *M. strigidorsa*. However, in the British Museum of Natural History alone there are 21 old skins, collected in Burma (15 specimens, 10 labelled as from Upper Burma), Sikkim (two specimens), the Naga Hills (one) and Nepal (one); the additional two skins are of unknown origin. The altitude of the Burmese collection sites ranges from 900 to 1,700 metres. The Kunming Institute of Zoology has another 10 specimens, all of which originated from Yunnan (China). Wang Ying-Xiang (pers. comm. 1988) observed one back-striped weasel in western Yunnan in 1978, in scrubby habitat close to a rice field. According to information received by local people, the species may live in dense scrub, secondary forest, and grassland above 600 metres.

Occurrence in protected areas: One was seen by Treesuchon in Phu Luang Wildlife Sanctuary (84,000 ha) in Thailand, in January 1988 (Nabhitabhata in litt. 1988).

Recommended action:

- A survey to identify places where the species occurs and to obtain some data on population size and densities.
- A more in-depth study of the habitat requirements, food preferences, etc., of this weasel should be undertaken to provide a basis for future conservation activities.



The Siberian yellow-throated marten (*Martes flavigula atterima*) is not threatened, but efforts are needed to prevent the extinction of the two island subspecies *M. f. chrysospila* from Taiwan and *M. f. robinsoni* from Java. (Photo by Roland Wirth)

Taiwan yellow-throated marten (*Martes flavigula chrysospila*)

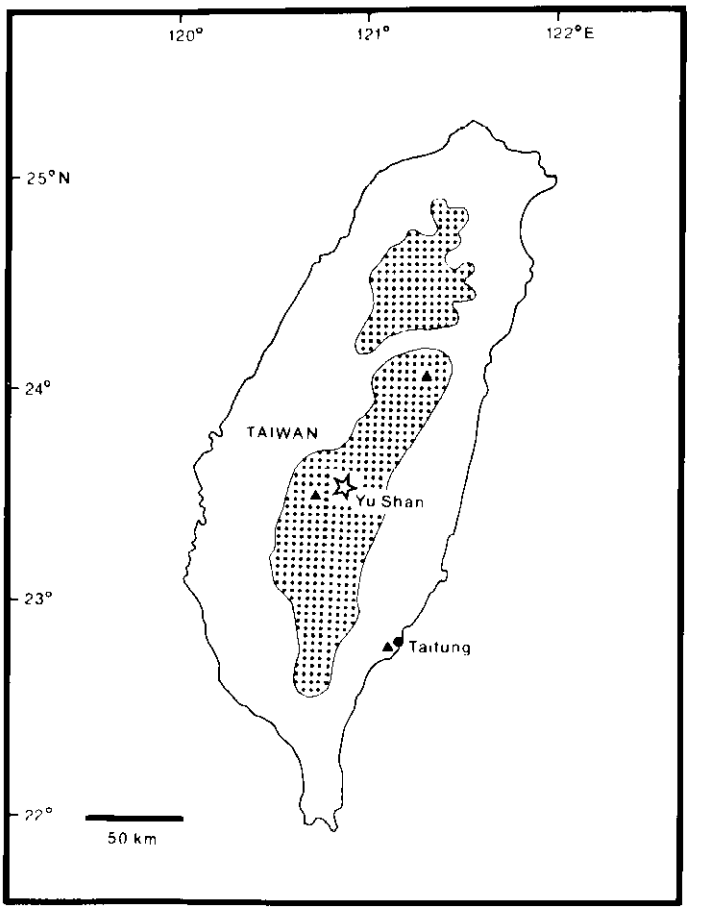
Subtropical China is an ecologically interesting transition zone where several faunas meet and many tertiary plant and animal relict species survive. In addition to this biogeographic background, Taiwan exhibits a high degree of insular endemism. The conservation needs of the Taiwan yellow-throated marten (*Martes flavigula chrysospila*) should not therefore be seen in isolation.

There has been some discussion as to the distinctiveness of the Taiwanese population of *M. flavigula*, but the specimens in the British Museum of Natural History are easily distinguishable from conspecifics from various parts of mainland China and Indochina. Distinguishing characters include the following: dark hairs with light tips on the upper head and neck, giving the effect of silvery grey sprinkling, a darker belly, and a more reddish hue to the overall body colours.

Distribution: Taiwan, particularly the mountainous districts (see Map 10).

Status: There are few recent data on the Taiwan yellow-throated marten. Kuroda (1952) believed that it could already be extinct. Curry-Lindahl (1972; in litt. 1987) states that the subspecies normally inhabits lowland forests and may have been driven to live in the remaining mountain forests, which might be less suitable habitat. G.S. Jones (in litt. to IUCN 1969) has seen only one specimen which was to be sold in a shop. The shop owner told him that he had come across only very few specimens during his lifetime and he felt that the marten was one of the rarest animals of Taiwan. This species has to some extent been persecuted to obtain its inner organs as food (Lai in litt. 1986). O'Gara (pers. comm. 1988) was told by local people that the species still existed in various mountain areas in the interior of Taiwan. The Taiwanese government has recently taken effective measures to stop uncontrolled forest destruction, but hunting remains a problem. The subspecies is listed in the U.S. Endangered Species Act.

Status in captivity: It is not known whether *M. f. chrysospila* has ever been kept in captivity. Of all the yellow-throated marten subspecies, the Siberian *M. f. atterima* seems to be the only one which has been bred in captivity, with 27 offspring being born at Kaunas Zoo (U.S.S.R.) between 1973 and 1982. The species is still being held at the zoos of Chiang Mai and Bangkok (Thailand), and at Brookfield Zoo (U.S.A.) and Houston Zoo (U.S.A.). Specimens of *M. f. henrici*, kept at the Philadelphia and Washington D.C. Zoos (U.S.A.), reached an age of 14 years (M.L. Jones in litt. 1987).

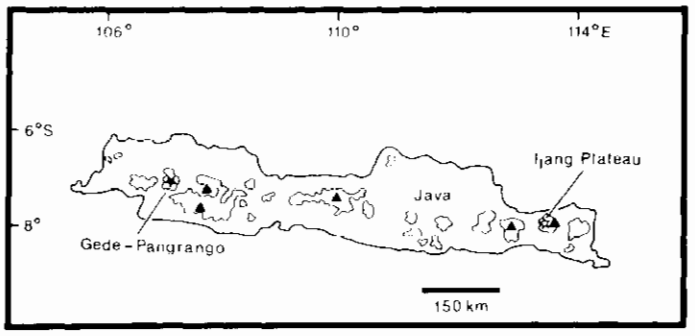


Map 10. Records (black triangles) of the endemic subspecies of the yellow-throated marten from Taiwan (*Martes flavigula chrysospila*). The specimen from the southeastern locality, close to the harbour city of Taitung, was probably collected elsewhere. Two forest blocks remain in central Taiwan (hatched areas; MacKinnon and MacKinnon 1986). Yu Shan National Park (open star) is very close to a site where the endemic subspecies has been collected.

Occurrence in protected areas: Not confirmed, but may occur in Yu Shan National Park (105,490 ha) in central Taiwan.

Recommended action:

- Field work to confirm the Taiwan yellow-throated marten's survival, and to clarify its present distribution and status.
- Tighter control is needed to limit the effect of hunting on all wildlife in Taiwan.



Map 11. All sites where museum specimens of the Javan yellow-throated marten (*Martes flavigula robinsoni*) have been collected (black triangles) are found in highland areas (the thin unbroken lines delimit all land above 750 m). The continued occurrence of the subspecies in Gunung Gede-Pangrango National Park is confirmed (black star). In contrast, the record from the Ijang Plateau is rather old, and it remains unconfirmed whether this marten is protected by the reserve which has been gazetted in this area.

Javan yellow-throated marten (*Martes flavigula robinsoni*)

The Javan yellow-throated marten (*Martes flavigula robinsoni*) is clearly distinct from its relatives in Peninsular Malaysia, Sumatra, and Borneo, which seem to be quite similar to each other. A similar situation is also found in the small-toothed palm civet (*Arctogalidia trivirgata*), emphasizing the zoogeographical peculiarity of Java.

Distribution: *M.f. robinsoni* inhabits the forested mountain areas throughout Java up to an altitude of 2,500 m (see Map 11). It is thought not to occur below an altitude of approximately 5,000 feet (Wegner 1949).

Status: Known from only a few museum specimens, the most recent of which (dating from 1959) is deposited in the Museum Zoologicum Bogoriense. Sightings of the species were reported in the 1970s. In 1979, Boeadi observed several yellow-throated martens in Gunung Gede-Pangrango National Park, west Java (pers. comm. 1986).

Status in captivity: Sody (1940) reports (and also supplies an illustration) of a Javan yellow-throated marten kept at an unknown locality in Java. This is the only known captive record of *M. f. robinsoni* (for the species as a whole, see the records listed under *M. f. chrysospila*).

Occurrence in protected areas: Gunung Gede-Pangrango National Park (15,000 ha). Several individuals were collected in Ijang Plateau Game Reserve (14,145 ha), east Java, 50 years ago; continued occurrence there needs confirmation.

Recommended action:

- Field surveys in several Javan reserves such as Gunung Halimun or Gunung Semeru to find out if the species is still present.
- Continuing protection of Gunung Gede-Pangrango National Park and an investigation to determine the population size of *M. f. robinsoni* in this park.

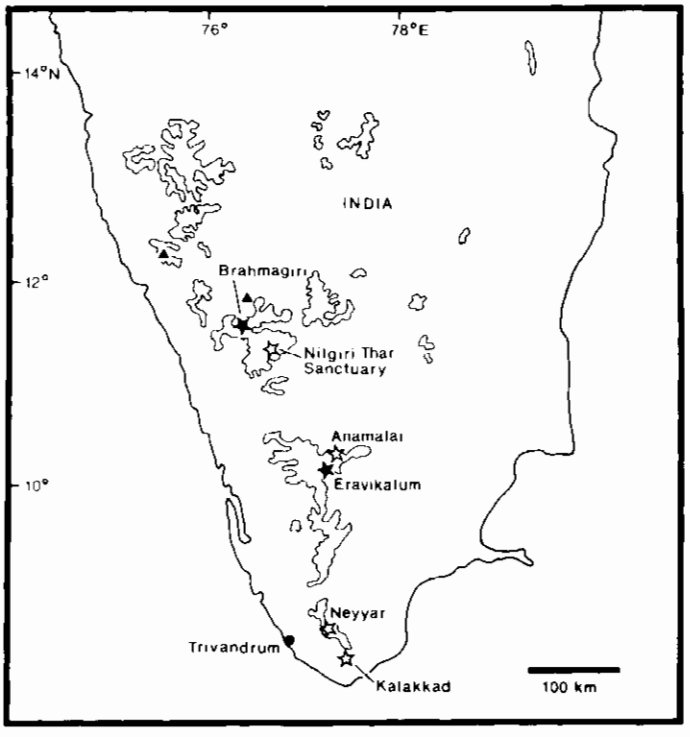
Nilgiri marten (*Martes gwatkinsi*)

After the last Pleistocene moist climate phase, evergreen forests in south Asia retreated to mountain areas, persisting today in the Himalayas and the Western Ghats. The isolation of the rain forests of the Western Ghats led to speciation of the Nilgiri marten (*Martes gwatkinsi*) from its common ancestor with the yellow-throated marten (*Martes flavigula*). *M. flavigula* is its nearest relative which still occurs in the Himalayas and further to the east (see above).

Distribution: Southern parts of Western Ghats and associated hill ranges from approximately 13° N, south to the hills of Travancore (see Map 12).

Status: Not more than 5-10 specimens can be found in museums. It was already considered as rare by Pocock (1941). Recent reports indicate that it survives in forest patches on mountain summits. Karanth (1985) confirmed the species' continuing occurrence in the Madikeri Forest Division, Karnataka. Balakrishnan (1986) states that the Nilgiri marten occurs in deciduous forest and grasslands. This, however, appears doubtful, as during extensive field work in Karnataka, Karanth (pers. comm. 1988) found evidence for the species' occurrence only in semi-evergreen and evergreen forests, but never in grasslands. It is also occasionally encountered in coffee and cardamon plantations. The marten is legally protected (Schedule I of the Indian Wildlife Protection Act) but is occasionally persecuted as a pest by bee-keepers in Kodagu district of Karnataka (Karanth pers. comm. 1988).

Status in captivity: *Martes gwatkinsi* has been kept once at Trivandrum Zoo, India, at the beginning of this century. No other records are available.



Map 12. Localities (black triangles) of museum specimens of the Nilgiri marten (*Martes gwatkinsi*). There are confirmed records of this marten from two reserves (black stars). A few additional protected areas in the Western Ghats are indicated by open stars (see also Map 15 and Map 21). All land above 1,000 m is shown by thin lines.

Occurrence in protected areas: The species is known to occur in Eravikalum-Rajamalai National Park (9,700 ha) in Kerala and in Brahmagiri Wildlife Sanctuary (18,100 ha) in Karnataka. It probably also occurs in the following Wildlife Sanctuaries (Kurup in litt. 1987): Anamalai (95,500 ha), Kalakkad (22,400 ha) and Nilgiri Tahr Sanctuary (7,800 ha) in Tamil Nadu, and Neyyar Wildlife Sanctuary (12,800 ha) in Kerala.

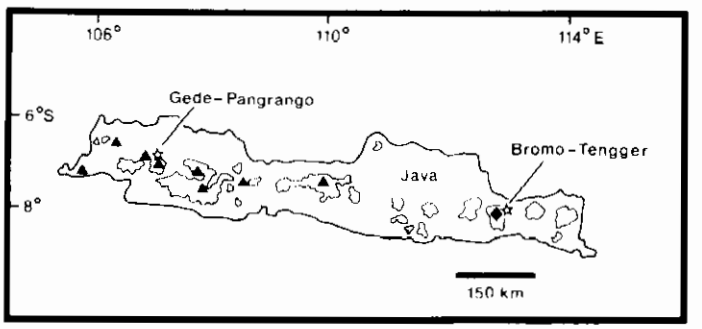
Recommended action:

- Field surveys to locate remaining populations of the species and to determine whether the existing reserves give adequate protection to *M. gwatkinsi* and its habitat.

Javan ferret-badger (*Melogale orientalis*)

The Javan ferret-badger (*Melogale orientalis*) represents the only endemic mustelid species of Java. Nothing is known of its ecology. It is sometimes treated as a subspecies of the large-toothed ferret-badger (*M. personata*). However, craniological studies of these species have shown that there are enough differences to justify specific rank (Everts 1968). Two subspecies have been described: *M. o. sundaicus* in west Java and *M. o. orientalis* in east Java.

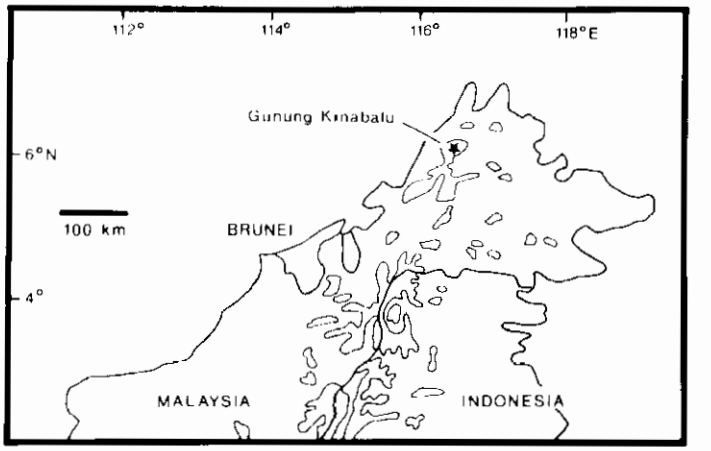
Distribution: The species is endemic to Java, Indonesia (see Map 13).



Map 13. There are two subspecies of the endemic Javan ferret-badger (*Melogale orientalis*) in Java. Records of *M. o. sundaicus* are indicated by black triangles. *M. o. orientalis* (black diamond) has been recorded from a highland area parts of which have been gazetted as a protected area (including Gunung Bromo, the Tengger Caldera, and Gunung Semeru: open star). It is uncertain where in central Java the two subspecies meet. Highland areas above 750 m are denoted by thin unbroken lines.

Status: No data on the status of the Javan ferret-badger are currently available, apart from the statement by Boeadi (pers. comm. 1987) that it occurs only patchily throughout the island. *M. personata* in Thailand inhabits cultivated land (Lekagul and McNeely 1977) and possibly the same applies to its Javan congener. One ferret-badger was found visiting gardens in the outskirts of Bogor town.

Status in captivity: In contrast to *M. personata*, the Javan ferret-badger has only rarely been kept in captivity. Jones (in litt. 1987) knows of one female that died at Schönbrunn Zoo, Vienna (Austria) in 1908, and other animals were kept at Paris (France) in 1883 and Amsterdam (Netherlands) in 1921.



Map 14. Gunung Kinabalu National Park (black star) is the only place where the Kinabalu ferret-badger (*Melogale everetti*) is known to occur. Other highland areas (above 1,000 m) of north Borneo are indicated by thin unbroken lines.

Occurrence in protected areas: Not known.

Recommended action:

- Field work to determine if and to what extent the two subspecies of *M. orientalis* are affected by the widespread habitat destruction in Java and what conservation action is needed.

Kinabalu ferret-badger (*Melogale everetti*)

The Kinabalu ferret-badger (*Melogale everetti*) has a very restricted distribution, being limited to one (or possibly a few) mountains in northeast Borneo. This is difficult to explain because other ferret-badgers are widespread in a variety of habitats. The taxonomy of the Kinabalu ferret-badger (and of *Melogale* in general) is not yet constant, and *M. everetti* has as often been treated as a distinctive species as it has been regarded a subspecies of the large-toothed ferret-badger (*M. personata*) or the Javan ferret-badger (*M. orientalis*).

Distribution: Known only from Mount Kinabalu in Sabah, East Malaysia, between 1,070 m and 3,000 m (see Map 14). It might also occur on Mount Tambayukon to the north of Kinabalu (Payne et al. 1985).

Status: Unknown, but due to this badger's very restricted range, population numbers could be rather low.

Status in captivity: The only captive records for *Melogale everetti* are two animals that lived at the National Zoo, Washington D.C. (U.S.A.) in 1951 and from 1953-1954, respectively (Jones in litt. 1987).

Occurrence in protected areas: Gunung Kinabalu National Park (78,000 ha).

Recommended action:

- Improved protection of Gunung Kinabalu National Park, the integrity of which is threatened by increasing tourist numbers, encroachment by shifting cultivators, and copper mining.

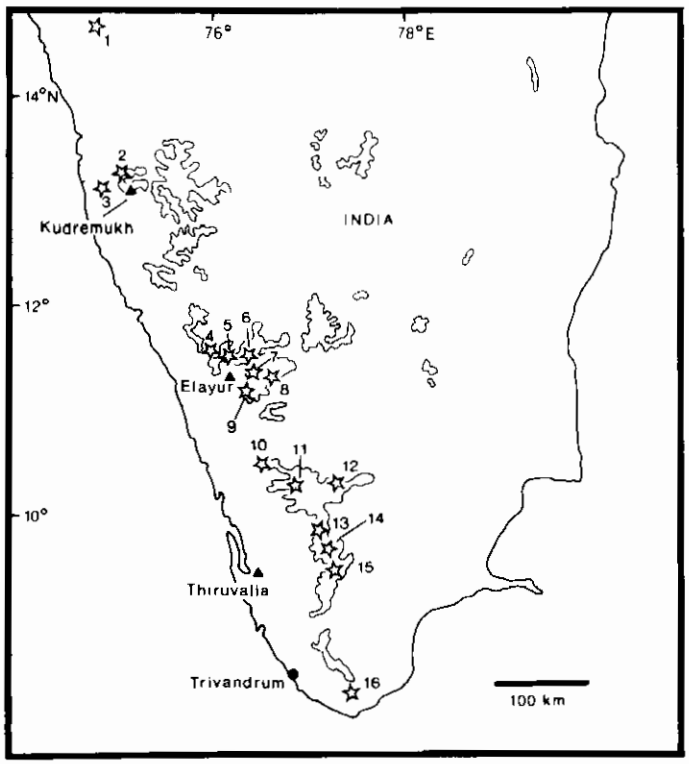
- Field work to assess whether the population of this ferret-badger in Gunung Kinabalu National Park is stable and to obtain more details on its distribution (Davies in litt. 1987).

Viverridae

Malabar civet (*Viverra civettina*)

The Malabar civet (*Viverra civettina*) is one of several mammalian endemics in the evergreen rain forest belt of southwest India. Its closest relative, the large-spotted civet (*Viverra megaspila*), sometimes regarded conspecific with *V. civettina*, ranges widely from Burma eastwards through southeast Asia.

Distribution: Previously found along the coastal hinterland and in the Western Ghats (south of Honnavar) in southwest India (see Map 15). *Viverra civettina* has probably disappeared from most of the coastal tracts and its continued existence in various parts of the Western Ghats needs confirmation.



Map 15. The Malabar civet (*Viverra civettina*), once believed to have been extinct, has been rediscovered in Elayur, and has possibly been sighted at two additional places (black triangles). The mountain range of the Western Ghats is indicated by thin lines (delimiting areas above 1,000 m). Protected areas where this elusive civet could survive, include (N.P. = National Park; W.S = Wildlife Sanctuary): 1: Dandeli W.S. (87,400 ha). 2: Sharavati Valley W.S. (43,100 ha). 3: Someshwara W.S. (8,800 ha). 4: Brahmagiri W.S. (18,100 ha). 5: Nagarhole N.P. (57,100 ha). 6: Bandipur N.P. (87,400 ha). 7: Mudumalai W.S. (32,100 ha). 8: Nilgiri Thar Sanctuary (7,800 ha). 9: Wayanad (84,400 ha). 10: Peechi-Vazhani W.S. (84,400 ha). 11: Parambikulam W.S. (28,500 ha). 12: Anamalai W.S. (95,500 ha). 13: Silent Valley N.P. (9,000 ha). 14: Idukki W.S. (7,000 ha). 15: Periyar W.S. (77,700 ha). 16: Kalakkad W.S. (22,400 ha).

Status: As far is known, only ten specimens exist in museums (Wozencraft in litt. 1988). The Malabar civet was apparently already rare at the turn of the century (Pocock 1941). The 1972 edition of the IUCN Mammals Red Data Book listed the species as "possibly extinct" (Goodwin and Holloway 1972). In more than half a century, there were only two possible sight records, one by Karanth in the Kudremukh area in Chikmagalur district, Karnataka, in 1975 (Karanth 1986), and one by Kurup at Thiruvalla in Pathanamthitta district, Kerala, in the 1970s (Kurup in litt. 1986). In March 1987, the continued existence of *V. civettina* was proven beyond any doubt by the capture of three specimens at Elayur, about 60 km east of Calicut in Kerala. When a team from the Zoological Survey of India, led by Kurup, investigated the incident, it was found that all three animals had died, but the correct species identification was confirmed on the basis of a skin from one of the dead specimens.

Status in captivity: The only indication of a captive Malabar civet is provided by Pocock (1941) who described a skin obtained from Trivandrum Zoo.

Occurrence in protected areas: The species is thought to occur in the Parambikulam Wildlife Sanctuary (28,500 ha) in Kerala state and Dandeli Wildlife Sanctuary (87,400 ha) in Karnataka. Further protected areas which might contain populations of *V. civettina* include the following: in Kerala State, Periyar Wildlife Sanctuary and National Park (77,700 ha) and Silent Valley National Park (9,000 ha), as well as the Wildlife Sanctuaries of Peechi-Vazhani (84,400 ha), Wayanad (84,400 ha), Idukki (7,000 ha), Aralam (5,500 ha), Chimeni (1,000 ha), and Shentaruni (10,000 ha); in Karnataka State, Nagarhole National Park (57,100 ha), the Wildlife Sanctuaries of Badra (401,000 ha), Brahmagiri (18,100 ha), Mookambika (24,600 ha), Sharavati Valley (43,100 ha), and Someshwara (8,800 ha). In Tamil Nadu, the civet may perhaps still occur in Anamalai (95,500 ha) and Kalakkad (22,400 ha) Wildlife Sanctuaries.

Large-spotted civet (*Viverra megaspila*). (Photo by Roland Wirth)

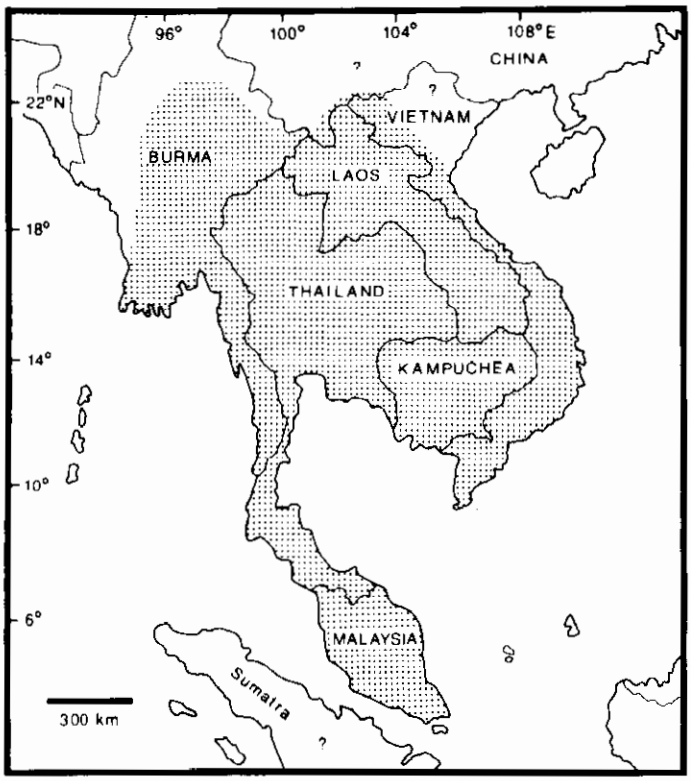
Recommended action:

- Status surveys along the Western Ghats to locate surviving populations, particularly within the listed conservation areas.
- A detailed ecological study at sites where the species still occurs is necessary to elucidate the causes of the civet's rarity, and to develop conservation measures to prevent its further decline.
- If remnant populations are found in isolated habitat areas where immediate protective measures are unlikely to succeed, consideration should be given to capturing these particular specimens as founder stock for a captive breeding programme. In light of the extreme rarity of the Malabar civet, such a breeding project should only be undertaken under the guidance of the IUCN/SSC Captive Breeding Specialist Group and the world's leading experts on the captive management of viverrids.

Large-spotted civet (*Viverra megaspila*)

Pocock (1941) placed the large-spotted civet (*Viverra megaspila*) together with the Malabar civet (*V. civettina*) in a separate genus *Moschothera*. Today, *Moschothera* is usually included as a subgenus in *Viverra*.

Distribution: Peninsular Malaysia, Thailand, Burma, Vietnam, Kampuchea, Laos, and southern Yunnan (Xishuangbanna province) and southwestern Guangxi in China (see Map 16).



Map 16. Generalized range of the large-spotted civet (*Viverra megaspila*), according to Lekagul and McNeely (1977) and Wang Ying-Xiang (pers. comm. 1988). A possible occurrence in Sumatra was indicated by Chasen (1940).

Status: Lekagul and McNeely (1977) state that *V. megaspila* is fairly common in Thailand, but more recently Nabhitabhata (in litt. 1986) reports the species as becoming rare in that country. According to Medway (1983), *V. megaspila* is widespread but rare in Peninsular Malaysia. Wang Ying-Xiang (in litt. 1986) includes the large-spotted civet in a list of species that need their conservation status checked in China. Hunting pressure on most wildlife is very great in those parts of China where the large-spotted civet has been recorded.

Status in captivity: Five zoos are known to have exhibited large-spotted civets between 1889 and 1960 (Jones in litt. 1987): Berlin (Germany), Philadelphia and Washington (U.S.A.), Osaka (Japan), and Rotterdam (Netherlands). In 1981, three *Viverra megaspila* were born at Bangkok Zoo (Thailand), but no further breeding has occurred since then. At present (1987) there are still three animals alive at Bangkok Zoo. Another place where the species is presently being kept in captivity is Chiang Mai Zoo, Thailand (Arnold pers. comm. 1987).

Large-spotted civet (*Viverra megaspila*). (Photo by Roland Wirth)

Occurrence in protected areas: There are a number of conservation areas, some quite large, throughout the range of *V. megaspila*. However, definitive reports of the species' occurrence in any of them are lacking.

Recommended action:

- Field surveys to locate surviving populations of *V. megaspila*. Efforts should be made to determine the causes of the apparent rarity of this species, which stands in contrast to the sympatric large Indian civet (*V. zibetha*) and the Malayan civet (*V. tangalunga*), both of which are widespread and common, but is reminiscent of the closely related Malabar civet (*V. civettina*). It is important to learn whether *V. megaspila* occurs in the major national parks and wildlife reserves in the region such as Taman Negara (Malaysia), and Khao Yai and Huai Kha Khaeng (both in Thailand).
- Reduction of hunting pressure on key populations of this species.

Spotted linsang (*Prionodon pardicolor*). (Photo by Roland Wirth)

- Improving the management of the captive breeding group at Bangkok Zoo. More founder animals should be added and other zoos and captive breeding specialists should participate in a cooperative breeding programme. This would also be important as a pilot project for the highly endangered Malabar civet from southwest India.

Spotted linsang (*Prionodon pardicolor*)

The genus *Prionodon* includes two species, the spotted linsang (*Prionodon pardicolor*) and the banded linsang (*P. linsang*). Of the former species, two subspecies have been described, *P. p. pardicolor* and *P. p. presina*, but their validity is uncertain (Wang Ying-Xiang in litt. 1986).

Distribution: Eastern Nepal, Bhutan, Sikkim, Assam, east Burma, Laos, northern Thailand, northern Vietnam, and western Sichuan, Yunnan, Guizhou, and southwestern Guangxi in China (see Map 17). The spotted linsang is confined to hill and mountain forests from 150 m to at least 2,700 m.

Status: The species occurs over a considerable part of southeast Asia but seems to be rare everywhere. Even as early as 1933, Pocock mentioned its probable scarcity because the collectors of the mammal survey of India obtained only a few skins. Bain and Humphrey (1982) include it among the endangered animals of Thailand, which lies on the southern fringe of its range. Nabhitabhata (in litt. 1986) thinks that the spotted linsang is the rarest viverrid in Thailand. He does not know of any sightings of the species during the last 10 years. Likewise, there are no recent records from any other country where *P. pardicolor* occurs, except for two from India and one from China: in 1982, a team of the Zoological Survey of India received reports of a spotted linsang from northern Sikkim, and some years ago a specimen was caught by a hunter from Lachung, north Sikkim (2,700 m; Ganguli-Lachungpa in litt. 1987). Wang Ying-Xiang (in litt. 1988) photographed one captured specimen from Mount Ailao in central Yunnan. Several Vietnamese zoologists informed Ratajszczak (in litt. 1988) that the species may still be common in Vietnam, and is offered in markets from time to time.

The spotted linsang is listed on CITES Appendix I.

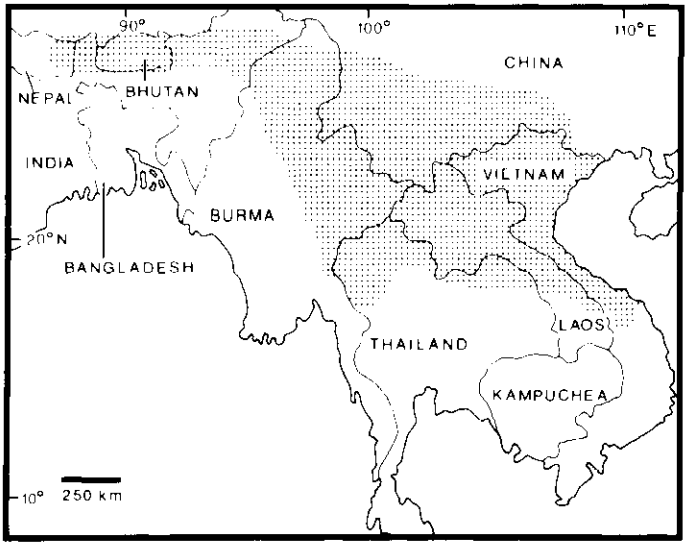
Status in captivity: *Prionodon pardicolor* has occasionally been kept in zoos, including those of Frankfurt (West Germany) and Houston (U.S.A.). At present (1987), only the Bangkok (Thailand) and Hong Kong Zoos are known to maintain the species. In 1986, two spotted linsangs were born in Bangkok Zoo and successfully raised by their parents, the only known case of captive breeding.

Occurrence in protected areas: A fairly large number of protected areas have been established throughout the range of the spotted linsang. It is likely to occur in some of them. However, we are not aware of any records.

Remarks: The banded linsang (*Prionodon linsang*), the only other species in the genus, seems to be still relatively numerous in certain parts of its range, particularly in Borneo. Some of its populations, such as those in Java, Bangka, Billiton, and the southern part of Thailand, are probably threatened.

Recommended action:

- Survey work to locate populations of *P. pardicolor*, particularly in existing conservation areas, and field research into the spotted linsang's ecological and conservation requirements.
- Research to determine the geographic variation of the species.
- Continuing efforts at Bangkok and Hong Kong Zoos to establish a captive colony of the species.



Map 17. Approximate distribution of the spotted linsang (*Prionodon pardicolor*), taken from Lekagul and McNeely (1977) and Wang Ying-Xiang (pers. comm. 1988).

Thai small-toothed palm civet (*Arctogalidia trivirgata leucotis*). (Photo by Roland Wirth)

Malayan small-toothed palm civet (*Arctogalidia trivirgata trivirgata*). (Photo by Roland Wirth)

Javan small-toothed palm civet (*Arctogalidia trivergata trilineata*). (Photo by Roland Wirth)

The small-toothed palm civet (*Arctogalidia trivirgata*) exhibits a remarkable degree of geographic variation: the photographs depict a representative of each of the three subspecies groups of this species (details are provided in the data sheet).

Javan small-toothed palm civet (*Arctogalidia trivirgata trilineata*)

The most distinctive subspecies of the small-toothed palm civet (*Arctogalidia trivirgata*) occurs in Java. Van Bemmel (1952) showed that the many subspecies of this civet can be divided into three groups: the *leucotis* group which occurs from Peninsular Thailand northwards, the *trivirgata* group from Malaya, Sumatra, Borneo and smaller islands in between, and *Arctogalidia trivirgata trilineata* from Java forming a third subspecies group of its own. The Javan subspecies has some similarities with *A. t. millsi* from the opposite edge of the species' range.

Distribution: Inhabits moist west Java, from the south coast up to 1,700 m (see Map 18).

Status: Already 50 years ago, the small-toothed palm civet was considered to be one of the rarest mammals of Java. About 24 museum specimens are known. It leads a strictly arboreal life and is restricted to primary forests far from human settlements. Unconfirmed sightings have been made during the 1970s. In 1978, Boeadi (pers comm. 1986) was able to obtain a specimen captured by local people, which was later released in the Ujung Kulon National Park.

Status in captivity: It is not known whether *A. trivirgata trilineata* has ever been kept in a zoo. However, at least five zoos in North America, Europe, and Asia presently exhibit other subspecies of *A. trivirgata*, and successful breeding has occurred in a minimum of three of these institutions. The species is long-lived in captivity (Jones in litt. 1987).

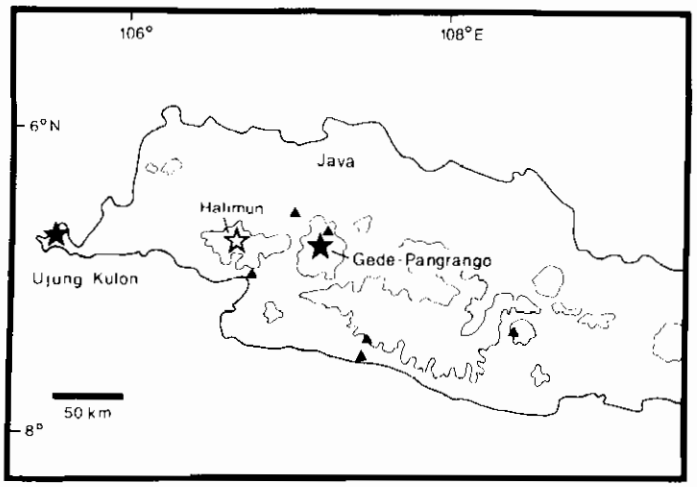
Occurrence in protected areas: Once, in 1939, two specimens were observed in Ujung Kulon National Park (78,619 ha) during the intensive surveys by Hoogerwerf (1970). According to Boeadi (pers. comm. 1986), this animal also occurs in Gunung Gede-Pangrango National Park (15,000 ha) near Bogor, where two specimens were collected in the 1930s, and possibly also in Gunung Halimun Nature Reserve (30,000 ha), but this needs confirmation.

Recommended action:

- Surveys, especially in the protected areas of west Java, to investigate the location and size of the remaining populations of the species. A special effort should be made in Ujung Kulon and Gunung Gede-Pangrango National Parks. These surveys should determine whether the current protected area system is sufficient to conserve viable populations of this species in Java.

Kangean common palm civet (*Paradoxurus hermaphroditus kangeanus*)

The common palm civet (*Paradoxurus hermaphroditus*) exhibits an astonishing degree of intraspecific variation: more than 30 subspecies have been described. Although a modern taxonomic revision is lacking, and some of these subspecies are probably not valid, this peculiar variability (typical of several viverrids, for example the genets) is a feature of major interest to evolutionary biology.



Map 18. The Javan small-toothed palm civet (*Arctogalidia trivirgata trilineata*) is confined to the moist western part of Java. There are only very few records (blacks triangles), and only two protected areas (black stars) are known to protect this rain-forest species. The thin lines indicate areas above 750 m.

P. h. kangeanus clearly differs from conspecifics from surrounding areas, like Java, Borneo, and the Philippines. It lives at the southeastern limit of the species' natural range, since all populations from the Lesser Sunda islands or still further to the east are thought to be the result of human aided introductions.

Distribution: The subspecies is confined to the Kangean archipelago (Indonesia) which numbers about 30 islands (see Map 19). The largest island of this small archipelago, Kangean, covers only 48,700 ha.

Status: The only recent reference to this subspecies is the one by De Jongh et al. (1982) who confirmed the continuing existence of *Paradoxurus* on Kangean on the basis of spoor found on the beach. Generally, common palm civets are very adaptable, but *P. h. kangeanus* is included here on account of its small range and also because *Paradoxurus hermaphroditus*, as a pet and follower of man was (and probably still is) widely transported by people. This implies the constant danger of introduction of other subspecies and the loss of endemic forms by hybridization.

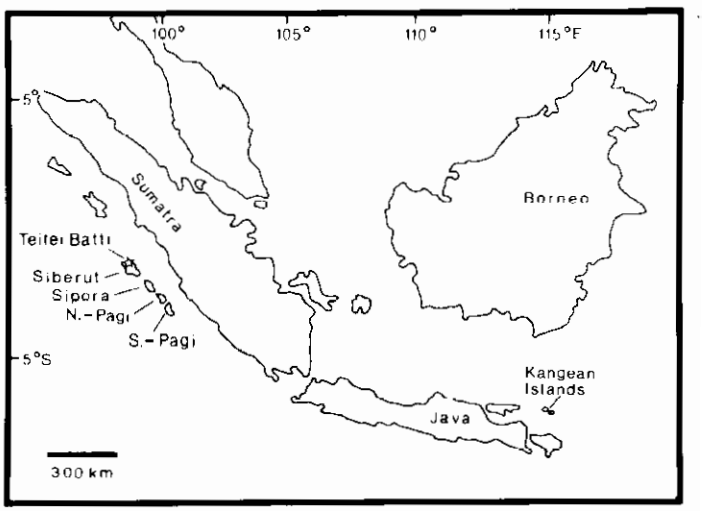
South Indian common palm civet. (*Paradoxurus hermaphroditus hermaphroditus*) (Photo by Roland Wirth)

The conservation of the Kangean common palm civet should also draw attention to a little known and isolated mammal community which includes two primate and two deer species, and probably two viverrids. These are all insufficiently known in regard to their taxonomy but presumably differ at subspecies level. De Jongh et al. (1982) state that is almost certain that even a still undescribed leopard (*Panthera pardus*) subspecies occurs on Kangean as well.

Status in captivity: No captive record of the Kangean subspecies of *P. hermaphroditus* is available. Other subspecies of the common palm civet, however, have often been exhibited in zoos, and have bred on numerous occasions.

Occurrence in protected areas: Parts of the Kangean islands are within a forest reserve and it is likely that the palm civet occurs there.

Remarks: As mentioned above, there are approximately 30 described subspecies of *Paradoxurus*, and some of them may be threatened. However, lacking a taxonomic revision, a few are merely listed in Appendix 3 of this Action Plan. A main threat to them appears to be hybridization with introduced conspecifics.



Map 19. The Mentawai archipelago (and to a much lesser extent the Kangean Islands) have a high degree of faunistic endemism. The three viverrids endemic to the Mentawais could occur in Teitei Batti Game Sanctuary (open star).

Recommended action:

- A survey to clarify the actual status and conservation needs of the Kangean palm civet.
- Inter-island transport of any wildlife in Indonesia should be discouraged as far as is possible, in order to protect the distinctive genetic and morphological characters of each island's subspecies.
- A taxonomic revision to identify all distinctive populations of *Paradoxurus*. A study of the mechanisms responsible for the astonishing variability of the genus would be desirable in order to draw attention to the problem of conservation of intraspecific variability.

Mentawai palm civet (*Paradoxurus lignicolor*)

The Mentawai Islands are home to a unique assemblage of endemic animal and plant species, which have evolved in geographic isolation. The Mentawai palm civet (*Paradoxurus lignicolor*) is part of this community. It is clearly distinctive from the subspecies of the common palm civet (*P. hermaphroditus*) occurring in Sumatra and Peninsular Malaysia and does not fit into the general pattern of geographical variation of the latter species (Groves in litt. 1986). In coat colour, *P. lignicolor* resembles the golden palm civet from Sri Lanka (*P. zeylonensis*). Pocock (1934) mentions additional differences in the skull, but does not grant species rank to that form. To ensure that these interesting populations of palm civets on the Mentawai Islands are not overlooked by conservationists, *P. lignicolor* is provisionally listed here as a full species. Hopefully, this view will stimulate interest to study the ecology and phylogenetic relationships of this little known mammal.

Distribution: Siberut, Sipora, and Pagi Islands in the Mentawai archipelago (see Map 19). A possibly valid subspecies, *P. lignicolor siberu*, has been described from Siberut Island (Chasen and Kloss 1927: but see Pocock 1934).

Status: All that is known about this animal comes from two museum specimens from Sipora Island, one from South Pagi Island, and one from Siberut. The related common palm civet (*P. hermaphroditus*) is usually fairly adaptable to habitat alterations. However, as shown by the elusive golden palm civet (*P. zeylonensis*) and brown palm civet (*P. jerdoni*), two species of palm civets lack this adaptability and can become very rare. Four logging companies are currently operating in Siberut. In the Pagi Islands, selective commercial logging has already severely modified 30,000 ha of lowland rain forest, and an additional 60,000 ha has been given out as a logging concession to a Singapore based lumber company (Tenaza 1987).

Status in captivity: No records.

Occurrence in protected areas: Although not confirmed, *P. lignicolor* presumably occurs in the Teitei Batti Game Sanctuary, Siberut, which has recently been expanded from its original 6,500 ha to 56,500 ha.

Recommended action:

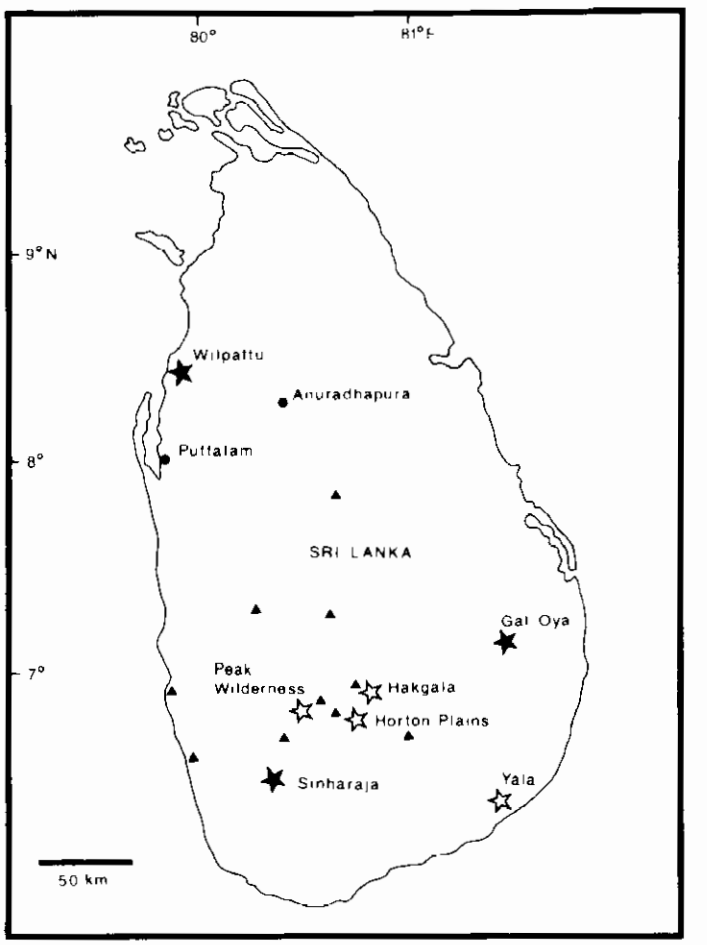
- Field research to obtain some basic data on the abundance and habitat and conservation requirements of the Mentawai palm civet.
- Research to assess the degree of geographic variation in the species. Three of the four primate species occurring in the Mentawai archipelago have different subspecies on Siberut and Pagi, and it should be investigated whether the generally very variable palm civets have also undergone radiation within the island group.

Golden palm civet (*Paradoxurus zeylonensis*)

The golden palm civet (*Paradoxurus zeylonensis*) is the only member of the Paradoxurinae which is endemic to Sri Lanka. It is much less a follower of man or an inhabitant of agricultural areas than the common palm civet (*P. hermaphroditus*). Very little is known of the natural history of this species.

Distribution: The golden palm civet occurs in parts of Sri Lanka (see Map 20). According to Phillips (1984) it is not uncommon but is locally distributed, both in the highlands and in the low country, particularly in the highlands around Kandy and in the Dimbulla and Dickoya districts of the Central Province. According to Wijesinghe (in litt. 1987), it is still widely distributed on the island but is more common in the wet zone than in the dry zone. It is thought to be quite common, especially in the Sinharaja Forest. Additional records from this forest come from Karunaratne et al. (1981) and from Baker (1971) who caught a live specimen there which was kept in captivity.

Status: The species is confined to a small range where natural habitats remain. It is known to inhabit lowland rain forest, evergreen mountain forests, and also dense monsoon forest (at Wilpattu). Lowland rain forest habitats have almost totally disappeared, with the main exception being the Sinharaja Forest. During



Map 20. The golden palm civet (*Paradoxurus zeylonensis*) is confined to Sri Lanka, where it seems to be absent or rare in most of the eastern and northern dry zone. The black triangles denote records from museum specimens. The occurrences in Wilpattu and Gal Oya National Parks, and in the Sinharaja Man and the Biosphere Reserve, are confirmed by recent sightings (black stars). Additional protected areas with suitable habitats are indicated by open stars.

Golden palm civet (*Paradoxurus zeylonensis*). (Photo by Asoka Subhawickrama)

a five-month period of research in Sinharaja (June to October, 1981), Kotagama caught eight golden palm civets using traps baited with bananas (Subhawickrama and Wijesinghe in litt. 1988). The impression of rarity implied by this rather low number might be misleading: rats (*R. rattus kandyanus*) had probably stolen many of the baits. The investigators suggest that the species is quite common in Sinharaja, both in logged and unlogged areas. Although a forest animal and a good climber, it seems to prefer the forest floor and undergrowth for foraging. Observations seem to point to the fact that it is adaptable to changing conditions in the forest and that it visits cultivated areas and villages in search for food. Older villagers are well aware of the fact that *P. zeylonensis* is responsible for the propagation of the Kitul palm (*Caryota urens*), which is valuable in the economy of the local people, and respect the animal for it, but the younger generation is indifferent to this fact and traps the animals (using as bait a sweet wine made from the sap of the Kitul palm). Their flesh is considered a delicacy.

Nugegoda (in litt. 1987) believes that the best area to see this species is in the northwest part of the country. This is confirmed by Hoffmann (in litt. 1987), who reports a number of observations from Wilpattu National Park and a few from its surroundings. Although Eisenberg and Lockhart (1972) saw only two specimens during an ecological study in Wilpattu over 14 months in 1968-69, Hoffmann encountered about a dozen live golden palm civets in this park in 1976. In 1976, Wilpattu suffered from a severe drought, and the palm civets that Hoffmann found at night on the part tracks were presumably in search of water. In daytime, he observed one or two moribund individuals, and found an unusually large number of golden palm civet carcasses (never observed before or since), probably of animals which had been killed by leopards while seeking water. From a game guard, Hoffmann learned that the species may be common in Wilpattu, as this guard once saw nine together feeding on the fruits of a thimbiri tree (*Diospyros malabarica*), presumably a preferred food (also in Phillips 1984). Hoffmann has never found the species outside Wilpattu, despite many years of intensive wildlife observations, apart from one carcass on the Puttalam-Anuradhapura road, which is in the same general area.

Status in captivity: The golden palm civet has been kept in zoos at Frankfurt (Germany), twice at London (U.K.) in 1844 and 1939, at Dublin (Eire) in 1897, and most recently at Dehiwela Zoo, Colombo (Sri Lanka). At Dehiwela it bred in 1983.

Occurrence in protected areas: Wilpattu National Park (131,884 ha), Sinharaja Man and the Biosphere Reserve (8,900 ha), and Gal Oya National Park (25,000 ha). Perhaps also occurs in the mountain forest reserves and in some of the new reserves gazetted as part of the Mahaweli Ganga development scheme.

Recommended action:

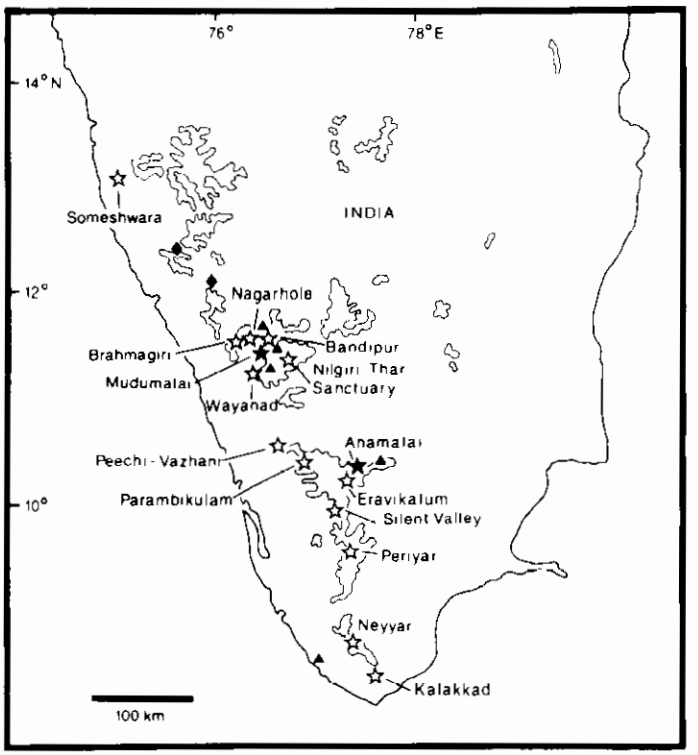
- Investigations in Wilpattu and Gal Oya National Parks and Sinharaja Forest to obtain an estimate of the population size there. Surveys in other established reserves in Sri Lanka, particularly in the new parks in the Mahaweli basin.
- Support for the current moves to consolidate the protection status of Sinharaja Forest Man and the Biosphere Reserve, the country's last sizeable area of lowland rain forest.
- Research into the species's ecological and conservation requirements to ascertain why it seems to be less successful in adapting to changes of its habitat than its congener *P. hermaphroditus*.
- Continued efforts to establish a breeding colony in captivity.

Brown palm civet (*Paradoxurus jerdoni*)

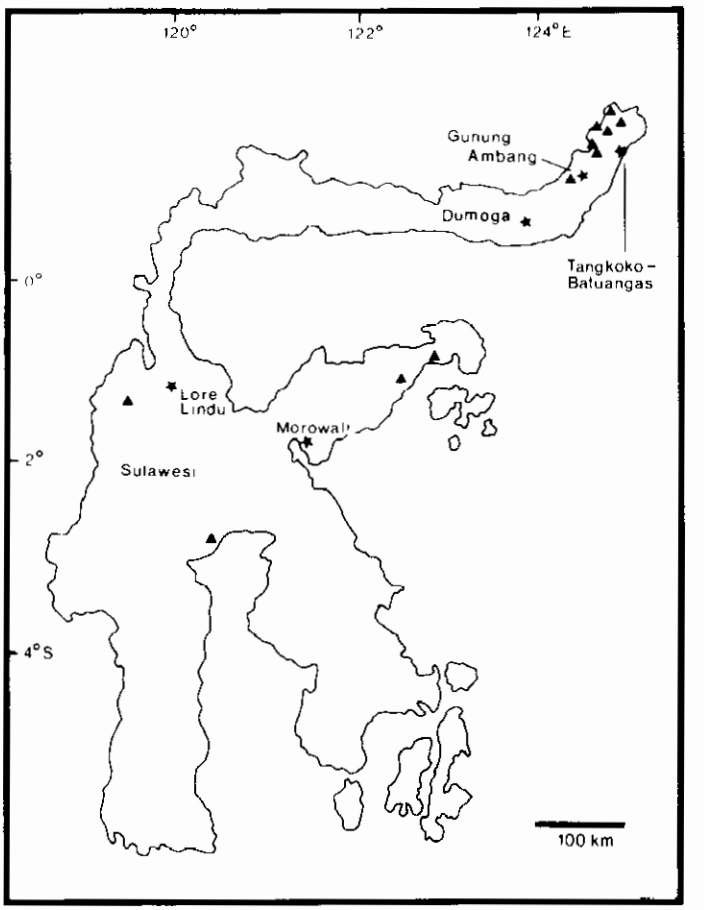
The brown palm civet (*Paradoxurus jerdoni*) is another species endemic to the evergreen rain forest belt of southwest India, further emphasizing the importance of this area for mustelid and viverrid conservation. Two subspecies of the brown palm civet are currently recognized, *P. j. jerdoni* and *P. j. caniscus*. The former should possibly be subdivided into more than one subspecies (Pocock 1939). The latter is known from only six specimens.

Distribution: Western Ghats and associated hill ranges, possibly as far north as Uttara Kannada district, Karnataka (see Map 21).

Status: Known from about 40 museum specimens. The only recent records of the species are sightings by Ajith Kumar (pers. comm. 1986) in the Anamalai Hills Wildlife Sanctuary (95,500 ha) of Tamil Nadu in 1983, and by Davidar (in litt. 1986), who in 1976 released one that had fallen into a porcupine trap in a garden at Coonoor. There is little information on habitat preferences but all specimens in the British Museum of Natural History and the Bombay Natural History Society's collection are from sites with either humid forest or coffee plantations (Karanth pers. comm. 1988).



Map 21. Both subspecies of the brown palm civet (*Paradoxurus jerdoni*) are endemic to the southwest Indian moist forest belt along the Western Ghats (areas above 1,000 m are indicated by thin lines). Localities of museum specimens of *P. j. jerdoni* are depicted by black triangles, and of the even less known *P. jerdoni caniscus* by black diamonds.



Map 22. Most records (black triangles) of the Sulawesi palm civet (*Macrogalidia musschenbroekii*) come from Minahassa peninsula in the north of Sulawesi (after Wemmer and Watling 1986). This endemic palm civet is protected in several national parks (black stars).

Status in captivity: Only three captive individuals of this species have been recorded: one lived at Berlin Zoo (Germany) from 1901-1904, one at the New York Bronx Zoo (U.S.A.) from 1926-1938 and one at Wassenaar Zoo (Netherlands) around 1969 (Jones in litt. 1987).

Occurrence in protected areas (Kurup in litt. 1987): The occurrence of *P. j. caniscus* is considered to be likely in Nagarhole National Park (57,100 ha) and in Brahmagiri Wildlife Sanctuary (18,100 ha), both in Karnataka state. *P. j. jerdoni* is known from Anamalai Wildlife Sanctuary (95,500 ha) and Mudumalai Wildlife Sanctuary (32,100 ha) in Tamil Nadu and is believed to live in the Nilgiri Tahr Sanctuary (7,800 ha) in the same state, as well as in the following reserves in Kerala: Eravikalum-Rajamalai National Park (9,700 ha), Silent Valley National Park (9,000 ha), Parambikalum Wildlife Sanctuary (28,500 ha), Wayanad Wildlife

Banded palm civet (*Hemigalus derbyanus*). (Photo by Houston Zoological Gardens)

Sanctuary (84,400 ha), and Aralam Wildlife Sanctuary 5,500 ha). Mookambika Wildlife Sanctuary (24,600 ha) and Someshwara Wildlife Sanctuary (8,800 ha) in Karnataka are also likely to have populations of the nominate subspecies.

Recommended action:

- Protection of the remaining forests throughout the Western Ghats.
- A field survey in the Western Ghats to identify areas where populations of the species still survive and what their conservation needs are.
- Research to clarify the geographic variation of the brown palm civet.

Sulawesi palm civet (*Macrogalidia musschenbroekii*)

This monotypic genus, endemic to Sulawesi, is one of the most prominent species of Wallacea, a faunal province lying on the borders of the Indomalayan and Oceanian zoogeographic realms. *Macrogalidia* is the only native species of Carnivora of Sulawesi.

Distribution: Sulawesi, Indonesia (see Map 22). Apart from the records by Wemmer and Watling (1986), most sightings are from Minahassa Peninsula in the north. A few have been recorded from other parts, such as in the island's centre, and south of Kulawi near the west coast.

Status: Listed as "Rare" in the IUCN Mammals Red Data Book (Goodwin and Holloway 1978). Wemmer and Watling (1986)

report that *Macrogalidia* is more widely distributed than previously believed, although the species appears not to be abundant. *Macrogalidia* occurs mainly in primary forest from sea level to montane rain forest and cloud forest. Lowland populations of the Sulawesi palm civet could be adversely affected by timber cutting and cultivation, but there is no immediate threat to its montane habitats.

Status in captivity: In 1985, three animals were kept at Ragunan Zoo, Jakarta; none of them is still alive. In 1986, two Sulawesi palm civets were captured at Lindu Lake, central Sulawesi, and kept in a local station of the Indonesian conservation authorities (Boeadi pers. comm. 1986).

Occurrence in protected areas: The species occurs in Dumoga-Bone National Park (330,000 ha; Rodenburg 1982), Gunung Ambang Reserve (8,638 ha) and in Tangkoko-Batuangas Reserve (8,867 ha), all three on Minahassa Peninsula, as well as in Lore Lindu (131,000 ha) and Morowali Reserves (160,000 ha; MacKinnon et al. 1980).

Recommended action:

- Continuing protection of the Dumoga Bone National Park and the reserves of Tangkoko-Batuangas, Gunung Ambang, Lore Lindu and Morowali.
- Further field research to collect data on population size trends of *Macrogalidia* in the reserves mentioned above.

Mentawai banded palm civets (*Hemigalus derbyanus minor* and *Hemigalus derbyanus sipora*)

The Mentawai Islands are the only small islands where the banded palm civet occurs. It is otherwise known from the larger landmasses of Sumatra, Borneo, Peninsular Malaysia, and Thailand. The absence of *Hemigalus derbyanus* from all other smaller islands in Sundaland supports the assumption that the species was not widely carried around by man as were some other viverrids. There is no reason to doubt that the banded palm civet is an autochthonous element of the Mentawai ecosystems. The validity of the subspecies *H. d. minor* has never been questioned. Pocock (1933), however, united *H. d. sipora* with *H. d. derbyanus* from Sumatra. An examination of the type specimen in the British Museum (Natural History) by Groves and its comparison with 21 skins and 16 skulls of *Hemigalus* from Sumatra, Borneo, and Malaya revealed that the *H. d. sipora* specimen falls outside the range of variation of the others, particularly in skull morphology (Groves in litt. 1987). Further investigations are needed.

Distribution: Mentawai Islands, Indonesia (see Map 19). *Hemigalus derbyanus minor* has been described from South Pagi Island and *H. d. sipora* from Sipora Island. The occurrence of the species on Siberut Island was recently confirmed by Tilson (in litt. 1986). *Hemigalus* probably also occurs on North Pagi Island, but this has never been confirmed.

Status: Not known, but probably affected by economic development programmes in the Mentawai Islands. The species preys on domestic chickens, and local people therefore trap it with rattan nooses. An animal captured in this way was the only specimen which Tilson (in litt. 1987) observed on Siberut. In Thailand, *Hemigalus* was found to prefer the ground level of primary forests, presumably frequenting stream banks.

The species as a whole is listed on CITES Appendix II.

Status in captivity: The banded palm civet was and still is occasionally kept and a few cases of breeding are recorded. There are no records for the subspecies from the Mentawais.

Occurrence in protected areas: No records, but probably occurs in the Teitei Batti Sanctuary (56,500 ha).

Recommended action:

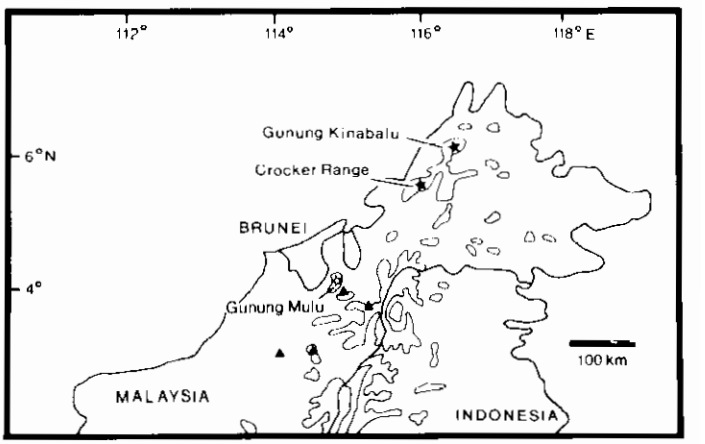
- Conservation projects in the Mentawais should take into account the needs of the endemic banded palm civets.
- An investigation of the taxonomic status of the Mentawai populations of *Hemigalus*.

Hose's palm civet (*Diplogale hosei*)

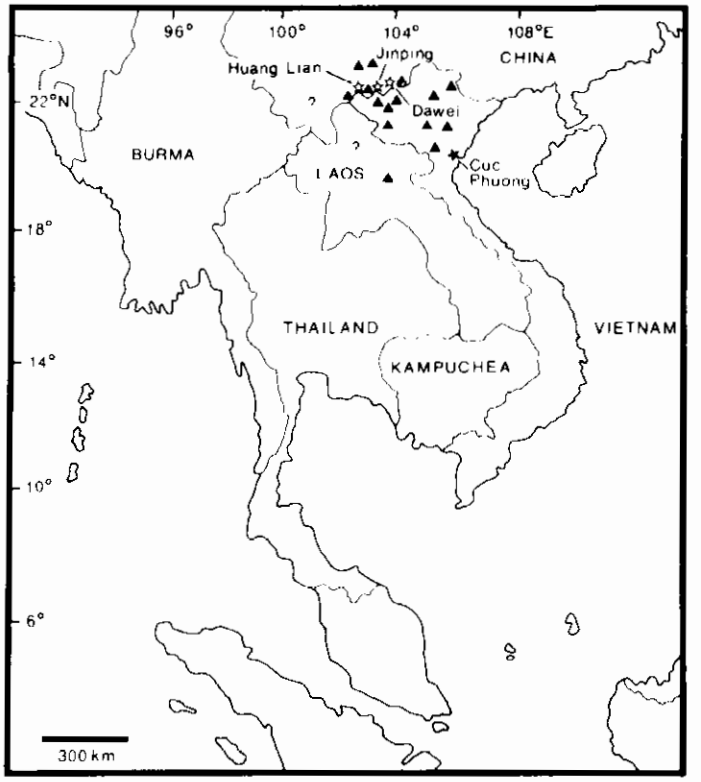
This elusive species is the sole living representative of the genus *Diplogale*.

Distribution: Endemic to a few mountain ranges in Sarawak and Sabah (East Malaysia): Mount Salekan, Mount Kinabalu and the Crocker Range above 1,200 m, the Kelabit Plateau above 1,100 m, Mount Dulit, Mount Kalulong, and Batu Song above 600 m (Payne et al. 1985). There are no records from Kalimantan, the Indonesian part of Borneo (see Map 23).

Status: Known only from 15 museum specimens, the last of which was collected in 1955. No scientist appears to have seen a living *Diplogale*. Phillips (in litt. 1986) reports a dead specimen that was caught in a snare at 1,200 m in cloud forest. During a faunal survey of Sabah, Davies and Payne (1982) failed to obtain any information of Hose's palm civet. As the species seems to be confused with the Bornean yellow-throated marten, field records must be treated with caution.



Map 23. Hose's palm civet (*Diplogale hosei*) has been collected in highland areas of Sarawak and Sabah, East Malaysia (black triangles). One collecting site is close to Gunung Mulu National Park (open star). The occurrences in Gunung Kinabalu and Crocker Range National parks are confirmed (black stars). All land above 1,000 m is shown within the thin unbroken lines.



Map 24. Most museum specimens of Owston's palm civet (*Chrotogale owstoni*) come from sites in northern Vietnam (black triangles). The species could be more widely distributed in Laos and southern China (Chinese localities partly from Wang Ying-Xiang pers. comm. 1988). Cuc Phuong (black star) is the only national park with a confirmed occurrence of this species, but a few Chinese reserves (open stars) could also include it.

Status in captivity: No records.

Occurrence in protected areas: In Gunung Kinabalu National Park (78,000 ha) and in Crocker Range National Park (139,919 ha), Sabah (Malaysia).

Recommended action:

- Improved protection of Gunung Kinabalu National Park, one of the ecologically richest reserves in southeast Asia, which has been reduced in size for mining and suffers from illegal shifting cultivation and tourism.
- Improvement of the protection of the recently established Crocker Range National Park which is being encroached by peasants (Davies in litt. 1987).
- Surveys throughout the mountain ranges where the species is said to occur, in order to obtain some basic data on its ecology and conservation requirements.

Owston's palm civet (*Chrotogale owstoni*)

Chrotogale owstoni is the sole living representative of its genus. Hardly anything is known of its natural history, but the stomachs of two Owston's palm civets contained earthworms (Nowak and Paradiso 1983), suggesting a specialized diet.

Distribution: Northern Vietnam, north Laos, and southern Yunnan and southwest Guangxi provinces, China (see Map 24).

Status: Known from about 20 museum specimens obtained in northern Vietnam, two from Laos, and at least 19 from China (17 deposited in the Kunming Institute of Zoology, and two in the Beijing Institute of Zoology). The specimens in the Kunming Institute of Zoology originated from Yunnan: 16 were bought from hunters in the counties of Piangbian, Hekou, Jinping, Lüchun, Honghe, Maguan, and Malipo, and one was captured by Wang Ying-Xiang in Lüchun county. Information collected by Wang Ying-Xiang (pers. comm. 1988) indicates that the species may be largely terrestrial, and that it prefers habitats in the vicinity of rivers in primary and secondary forests. It can survive close to villages. Like most wildlife in southern China, Owstons's palm civet is subject to considerable hunting pressure. Ratajszczak (in litt. 1988) saw a mounted Owston's palm civet in the visitor centre of Cuc Phuong National Park (Vietnam), which had been killed by poachers in the park. According to local hunters, the species may still be common in the Cuc Phuong region, even approaching houses in search of kitchen wastes.

Status in captivity: No records.

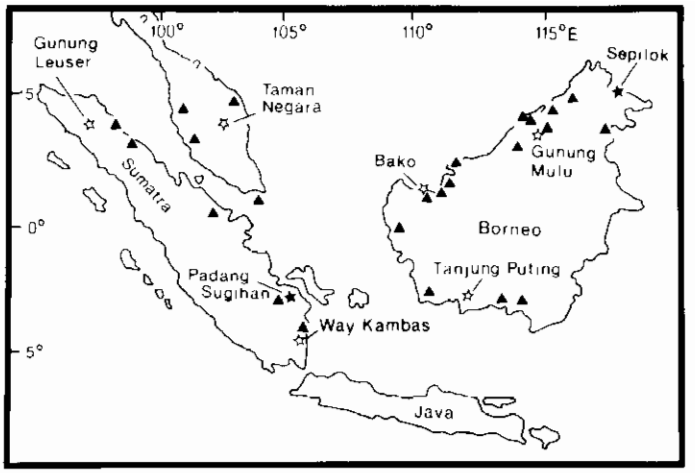
Occurrence in protected areas: Cuc Phuong National Park (22,200 ha) in Ha Nam Ninh province, Vietnam (Ratajszczak in litt. 1988; also confirmed by Nguyen Ba Thun in Szaniawski 1987). In China it is thought to survive in the Dawei Mountain National Reserve (15,300 ha), Jinping Divide National Reserve (10,800 ha), and Huanglian Mountain National Reserve (13,900 ha), all in Yunnan (Wang Ying-Xiang pers. comm. 1988).

Recommended action:

- Survey work to locate additional populations of the species.
- Research to obtain ecological data as a basis for better conservation planning.
- International assistance to Vietnam to increase protection of the Cuc Phuong National Park and to reduce poaching in the park.
- Reduction of the hunting pressure on this species and other threatened wildlife in China and Vietnam.

Otter civet (*Cynogale bennettii*)

The genus *Cynogale* contains only two species (usually treated as subspecies), the otter civet (*C. bennettii*) and Lowe's otter civet (*C. lowei*). Both are rare and little-known. The common name for this species refers to its semi-aquatic life style. Several morphological adaptations such as broad, webbed feet and muscles which close the nose and ears from intruding water indicate a higher degree of specialization than is found in other aquatic viverrids, such as the aquatic genet (*Osbornictis piscivora*) or the marsh mongoose (*Atilax paludinosus*). Otter civets are believed to hunt by lying in ambush in water.



Map 25. Museum specimens of the otter civet (*Cynogale bennettii*) are chiefly from riverine habitats near the coast. The Thai localities (question marks) suggested by Nabhitabhata (in litt.) require confirmation. Among the many protected areas within the otter civet's range (a few of which are indicated by open stars), only Sepilok Forest Reserve and Padang-Sugihan Wildlife Reserve have confirmed records (black stars).

Distribution: Borneo, Sumatra, Peninsular Malaysia, and presumably the Yala and Pattani Provinces of Thailand (see Map 25). The Thai records are considered by Nabhitabhata (in litt.) as only "partially reliable" because there are only reports from animal dealers and private persons keeping pet specimens. There is one old record from Singapore. Most museum specimens were collected from the following rivers: Sempang, Kendawangan, Mandawei, and Ulu Rejang in Borneo, and from near the mouth of the Gasip River (at Siak), in Sumatra. Other records include those by Lyon (1908, 1911) who mentions Aru Bay in east Sumatra, and Pocock (1933) who refers to Gunung Mulu and Gunung Dulit in Borneo. T. Harrison saw an otter civet at about 1,370 m on a steep hillside above Bario in Borneo (Medway 1977).

Status: Museum specimens include about 40 from Borneo, 12 from Sumatra, and 8 from Peninsular Malaysia. An occurrence in southern Thailand is not substantiated by museum specimens, but the single otter civet presently being held at Bangkok Zoo is said to have been captured in that country (Meekvichai pers. comm. 1987). Recent reports of the species are few. During a faunal survey of Sabah in 1982, it was definitely recorded only once, on the basis of a photograph of a dead animal taken near Sungai Pin in middle Kinabatangan. Other verbal reports remained unconfirmed (Davies and Payne 1982). More recently, one was observed in undisturbed lowland dipterocarp forest in the Sepilok Forest Reserve, Sabah (Payne in litt. 1986) and a single specimen was killed in Peninsular Malaysia in 1986 (Mohd. Khan pers. comm. 1987). Even in the more remote areas of southeast Asia, settlements are usually along rivers, and thus *Cynogale*, with its habitat requirements, is probably heavily affected by human colonization and by expanding rice culture.

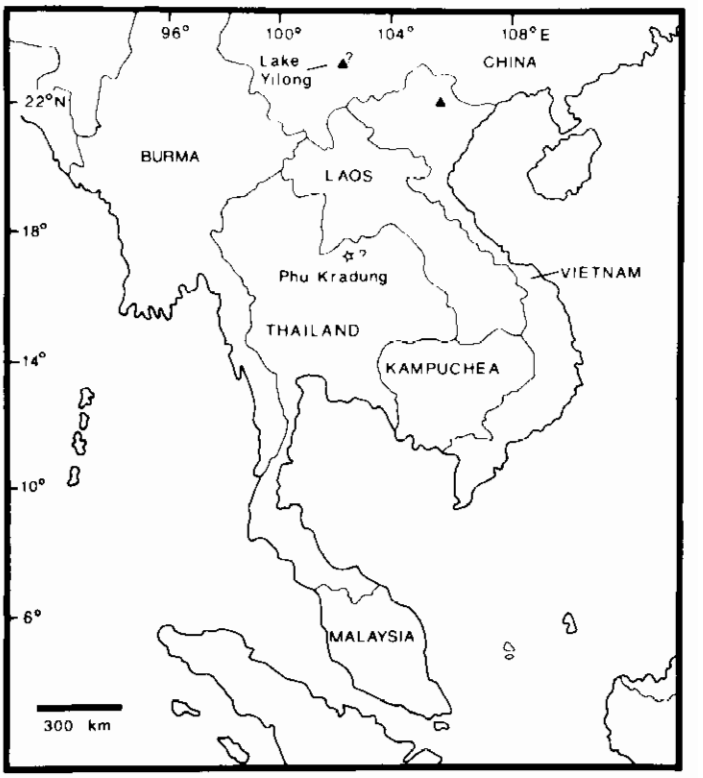
The otter civet is listed on CITES Appendix II.

Status in captivity: *Cynogale bennettii* has never been bred in captivity, although the species has been kept in zoos in Bangkok (Thailand), Calcutta (India), Taipeng (Malaysia), Wassenaar (Holland; from 1967 until around 1972), London (United Kingdom; in 1954), and San Diego (U.S.A.; in 1970-1971). In early 1987, only a single old animal at Bangkok Zoo was still alive.

Occurrence in protected areas: Sepilok Forest Reserve (4,000 ha), Sabah (East Malaysia) and Padang-Sugihan Wildlife Reserve (75,000 ha), Sumatra (Phillips 1986). The area recorded by Pocock (see above) from Mount Mulu now probably lies within Gunung Mulu National Park (52,886 ha), Sarawak. There are numerous other conservation areas, some of them quite large, throughout the range of the species, but it is not known whether any of these contain sizeable populations, or even whether the species occurs there at all.

Recommended action:

- Surveys throughout the range of the species to locate surviving populations.
- A study of the species to identify its exact habitat requirements and its vulnerability to human alteration of the environment.
- An experimental captive breeding project to gather data on the captive maintenance of the species. This is also important as a pilot project for eventual captive breeding of the related and probably highly endangered Lowe's otter civet (*Cynogale lowei*). While captive breeding of both *Cynogale* species may be directly needed as a safeguard against extinction, an additional aim of this proposed project would be to obtain information on the species' biology to facilitate efforts to locate and study these elusive animals in the wild.



Map 26. Lowe's otter civet (*Cynogale lowei*) is a mysterious species, known only from the type specimen collected in north Vietnam (black triangle). Possible sightings have been reported from Lake Yilong (China) and Phu Kradung National Park, Thailand (open star).

Otter civet (*Cynogale bennettii*). (Photo by Zoological Society of San Diego)

Lowe's otter civet (*Cynogale lowei*)

Lowe's otter civet (*Cynogale lowei*) is one of only four viverrid species which have adapted to a semi-aquatic life (see the previous data sheet for *Cynogale bennettii*). Taxonomists do not agree on whether it merits full specific rank, or should be included as a subspecies in *C. bennettii*. With only one skin and no skull available, this question cannot be solved.

Distribution: Known only from the skin of one immature specimen now in the British Museum (Natural History) which was collected in the north of Vietnam (see Map 26). If it really occurs in south Yunnan (China) and northeast Thailand (see status section), it will probably also be found in intervening areas of northern Laos.

Status: The only known museum specimen was collected in Backan, north Vietnam, in 1926. Wang Ying-Xiang (in litt. 1986) reports that he saw a skin of *C. lowei* in a fisherman's house near Yilong Lake in southern Yunnan in 1973. In Thailand, Nabhitabhata (pers. comm. 1987) obtained a very detailed description of an animal that a wildlife warden had observed in Phu Kradung National Park, in the northeast, in 1986. The wildlife warden

insisted that the animal he had seen was not an otter, and according to his description it could have only been one of the two *Cynogale* species. If any *Cynogale* species occurs in northeast Thailand, it is probably *C. lowei* rather than *C. bennettii*. In any event, Lowe's otter civet remains one of the least known and rarest of all viverrids, and while all threats affecting *C. bennettii* will certainly also affect *C. lowei*, the latter species has a much more restricted distribution with only a few conservation areas included in its presumed range.

The otter civet (*Cynogale bennettii*) is included in CITES Appendix II. Since *C. lowei* is frequently considered to be conspecific with *C. bennettii*, the protection from commercial trade conferred by this listing should extend to this species which is presumably much rarer.

Status in captivity: No records.

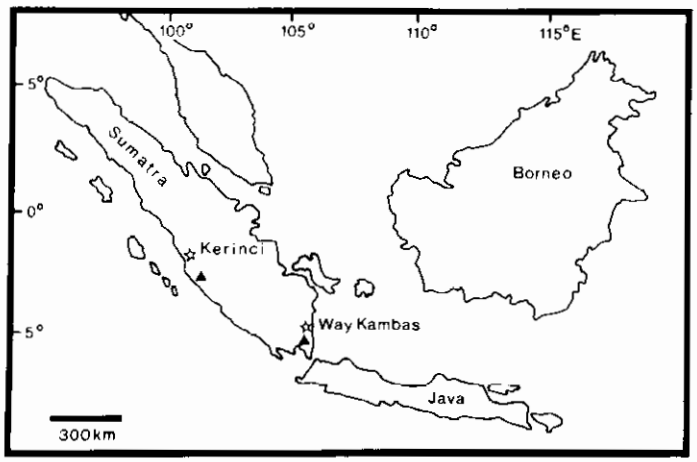
Occurrence in protected areas: Possibly in Phu Kradung National Park (34,800 ha) in Thailand, but this needs confirmation.

Recommended action:

- Field surveys in the Phu Kradung National Park of Thailand and in other areas with potential habitat in northern Vietnam, Laos, and southern China to ascertain whether the species survives at all.
- Immediate protection should be given to any site where Lowe's otter civet is found, and an ecological study should be initiated.

Sumatran collared mongoose (*Herpestes semitorquatus uniformis*)

The collared mongoose (*Herpestes semitorquatus*) is a brightly coloured mongoose which occurs only in Sumatra and Borneo, and not in Java nor in Peninsular Malaysia. This rather unusual distribution pattern is shared by only six other mammal species. *Herpestes semitorquatus uniformis* is distinguished from the Bornean *H. s. semitorquatus* by the near absence of dark agouti-banding on the individual hairs, which results in a bright fox-red body colour.



Map 27. The type locality and one additional record (black triangles) are all that is known of the distribution of the Sumatran collared mongoose (*Herpestes semitorquatus uniformis*). Two protected areas are situated relatively close to these sites, but records are lacking (open stars).

Distribution: The subspecies *H. s. uniformis* is endemic to (parts of) Sumatra (see Map 27).

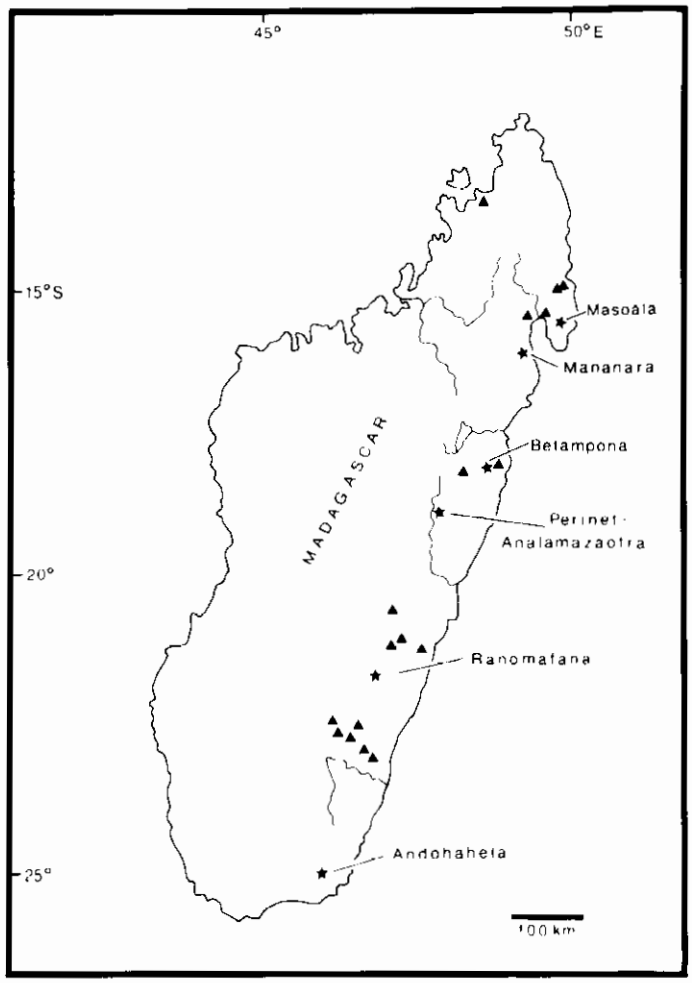
Status: Unknown. Whereas *H. s. semitorquatus* is recorded from scattered localities throughout Borneo (Payne et al. 1985), very little published information exists on *H. s. uniformis*, which is also rare in museum collections (there is no specimen at the Museum Zoologicum Bogoriense in Bogor, Indonesia). The subspecies was described from two specimens collected at Ayer Taman, Gunung Pasaman (Ophir district, west Sumatra), at an altitude of 300 m (Robinson and Kloss 1919). Jentink (1894) mentions one specimen from Soekadana (Lampongs, south Sumatra).

Status in captivity: Records are lacking for both subspecies.

Occurrence in protected areas: The reason why *H. s. uniformis* has not been recorded from any of the large reserves in Sumatra may be that few attempts have so far been made to catalogue their small mammal faunas.

Recommended action:

- Field surveys to define more accurately the current status of the Sumatran collared mongoose, and to assess its conservation requirements.



Map 28. The Malagasy civet (*Fossa fossana*) is endemic to the east Malagasy rain-forest zone. Recorded localities (black triangles) have been taken from Albignac (1973). Several nature reserves (black stars) are known to protect this viverrid.

Malagasy civet (*Fossa fossana*). (Photo by Wolfgang Dreier)

Malagasy Realm

Viverridae

Malagasy civet (*Fossa fossana*)

The Malagasy civet (*Fossa fossana*) is sometimes classified with the southeast Asian Hemigalinae. Whether this reflects its real affinities, or only the retention of common basic characteristics, is a matter of debate. The exact answer to this question, however, will probably shed light on the history of early colonization of Madagascar, which took place during the island's drift away from the African continent. Taxonomists have created a separate subfamily for this species, Fossinae (sometimes also containing *Eupleres*). This has been suggested as being an ancestral group to the Malagasy mongooses (Albignac 1973).

Distribution: Rain forests in eastern and northern Madagascar and in the Sambirano area (see Map 28).

Status: Still not uncommon in the remaining moist forest habitat. This habitat is rapidly shrinking, however, and has now been reduced to isolated patches. According to Nicoll (in litt. 1987), the species's stronghold is in the northeast, in the Mananara Nord area and the Masoala peninsula. *Fossa* is trapped for its meat (Albignac 1973). The Malagasy civet is listed on CITES Appendix II.

Status in captivity: In 1987, no animals appeared to be in captivity. The last captive individuals at Antwerp Zoo (Belgium) and the National Zoo in Washington (U.S.A.), where the species bred in 1969, 1970, and 1973, all died earlier this decade. Jones (in litt. 1987) has provided the following records: Berlin (Germany) from 1915-1917, Hamburg (Germany) in 1887, and Jardin des Plantes, Paris (France) in the 1970s.

Occurrence in protected areas: Nicoll (in litt. 1987) mentions the planned national park of Ranomafana, lying east of Fianarantsoa, as an important site for *Fossa* and he suggests that the species's stronghold lies in the northeast around Mananara Man

Western fanalouc (*Eupleres goudotii major*). (Photo by Roland Albignac)

and the Biosphere Reserve (20,000 ha) and the planned Masoala Reserve. Further records (Albignac pers. comm. 1987; Nicoll in litt. 1987) have been obtained from the following protected areas: Réserve Naturelle Intégrale No. 1 de Betampona (2,228 ha), Réserve Naturelle Intégrale No. 11 de Andohahela (760,020 ha) and Réserve Speciale de Analamazaotra-Périnet (810 ha).

Remarks: Care should be taken not to confuse the genus *Fossa* with the fossa (*Cryptoprocta*), which belongs to a different subfamily (Cryptoproctinae).

Recommended action:

- Adequate protection of the planned Masoala Reserve, Mananara Man and the Biosphere Reserve, the planned Parc National de Ranomafana and the other conservation areas mentioned above.
- The number of Malagasy civets killed by direct human persecution should be kept to a minimum, possibly by legal protection, with an exception being the trapping of known chicken-raiding individuals (Nicoll in litt. 1987).

Fanalouc (*Eupleres goudotii*)

The fanalouc (*Eupleres goudotii*) feeds almost exclusively on earthworms, and only occasionally takes amphibians or insects and their larvae. *Eupleres* (and the Malagasy civet, *Fossa fossana*) are capable of storing large fat deposits in their tails, in order to survive periods of food deficiency (Albignac in Jolly et al. 1984). A comparison of the hormonal and bioperiodical triggering of this physiological adaptation, with similar but day-length-dependent adaptations in hibernating mammals in the temperate and subarctic zones, would be of great scientific interest.

The genus *Eupleres* contains two distinctive populations, *E. g. goudotii* in the northeast and *E. g. major* in the northwest of Madagascar. *E. g. major* has occasionally been treated as specifically distinctive from *E. g. goudotii*.

Eastern fanalouc (*Eupleres goudotii goudotii*)

The eastern fanalouc is endemic to rain forests and marshes (dominated by *Cyperaceae*, *Raphia*, and *Pandanus*) in the east of Madagascar (see Map 29).

Status: Listed as "Vulnerable" in the IUCN Mammal Red Data Book (Goodwin and Holloway 1978). The subspecies is still widespread in remaining suitable habitat, but is nowhere common. The total area of primary forest in Madagascar is already relatively small, and undisturbed forests could be lost completely within one or two decades if present rates of clearance continue (Nicoll in litt. 1987). Marshes, too, are increasingly being drained. Predation by dogs is a problem, but competition with the introduced small Indian civet (*Viverricula indica*), as mentioned in the IUCN Mammal Red Data Book and by Albignac (1973), seems not to be important to *Eupleres* (Nicoll in litt. 1987). Since its meat is highly appreciated by the local human population, the fanalouc is frequently hunted (Albignac in Jolly et al. 1984). *Eupleres goudotii* is listed on CITES Appendix II.

Status in captivity: Probably none in captivity at present and only one individual of the nominate subspecies appears to have been kept in the past, at the Parc Zoologique de Tsimbazaza, Antananarivo (Madagascar).

Occurrence in protected areas: There are records from Mananara Man and the Biosphere Reserve (20,000 ha), and the former

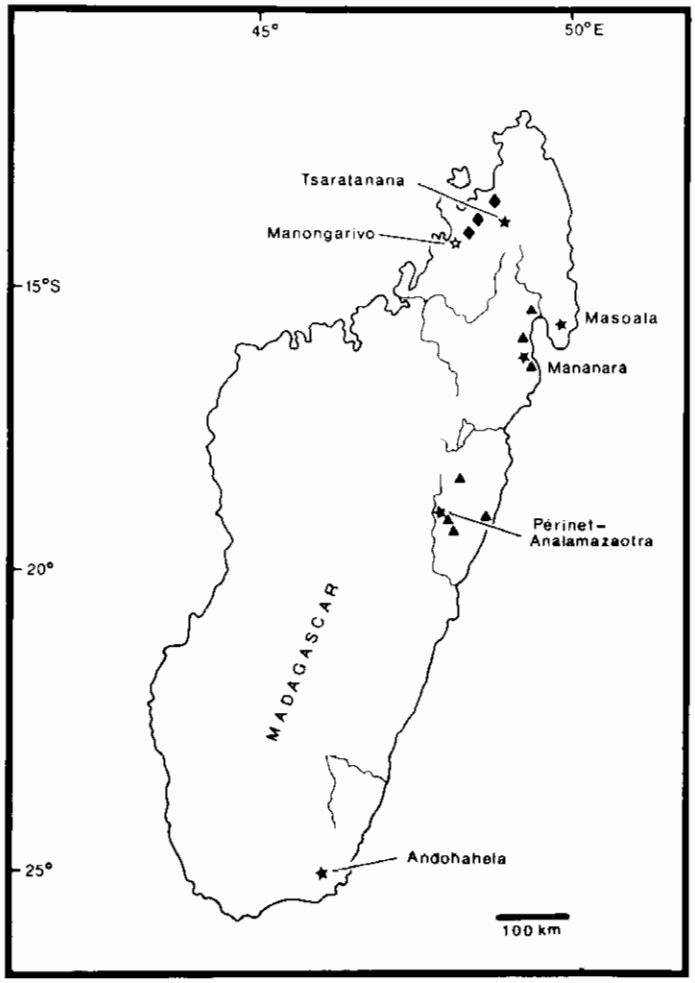
Réserve Naturelle Intégrale No. 2 on Masoala peninsula which was degazetted in 1964 (Albignac pers. comm., 1987). However, according to Nicoll (in litt. 1987), a new reserve might be declared on Masoala peninsula. Further records of the species come from Réserve Naturelle Intégrale No. 11 de Andohahela (760,020 ha) and the Réserve Spéciale de Analamazaotra-Périnet (810 ha).

Western fanalouc (*Eupleres goudotii major*)

The western fanalouc is endemic to undisturbed forest areas and wetlands (with *Raphia* and *Aframomum*) in northwestern Madagascar, north of Marovoay (see Map 29). Most records are from the Sambirano area (Albignac, 1973).

Status: The largest populations appear to occur in northwestern Malagasy rain forests (Nicoll in litt. 1987).

Status in captivity: Being very susceptible to stress, *Eupleres* is difficult to maintain in captivity. At the Parc Zoologique de Tsimbazaza, Antananarivo, however, successful breeding has been achieved three times from a total of nine *E. g. major* kept. There are no present records.



Map 29. The distribution of the fanalouc (*Eupleres goudotii*) after Albignac (1973): black triangles refer to the subspecies *E. g. goudotii*, and black diamonds to *E. goudotii major*. The nominate race is known to occur in a few gazetted or planned reserves (black stars), but *E. goudotii major* is confirmed only from Reserve Naturelle Intégrale de Tsaratanana, although it might occur also in the Réserve Spéciale de Manongarivo.

Occurrence in protected areas: Known to exist in the Réserve Naturelle Intégrale de Tsaratanana (48,622 ha), southeast of Ambanja (Goodwin and Holloway 1978; Albignac pers. comm. 1987). It probably also occurs in the Réserve Spéciale de Manongarivo (35,250 ha).

Recommended action (for both subspecies):

- Improvement of the protection status of all reserves known to have populations of *Eupleres*.
- Declaration of further marshlands as conservation areas.
- The species needs complete nation-wide protection.
- Initiation of an internationally coordinated captive breeding programme.

Malagasy broad-striped mongoose (*Galidictis fasciata*)

The Malagasy mongooses show an impressive example of adaptive radiation in predator-poor Madagascar, having evolved into four genera with five species. The Malagasy broad-striped mongoose (*Galidictis fasciata*) is the species most specialized for flesh-eating in this group.

Distribution: Two subspecies inhabit the rain forests and coastal marshes of eastern Madagascar (see Map 30): *G. f. striata* lives in the hinterlands of Toamasina in the northeast (several museum specimens coming from Brickaville area), and *G. f. fasciata* inhabits the forests of the Mananjari and Farafangana districts in the southeast. One museum specimen comes from Ambinanindrano near Ifanadiana. Nicoll (in litt. 1987) observed *G. fasciata* south of Fandrarazana river which extends the known range of the species further to the north than previously thought.

Status: Nicoll (in litt. 1986) reports that *G. f. striata* may be confused with the sympatric Malagasy civet (*Fossa fossana*) and this could be the reason for the scarcity of reliable records. *Galidictis f. fasciata* appears to be locally common but somewhat patchily distributed over its entire range. Both subspecies are threatened by habitat destruction. However, there are sight records from degraded rain forests, as well as one from a salt marsh (Nicoll in litt. 1987).

Status in captivity: There is one record from the Ménagerie du Jardin des Plantes, Paris, where a single male specimen of *"Galidictis striata"* (*G. f. striata* or just a synonym of *G. fasciata*?) was kept from January to August 1963. The same zoo reports *"G. barri"* from 1905. The Antananarivo Zoo (Madagascar) also kept this species before 1957 (Jones in litt. 1987).

Occurrence in protected areas: The species occurs in the Mananara Man and the Biosphere Reserve and in Ranomafana to the east of Fianarantsoa, which is scheduled to become a national park. Also reported from Réserve Naturelle Intégrale No. 1 de Betampona (2,228 ha). Reports from Réserve Naturelle Intégrale No. 12 de Marojejy (60,150 ha) in the northeast may be due to a confusion with *Fossa* (Nicoll in litt. 1987).

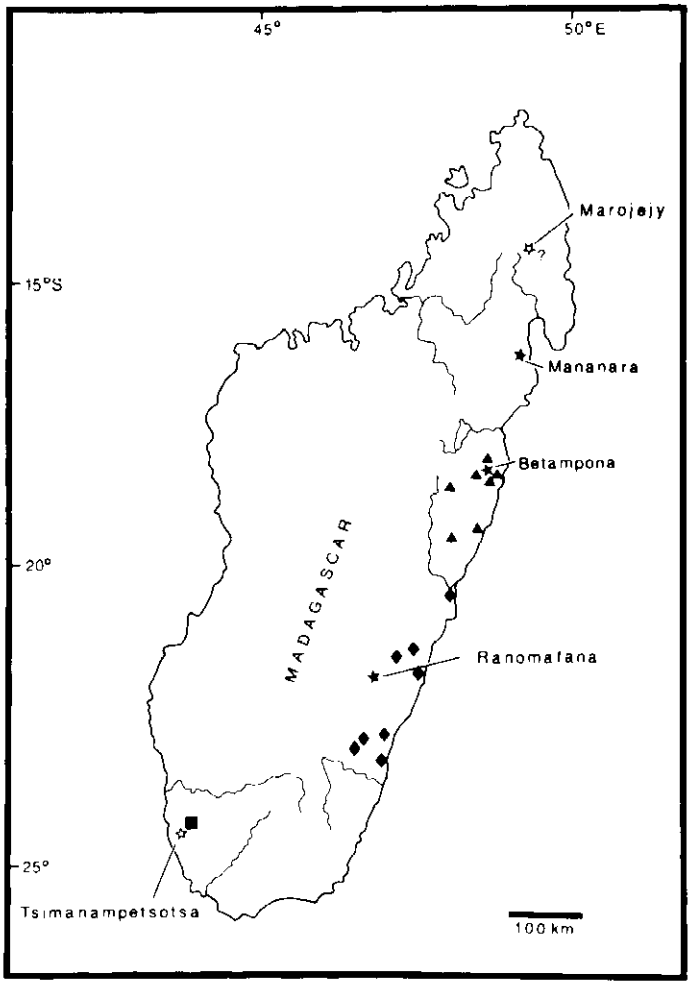
Recommended action:

- Nicoll (in litt. 1987) suggests partial legal protection, so that only chicken-raiding individuals may be persecuted.

Giant striped mongoose (*Galidictis grandidieri*)

The giant striped mongoose (*Galidictis grandidieri*) is the largest of all Malagasy mongooses, and also the least known. Only three museum specimens are known to exist, and it was not until 1986 that it was described as a new species (Wozencraft 1986).

Distribution: The limits of the distribution are unknown at present. Only one of the museum specimens has exact locality data (see Map 30): Lac Tsimanampetsotsa (24° 08' S, 43° 46' E). This collection locality suggests an ecological and geographical separation of *Galidictis grandidieri* from *G. fasciata*, the only other species in the genus (Wozencraft 1986). The latter species has only been collected in rain forests east of the eastern escarpment.



Map 30. The Malagasy broad-striped mongoose (*Galidictis fasciata*) is confined to the Malagasy rain forest zone (after Albignac 1973; Wozencraft 1986). Its subspecies *G. f. fasciata* is denoted by black triangles, and *G. f. striata* by black diamonds. The three protected areas indicated by black stars are known to include this endemic mongoose but it remains doubtful if it also occurs in the Réserve Naturelle Intégrale de Marojejy (open star).

The giant striped mongoose (*Galidictis grandidieri*) is thought to occur in the southwestern arid zone, and is denoted by a black square. The site where the type specimen has been collected is close to (or within) the Réserve Naturelle Intégrale de Tsimanampetsotsa.

Status: Unknown. Only three museum specimens exist. A.L. Rand collected one of them in 1929 and suggested that the species was probably abundant at that time. Nothing else had been reported until 1987 when Langrand visited the Tsimanampetsotsa area and reported that villagers there are familiar with a mongoose which, according to the description they provided, could be *G. grandidieri* (Nicoll in litt. 1987).

Status in captivity: No records.

Occurrence in protected areas: Probably in Réserve Naturelle Intégrale No. 10 de Tsimananpetsotsa (43,200 ha), which lies in the area of the type locality of the species.

Recommended action:

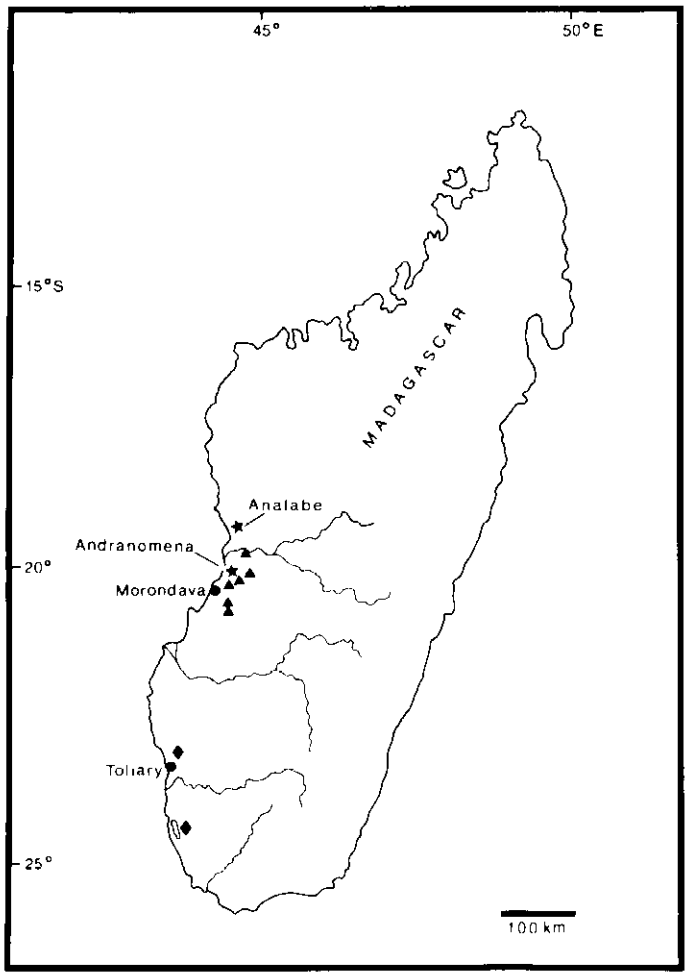
- A field survey in Lac Tsimanampetsotsa Reserve and in areas with similar habitat in southwest Madagascar to determine the distribution and abundance of the species.
- If a population is discovered, an ecological study of the species should be undertaken to determine its conservation requirements.
- Nicoll (in litt. 1987) suggests total national protection by law.

Malagasy narrow-striped mongoose (*Mungotictis decemlineata*)

The Malagasy narrow-striped mongoose (*Mungotictis decemlineata*) inhabits the seasonal forests of western Madagascar. The nominate subspecies (*M. d. decemlineata*) occurs in woodlands dominated by Malagasy endemic species of baobab (*Adansonia*), and *M. d. lineata* is presumedly found in the famous Didiereaceae thickets in the southwest part of the island.

Distribution: The nominate subspecies (*M. d. decemlineata*) is restricted to the central west coast area of Madagascar, from the Tsiribihina river southwards to the Mangoky river. According to Albignac (pers. comm. 1987), the Morondava area is a stronghold. The subspecies *M. d. lineata* is known from only two specimens from Toliary Bay (collected in 1847) and from Lac Tsimanampetsotsa (collected in 1930), both situated in southwestern Madagascar (see Map 31).

Status: Nothing is known about the numbers and the exact distribution of *M. d. lineata*. The nominate subspecies *M. d. decemlineata* is still locally common in baobab forest between the Morondava and Tsiribihina rivers. There are still considerable tracts of spiny bush and deciduous forest in the region north of Toliary, and there appears to be very little direct human persecution of this mongoose. However, the vegetation cover is being burnt and cut in many places at an alarming rate (Nicoll in litt. 1987). According to Albignac (1972), *Mungotictis* is able to live in degraded forests. The taxonomic status of the southern populations of *Mungotictis*, their relationship to each other and to *M. d. decemlineata*, as well as their assignment to *M. d. lineata*, remains problematic at present. This further hampers any attempt to evaluate their conservation status.



Map 31. The Malagasy narrow-striped mongoose has two subspecies: *M. d. decemlineata* is denoted by black triangles, and *M. d. lineata* by black diamonds (from Albignac 1973).

Status in captivity: The Parc Zoologique de Tsimbazaza, Antananarivo (Madagascar) maintained a small captive colony of the species until 1987. Albignac (1973) reports three cases of captive breeding, and provides details on mating behaviour, gestation, and development of the offspring. The species was exhibited in London Zoo (United Kingdom) in 1848 and 1906, and in Antananarivo prior to 1957 (Jones in litt. 1987), as well as at Montpellier Zoo (France) in the 1970s.

Occurrence in protected areas: According to Nicoll (in. litt. 1987), the species occurs in the privately owned Analabe Reserve, which contains a sizeable population of *Mungotictis*. It also occurs in the Réserve Spéciale d'Andranomena (6,420 ha) and in the Kirindy Forest. Kirindy is a forestry concession lying 60 km north of Morondava which provides complete protection to *Mungotictis*. It is managed by the Coopération Suisse.

Recommended action:

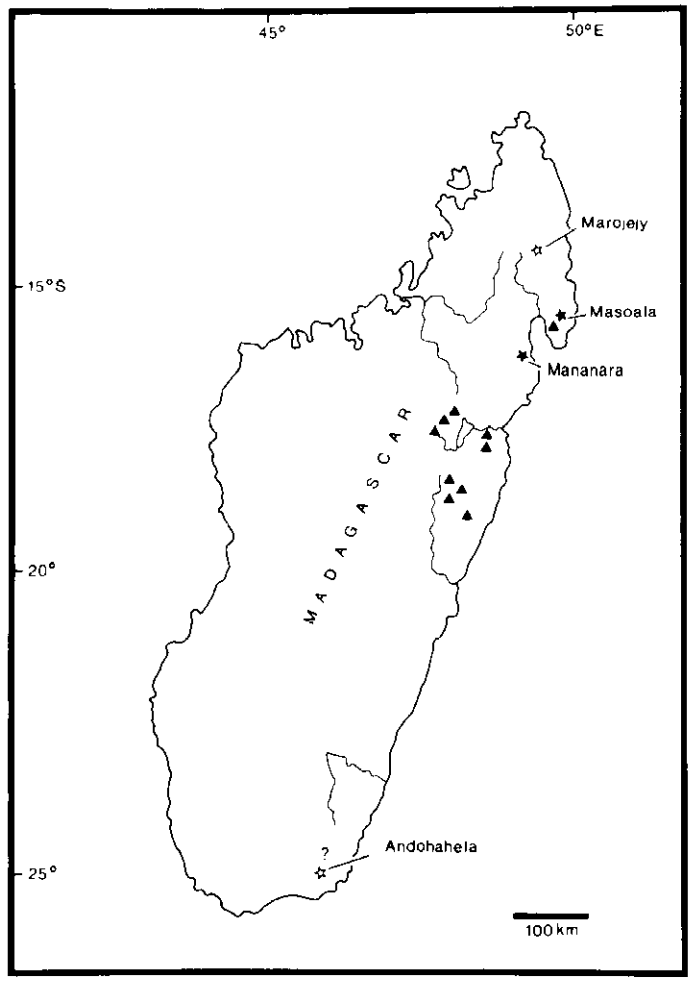
- Albignac (1973) recommends establishment of a reserve within the range of the nominate subspecies, which means in the baobab dominated dry forests in the Morondava/Belo-sur-Tsiribihina area of central west Madagascar. The Malagasy giant rat (*Hypogeomys antimena*), the largest endemic rodent of Madagascar, would also benefit from such protection.
- Field work to locate populations of the subspecies *M. d. lineata*.
- Nicoll (in litt. 1987) suggests total national protection for the species.

Malagasy brown-tailed mongoose (*Salanoia concolor*)

In the course of the radiation of the Malagasy mongooses, the Malagasy brown-tailed mongoose (*Salanoia concolor*) acquired a tendency to become insectivorous. It is the least known Malagasy mongoose apart from the recently discovered giant striped mongoose (*Galidictis grandidieri*).

Distribution: Medium-altitude rain forests of east Madasgacar (see Map 32). Most museum specimens were obtained from the north and east of Lac Alaotra. This habitat is shared with the Malagasy civet (*Fossa fossana*) and the Malagasy ring-tailed mongoose (*Galidia elegans*).

Status: *Salanoia* is considered to be very thinly distributed, and Nicoll (in litt. 1986) has rarely encountered local people who know of the species. However, due to its cryptic colouration, and also due to a superficial resemblance to *Galidia*, the species tends to be overlooked. During survey work in 1987, Nicoll and his col-



Map 32. The Malagasy brown-tailed mongoose (*Salanoia concolor*) is among the least known Malagasy viverrids. It could be more widely distributed than suggested here (following Albignac 1973).

leagues found it to be relatively common in the Mananara Nord area and the Masoala peninsula, as well as in the forests in between. It raids domestic fowl and is trapped accordingly (Nicoll in litt. 1987).

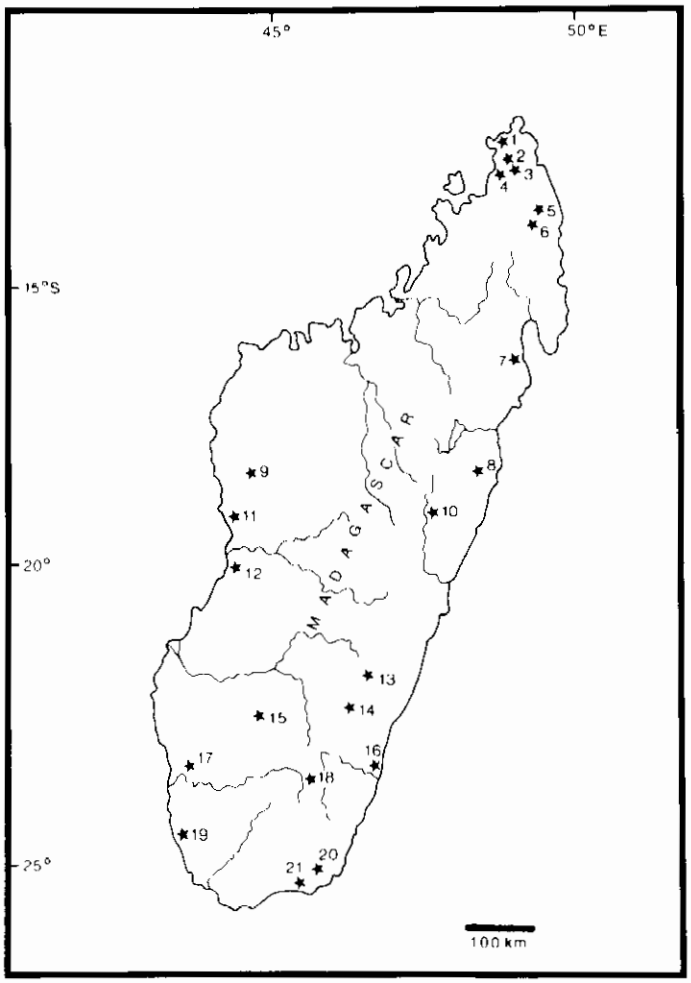
Status in captivity: The species has probably never bred in captivity, although it was exhibited at Amsterdam Zoo (Netherlands) in 1911, at Berlin Zoo (Germany) from 1902-1907, and again from 1908-1913, as well as at the zoo in Antananarivo (Madagascar) until 1957 (Jones in litt. 1987).

Occurrence in protected areas: *Salanoia* occurs in the Mananara Man and the Biosphere Reserve and in the planned reserve on the Masoala peninsula. It can presumably also be found in Réserve Naturelle Intégrale No. 12 de Marojejy (60,150 ha). A record from Andohahela (Réserve Naturelle Intégrale No. 11) in the south is probably the result of a confusion with the fanalouc (*Eupleres goudotii*).

Recommended action:

- Field surveys to locate more populations of the species.
- Nicoll (in litt. 1987) suggests total legal protection except for individuals which raid domestic chickens.

Fossa (*Cryptoprocta ferox*). (Photo by Roland Wirth)



Map 33. The fossa (*Cryptoprocta ferox*) is widespread in Madagascar and occurs in many protected areas (data from Nicoll in litt., 1987; R.N.I. = Réserve Naturelle Intégrale; P.N. = National Park; R.S. = Réserve Spéciale; M.A.B. = Man and the Biosphere Reserve): 1: R.S. de la Forêt d'Ambre (4,810 ha). 2: P.N. de la Montagne d'Ambre (18,200 ha). 3: R.S. d'Analamerana (34,700 ha). 4: R.S. d'Ankara (18,220 ha). 5: R.N.I. de Marojejy (60,150 ha). 6: R.S. d'Anjanaharibe (32,100 ha). 7: Mananara M.A.B. 8: R.N.I. de Betampona (2,228 ha). 9: R.N.I. du Tsingy de Bemaraha (152,000 ha). 10: R.S. d'Anamalazaotra-Périnet (810 ha). 11: Analabe. 12: R.S. d'Andranomena (6,420 ha). 13: Ranomafana. 14: R.N.I. d'Andringitra (31,160 ha). 15: P.N. de l'Isalo (81,540 ha). 16: R.S. de Manombo (5,020 ha). 17: R.S. de Beza-Mahafaly (600 ha). 18: R.S. de Kalambatritra (28,250 ha). 19: R.N.I. de Tsimanampetsotsa (43,200 ha). 20: R.N.I. d'Andohahela (76,020 ha). 21: Berenty (265 ha).

Fossa (*Cryptoprocta ferox*)

The fossa (*Cryptoprocta ferox*), the only species of its subfamily (Cryptoproctinae), shows an intriguing combination of morphological traits of both the feline and viverrid lineages of carnivoran evolution. Its dentition is reminiscent of felids, and the species has been placed in the Felidae family by some authors. Alternatively, it has been considered to be a primitive connecting link, or a viverrid that has acquired feline characters through convergence. It is the largest native predator in Madagascar.

Distribution: Madagascar. Found throughout the island, except for some parts of the central high plateau (see Map 33).

Status: *Cryptoprocta* is listed as "Vulnerable" in the IUCN Mammals Red Data Book (Goodwin and Holloway 1972). According to this source, the species' population has been depleted and continues to decline. Nicoll (in litt. 1986) reports that the fossa is still reasonably common and widespread. Mittermeier (in litt. 1986) found the species common in the Analabe region north of Morondava. Albignac (1973; pers. comm. 1987) and Nicoll (in litt.

Abyssinian genet (*Genetta abyssinica*). (Photo by Bildarchiv Okapia)

1987) report the fossa as particularly common around Morondava in central west Madagascar, possibly due to the occurrence in the area of the rodent *Hypogeomys* on which the fossa preys (and with whose population densities *Cryptoprocta* numbers are reported to cycle). Further strongholds may be Antalaha in the northeast and Bongolava. The fossa is to some extent persecuted as a chicken thief. The fossa is listed on CITES Appendix II.

Status in captivity: *Cryptoprocta* has always been rather rare in captivity, but due to successful breeding, the captive population has now increased to approximately 30 individuals. Potential or actual breeding groups exist in the zoos of Duisburg (West Germany), Basel (Switzerland), Montpellier (France), and San Diego (U.S.A.).

Occurrence in protected areas: There are records from a large number of reserves (Nicoll in litt., 1987): from Parc National de la Montagne d'Ambre (18,200 ha) and Parc National de l'Isalo (81,540 ha). From the following Réserves Naturelles Intégrales: R.N.I. No. 1 de Betampona (2,228 ha), R.N.I. No. 5 d'Andringitra (31,160 ha), R.N.I. No. 7 de l'Ankarafantsika (60,520 ha) , R.N.I. No. 9 du Tsingy de Bemaraha (152,000 ha), R.N.I. No. 10 de Tsimanampetsotsa (43,200 ha), R.N.I. No. 11 d'Andohahela (76,020 ha) and R.N.I. No. 12 de Marojejy (60,150 ha). From the ten Réserves Spéciales de Anamalerana (34,700 ha), Anjanaharibe (32,100 ha), Kalambatritra (28,250 ha), Ankara (18,220 ha), Andranomena (6,420 ha), Manombo (5,020 ha), Forêt d'Ambre (4,810 ha), Anamalazaotra-Périnet (810 ha), and Beza Mahafaly (600 ha). Other protected areas with *Cryptoprocta* populations include the Mananara Man and the Biosphere Reserves, a proposed World Heritage Site near Anksalova, and the private reserves of Berenty (265 ha) and Analabe, as well as the Kirindy Swiss Cooperation forestry concession near Morondava. The reserves of Andranomena, Analabe, and the Kirindy forest are especially valuable, as they are situated within the baobab forests in the western coastal plain near Morondava, where peak densities of the fossa have been observed.

Remarks: *Cryptoprocta* is widespread and not immediately threatened, in contrast to many other Malagasy endemic species. However, being the largest of all Malagasy carnivores and quite well-known both in Madagascar and worldwide, it is important as a "flagship species" for conservation in Madagascar. Care should be taken not to confuse the fossa (*Cryptoprocta*) with the Malagasy civet of the genus *Fossa*.

Recommended action:

- Field research to assess the population size of *Cryptoprocta* within the conservation areas of Madagascar.
- Establishment of a cooperative management plan for the captive population of *Cryptoprocta*.

Afrotropical Realm

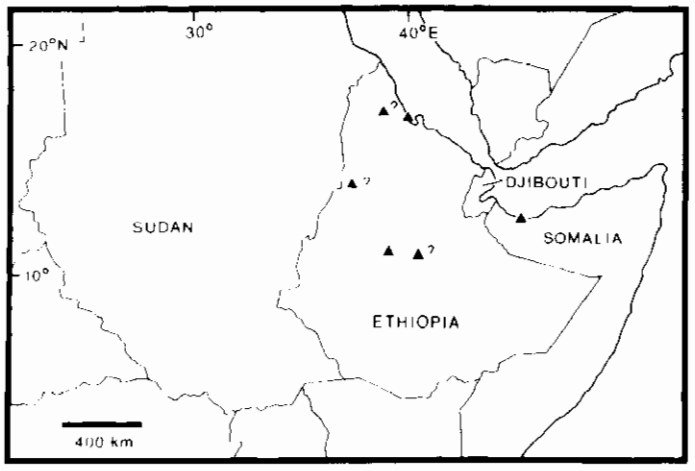
Viverridae

Abyssinian genet (*Genetta abyssinica*)

On account of its morphological distinctiveness, the Abyssinian genet (*Genetta abyssinica*) is occasionally placed in a separate subgenus *Pseudogenetta*, together with the Haussa genet (*Genetta thierryi*). It has characteristic pelage patterns consisting of five more or less continuous longitudinal black stripes on the back

(instead of a series of spots) and continuous interdigital and metacarpal pads on the forepaws. In other species of *Genetta*, the forepaw pads are separated by a band of fur. These features should help to easily distinguish this species from any other genet. Such correct identification is important because the exact range and the habitats of the Abyssinian genet remain unknown.

Distribution: Ethiopia, possibly also Djibouti and northern Somalia (see Map 34). It is still unclear whether *G. abyssinica* is a highland forest form, as claimed by most authors, or an inhabitant of the Somali arid lowlands, as is suggested by the apparently confirmed origin of Blanford's specimens from the Bay of Zula (Yalden et al. 1980; Yalden in litt. 1987).



Map 34. The records (black triangles) shown in this map are all that is known of the distribution of the Abyssinian genet (*Genetta abyssinica*). The exact locations of some of them (marked with a question mark) are uncertain (from Yalden et al. 1980).

Status: Known from about half a dozen museum specimens. Sightings have been reported from 11 localities. Most of them are doubtful because of possible confusion with other genets (Yalden in litt. 1987; Yalden et al. 1980). Already Rüppell (1835-1840) mentioned the scarcity of this species in comparison with other genets. As long as the habitat requirements of *G. abyssinica* are not known, it is an open question as to what extent its survival is threatened by the continued serious forest fragmentation in the Ethiopian highlands, or the desertification in the arid regions of the Horn of Africa.

Status in captivity: Three Abyssinian genets were kept at Frankfurt zoo from 1949 to 1958 (Faust and Jones in litt. 1987).

Occurrence in protected areas: Not known.

Recommended action:

- Field work to identify the species' exact distribution and its habitat and conservation requirements.

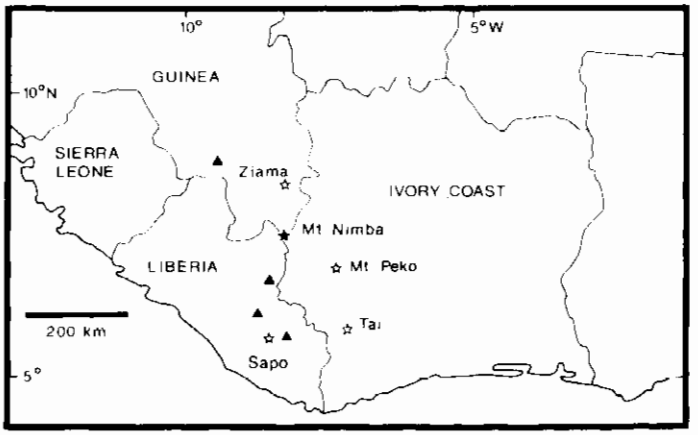
Johnston's genet (*Genetta johnstoni*)

The classification of Johnston's genet in a separate subgenus (*Paragenetta*), of which it is the sole member, is justified because of deviating skull and dentition characters, possibly indicating an insectivorous diet (Rosevear 1974). Johnston's genet was first described by Pocock in 1907 from five "flat, native-prepared headless skins" collected in Liberia, of which only two still exist. Fifty years later Kuhn described the species from two skulls as *Genetta lehmanni*.

Distribution: Known from a small area of rain forest in Liberia and from one specimen from Macenta, Guinea (see Map 35).

Status: Only eight museum specimens are available. This species has hardly been seen alive by a scientist and no specimens have been collected during the last 20 years.

Status in captivity: No records.



Map 35. Records (blacks triangles) of Johnston's genet (*Genetta johnstoni*) are confined to the Upper Guinea rain forest (following Kuhn 1965; Rosevear 1974). Several protected areas (open stars) could include this genet, but confirmed sightings have only been reported from the reserve at Mount Nimba (black star).

Occurrence in protected areas: There are a small number of protected areas within the range of Johnston's genet. However, the species is only reported from the Réserve Naturelle Intégrale de Mont Nimba (Lamotte and Tranier 1983; IUCN 1987) which lies partly in Ivory Coast (5,000 ha) and in Guinea (13,000 ha). The Guinean sector is also a Man and the Biosphere Reserve (17,130 ha) and the total area a World Heritage Site. A contiguous reserve in Liberia is being planned.

Recommended action:

- Field surveys, particularly in conservation areas, to establish whether populations exist within officially protected forests in addition to the reserve at Mount Nimba. Any such effort should be combined with a search for the Liberian mongoose (*Liberiictis kuhni*) and Leighton's linsang (*Poiana richardsoni liberiensis*), both equally little known species of the endemic viverrid fauna of the Upper Guinea rain forest.

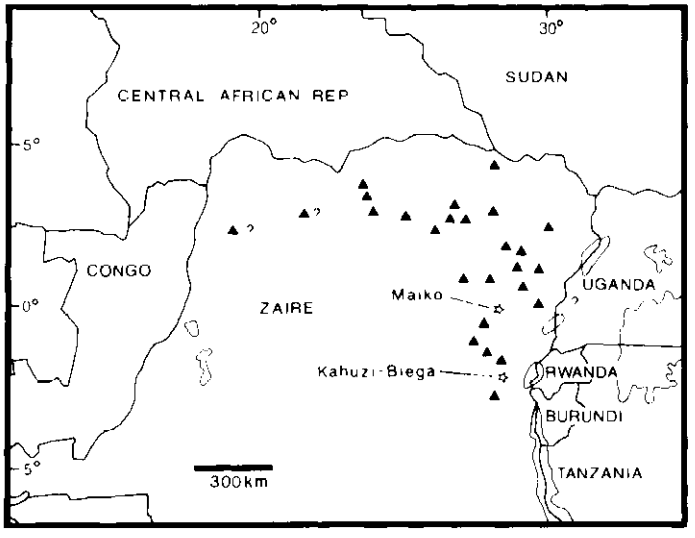
Giant genet (*Genetta victoriae*). (Photo by Urs Rahm)

Giant genet (*Genetta victoriae*)

The giant genet (*Genetta victoriae*) is the largest species of its genus. In some aspects, it resembles a civet (*Civettictis*).

Distribution: The giant genet occurs in forests between the Zaire, Lualaba and Oubangi rivers and the rift valley in northeast Zaire (see Map 36). Published reports of its occurrence outside Zaire (such as western Uganda; see Kingdon 1977) could not be confirmed and have been doubted by other authorities.

Status: Present knowledge suggests that the species is patchily distributed, being quite abundant in some places and nearly absent from intervening areas, without, as yet, any known correlation with particular environmental factors. Colyn (pers. comm. 1987), for example, found it very rare in the area between the Uma and Enano rivers, east of Kisangani, whereas the reports by local people and the presence of several specimens obtained by local hunters indicate that it is fairly common along the road from Kisangani to Buta (between the Aruwimi and Lindi rivers). As long as we do not know the reasons for the absence or near-absence of *Genetta victoriae* from large areas of apparently suitable habitat, the species should be considered at risk.



Map 36. Occurring over a large area, the giant genet (*Genetta victoriae*) appears to be patchily distributed (after Schlawe 1980). A possible occurrence in Uganda needs confirmation, and there are no records from the large rain forest national parks of eastern Zaire (open stars).

Status in captivity: No present records. The giant genet has apparently never been bred in captivity and we know of only three captive specimens: one lived at Antwerp Zoo from 1957 to 1958, and another was kept by Rahm (1966) during his stay in Zaire in 1960. One museum specimen deposited in Tervuren (Belgium) in 1941 was said to have lived at what is now Kinshasa Zoo in Zaire (Jones in litt. 1987).

Occurrence in protected areas: Although not confirmed, it is almost certain that *Genetta victoriae* occurs in the Maiko National Park (1,083,000 ha).

Recommended action:

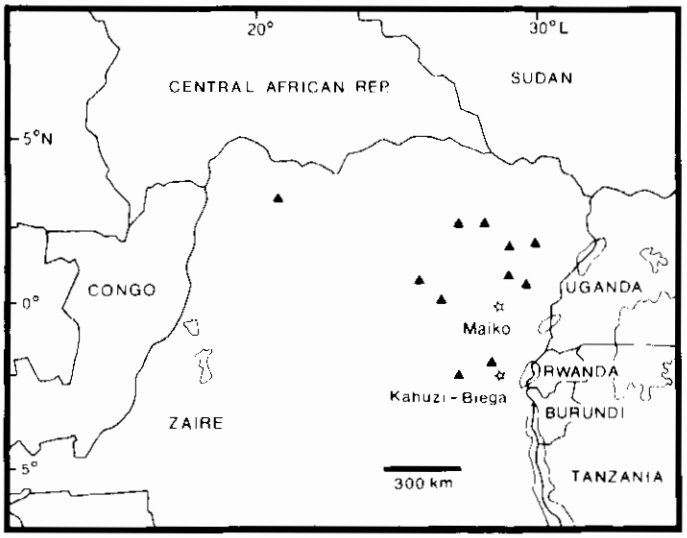
- An ecological study to identify the reasons for the giant genet's patchy distribution pattern.
- Protection of Maiko National Park.

Giant genet (*Genetta victoriae*). (Photo by Urs Rahm)

Aquatic genet (*Osbornictis piscivora*)

The aquatic genet (*Osbornictis piscivora*), which has been called "Africa's rarest carnivore," is the sole living representative of its genus. The species is thought to hunt in water, possibly like a mink, but presumably unlike the otter civets, which are reported to lie in ambush. Van Rompaey (1988) summarized the few available data on the natural history of this elusive species.

Distribution: The lowland rain forest between the right bank of the Zaire/Lualaba river and the western ridge of the Albertine rift valley in north-eastern Zaire (see Map 37). Rahm (1966) recorded the species from Bushi (in the Itebero region of Zaire, 1°40' S,



Map 37. The aquatic genet (*Osbornictis piscivora*) is so little known that the few records (black triangles) given in this map are entirely based on animals acquired from local hunters (after Van Rompaey 1988).

28°05' E). There is no museum specimen from east of the rift valley, and the supposed occurrence of the species in Uganda and Burundi has been doubted (Bere 1975; Kingdon 1977; Verschuren 1978).

Status: Known from 31 museum specimens. Nearly all specimens were obtained from native hunters who caught the animals with snares usually put out on trails near small rivers (Van Rompaey 1988). A few had been hunted with dogs, and villagers reported to Colyn (pers. comm. 1987) that aquatic genets sometimes raid chicken houses. The species is discontinuously distributed within its range, and there seems to be a correlation between the occurrence of the aquatic genet and large homogeneous stands of *Gilbertiodendron* forests (Hart in litt. 1985; Colyn and Gevaerts 1986). There are two museum specimens from the Epulu region, but Hart (in litt. 1985) did not find any evidence of *Osbornictis* after 30 months of field work in this area. The little knowledge available on the biology of *Osbornictis* comes from local people and the animal has probably never been observed by a scientist. Allen (1924) provided a photograph of the species's habitat. *Osbornictis* is given complete protection by the Zairean government (Ordinance no. 79-244 of 16 October, 1979).

Status in captivity: Has probably never been kept in a zoological garden, but Kock (pers. comm. 1988) recently met a private individual near Frankfurt (West Germany) possessing one specimen as a pet (acquired during a stay in Zaire).

Occurrence in protected areas: Although no definite record exists, *Osbornictis* almost certainly occurs in Maiko National Park (1,083,000 ha), Zaire. The park has large tracts of *Gilbertiodendron* forest and specimens of the aquatic genet have been collected in the vicinity: less than 100 km to the west of Maiko by Gevaerts and Colyn in 1981 and 1982, and about 100 km to the east of this national park by Hart in the early seventies (Hart and Timm 1978).

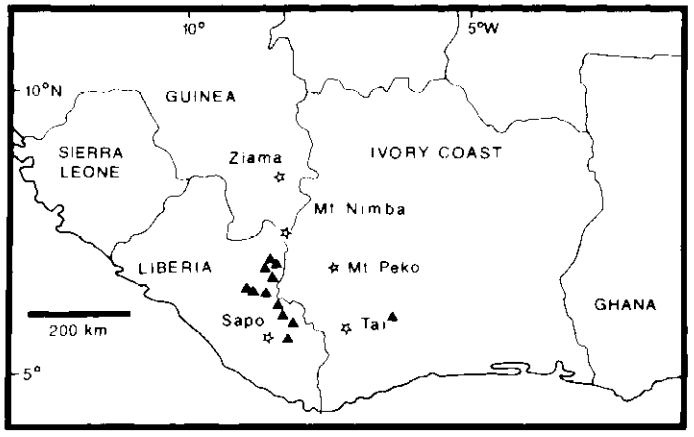
Recommended action:

- An ecological study is needed to identify the exact habitat requirements of the aquatic genet and the environmental factors responsible for the presumed correlation of its occurrence with *Gilbertiodendron* forests.
- Protection of Maiko National Park.
- Establishment of Okapi National Park in Ituri Forest.

Aquatic genet (*Osbornictis piscivora*). (Watercolor by Carl Brenders)

Leighton's linsang (*Poiana richardsoni liberiensis*)

The West African subspecies of the African linsang (*Poiana richardsoni liberiensis*) occurs in an area widely disjunct from the range of other *Poiana* populations, which live from Bioko Island and Cameroon eastwards. *Poiana richardsoni liberiensis* differs from the more easterly *Poiana* forms in a number of colour and pattern features, and was given species rank under the name *Poiana leightoni* by Rosevear (1974). With the Liberian mongoose (*Liberiictis kuhni*) and Johnston's genet (*Genetta johnstoni*), Leighton's linsang is one of the carnivores with a very restricted range in parts of the Upper Guinea rain forest belt, demonstrating the importance of this region as one of the core areas for viverrid conservation in Africa (see Chapter 6, section 6.3).



Map 38. Leighton's linsang (*Poiana richardsoni liberiensis*) is the subspecies of the African linsang that inhabits the rain forests to the west of the Dahomey gap (following Kuhn 1965; Rosevear 1974). Although there are records (black triangles) from the vicinity of large reserves (open stars), an occurrence within any protected area remains unconfirmed.

Distribution: Parts of Liberia and Ivory Coast, and perhaps Sierra Leone (see Map 38).

Status: Known only from about a dozen museum specimens collected in central and northeastern Liberia (Kuhn 1965; Rosevear 1974) and from a record by Beaufort (1965) from Gagnoa in Ivory Coast. Rosevear (1974) considered it rare and very localized. The most recent records are two skins obtained by Taylor (1988) in eastern Liberia, one in Mali village (6°40' N, 8°40' W), and one in Bao Town (6°15' N, 8°10' W).

Status in captivity: A few zoos are reported to have had *Poiana richardsoni* in their collections earlier this century, but most, if not all of these were probably misidentified genets (Jones in litt. 1987). No present records are available and the genus *Poiana* has probably never been captive-bred.

Occurrence in protected areas: The type locality of this subspecies in southern Grand Gedeh (15 to 20 miles west of the Putu Mountain, Liberia) is not far away from the northern boundary of Sapo National Park (130,700 ha).

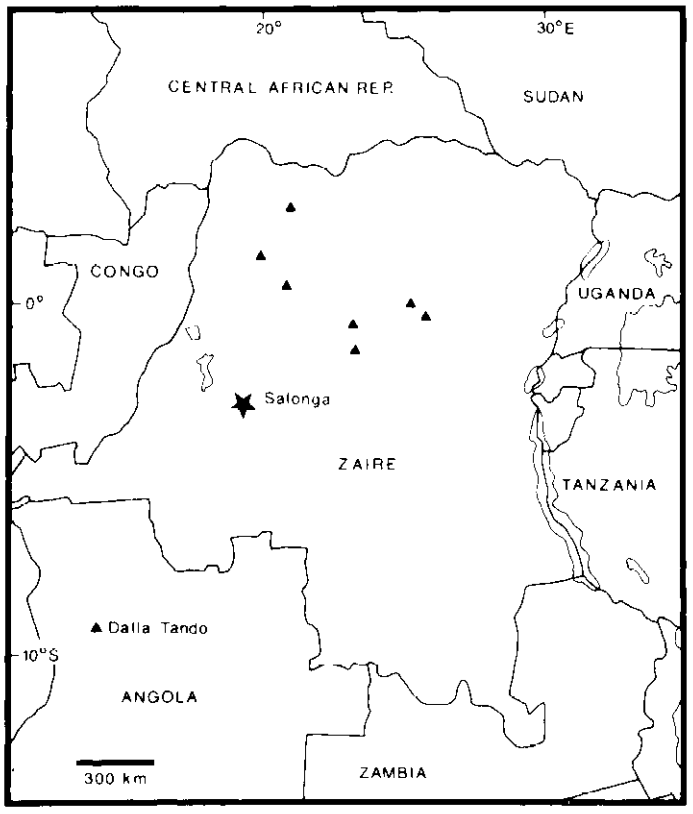
Recommended action:

- Survey work to find out whether *Poiana* occurs in any of the protected areas of the region.
- The creation of a captive colony may be the only feasible way to study the species's biology, since the linsang's arboreal lifestyle (it is supposed to live in tree crowns from 30 m upwards) makes it very difficult to study in the wild.

Ansorge's or Angolan cusimanse (*Crossarchus ansorgei*)

Ansorge's cusimanse (*Crossarchus ansorgei*) is the least known of the four species of the genus *Crossarchus*. Of all the forest-dwelling viverrids, Alexander's cusimanse (*C. alexandri*) and Ansorge's cusimanse (*C. ansorgei*) are the most important in terms of protein supply of the local human population in the Zairean rain forest (Colyn et al. 1988).

Distribution: The range in Zaire is confined to the rain forest region from the left bank of the Zaire river southwards (see Map 39). However, it does not occur in the extensive swamps of this area. The type specimen was collected in a forest relic in Dalla Tando, north Angola, in 1908.



Map 39. Most records (black triangles) of Ansorge's cusimanse (*Crossarchus ansorgei*) originate from Zaire, and this mongoose also occurs in Salonga National Park (black star). The specimen from north Angola presumably indicates an isolated relict population (Colyn and Van Rompaey in press).

Status: Until 1984 only two specimens were known, the type specimen from Angola and one from Baringa in equatorial Zaire. Colyn (1984) collected numerous more in the forest region of the Lomami-Lualaba river system between the Kitcho-ya-Tembo river and the Lusa river. He states that in this area the species is fairly common, and he confirms its presence in the Baringa region.

Status in captivity: With the exception of two individuals which Colyn (pers. comm., 1987) kept for several months at his home at Kisangani in 1983, there have been no known captive *C. ansorgei*.

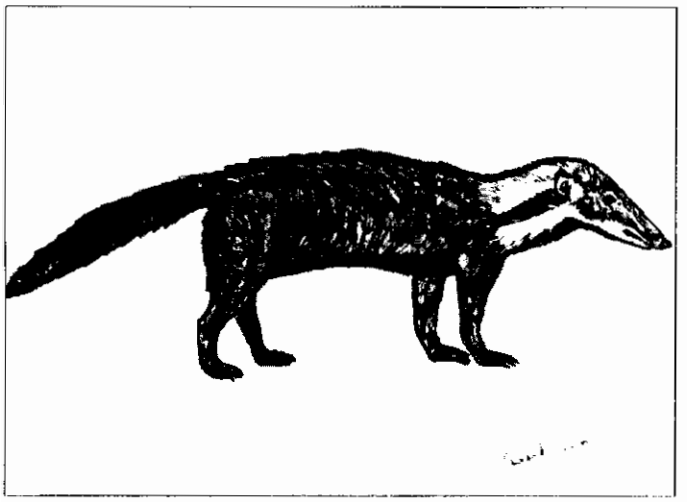
Occurrence in protected areas: Salonga National Park (3,656,000 ha), Zaire.

Recommended action:

- The presence of *C. ansorgei* in the Lomami-Lualaba region in Zaire confirms the necessity of establishing a protected

area in the north of this forest block which encompasses several endemic mammalian taxa.

- A survey for the species in Angola. The locality of the only specimen originating from Angola seems to be isolated from the Zairean range of *C. ansorgei*, and the Angolan population may represent a separate subspecies. This matter is currently being studied by Colyn and Van Rompaey.



Liberian mongoose (*Liberiictis kuhni*). (Drawing by Roland Wirth)

Liberian mongoose (*Liberiictis kuhni*)

The Liberian mongoose (*Liberiictis kuhni*) is the sole representative of its genus. It is one of the most specialized of all mongooses and is believed to be restricted to habitats with deep sandy soil where it digs for earthworms and beetle larvae (Kuhn pers. comm. 1986). According to Curry-Lindahl (1984), the Liberian mongoose exhibits a striking behavioural and morphological resemblance to the American procyonid genus *Nasua*, an interesting example of phylogenetic convergence between organisms of two families.

Distribution: A small area of northeastern Liberia (see Map 40), and possibly also in neighbouring Ivory Coast, Sierra Leone and Guinea (Schlitter in litt. 1987). Taylor (in litt. 1988) suspects that the species may also occur in certain areas of western Liberia, such as the Mano region. Curry-Lindahl (in litt. 1987) observed one individual in Liberia (in the area between Sanniquellie, Kahnplé and the Ivory Coast border).

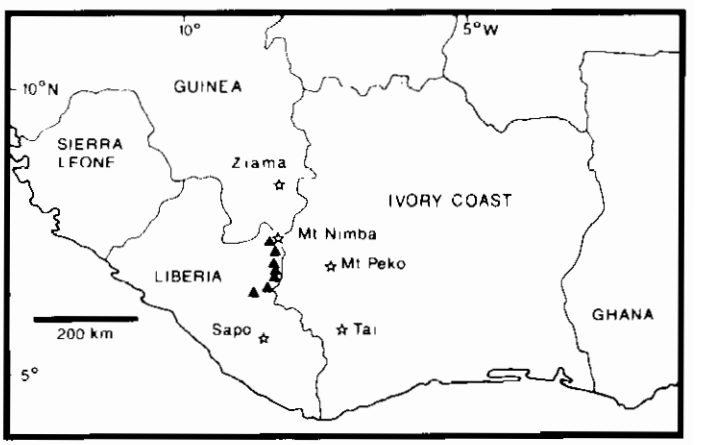
Status: Only known from 25 museum specimens. As mentioned above, the species is thought to be confined to areas with deep sandy soil, and habitats with laterite soil appear to be unsuitable for it. It has also been suggested (Kuhn pers. comm. 1986) that *Liberiictis* may be outcompeted by the related cusimanse (*Crossarchus obscurus*) outside its optimum habitat. All wildlife, including the Liberian mongoose, is heavily hunted for food by the local human population in this part of Africa. The last sight record we are aware of is the one by Curry-Lindahl (in litt. 1987) in 1978, when one individual was observed in a mosaic of primary and secondary forest. In early 1988, Taylor (in litt. 1988) obtained the skull of one animal, which had been hunted for food, in a village in the Gbi forest south of Tapeta (Liberia). The mongoose had been shot out of a group of 15 animals foraging near the village. He also received sighting reports from Gbi. This forest is already greatly degraded, as it is being logged and invaded by squatter villagers. Gbi is a partly deciduous forest, whereas the species could not be located in the evergreen lowland rain forests of Sapo National Park by Taylor (in litt. 1988). *Liberiictis* is relatively well-known in villages in Nimba, Grand Gedeh and Sinoe counties (Liberia), but is generally reported to be rare and declining. Since the animal is easy to approach when digging for worms, hunting poses little difficulty.

Status in captivity: No records.

Occurrence in protected areas: The species may occur in Sapo National Park (130,700 ha), Liberia, although Taylor (in litt. 1988) did not find it there despite trapping efforts. There are other reserves in the vicinity of the Liberian mongoose's range in Ivory Coast and Guinea, but records are lacking.

Recommended action:

- Surveys to determine whether the Liberian mongoose occurs in one of the protected areas of the region, and whether they are sufficient for the long-term conservation of the species.
- Efforts to locate any populations outside these protected areas. Schlitter (in litt. 1986) obtained museum specimens of *Liberiictis* from an area with heavily disturbed forest.
- Due to the restricted range of the species and the heavy hunting pressure on it, establishment of a captive breeding colony could be an important safeguard against extinction. A cooperative project by some zoos and the IUCN/SSC Captive Breeding Specialist Group would be desirable to obtain some founder stock for a breeding colony.

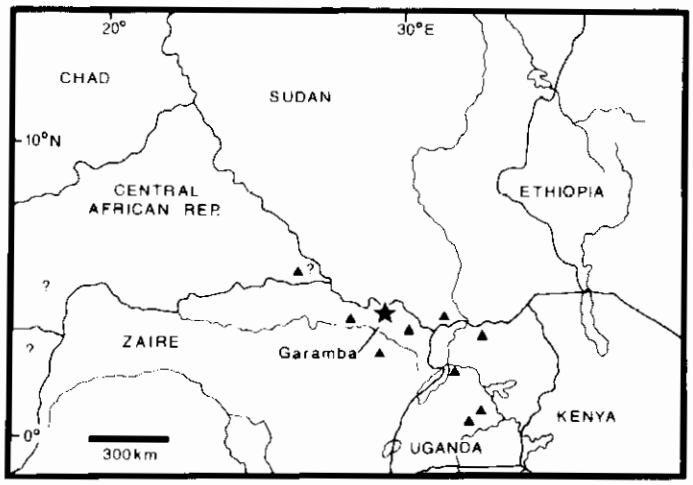


Map 40. Although the Liberian mongoose (*Liberiictis kuhni*) could be more widespread in Liberia (see the data sheet), the few known specimens (blacks triangles) all come from a rather restricted area (following Kuhn in litt. 1988; Taylor in litt. 1988). No record could be obtained from a protected area, though there are some reserves in the species' general distribution area (open stars), and a survey has been carried out in Sapo National Park.

Pousargues' mongoose (*Dologale dybowskii*)

Pousargues' mongoose (*Dologale dybowskii*) was originally described as *Crossarchus dybowskii* from six specimens collected in what is now the Central African Republic. Specimens from Sudan were named *Herpestes nigripes* in 1924, and animals from northeastern Zaire *Helogale hirtula robusta*. *Dologale* is a monotypic genus.

Distribution: The species ranges through northeast Zaire, the Central African Republic, southern Sudan and west Uganda (see Map 41). A few very old specimens at the Paris Natural History Museum are from Sanghe, which is a district in what is now the Congo Republic (although an area of this name can also be found in the Central African Republic).



Map 41. The exact range limits of Pousargues' mongoose (*Dologale dybowskii*) are unknown. In addition to the records published by Kingdon (1977), there are hints that the species ranges further to the west (question marks). With the exception of Garamba National Park (black star), all reserves in this region lack records.

Status: Known from about 30 museum specimens. No records or sightings have been reported for at least ten years. *Dologale* is similar to the genus *Helogale* and this lack of records may be at least partly due to misidentifications (Wozencraft in litt. 1988). Kingdon (1977) sighted a possible specimen at Singo. It is thought to be a species inhabiting the ecotone between closed forest and savanna.

Status in captivity: Pousargues' mongoose has apparently never been kept in captivity. A group of mongooses kept at Wrozlaw Zoo and thought to be *Dologale* has now been identified as the small Indian mongoose (*Herpestes auropunctatus*).

Occurrence in protected areas: Garamba National Park (492,000 ha), Zaire.

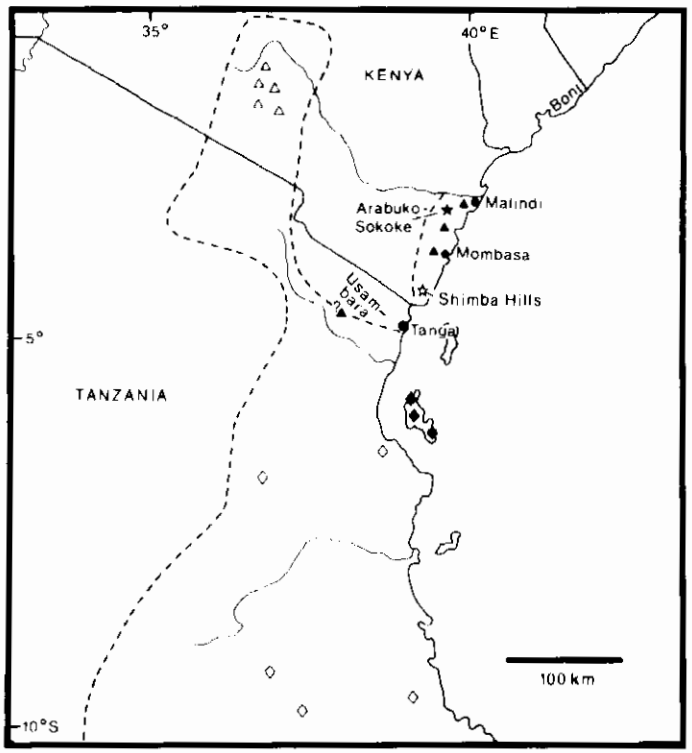
Recommended action:

- Since nothing is known of the species' biology, any survey should be accompanied by initial studies of its ecological and conservation requirements.
- Continuing protection of Garamba National Park.

Sokoke bushy-tailed mongoose (*Bdeogale crassicauda omnivora*)

This distinctive yellowish subspecies of the dark brown bushy-tailed mongoose (*Bdeogale crassicauda*) is very poorly known (Heller 1913). It has not been studied and little information is available on its distribution, conservation status, ecology or behaviour.

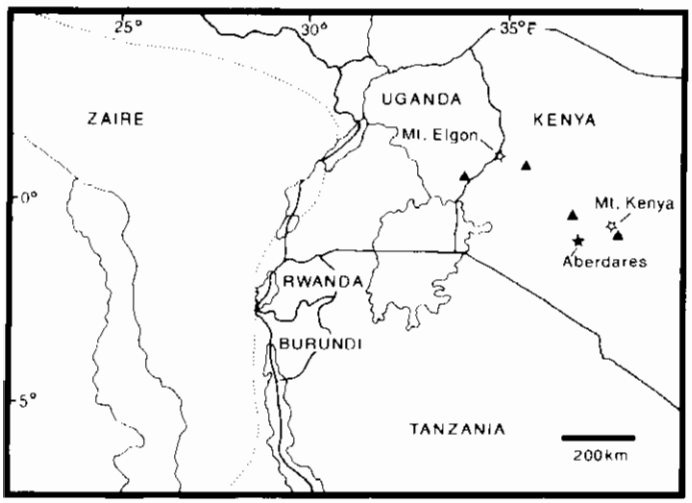
Distribution: The Sokoke bushy-tailed mongoose (*B. c. omnivora*) is known from the coastal rain forest of Kenya (particularly the Arabuko-Sokoke Forest) and—doubtfully—the northeastern forests of Tanzania (the hinterland of Tanga and the Usambara Mountains; see Map 42). The Los Angeles Museum of Natural History possesses two bushy-tailed mongooses from Boni Forest in Lamu District (close to the Somali border), and one from Kipine in Tana River District (Fanshawe in litt. 1988). We do not know which subspecies occurs in these northern areas. Populations of *B. c. omnivora* are isolated from the nearest other subspecies (see Map 42): *B. c. nigrescens* in the Nairobi area, *B. c. tenuis* on Zanzibar and probably also from *B. c. crassicauda* and *B. c. puisa* to the south in Mozambique and Zambia (Ansell 1978; Taylor 1987).



Map 42. It is not certain whether the Sokoke bushy-tailed mongoose (*Bdeogale crassicauda omnivora*), which is denoted by black triangles, occurs in the Usambara Mountains and in Boni Forest (see the data sheet). White diamonds denote the subspecies *B. c. puisa*, black diamonds *B. c. tenuis*, and white triangles *B. c. nigrescens* (following Kingdon 1977; Taylor 1986). The Arabuko-Sokoke Nature Reserve is the only protected area with confirmed records of *B. c. omnivora*, but an occurrence in the Shimba Hills National Reserve seems possible (open star). The broken line delimits the range of the bushy-tailed mongoose as suggested by Kingdon (1977), although the range is more extensive in coastal Kenya (from Malindi northwards).

Status: *Bdeogale crassicauda* in general is a rare species which nowhere occurs at great densities. The reasons for this scarcity are unknown (Taylor 1987). Few specimens of the subspecies *B. c. omnivora* have been collected, and since it is endemic to the rapidly decreasing narrow coastal belt of evergreen forest, this mongoose is almost certainly endangered. Since the presumed occurrence of *B. c. omnivora* in the Usambaras is based on three museum specimens, of which at least two (in the Museum of Comparative Zoology, Cambridge, U.S.A.) are blackish (melanistic ?) and lack the distinctive yellow colour of this form (Rutzmoser in litt. 1988), and since the specimens from Boni Forest are not yet determined to the subspecies level, the only place where it is known to occur with certainty is the Arabuko-Sokoke Forest near Malindi, Kenya. This forest was halved in size between 1956 and 1966 (Ripley and Bond 1971), with approximately 36,000 ha remaining in 1975. About 4,300 ha are legally protected in the Sokoke Forest Nature Reserve but even there protection is not enforced, as is confirmed by Kelsey and Langton (1984) who found freshly cut stumps, logs, and occasional planks of wood sawn inside the reserve in 1983. Apart from the fact that the Arabuko-Sokoke Forest consists of different forest communities, not all of which are adequately represented in the reserve, the total protected area is probably too small to protect any sizeable population of the Sokoke bushy-tailed mongoose, even if the reserve contained only optimum habitat for the species.

Status in captivity: Taylor kept the closely related *B. c. nigrescens* in captivity for several months and found the species docile and easy to keep. One very old specimen of *B. crassicauda* survives in Heidelberg Zoo, but there are no captive records of *B. c. omnivora*.



Map 43. Jackson's mongoose (*Bdeogale jacksoni*) is frequently treated as a subspecies of the black-footed mongoose (*Bdeogale nigripes*). The latter species inhabits the Central African rain forest, the approximate eastern edge of which is indicated by a dotted line. *B. jacksoni* has a disjunct distribution and is confined to some East African highlands (following Kingdon 1977). Mount Elgon and Mount Kenya National Parks are indicated as examples of several reserves within the species's range which lack records. Jackson's mongoose occurs in Aberdare National Park (black star).

Occurrence in protected areas: Sokoke Forest Nature Reserve (also called Arabuko-Sokoke Forest Reserve; 2,697 and 1,635 ha), Kenya. If the taxon occurs in the Usambara Range in Tanzania, it might profit from current efforts, coordinated by IUCN, to use the mountain forests following ecologically sound principles, including the creation of strictly protected areas. Since old records come from Shimba Hills, the species might be found in the Shimba Hills National Reserve (19,251 ha).

Recommended action:

- Consideration should be given to grant national park status to an enlarged Sokoke Forest Nature Reserve. The proximity of the tourist resort of Malindi and the various attractions of the Arabuko-Sokoke area, such as the ancient town of Gede and the experience of evergreen forest adjacent to coral reefs (the latter are already under national park status and a much frequented tourist attraction), might point to an alternative use of the unique forest resources.
- A field survey should be initiated soon to ascertain whether the animal can still be found in the Sokoke Forest and which subspecies occurs in the Usambara Mountains. The Shimba Hills National Reserve in Kwale district (Kenya) should be included in this survey. Its evergreen forests are known to contain a number of other east-coast endemics. If the bushy-tailed mongoose is recorded in the Shimba Hills, this finding would increase the urgency to stop the *Pinus* afforestation schemes there, which are replacing natural vegetation in this important national reserve. Furthermore, the burning management intended to increase the forage quality of the reserve's grasslands (for the population of the northern sable antelope subspecies *Hippotragus niger roosevelti*) must be carried out with care, so that fire damage of the forest fringes is avoided. The forest pockets to the northeast of Sokoke (e.g. Boni and Witu Forests), some of which are within the planned network of coastal reserves in Kenya, should also be surveyed. The subspecific status of the Boni population needs clarification.
- Captive breeding should be seriously considered as a safety measure in light of the very low population of *B. c. omnivora* which may now survive in the wild.

Jackson's mongoose (*Bdeogale jacksoni*)

Originally described by Thomas as a mustelid under the name of *Galeriscus jacksoni*, Jackson's mongoose (*Bdeogale jacksoni*) differs from the black-footed mongoose (*Bdeogale nigripes*) of west and central Africa in its possibly smaller dimensions, its thicker and longer coat, and in having deeply yellow sides on the neck and throat. This form is considered by some authors to be a subspecies of *B. nigripes*.

Distribution: Central Kenya and southeastern Uganda (see Map 43).

Little is known about the biology and status of the black-footed mongoose (*Bdeogale nigripes*), but as it occurs in the vast tracks of tropical rain forest remaining in Zaire, it is not thought to be threatened at present. Two east African forms of *Bdeogale*, the subspecies *B. crassicauda omnivora* and the species *B. jacksoni* are at risk, however. (Photo by Wolf Suschitzky)

Status: Only known from a few museum specimens. No field data are available apart from occasional records in the Aberdare mountains in Kenya (Kingdon pers. comm. 1986). The type locality, Manzini (Moreau et al. 1945), lies at the southern end of the Kinangop Plateau in the Kenyan highlands, very high up in the bamboo zone.

Status in captivity: No records. Its closest relative, *Bdeogale nigripes*, has been represented in the past in zoo collections on a few occasions. There is no reported case of captive breeding of any *Bdeogale* species.

Occurrence in protected areas: Aberdare National Park (76,619 ha; Kingdon pers. comm. 1986) and possibly Mount Kenya National Park (58,800 ha).

Recommended action:

- Continued protection of the Aberdare National Park. Its proposed enlargement should be considered.
- Surveys of Mount Kenya and other areas with suitable habitats areas to find out whether as yet unknown populations exist. There are a number of small mountain forests in the Kenyan highlands, as well as a few large ones (e.g. Mau Forest) which are not yet well known in terms of their small mammal fauna, even though some are being encroached by the rapidly increasing human population.
- A small-scale captive breeding programme for *Bdeogale* would be useful to gain knowledge of the genus.

Neotropical Realm

Mustelidae

Tropical weasel (*Mustela africana*)

The predominantly Holarctic genus *Mustela* is represented in the Neotropics by a number of subspecies of the widely distributed long-tailed weasel (*Mustela frenata*) and by two endemic species, the tropical weasel (*M. africana*) and the Colombian weasel (*M. felipei*). Izor and De La Torre (1978) reopened the question as to whether the two endemic Neotropical species should be classified in their own genus (*Grammogale*). Both the *Grammogale* species are of conservation concern (though we do not recognize the genus here). Two subspecies of *Mustela africana* are recognized, *M. a. africana* in the east and *M. a. stolzmani* in the west.

Distribution: Until recently, the species was known only from the drainage areas of three western tributaries of the Amazon in eastern Ecuador and eastern Peru (the Napo, the Maranon, and the Ucayali), and, some 2,800 km further to the east, from the Amazon delta (see Map 44). Recent records have come from areas in between these vastly disjunct ranges (Izor and Peterson 1985), so that the species may be much more widespread in Amazonia than was previously thought.

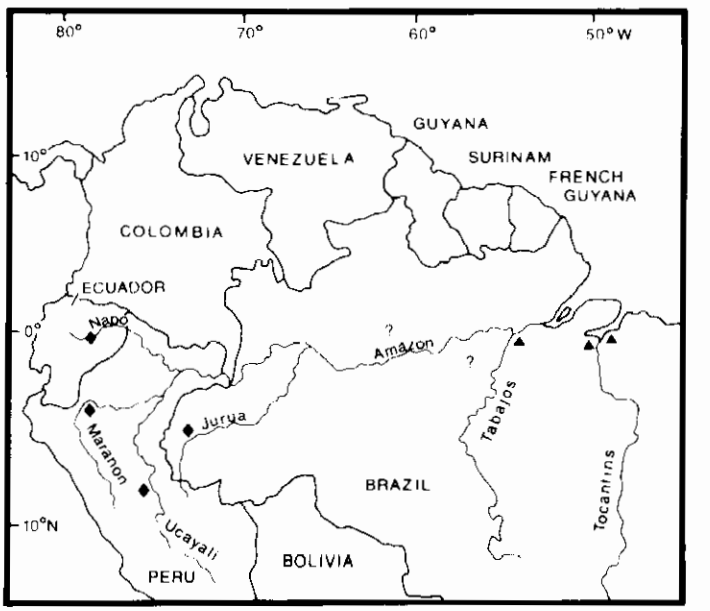
Status: We are aware of approximately 30 specimens collected in the 170 years since the discovery of the species. The west Amazonian subspecies *M. a. stolzmani* is known from only a handful of museum specimens. Most aspects of the natural history of the tropical weasel are unknown, but the naked foot soles with interdigital webbing and its reported swimming abilities (Tate 1931) suggest a semiaquatic life. Considering that river courses are still the major routes of human settlement in Amazonia, the species could be seriously at risk. If current Brazilian development plans are intensified to convert forests near rivers and alluvial soils for agricultural use, this could have a detrimental effect on the species.

Status in captivity: Probably not in captivity at present but the specimens in Museum Goeldi, Belem (Brazil), originated from the zoological garden in the city of Belem (Izor in litt. 1987).

Occurrence in protected areas: The tropical weasel may occur in several of the large national parks of Amazonia, but we are not aware of any record.

Recommended action:

- A study to understand the species's ecological requirements. The equally little known small-eared dog (*Dusicyon microtis*) is the only other carnivore species that is restricted to the Amazonian rain forests. Both species may be the highest priority for conservation-related research on carnivores in Amazonia.

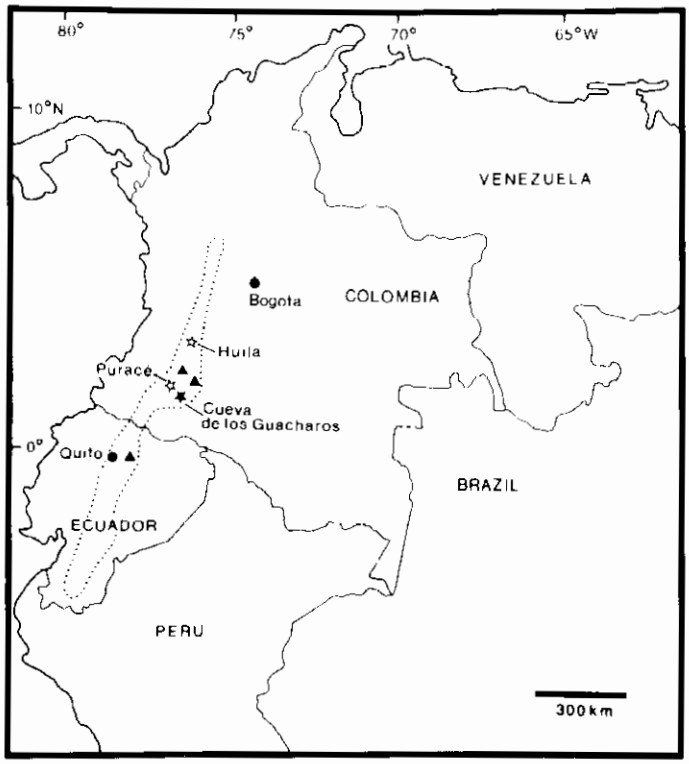


Map 44. The tropical weasel (*Mustela africana*) appears to be more widespread than formerly thought (following Izor and Peterson 1986). The nominate subspecies (black triangles) has been collected in the general region of the Amazon delta, and *M. africana stolzmani* (black diamonds) near some western tributaries of the Amazon river.

Colombian weasel (*Mustela felipei*)

Hardly anything is known of the Colombian weasel (*Mustela felipei*) which was described in 1978. Izor and De La Torre (1978) state that in some respects it is the less advanced of the two *Grammogale* species. Live Colombian weasels have never been observed by a scientist.

Distribution: *Mustela felipei* has been collected along rivers between 1,750 and 2,700 m in the provinces of Huila and Cauca, Colombia (see Map 45). The species was thought to be endemic to the Cordillera Central of Colombia but Izor (in litt. 1987) has recently found a museum specimen from Andean Ecuador.



Map 45. This map depicts the distribution of all known records (black triangles) of the recently described Colombian weasel (*Mustela felipei*), and the presumed range is indicated by a dotted line (after Izor in litt. 1987).

Status: Since the discovery of the Colombian weasel, only four specimens have been obtained, three from Colombia and one from Ecuador. Hardly anything is known of its habitat preferences. The few specimens have been obtained from an altitude where cloud forests predominate. One Colombian weasel was collected in the upper Suaza river valley (Cueva de los Guacharos National Park). This part of the Suaza river contains stretches with torrential currents which are interrupted by quiet pools (Rodriguez in litt. 1988). If the species depends on riverine habitats within its small range, it must be considered to be of great conservation concern. *Mustela felipei* is probably the rarest carnivore in South America.

Status in captivity: No records.

Occurrence in protected areas: One specimen has been collected near the administrative centre of the Cueva de los Guacharos National Park (9,000 ha; Rodriguez in litt. 1988). The Parque Nacional de Huila (158,000 ha) and Parque Nacional de Puracé (83,000 ha) are also close to collecting sites of *M. felipei* (Liebermann pers. comm. 1988). Two of the very few recent sightings of the threatened yellow-eared parrot (*Ognorhynchus icterotis*) have been made in the Parque Nacional de Puracé and Parque Nacional de Cueva de los Guacharos in the late seventies. The occurrence of two of the least known threatened species emphasizes the value of these national parks, and the need for conservation action in the region.

Recommended action:

- A survey to search for the species and to study its ecological requirements should be launched as soon as possible.
- Immediate protection should be given to any site containing a population of the species, or, if this is not possible or unlikely to meet with success in the long term, efforts should be made to start a captive colony.

Grey-headed tayra (*Eira barbara senex*). (Photo by Edwin and Peggy Bauer)

Grey-headed tayra (*Eira barbara senex*)

The tayra (*Eira barbara*) is widely distributed throughout forested regions in the Neotropics. Approximately eight subspecies are recognized, of which several may be threatened. However, present knowledge is insufficient to be certain of the intraspecific variability. The grey-headed tayra (*Eira barbara senex*), occurring at the northern margin of the tayra's range, is easy to distinguish due to its large size and characteristic head colouring.

Distribution: This subspecies occurs in the tropical forests of southern Mexico, Guatemala, Belize, and northern Honduras (one record only). The range in Mexico includes areas in Veracruz,

Tabasco, Campeche, the Yucatan peninsula, Chiapas, and Oaxaca (see Map 46). There is one historical record (1901) of tayras in Sinaloa. Sinaloa is approximately 2,000 km north of the nearest extant tayra population in Oaxaca. The Sinaloa population is extinct, and during the last decades many field workers have failed to find any specimens remaining in the area which had been cleared for agricultural use (Ceballos in litt. 1987). It was probably a Pleistocene relict population.

Map 46. The northern Sinaloa population of the grey-headed tayra (*Eira barbara senex*) is extinct and the rain-forest habitats in the remaining range are decreasing rapidly. Black triangles denote *E. barbara senex*, black diamonds *E. b. inserta*. The dotted line shows the presumed border between the ranges of both subspecies (following Hall 1981; Cuaron in litt. 1988). Protected areas with confirmed records of the grey-headed tayra are indicated by black stars.

Status: In Mexico, the range of the tayra has been greatly reduced over the last decades because tropical forests, particularly rain forests, have been destroyed at an alarming rate. Very few large tracts of moist forest now remain. Small populations of tayras survive throughout the historical range, except Sinaloa, but most, if not all, are threatened by habitat destruction and hunting. The grey-headed tayra is classified as "Endangered" by Ceballos and Navarro (in press). Important areas of tropical forest that are not protected but have populations of tayras are the Sierra de Santa Marta and Volcan de San Martin in Veracruz, Los Chimalapas in Oaxaca, several small mountain ranges in Tabasco, and the region along the Usumacinta River in Guatemala.

Status in captivity: The tayra is kept in zoos throughout the world in small numbers. The 240 institutions covered by ISIS had 23 individuals in 1987, of which only two were identified to subspecies level. The species is rarely bred, however, with only two specimens successfully raised in zoos in 1982 and 1983 (Olney 1984, 1985). Poglayen-Neuwall (1975, 1976) describes mating behaviour, gestation, and post-natal development of the species. Three individuals of the subspecies *E. b. senex* are presently kept in Tuxtla Guttiérrez Zoo (Chiapas, Mexico), one in Belize Zoo, and five at the Zoologico Nacional La Aurora (Guatemala City). An unknown number lives at the small menagerie of the Estacion de Biologia Los Tuxtla (Veracruz, Mexico; Cuaron in litt. 1988). The only instance of captive breeding at one of these institutions took place at Tuxtla Guttiérrez in the early 1980s, but the offspring did not survive (Cuaron in litt. 1988).

Occurrence in protected areas (Cuaron in litt., 1988): The grey-headed tayra is found in the Man and the Biosphere Reserves of Sian K'aan (500,000 ha) and the Montes Azules (330,210 ha), the reserve of Los Tuxtlas (1,000 ha) in Veracruz (a biological station of the National University of Mexico), and in the following protected areas in Chiapas: Reserva Ecológica Selva del Ocote (48,000 ha), Reserva El Triunfo (10,000 ha) and Parque Educativo La Laguna Belgica (about 44 ha). In Guatemala, the Parque Nacional Tikal (57,600 ha) probably protects this subspecies. Few of these reserves are adequately controlled, and some exist on paper only.

Recommended action:

- Improved protection of the reserves where the tayra lives, particularly the Monte Azules Man and the Biosphere Reserve, which contains some 280,000 ha of undisturbed forest, and, being contiguous to El Peten (Guatemala) and forests in the Yucatan peninsula and in Belize, constitutes one of the largest remnants of tropical forest habitat in Central America.
- Support for ongoing efforts to improve the network of tropical forest reserves in Central America. The Instituto de Historia Natural is working for an enlargement of the Reserva El Triunfo in Chiapas from 10,000 to 80,000 ha (and for an improvement of its protection status). A new protected area (Kalakmul) is planned in Campeche, containing more than 200,000 ha of tropical forest, and two international reserves have been proposed including Kalakmul (Mexico) and El Peten (Guatemala), and around Rio Azul (Guatemala) and adjoining regions in Mexico and Belize (Cuaron in litt. 1988).
- Field surveys, particularly in areas with larger tracts of tropical rain forests, to determine the tayra's population status, especially in Balancan (Tabasco) and in the Sierra del Madrigal (Tabasco and Chiapas).

Grey-headed tayra (*Eira barbara senex*). (Photo by Carol Farnetti)

- Field data on the biology of tayras, such as on home range sizes and on other similar aspects which are important for determining the species' conservation requirements.
- Since zoological gardens in three Central American countries keep *E. b. senex*, this subspecies would be an ideal candidate for the first international cooperative captive breeding programme in this part of the world.

Pygmy spotted skunk (*Spilogale pygmaea*)

The pygmy spotted skunk (*Spilogale pygmaea*) is the smallest skunk and the only carnivore species endemic to the mainland of Mexico. Three subspecies, *S. p. pygmaea*, *S. p. australis*, and *S. p. intermedia* have been described (López-Forment and Urbano 1979). The validity of these races has been doubted, because this skunk's continuous range renders subdivisions somewhat arbitrary.

Distribution: The pygmy spotted skunk is endemic to the Mexican Pacific coast in Sinaloa, Nayarit, Jalisco, Colima, Michoacán, Guerrero, and Oaxaca (see Map 47). The nominate subspecies is found in the north of the range, *S. p. intermedia* in Jalisco and Colima, and *S. p. autralis* to the south of the latter. The species inhabits the tropical zone below 100 metres (Van Gelder 1959).

Status: The species is secretive and apparently rare but the causes for this scarcity are unclear. During one and a half years of research in Chamela Biological Station, Ceballos (in litt. 1987) saw only two individuals, one dead and the other caught in a mouse trap. *Spilogale pygmaea* seems to be able to survive in close proximity to human settlements if enough habitat is preserved. There are still large areas of dry forest remaining in the pygmy skunk's range. Ceballos and Miranda (1987) and López-Forment and Urbano (1979) summarize what is known on this skunk's natural history. The species is classified as "Vulnerable" by Ceballos and Navarro (in press).

Status in captivity: Breeding of the pygmy spotted skunk in captivity at the Michigan State University Museum and the development of the offspring is described by Teska et al. (1981). From an initial eight skunks, nine separate male-female pairings were made, and one resulted in the birth of six young. This captive colony was maintained from 1972-1976.

Map 47. Records (black triangles) of the pygmy spotted skunk (*Spilogale pygmaea*) are restricted to the forests in a narrow coastal strip of Pacific Mexico (following Hall 1981). The only reserve where the pygmy skunk is known to occur, Chamela (black star), is rather small (1,584 ha).

Occurrence in protected areas: *Spilogale pygmaea* is known to occur in the small (1,584 ha) biological station of the National University of Mexico in Chamela, Jalisco (Ceballos in litt. 1987). The Reserva de la Biosfera Sierra de Manantlan (140,000 ha) in Jalisco is not far from Chamela, but records of the species are lacking. Another protected area within the presumed range of the pygmy spotted skunk is the Parque Nacional Lagunas de Chacahua in Oaxaca (Cuaron in litt. 1988).

Recommended action:

- Field surveys to determine the pygmy spotted skunk's present distribution and status, and field studies to determine its ecological requirements and conservation needs.

Chapter 5. Four Different Approaches for Conservation Action

From our review of the most threatened or least known mustelids and viverrids, the IUCN/SSC Mustelid and Viverrid Specialist Group concludes that four different approaches are needed if the present diversity of both families is to be maintained.

5.1 Establishment and Effective Management of Reserves

Without any doubt, habitat conservation is the most appropriate way of ensuring the survival of almost all the species and subspecies dealt with in this action plan. Unfortunately, many of the identified threatened taxa are not definitely known to occur in a particular protected area (see Table 1) and for none of these is there any information as to the population size within reserves. This means that in no case can we be sure that a threatened mustelid or viverrid is already sufficiently protected by the existing network of protected areas, particularly in view of the fact that we know so little about the ecological requirements of nearly all those species.

Table 1. Threatened mustelids and viverrids not definitely recorded from any protected area.

Palearctic Realm

Tsushima marten (*Martes melampus tsuensis*)
Ibiza small-spotted genet (*G. genetta isabelae*)

Nearctic Realm

Black-footed ferret (*Mustela nigripes*)
Big-Thicket hog-nosed skunk (*Conepatus mesoleucus telmalestes*)

Indomalayan Realm

Taiwan yellow-throated marten (*Martes flavigula chrysospila*)
Javan ferret-badger (*Melogale orientalis*)
Malabar civet (*Viverra civettina*)
Large-spotted civet (*Viverra megaspila*)
Spotted linsang (*Prionodon pardicolor*)
Kangean common palm civet (*Paradoxurus hermaphroditus kangeanus*)
Mentawai palm civet (*Paradoxurus lignicolor*)
Mentawai banded palm civets (*Hemigalus derbyanus minor* and *H. d. sipora*)
Lowe's otter civet (*Cynogale lowei*)
Sumatran collared mongoose (*Herpestes semitorquatus uniformis*)

Malagasy Realm

Giant striped mongoose (*Galidictis grandidieri*)

Afrotropical Realm

Abyssinian genet (*Genetta abyssinica*)
Giant genet (*Genetta victoriae*)
Aquatic genet (*Osbornictis piscivora*)
Leighton's linsang (*Poiana richardsoni liberiensis*)
Liberian mongoose (*Liberiictis kuhni*)

Neotropical Realm

Tropical weasel (*Mustela africana*)

With these limitations in mind, a list is provided, in geographic order, of reserves known to protect one or several threatened mustelids or viverrids (Table 2). Additional protected areas that are likely to have populations of the taxa of concern have been listed in the individual species accounts.

Table 2. Protected areas with confirmed[1] occurrence of threatened mustelids or viverrids

Palearctic Realm	
Bulgaria	
Ropotamo River N.P. (847 ha)	European marbled polecat (*Vormela p. peregusna*)
Srebarna Pelican Reserve (600 ha)	European marbled polecat (*Vormela p. peregusna*)
Finland	
Lemmenjoki N.P. (172,197 ha)	European wolverine (*G. g. gulo*)
Malla N.P. (3,000 ha)	European wolverine (*G. g. gulo*)
France	
Parc Naturel Régional de la Grande Brière (40,000 ha)	European mink (*Mustela lutreola*)
Réserve Naturelle du Lac du Grandlieu (2,700 ha)	European mink (*Mustela lutreola*)
Norway	
Hardangervidda N.P. (340,000 ha)	European wolverine (*G. g. gulo*)
Börgefjell N.P. (106,500 ha)	European wolverine (*G. g. gulo*)
Övre Dividal N.P. (75,000 ha)	European wolverine (*G. g. gulo*)
Rondane N.P. (57,500 ha)	European wolverine (*G. g. gulo*)
Dovrefjell N.P. (26,500 ha)	European wolverine (*G. g. gulo*)
Övre Pasvik N.P. (6,300 ha)	European wolverine (*G. g. gulo*)

Sweden	
Padjelanta N.P. (201,000 ha)	European wolverine (*G. g. gulo*)
Sarek N.P. (194,000 ha)	European wolverine (*G. g. gulo*)
Stora Sjöfallet N.P. (138,000 ha)	European wolverine (*G. g. gulo*)
U.S.S.R.	
Laheema N.P. (64,911 ha)	European mink (*Mustela lutreola*)
Tsentralno-Lesnoi Nature Reserve (21,348 ha)	European mink (*Mustela lutreola*)
Karpatskii Nature Reserve (18,544 ha)	European mink (*Mustela lutreola*)
Ritsa-Avakhar Nature Reserve (15,923 ha)	European mink (*Mustela lutreola*)
Dunaiskie Plavni Nature Reserve (14,851 ha)	European mink (*Mustela lutreola*)
Cernomora Nature Reserve (9,695 ha)	European mink (*Mustela lutreola*)
Adzhametsky Nature Reserve (4,868 ha)	European mink (*Mustela lutreola*)
Kanevskii Nature Reserve (1,800 ha)	European mink (*Mustela lutreola*)
Lugansky Nature Reserve (1,580 ha)	European marbled polecat (*Vormela p. peregusna*)
Ukrainski Stepni Nature Reserves (1,634 ha)	European marbled polecat (*Vormela p.peregusna*)
Sevan N.P. (150,000 ha)	Marbled polecat (*Vormela peregusna* ssp.)
Ag-Ghelsky Nature Reserve (9,100 ha)	Marbled polecat (*Vormela peregusna* ssp.)
Laplandsky Nature Reserve (161,254 ha)	European wolverine (*G. g. gulo*)
Kandalakshsky Nature Reserve (58,100 ha)	European wolverine (*G. g. gulo*)
Darvinsky Nature Reserve (112,630 ha)	European wolverine (*G. g. gulo*)
Kivach Nature Reserve (10,460 ha)	European wolverine (*G. g. gulo*)
Kronotskii Nature Reserve (1,099,000 ha)	Siberian wolverine (*G. gulo sibiricus*)
Sikhote-Alinsky Nature Reserve (347,052 ha)	Siberian wolverine (*G. gulo sibiricus*)
Zeiskii Nature Reserve (82,567 ha)	Siberian wolverine (*G. gulo sibiricus*)
Magadan Nature Reserve (8,692 ha)	Siberian wolverine (*G. gulo sibiricus*)

Nearctic Realm	
Canada	
Jasper N.P. (1,087,800 ha)	American wolverine (*G. gulo luscus*)
Banff N.P. (664,076 ha)	American wolverine (*G. gulo luscus*)
Kootenay N.P. (137,788 ha)	American wolverine (*G. gulo luscus*)
Yoho N.P. (131,313 ha)	American wolverine (*G. gulo luscus*)
Waterton Lakes N.P. (52,577 ha)	American wolverine (*G. gulo luscus*)
U.S.A.	
Denali N.P. (2,356,900 ha)	American wolverine (*G. gulo luscus*)
Yellowstone N.P. (899,139 ha)	European wolverine (*G. g. gulo*)
Grand Teton N.P. (124,140 ha)	American wolverine (*G. gulo luscus*)
Kenai National Wildlife Refuge (781,700)	Kenai wolverine (*G. gulo katschemakensis*)
Yosemite N.P. (308,300 ha)	Western wolverine (*G. gulo luteus*)
Mt. Rainier N.P. (96,712 ha)	Western wolverine (*G. gulo luteus*)
Indomalayan Realm	
India	
Brahmagiri W.S. (18,100 ha)	Nilgiri marten (*Martes gwatkinsi*)
Eravikalum-Rajamalai N.P. (9,700 ha)	Nilgiri marten (*Martes gwatkinsi*)
Anamalai W.S. (95,500 ha)	Brown palm civet (*Paradoxurus jerdoni*)
Mudumalai W.S. (32,100 ha)	Brown palm civet (*Paradoxurus jerdoni*)
Indonesia	
Gunung Gede-Pangrango N.P. (15,000 ha)	Indonesian mountain weasel (*Mustela lutreolina*)
	Javan yellow-throated marten (*Martes flavigula robisoni*)
	Javan small-toothed palm civet (*Arctogalidia trivirgata trilineata*)
Ujung Kulon N.P. (78,619 ha)	Javan small-toothed palm civet (*Arctogalidia trivirgata trilineata*)

Dumoga-Bone N.P. (330,000 ha)	Sulawesi palm civet (*Macrogalidia musschenbroekii*)
Lore Lindu Reserve (200,000 ha)	Sulawesi palm civet (*Macrogalidia musschenbroekii*)
Morowali Reserve (200,000 ha)	Sulawesi palm civet (*Macrogalidia musschenbroekii*)
Tangkoko-Batuangas Reserve (8,867 ha)	Sulawesi palm civet (*Macrogalidia musschenbroekii*)
Gunung Ambang N.P. (8,638 ha)	Sulawesi palm civet (*Macrogalidia musschenbroekii*)
Padang-Sugihan Wildlife Reserve (75,000 ha)	Otter civet (*Cynogale bennettii*)
Malaysia (Sabah)	
Crocker Range N.P. (139,919 ha)	Hose's palm civet (*Diplogale hosei*)
Gunung Kinabalu N.P. (78,000 ha)	Kinabalu ferret-badger (*Melogale everetti*)
	Hose's palm civet (*Diplogale hosei*)
Sepilok Forest Reserve (4,000 ha)	Otter civet (*Cynogale bennettii*)
Sri Lanka	
Wilpattu N.P. (131,884 ha)	Golden palm civet (*Paradoxurus zeylonensis*)
Gal Oya N.P. (25,000 ha)	Golden palm civet (*Paradoxurus zeylonensis*)
Sinharaja M.A.B. (8,900)	Golden palm civet (*Paradoxurus zeylonensis*)
Thailand	
Phu Luang W.S. (84,000 ha)	Back-striped weasel (*Mustela strigidorsa*)
Vietnam	
Cuc Phuong N.P. (22,200 ha)	Owston's palm civet (*Chrotogale owstoni*)
Malagasy Realm	
Madagascar	
Réserve Naturelle Intégrale d'Andohahela (760,020 ha)	Malagasy civet (*Fossa fossana*)
	Eastern fanalouc (*Eupleres g. goudotii*)
	Fossa (*Cryptoprocta ferox*)
Mananara M.A.B. (20,000 ha)	Malagasy civet (*Fossa fossana*)
	Eastern fanalouc (*Eupleres g. goudotii*)
	Malagasy broad-striped mongoose (*Galidictis fasciata*)
	Malagasy brown-tailed mongoose (*Salanoia concolor*)
	Fossa (*Cryptoprocta ferox*)
Réserve Naturelle Intégrale de Betampona (2,228 ha)	Malagasy civet (*Fossa fossana*)
	Malagasy broad-striped mongoose (*Galidictis fasciata*)
	Fossa (*Cryptoprocta ferox*)
Réserve Spéciale de Anamalazaotra-Périnet (810 ha)	Malagasy civet (*Fossa fossana*)
	Eastern fanalouc (*Eupleres g. goudotii*)
Masoala Reserve (planned)	Malagasy civet (*Fossa fossana*)
	Eastern fanalouc (*Eupleres g. goudotii*)
	Malagasy brown-tailed mongoose (*Salanoia concolor*)
	Fossa (*Cryptoprocta ferox*)
Ranomafana N.P. (planned)	Malagasy civet (*Fossa fossana*)
	Malagasy broad-striped mongoose (*Galidictis fasciata*)
	Fossa (*Cryptoprocta ferox*)
Réserve Naturelle Intégrale de Tsaratanana (48,622 ha)	Western fanalouc (*Eupleres goudotii major*)
Réserve Spéciale d'Andranomena (6,420 ha)	Malagasy narrow-striped mongoose (*Mungoticits decemlineata*)
	Fossa (*Cryptoprocta ferox*)
Kirindy Forest Reserve	Malagasy narrow-striped mongoose (*Mungotictis decemlineata*)
	Fossa (*Cryptoprocta ferox*)
Analabe Reserve (private reserve)	Malagasy narrow-striped mongoose (*Mungotictis decemlineata*)
	Fossa (*Cryptoprocta ferox*)
Réserve Naturelle Intégrale du Tsingy de Bemaraha (152,000 ha)	Fossa (*Crytoprocta ferox*)
L'Isalo N.P. (81,540 ha)	Fossa (*Cryptoprocta ferox*)

Réserve Naturelle Intégrale de l'Ankarafantsika (60,520 ha)	Fossa (*Cryptoprocta ferox*)
Réserve Naturelle Intégrale de Marojejy (60,150 ha)	Fossa (*Cryptoprocta ferox*)
Réserve Naturelle Intégrale de Tsimanampetsotsa (43,200 ha)	Fossa (*Cryptoprocta ferox*)
Réserve Spéciale d'Anamalerana (34,700 ha)	Fossa (*Cryptoprocta ferox*)
Réserve Spéciale d'Anjanaharibe (32,100 ha)	Fossa (*Cryptoprocta ferox*)
Réserve Naturelle Intégrale d'Andringitra (31,160 ha)	Fossa (*Cryptoprocta ferox*)
Réserve Spéciale de Kalambatritra (28,250 ha)	Fossa (*Cryptoprocta ferox*)
Réserve Spéciale d'Ankara (18,220 ha)	Fossa (*Cryptoprocta ferox*)
Montagne d'Ambre N.P. (18,200 ha)	Fossa (*Cryptoprocta ferox*)
Réserve Spéciale de Manombo (5,020 ha)	Fossa (*Cryptoprocta ferox*)
Réserve Spéciale de la Forêt d'Ambre (4,810 ha)	Fossa (*Cryptoprocta ferox*)
Réserve Spéciale de Beza Mahafaly (600 ha)	Fossa (*Cryptoprocta ferox*)
Berenty Reserve (265 ha; private reserve)	Fossa (*Cryptoprocta ferox*)
Afrotropical Realm	
Guinea	
Réserve Naturelle Intégrale de Mont Nimba (13,000 ha)	Johnston's genet (*Genetta johnstoni*)
Ivory Coast	
Réserve Naturelle Intégrale de Mont Nimba (5,000 ha)	Johnston's genet (*Genetta johnstoni*)
Kenya	
Arabuko-Sokoke Nature Reserve (2,697 and 1,635 ha)	Sokoke bushy-tailed mongoose (*Bdeogale crassicauda omnivora*)
Aberdare N.P. (76,619 ha)	Jackson's mongoose (*Bdeogale jacksoni*)
Liberia	
Mount Nimba N.P. (planned)	Johnston's genet (*Genetta johnstoni*)
Zaire	
Garamba N.P. (492,000 ha)	Pousargues' mongoose (*Dologale dybowskii*)
Salonga N.P. (3,656,000 ha)	Ansorge's cusimanse (*Crossarchus ansorgei*)
Neotropical Realm	
Mexico	
Sian K'aan M.A.B. (500,000 ha)	Grey-headed tayra (*Eira barbara senex*)
Montes Azules M.A.B. (331,200 ha)	Grey-headed tayra (*Eira barbara senex*)
Reserva Ecológica Selva del Ocote (48,000 ha)	Grey-headed tayra (*Eira barbara senex*)
Reserva El Triunfo (10,000 ha)	Grey-headed tayra (*Eira barbara senex*)
Los Tuxtlas Biological Station (1,000 ha)	Grey-headed tayra (*Eira barabara senex*)
Parque Educativo La Laguna Belgica (46.5 ha)	Grey-headed tayra (*Eira barbara senex*)
Chamela Biological Station (1,584 ha)	Pygmy spotted skunk (*Spilogale pygmaea*)
Colombia	
Cueva de los Guacharos N.P. (9,000 ha)	Colombian weasel (*Mustela felipei*)

[1] "Confirmed" means that a relatively recent record is available, either from the literature or by a member or correspondent of the Mustelid and Viverrid Specialist Group. For species which are easily misidentified in the field we do not consider records as "confirmed" unless it is specified that confusion with similar forms can be excluded (e.g. the European and the American minks).
N.P. = National Park; M.A.B. = Man and the Biosphere Reserve; W.S. = Wildlife Sanctuary.

5.2 Field Surveys

Considering the lack of data on the distribution and status of most taxa, field surveys investigating these aspects are important for identifying the sites and the problems on which conservation activities should concentrate.

Elucidating the exact geographic range of the species is especially important for the tropical forest species (which include most of the threatened taxa). As is shown in the data sheets, several genera are only known from a few museum specimens. Range data from museum labels such as "Liberia" or "Borneo" are not very helpful when deciding if the distribution includes well-managed conservation areas of sufficient size. Even if a reserve is located within the general distribution area of an endangered species, it does not mean that the animal really occurs within this protected area, or even that it protects a sizeable and viable population. Ecological work on tropical rain forest birds and mammals has shown that many species are patchily distributed. This mosaic-like distribution pattern can often not be anticipated or even explained from evident ecological boundaries, such as different types of forests, altitudinal zonation, and the like. Sometimes a species

boundary appears to run through a seemingly homogenous forest. There may be subtle but undetected biotic boundaries of ecological niches, resulting from the species richness of these forests. This biotic complexity, varying in its specific composition from place to place, may render it impossible for a certain species to live a few kilometers away from one of its healthy populations, even within the same forest.

This is why survey work is needed to broaden our empirical basis. The rediscovery of the Malabar civet (*Viverra civettina*), presumed to be extinct in the 1978 IUCN Mammals Red Data Book, shows how rewarding such work can be. Since most of our areas of interest (see Chapter 6, section 6.3) are of similar importance to other threatened species, many of the surveys we have recommended are valuable to other specialist groups, too. Because of this common interest, funds and expertise could be shared, and conservation projects will benefit several endangered taxa. For this reason, we suggest that the specific surveys which we have recommended be best incorporated as parts of fully funded national biological surveys.

It is acknowledged that while the taxa mentioned in this action plan are considered to be of prime concern, other mustelid and viverrid species should be included in any surveys. This is obviously important because some of the survey regions lie in zoologically little-studied parts of the globe. The survey priorities suggested in this action plan (see Chapter 6, section 6.4) are not only directed towards international conservation organizations. Their implementation should also be considered by universities, local conservation groups, government departments, or interested naturalists. Indeed, the difficulties implied in a search for elusive, nocturnal, and solitary small carnivores occurring at low densities may mean that in some species surveys by foreign zoologists (usually of a few weeks duration and frequently covering large areas) may not constitute the most efficient way of gaining the much-needed status information.

5.3 Research

The paucity of data on the natural history of many threatened mustelids and viverrids leads us to emphasize the importance of conservation-related research. Particularly pressing are the following three aspects: clarification of the ecological requirements of the species, taxonomy to evaluate the intraspecific variation, and population genetics to learn more about the minimum population sizes needed for long-term conservation.

The necessity of taxonomic revisions. Approximately 420 forms of mustelids (excluding the otters) and 350 forms of viverrids have been described, representing about 53 and 70 species respectively. While new species and subspecies continue to be described, several will be considered invalid in future taxonomic revisions. One must bear in mind that many forms were described decades or even a century ago, in a period when the concept of a species was quite different from the one prevailing today. Following the rise of the biological species concept, which considers a species to include all populations of animals related closely enough to reproduce with each other, many taxa described on the basis of minor differences have been subsumed under one species name (in addition to the truly invalid ones, based on aberrant single individuals, or on misinterpreted sexual, ontogenetic, or seasonal variation). This approach has many advantages from a scientific perspective, and has proved to be justified and successful. However, since the conservation of intraspecific variability (apart from a very few popular organisms) enjoys little support even in many conservation circles, and since laws are confined to named taxa, the progress in systematics can mean that the preservation of morphologically similar populations is overlooked. This problem is not considered to be serious by many conservationists, but it should not be forgotten that subtle microtaxonomic differences are the only indicators we have today, in both families, of a certain period of separate evolution in isolation. Biochemical and population genetics studies, or investigations into comparative physiology or regional differences in behaviour, are almost completely lacking in these two families, and even if begun immediately on a large scale (of which there is no sign), would take a very long time. Thus, microtaxonomy is the only indication we have of possible adaptations to climatic or nutritional differences, or to different competitors, parasites, or strains of pathogens. For example, it appears likely that a species like the yellow-throated marten (*Martes flavigula*) is genetically differentiated in its vast geographic and ecological range, at least in terms of allele frequency in polymorphic genetic loci. This species inhabits a wide spectrum of habitats, from the boreal and temperate forests of northern China, subtropical China, and the mountain forests of the Himalayas, to the tropical rain forests of Malaysia and the cloud forests of Java's volcanoes. Differences in food species and in the daily (or circumannual) economy of dealing with the environment are certain. The threatened subspecies from Java and Taiwan could well be evolving into new species, following their isolation from the mainland populations.

Our profound ignorance of such issues excludes insights such as those that have been gained in the more intensively studied primates, where different populations of the night monkey (*Aotus trivirgatus*) proved to be specifically distinctive and quite differently adapted to local strains of the malaria pathogen *Plasmodium*. A similar case in mustelids and viverrids, like an increased resistance to rabies virus strains, could be of critical importance for reintroduction programmes.

Considering the small number of taxonomists, revisions of intraspecific geographic variation will not be easy. A philosophy of "taxonomic splitting" is preferred so long as comprehensive investigations (including morphological, physiologal, behavioural and genetic aspects) aimed at studying regional adaptations, are lacking. From such considerations, our decision has been to include tentatively some taxonomic borderline cases in our list of threatened mustelids and viverrids, the "validity" of which is being debated on the basis of a few skulls or skins (see Chapter 2 and Appendix 4).

Field studies evaluating the conservation needs of threatened mustelids and viverrids. Despite obvious difficulties in studying mustelids and viverrids in the field because many species are solitary, nocturnal, or arboreal, investigations evaluating their ecological requirements are essential for long-term conservation. It must be repeated that a number of threatened mustelids and viverrids have never been studied by scientists, or even seen in the

wild. Such field work may not be possible without live-trapping of the animals. Only persons experienced in trapping and marking should be involved in order to minimize risks to the animals under observation.

Research conducted on the factors limiting the population size of threatened mustelids and viverrids is strongly encouraged. The reason for small population numbers of several threatened species is evident if the species or subspecies are confined to a small island or an otherwise restricted habitat. Interestingly, however, other species have been recorded over large areas but appear to occur in very low numbers everywhere, or perhaps more normally in only a few isolated populations. The reasons for such peculiar distribution patterns require investigation. Dependence on a rare and patchily distributed habitat type, specialization on food items that are only locally available, or competition with other species are possible explanations. The susceptibility to particular diseases which have eliminated the species of concern from wide areas could also be the cause of the observed scarcity in certain cases. It has been speculated that scarcity for "natural reasons" is an indication that a species is on its way to natural extinction. This is very difficult to prove and it is equally likely that such complex distribution patterns are the result of inter-specific competition. Such competition necessarily results in a decrease in the breadth of ecological niches in areas of high biological diversity. For no mustelid and viverrid which has low population numbers for "natural" reasons do we know the cause of this phenomenon. Even slight human impact on otherwise intact ecosystems, such as an increase in village dogs or cats (carrying diseases transmittable to other carnivores) can prove detrimental to mustelids and viverrids. Distinctive populations, or even low-density species as a whole, may disappear without anybody noticing the cause of this creeping process.

Of great importance is the need to evaluate the effects of conservation measures for large carnivores on the status of mustelids and viverrids. These could be detrimental as a result of increased competition. The management of protected areas, frequently aimed at increasing the population numbers of spectacular large mammals, needs critical analysis, because it can be associated with large-scale changes in the vegetation structure, possibly with a negative impact on, among numerous other organisms, arboreal viverrids and mustelids.

Research into the feeding ecology and the social behaviour in order to improve techniques for captive management. Although the American mink (*Mustela vison*) is one of the most frequently bred fur-bearing animals in captivity, and has even been domesticated, and several other species of mustelid have also been bred for commercial purposes, the breeding of mustelids and viverrids in zoological gardens has not been very successful. The main reason for this situation is the general neglect of both families in zoos (see Chapters 5.4 and 6.4). However, there are also some specific difficulties which ought to be overcome if captive breeding is to be improved. One problem is the lack of knowledge of the species' social structures. In many cases, we do not know how many animals should be kept together, when or for how long to separate the sexes, or when it is best to remove offspring from breeding groups. Lack of knowledge of the food requirements is another problem for the captive management of some threatened mustelids and viverrids. Species such as the fanalouc or the Liberian mongoose are thought to be specialized in their diets, feeding predominantly on earthworms and insect larvae.

Research into the population genetics of mustelids and viverrids. A better understanding of the species' social structures and of their patterns and distances of migration and dispersal is essential in order to estimate minimum population sizes needed for the preservation of the genetic variability within populations. Inbreeding is high within small remnant populations, and leads to the loss of genetic variability (see chapter 3.2). The rate of this loss depends on, among other parameters, the social structure and mating system of the species (for example, with how many females an average male mustelid or viverrid reproduces). It also depends on population dynamics: in stable populations the loss of genetic polymorphism is less rapid than in populations which fluctuate in size. Although there are indications in a number of mustelid and viverrid species of population cycles in response to the abundance of prey species, we do not have quantitative data to use this kind of information for the calculation of the consequences on genetic variability within a population.

Another kind of datum necessary to evaluate the genetic status of populations is derived from the analysis of biochemical variability between individuals. Such molecular research reveals marker genes which are polymorphic within or between populations. These polymorphisms allow a monitoring of the genetic status of populations (see Chapter 6.4).

5.4 Captive Breeding

The IUCN/SSC Mustelid and Viverrid Specialist Group recognizes that management and captive breeding can be powerful tools in ensuring the survival of endangered species. Their value for conservation is evident in all cases where protection of the animal and its natural habitats is not likely to be successful. Captive breeding, however, is to be seen as a support, not a substitute, for conservation efforts in the wild.

Several problems, some of which cannot yet be completely evaluated given the present state of knowledge, are connected with this approach. Since conditions in captivity are different from the normal environment that a species has to live with in the wild, captive breeding over several generations poses the risk of unintentionally selecting animals for further breeding which would not be capable of reproduction if subject to the conditions of natural selection. For example, veterinary care in the zoo allows individuals to survive which would succumb to disease in nature. In the wild, the offspring of a breeding pair disperses and, after maturation, seeks its breeding partner a distance away from its place of birth. The average dispersal distance varies from species to species. In captivity, the exchange of animals between breeding groups in a variety of institutions clearly cannot exactly match the species-specific degree of mixing of the wild population. This holds true especially in species whose social structure is so little known, as is the case with most mustelids and viverrids. Therefore, the degree of average relatedness and inbreeding will differ in captive animals from the one typical of the species' natural social systems. We do not yet know the necessary details to evaluate the consequences of this change of the genetic structure of mustelid

and viverrid populations, but there is evidence that some changes, such as an increase in inbreeding, can be detrimental to long-term fitness. It is suggested that these problems should not only be acknowledged but also actively investigated by all institutions working for conservation.

We recommend that some of the world's most highly reputed zoos work with one or a few species to gain experience in housing, feeding, breeding, and husbandry of threatened mustelids and viverrids, with the aim of being well-prepared if ongoing and future field work reveals the necessity to initiate a breeding programme as a last effort to save a species (see chapter 6.4). The unsatisfactory case of the black-footed ferret (*Mustela nigripes*), where basic research in captive management had to be performed using the last few survivors, supports this argument.

With the genetic and demographic implications of keeping a species in captivity over many generations, and the resulting needs to maintain a sufficiently large population, it is also acknowledged that saving a species by captive management requires an appreciable investment of funds and expertise. Building up viable populations in the long run should therefore concentrate on the most seriously threatened taxa. Unfortunately, many of the more than 50 taxa identified by this conservation action plan are so poorly known that it is not possible to say whether they are endangered to such an extent that even their short-term survival can only be ensured by captive breeding.

Although it is evident that only a few zoological gardens have the expertise and funds for comprehensive biological research, basic data of relevance for future conservation actions can be gathered without sophisticated laboratory facilities. Any report on diets, diseases, causes of death, and behaviour can be of great use to zoo biologists. We consider the number and the quality of scientific papers published on the species maintained as a very suitable indicator of the efforts of zoological gardens towards what must be achieved.

Chapter 6. Priorities for mustelid and viverrid conservation

Following the preceding analysis of the problems facing mustelids and viverrids, a number of conservation projects can be proposed. In view of the very limited knowledge of most species, many of these proposals are directed towards a better understanding of the status and the natural history of the species. To facilitate a quick comparison of the relative priorities for action, a rough priority rating-system has been developed.

When suggesting these activities, we must express our conviction that even if a good proportion of these essential projects can be funded and carried out with success, the long-term survival of many mustelids and viverrids in their natural habitats remains doubtful unless additional developments occur, which are much more difficult to achieve. The system of ethical values prevailing in many societies, which places man outside the context of living nature, is the ultimate cause for a large number of the ecologically undesirable developments which are discussed in this action plan. This ethical aspect is outside the scope of this document (and our competence), but we feel obliged to mention it in order to exclude the misleading conception that the consequences of certain human activities can be easily remedied by providing the funds necessary for the following catalogue of minimum conservation actions.

6.1 Priority Rating Criteria

The set of criteria which has been used to identify the most urgent conservation problems is detailed in Table 3. Because of the lack of reliable data on the status and the ecological requirements of many mustelids and viverrids, this priority rating system is inevitably rather simple and its value should be judged as provisional.

The widespread concept of rating species on the basis of their taxonomic distinctiveness, thus automatically giving endangered monotypic genera higher priority for conservation action than multi-species genera (and neglecting subspecies), is not followed here because of its very far-reaching consequences (see Appendix 4). The system adopted here to identify conservation priorities focuses on the following criteria: a rough estimate of the status of a species' habitat; its range size; its occurrence in protected areas; and the amount of additional knowledge which is needed in order to develop a strategy to ensure the animal's survival. One reason for ignoring taxonomic distinctiveness is the lack of comparability of taxonomic levels between different animal groups: what is called a genus in viverrids might be quite different from a genus in birds or insects (see also Hennig 1950). Moreover, the existence of a great number of species and subspecies can mean that a taxon is in active radiation, and possibly will (although evolutionary processes cannot be anticipated) contribute to the natural diversity of coming ages. As a consequence, taxa which are attributed a low rank in the taxonomic hierarchy do not receive such a low ranking here, so that the likelihood of funding projects for their conservation is not reduced (this argument does not dispute the conservation value of monotypic taxa).

Moreover, it should not be forgotten that by evaluating conservation priorities on the basis of taxonomic distinctiveness we ignore the aesthetic aspect of conservation. Aesthetics and emotions are important factors in the conservation of natural diversity. These parameters cannot easily be reduced to numbers.

Table 3. Priority rating system for mustelid and viverrid conservation

1. Is the species/subspecies decreasing or believed to be decreasing?
2. Is the species/subspecies endemic to a very small area, or, if it was widespread, does it now only occur in a small fragment of its former range?
3. Is the species/subspecies endemic to an area or habitat type with serious environmental degradation throughout?
4. Is the species/subspecies very poorly known?

5. Does the species/subspecies have specific habitat requirements which may render it particularly vulnerable, and/or does it naturally occur at low population densities?

6. Is the species/subspecies subject to intensive uncontrolled hunting pressure?

7. Does the species/subspecies occur in at least one adequately protected conservation area?

8. Is there a large population of the species/subspecies in at least one conservation area?

In the case of the first six questions the answer

Yes means that there is a factor either likely to affect negatively the taxon's survival or our ability to develop conservation measures. Every **Yes** is rated with "2".

Not Known means that there may be threats but we cannot evaluate their significance. **Not Known** is therefore rated with "1".

No means that this particular problem is not affecting the taxon's survival and accordingly is rated with "0".

In the case of questions 7 and 8 there is vice versa rating, in that questions answered with **No** are rated with "2", and **Yes** with "0".

6.2 Priority Species

The priority scores for each threatened mustelid and viverrid species are listed in Table 4. Bearing in mind the unavoidable shortcomings of such numerical systems, we conclude that the taxa of greatest concern are (the rating numbers are added in parentheses):

Liberian mongoose (*Liberiictis kuhni*) (14)
Lowe's otter civet (*Cynogale lowei*) (14)
Malabar civet (*Viverra civettina*) (13)
Taiwan yellow-throated marten (*Martes flavigula chrysospila*) (13)
Sokoke bushy-tailed mongoose (*Bdeogale crassicauda omnivora*) (13)
Black-footed ferret (*Mustela nigripes*) (12)
Fanalouc (*Eupleres g. goudotii* and *E. g. major*) (12)
Colombian weasel (*Mustela felipei*) (12)
Owston's palm civet (*Chrotogale owstoni*) (12)

With the exception of the black-footed ferret (*Mustela nigripes*), which is probably extinct in the wild, and is showing initial encouraging signs of recovery in captivity, the natural history of all these species or subspecies is almost unknown, and they have been recorded only from very restricted ranges. Two of them, the Malabar civet (*Viverra civettina*) and the Taiwan yellow-throated marten (*Martes flavigula chrysospila*), have at times been thought to be extinct. Most live in regions where human damage to natural habitats is already serious and is likely to increase further. Furthermore, the Liberian mongoose (*Liberiictis kuhni*), Owston's palm civet (*Chrotogale owstoni*), and the Taiwan yellow-throated marten are known to be subject to extensive hunting pressure.

On a more regional scale, conservation measures for the European mink (*Mustela lutreola*) are a high priority, too. This species' fragmented remnant populations in France have been studied long enough to suggest a strategy to remove the most pressing threats. It seems certain that unless the conservation activities suggested in this action plan are implemented, this mustelid's extinction in the European Community by accidental human killing cannot be prevented.

Table 4. Priority numbers of threatened mustelids and viverrids (The eight columns correspond to the rating questions outlined in Table 3).

	1	2	3	4	5	6	7	8	Total
Palearctic Realm									
European mink (*Mustela lutreola*)	2	0	2	0	2	2	0	1	9
European marbled polecat (*Vormela p. peregusna*)	2	0	2	0	1	0	0	1	6
Tsushima marten (*Martes melampus tsuensis*)	2	2	0	2	1	0	2	2	11
Wolverine (*G. gulo*)	2	0	0	0	2	1	2	1	8
Ibiza small-spotted genet (*G. genetta isabelae*)	1	2	0	2	0	0	2	2	9
Nearctic Realm									
Black-footed ferret (*Mustela nigripes*)	2	2	2	0	2	0	2	2	12
Wolverine (*G. gulo*)	2	0	0	0	2	1	2	1	8
Big-Thicket hog-nosed skunk (*Conepatus mesoleucus telmalestes*)	2	2	0	2	1	1	1	2	11
Indomalayan Realm									
Indonesian mountain weasel (*Mustela lutreolina*)	1	1	2	2	1	1	0	1	9
Back-striped weasel (*Mustela strigidorsa*)	1	0	2	2	1	1	0	1	8
Taiwan yellow-throated marten (*Martes flavigula chrysospila*)	2	2	2	2	1	2	1	1	13
Javan yellow-throated marten (*M. f. robinsoni*)	2	2	2	2	1	1	0	1	11
Nilgiri marten (*Martes gwatkinsi*)	2	2	2	2	1	1	0	1	11
Javan ferret-badger (*Melogale orientalis*)	1	1	2	2	0	1	1	1	9

	1	2	3	4	5	6	7	8	Total
Kinabalu ferret-badger (*Melogale everetti*)	1	2	0	2	1	1	0	1	8
Malabar civet (*Viverra civettina*)	2	2	2	2	1	2	1	1	13
Large-spotted civet (*Viverra megaspila*)	2	0	0	2	1	1	1	1	8
Spotted linsang (*Prionodon pardicolor*)	2	0	0	2	1	2	1	1	9
Javan small-toothed palm civet (*Arctogalidia trivirgata trilineata*)	2	2	2	2	1	1	0	1	11
Kangean common palm civet (*Paradoxurus hermaphroditus kangeanus*)	1	2	1	2	0	1	1	1	9
Mentawai palm civet (*Paradoxurus lignicolor*)	1	2	2	2	1	1	1	1	11
Golden palm civet (*Paradoxurus zeylonensis*)	1	2	2	2	1	0	0	1	9
Brown palm civet (*Paradoxurus jerdoni*)	2	2	2	2	1	1	0	1	11
Sulawesi palm civet (*Macrogalidia musschenbroekii*)	1	2	0	2	1	1	0	1	8
Mentawai banded palm civets (*Hemigalus derbyanus minor* and *H.d. sipora*)	1	2	2	2	1	1	1	1	11
Hose's palm civet (*Diplogale hosei*)	1	2	0	2	2	1	0	1	9
Owston's palm civet (*Chrotogale owstoni*)	2	2	2	2	1	2	0	1	12
Otter civet (*Cynogale bennettii*)	2	0	2	2	2	1	0	1	10
Lowe's otter civet (*Cynogale lowei*)	2	2	2	2	2	2	1	1	14
Sumatran collared mongoose (*Herpestes semitorquatus uniformis*)	1	1	1	2	1	1	1	1	9
Malagasy Realm									
Malagasy civet (*Fossa fossana*)	2	2	2	0	1	2	0	1	10
Fanalouc (*Eupleres goudotii*)	2	2	2	2	1	2	0	1	12
Malagasy broad-striped mongoose (*Galidictis fasciata*)	1	2	2	2	1	1	0	1	10
Giant striped mongoose (*Galidictis grandidieri*)	1	2	2	2	1	1	1	1	11
Malagasy narrow-striped mongoose (*Mungotictis decemlineata*)	2	2	2	0	1	0	0	1	8
Malagasy brown-tailed mongoose (*Salanoia concolor*)	1	2	2	2	1	1	0	1	10
Fossa (*Cryptoprocta ferox*)	1	0	2	0	0	2	0	1	6
Afrotropical Realm									
Abyssinian genet (*Genetta abyssinica*)	1	1	2	2	1	2	1	1	11
Johnston's genet (*Genetta johnstoni*)	1	2	2	2	1	1	1	1	11
Giant genet (*Genetta victoriae*)	1	0	0	2	2	1	1	1	8
Aquatic genet (*Osbornictis piscivora*)	1	0	0	2	2	1	1	1	8
Leighton's linsang (*Poiana richardsoni liberiensis*)	1	2	2	2	1	1	1	1	11
Ansorge's cusimanse (*Crossarchus ansorgei*)	1	0	0	2	0	2	0	1	6
Liberian mongoose (*Liberiictis kuhni*)	2	2	2	2	2	2	1	1	14
Pousargues' mongoose (*Dologale dybowskii*)	1	2	0	2	1	1	0	1	8
Sokoke bushy-tailed mongoose (*Bdeogale crassicauda omnivora*)	2	2	2	2	2	1	1	1	13
Jackson's mongoose (*Bdeogale jacksoni*)	1	2	2	2	1	1	0	1	10
Neotropical Realm									
Tropical weasel (*Mustela africana*)	1	0	2	2	2	1	1	1	10
Colombian weasel (*Mustela felipei*)	2	2	2	2	2	1	0	1	12
Grey-headed tayra (*Eira barbara senex*)	2	2	2	2	1	1	0	1	11
Pygmy spotted skunk (*Spilogale pygmaea*)	1	2	0	2	1	0	0	2	8

6.3 Core Areas for Mustelid and Viverrid Conservation

If we compare the geographic distribution of the threatened mustelids and viverrids, it emerges that seven core areas cover approximately 50 percent of the taxa of concern. Conservation activities within these areas are a priority, particularly since they are of similar importance for the conservation of other organisms. These core regions are listed below (taxa marked with an asterisk are endemic to that area; rating numbers are given in parentheses).

Madagascar

Tropical and subtropical lowland rain forest, deciduous forests, baobab savanna, spiny bush.

Fanalouc (*Eupleres g. goudotii** and *E. g. major**) (12)
Giant striped mongoose (*Galidictis grandidieri**) (11)
Malagasy civet (*Fossa fossana**) (10)
Malagasy brown-tailed mongoose (*Salanoia concolor**) (10)
Malagasy broad-striped mongoose (*Galidictis f. fasciata** and *G. f. striata**) (10)
Malagasy narrow-striped mongoose (*Mungotictis d. decemlineata** and *M. d. lineata**) (8)
Fossa (*Cryptoprocta ferox**) (6)
Total priority number: 67

Northern Vietnam (including adjacent areas in China, Laos, and Thailand)

Tropical semi-evergreen and deciduous forest, mountain forests.

Lowe's otter civet (*Cynogale lowei**) (14)
Back-striped weasel (*Mustela strigidorsa*) (8)
Spotted linsang (*Prionodon pardicolor*) (9)
Owston's palm civet (*Chrotogale owstoni**) (12)
Large-spotted civet (*Viverra megaspila*) (8)
Total priority number: 51

Java (Indonesia)

Mountain and lowland rain forests, tropical deciduous forests.

Javan small-toothed palm civet (*Arctogalidia trivirgata trilineata**) (11)
Javan yellow-throated marten (*Martes flavigula robinsoni**) (11)
Javan ferret-badger (*Melogale orientalis**) (10)
Indonesian mountain weasel (*Mustela lutreolina*) (9)
Total priority number: 41

Upper Guinea rain forests (including parts of Liberia, Ivory Coast, and Guinea)

Tropical evergreen and semi-evergreen lowland rain forest, mountain rain forest.

Liberian mongoose (*Liberiictis kuhni**) (14)
Johnston's genet (*Genetta johnstoni**) (11)
Leighton's linsang (*Poiana richardsoni liberiensis**) (11)
Total priority number: 36

Western Ghats (southwest India: provinces of Kerala, Karnataka, and Tamil Nadu)

Tropical evergreen rain forest.

Malabar civet (*Viverra civettina**) (13)
Nilgiri marten (*Martes gwatkinsi**) (11)
Brown palm civet (*Paradoxurus j. jerdoni** and *P. j. caniscus**) (11)
Total priority number: 35

Northern Borneo (East Malaysia and adjacent parts of Indonesian Borneo)

Tropical evergreen lowland and mountain rain forests. Possibly heath forests.

Otter civet (*Cynogale bennettii*) (10)
Hose's palm civet (*Diplogale hosei**) (9)
Kinabalu ferret-badger (*Melogale everetti**) (8)
Total priority number: 27

Sumatra (Indonesia)

Tropical lowland and mountain rain forests.

Otter civet (*Cynogale bennettii*) (10)
Indonesian mountain weasel (*Mustela lutreolina*) (9)
Sumatran collared mongoose (*Herpestes semitorquatus uniformis**) (8)
Total Priority number: 27

6.4 Priority Projects for Conservation Action

In this section, the activities recommended to start a conservation programme for threatened mustelids and viverrids are listed. The relative urgency of the following proposals for field surveys, research studies, conservation awareness campaigns, and habitat conservation measures can be compared by combining the priority rating numbers (see Table 4) of all species affected by a project in question.

Objective 1:

To acquire basic information on the distribution and the status of mustelids and viverrids of conservation concern, and to conduct ecological, taxonomic, and genetic research in order to gain more detailed knowledge about their conservation requirements.

Surveys and field studies of the least known threatened mustelids and viverrids. For many threatened mustelids and viverrids, our present state of knowledge necessitates a concentration on field surveys and initial studies in order to obtain the information needed for more detailed conservation recommendations. Of particular importance is the need to discover centres of abundance, in order to determine whether the present network of protected areas includes viable populations, or whether new reserves would be desirable.

Many mustelids and viverrids are rather difficult to locate in the wild, particularly the nocturnal species. Indeed, some threatened genera have never been observed in the field. Therefore, it is recommended that field surveys expand into research studies as soon as a population is discovered. Habitat preferences, diets, approximate population densities, social structure, and obvious short-term threats should be identified.

The considerable difficulty in searching for such elusive species might imply that field surveys by foreign experts do not constitute the most cost-effective method of approach in the conservation of these species. However, we consider that the primary responsibility for carrying out such surveys rests with local wildlife organizations, universities, government departments, and interested individuals, rather than the international conservation organizations. We urge everybody, including trappers and hunters, to communicate to members of the IUCN/SSC Mustelid and Viverrid Specialist Group their knowledge and understanding of any of the mustelids and viverrids listed below.

Priorities for field surveys. The distribution patterns of the taxa listed in this section are either almost completely unknown, or are at least insufficiently known, as is their occurrence within the protected areas in their presumed range. Therefore, surveys are essential to obtain data on range size and habitats. Without this information (and additional follow-up investigations) it is difficult to formulate recommendations for habitat protection or other long-term measures to conserve these particular species. These enumerations should be read in conjunction with the respective national summaries of necessary conservation action (see Appendix 2). The priority scores of the taxa are added in parentheses.

Palearctic Realm
European mink (parts of the U.S.S.R.) (9)

Nearctic Realm
Big-Thicket hog-nosed skunk (9)

Indomalayan Realm
Taiwan yellow-throated marten (13)
Javan yellow-throated marten (11)
Javan ferret-badger (10)
Indonesian mountain weasel (9)
Back-striped weasel (8)
Lowe's otter civet (14)
Malabar civet (13)
Javan small-toothed palm civet (11)
Mentawai palm civet (11)
Brown palm civet (11)
Mentawai banded palm civet (11)
Owston's palm civet (12)
Sumatran collared mongoose (8)

Malagasy Realm
Giant striped mongoose (11)

Afrotropical Realm
Liberian mongoose (14)
Sokoke bushy-tailed mongoose (13)
Abyssinian genet (11)
Johnston's genet (11)
Leighton's linsang (11)
Pousargues' mongoose (8)
Ansorge's cusimanse (isolated Angolan part of distribution) (6)

Neotropical Realm
Colombian weasel (12)

Priorities for field studies. In the following taxa, the overall distribution pattern is known. However, the lack of data on their ecological requirements renders it impossible to judge whether the reserves within their distributional limits provide adequate protection. Clearly, all mustelids and viverrids listed above will fall under this category, once surveys have revealed their ranges and habitats. Priority scores are again added in parentheses.

Palearctic Realm
Tsushima marten (11)
European mink (9)
European marbled polecat (6)

Indomalayan Realm
Nilgiri marten (11)
Otter civet (10)
Spotted linsang (9)
Hose's palm civet (9)
Golden palm civet (9)
Kinabalu ferret-badger (8)
Large-spotted civet (8)
Sulawesi palm civet (8)

Afrotropical Realm
Jackson's mongoose (10)
Giant genet (8)
Aquatic genet (8)
Ansorge's cusimanse (6)

Neotropical Realm
Grey-headed tayra (11)
Tropical weasel (10)

In addition to these taxa, there are several others which have only been studied by one, or a very few researchers. Detailed, long-term field research is almost totally lacking for most mustelids and viverrids of conservation concern, particularly for almost every tropical species (compare Chapter 1, section 1.3 and Chapter 5, section 5.3).

NOTE: Summaries of proposed field surveys and field studies are listed in Appendix 2.

Evaluating standardized field methods to assess numbers of mustelids and viverrids in the field. Data on population sizes and densities of elusive species are rarely comparable, especially when standardized counting methods are not applied. Field data suggesting changes in population sizes are therefore often unreliable. The formulation, by experienced wildlife biologists, of guidelines

for counting or estimating the abundancies of mustelids and viverrids, and their publication and dissemination, is among the highest research priorities.

Research on the causes of the "natural scarcity" of mustelids and viverrids. In addition to the investigations into the special ecological requirements of single species, research on the causes of the "natural scarcity" of a number of widespread mustelids and viverrids is important. For the majority of these species, the factors limiting their population size, or restricting their occurrence to certain patches within their overall range, are unknown. Therefore, we do not know whether management activities in protected areas lessen the likelihood of local extinction of such low-density species. This problem is clearly very difficult to study, but the factors possibly responsible for low population densities (for example, social spacing mechanisms, specialized diets, diseases, parasites, or competitors) are amenable to scientific analysis, and any ecological work on such species should aim to include these aspects. Among the species of conservation concern which appear to qualify for this category, the following may serve as examples: wolverine (*Gulo gulo*), large-spotted civet (*Viverra megaspila*), otter civet (*Cynogale bennettii*), giant genet (*Genetta victoriae*), aquatic genet (*Osbornictis piscivora*), and bushy-tailed mongoose (*Bdeogale crassicauda*).

Assessing the effect of pesticides on the European mink. Chlorinated organic pesticides (PCBs) have a detrimental effect on the fertility of the American mink (*Mustela vison*). It is not known what role such toxicants have played in the decline of the European mink (*Mustela lutreola*). The concentrations of chlorinated hydrocarbons should be measured using tissues of accidentally trapped European minks.

Taxonomic revisions of the intraspecific variation of selected mustelids and viverrids. For the following species taxonomic revisions are a priority, because subspecies with very small ranges have been described, which, if valid, must be considered as threatened (see also Appendix 3): European mink (*Mustela lutreola*), wolverine (*Gulo gulo*), stoat (*Mustela erminea;* island subspecies) and *Mustela frenata* (island and Neotropical subspecies), tayra (*Eira barbara*), Mentawai banded palm civets (*Hemigalus derbyanus* ssp.), small-toothed palm civet (*Arctogalidia trivirgata*), and binturong (*Arctictis binturong*). Moreover, it is important to clarify whether *Mustela humakeri* from Sumatra and *Herpestes hosei* from Borneo are distinctive species or subspecies, or whether the type specimens are aberrant individuals of more widespread species.

In the case of the hog-nosed skunk (*Conepatus*), a revision is necessary because despite a lack of agreement on how to classify the genus and how to delimit the described taxa, the Patagonian hog-nosed skunk (*C. humboldtii*) is listed on Appendix II of CITES (see below).

In addition to these species, three viverrid genera, *Genetta*, *Paradoxurus*, and *Paguma* are in particular need of a thorough revision. The common palm civet (*Paradoxurus hermaphroditus*) appears never to have been revised since the studies by Pocock in the 1930s, although it exhibits an extraordinary geographic variability and many questions as to its classification remain open. This is regrettable, as several of its approximately 30 subspecies are confined to very small islands and must have tiny populations.

Genetta is also higly variable. In contrast to *Paradoxurus*, it has attracted considerable interest from taxonomists: recent revisions have been by Schlawe (1981), Crawford-Cabral (1980, 1981), and Coetzee (1977), and regional studies, covering Central Africa, West Africa, and southern Africa, respectively, have been carried out by Crawford-Cabral (1969, 1970), Rosevear (1974), and Smithers (1983). However, there is a fundamental disagreement among these authors on many points, even in cases where identical material was studied. Van Rompaey and Colyn (unpublished data) were not able to separate the supposed species *Genetta servalina* and *G. rubiginosa* by investigating skull morphology in a series of about 100 skulls from Zaire, and could not definitely determine the specific status of the *G. rubiginosa* material, which has been variously assigned to *G. maculata, G. pardina, G. tigrina,* or *G. rubiginosa,* by different workers. This taxonomic confusion renders certain conservation recommendations premature. A molecular analysis of genet taxonomy would probably contribute to a better understanding.

Research into the social structure and population genetics of selected mustelids and viverrids. A short discussion of the genetic factors that must be considered in the long-term management of fragmented remnant populations, and for captive breeding, is presented in Chapters 3 and 5 (sections 3.2, 5.3, and 5.4). The sections also emphasize the importance of gaining data on the species' social structures for interpretation by geneticists. In addition, knowledge on polymorphic gene systems is required in order to reconstruct the pedigrees of captive stocks, and to monitor genetic changes within or between populations. However, no genetic polymorphism could be detected by the biochemical method of starch gel electrophoresis during the only study which has been published on the biochemical genetics of mustelids (Simonsen 1982), although 121 beech martens (*Martes foina*), 39 least weasels (*Mustela nivalis*), 24 polecats (*Mustela putorius*), and 13 stoats (*Mustela erminea*) from the wild were screened and 25 genetic loci were investigated in each specimen. No research has been conducted on the genetic variability of viverrids. This means that we not yet know of any appropriate genetic markers in either family. Molecular studies on the population genetics of mustelids and viverrids would be valuable.

Objective 2:

Promote research which would demonstrate the feasibility of, and the economic benefits from, the sustainable utilization of mustelids and viverrids for human welfare.

Feasibility study to test the suitability of increasing "civet" production for the perfume industry. As was described in Chapter 1 (section 1.2), African civets (*Civettictis civetta*) are kept in Ethiopia for the production of a musk-like secretion (civet) which is exported for the use of the perfume industry. Intensifying this small-scale industry requires a breeding programme for the traditionally wild-caught civets. This would demonstrate the value of viverrids in Ethiopia. Likewise, the suitability of other species

of viverrid or mustelid (such as other civet species, stink badgers, and skunks) for similar economic use could be investigated. The research carried out to breed these species on a commercial basis could provide valuable insights for the captive management requirements of related, threatened species. Any efforts to increase civet production and civet substitutes from other species, will require a market study to assess the size and nature of the demand within the perfume industry.

Feasibility study for farm-breeding of the European mink. Whereas the American mink (*Mustela vison*) has been domesticated and is farm-bred on a large scale, its European congener is critically threatened and nearing extinction in the European Community, and possibly elsewhere. Evaluating the suitability of the European mink (*Mustela lutreola*) for farm-breeding is not primarily recommended for possible economic aims (though such benefits would be useful) but mink farms should have the expertise to produce sufficient numbers of this species quickly for reintroduction into areas where the species has already disappeared but where habitat is still available.

Assessment of the sustainability of the trade in furs of hog-nosed skunks. The trapping of several northern boreal and subarctic mustelid species appears to be sustainable, thereby guaranteeing long-term economic profits, as well as the survival of the persecuted species, but doubts have been expressed as to the sustainability of the hunting of South American hog-nosed skunks (*Conepatus* spp.). Argentinian *Conepatus* skins are, or were, traded in considerable numbers in the 1970s, with an average of some 155,000 pieces exported from Argentina annually (Anon. 1987a). Up to four species of hog-nosed skunks (*Conepatus castaneus, C. chinga, C. humboldtii,* and *C. rex*) are recognized as occurring in Argentina, but the taxonomy of the genus is not clear (Kipp 1965). Some authorities have argued that there are only two (Kipp 1965) or one species (Howard and Marsh 1982) in the region, with several more or less clearly defined subspecies. It is thought that *C. humboldtii* suffers most from the fur trade. *Conepatus humboldtii* is the population living from Chiloe province in Chile and the Chubut province and western Rio Negro, Argentina, south to the Straits of Magellan (a range of about 550,000 km^2). It is listed on Appendix II of CITES and has been protected in Argentina since 1983. In Chile, the whole genus *Conepatus* has been protected since 1972. Following legal protection in Argentina, the number of *C. humboldtii* skins exported dropped from over 44,000 in 1982 to less than 3,000 in 1983. However, since the other *Conepatus* forms are neither protected in Argentina nor covered by CITES, and since the taxonomy and correct identification of the different *Conepatus* taxa remains controversial, it is unknown how many misidentified skins of *C. humboldtii* still are traded under other names. Kipp (1965) stated that "true" *humboldtii* is not clearly separable from *C. castaneus,* the two taxa being merely extreme phases of clinal variation. Studying the taxonomy of *Conepatus* appears to be necessary therefore, because the present information does not facilitate (or even allow) the correct implementation of CITES regulations. Misidentifications cannot be excluded, nor is it possible to determine whether there are any distinctive threatened taxa of *Conepatus.* Monitoring the geographic origin of traded skins might elucidate the potential threats to local populations. It would be beneficial to list *Conepatus* as a whole on Appendix II of CITES, to make trade monitoring meaningful at all. In addition to the resolution of these taxonomic problems, it is recommended that research be carried out to determine which of the populations of *Conepatus* in Argentina are the most suitable for sustainable harvesting. If necessary, it might be advisable to establish annual export quotas for defined populations. It would also be worth investigating the possibility of returning a proportion of the profits for the continued conservation of the resource.

Objective 3

To enhance public interest in mustelids and viverrids by dissemination of information.

Disseminating knowledge on the fate of the European mink in western France. Investigations into mink ecology in western France by A. J. Braun have revealed that a public education campaign for the species in France is very urgent. This project should initially concentrate on Brittany and include the production (and distribution to as many hunters as possible) of a poster which explains the different characteristics of the European mink (*Mustela lutreola*) and the introduced American mink (*M. vison*). This poster should also show the other semi-aquatic mammals—polecat, otter, and the introduced muskrat and coypu. A booklet describing the natural history and precarious state of the European mink is needed, including clear recommendations of how to trap American minks and muskrats without threatening *M. lutreola.* This publication should also include contact addresses of experts to deal with accidentally trapped specimens. Live-caught *M. lutreola* should be investigated and preferably tagged by a zoologist. Injured individuals may serve as founder animals in a planned captive breeding project at Mulhouse Zoo, and European minks inadvertently killed should be analyzed for pesticide and heavy metal concentrations in their tissues (see above). Candidates for hunting licences, and people trained to trap muskrats, would be the other target groups for this campaign. The presentation of slides during the training courses would be helpful. A very effective way to reduce the high mortality of *M. lutreola* in traps set for other species would be to finance a survey in Brittany, the species' stronghold, to make personal contact with trappers and gamekeepers, and to check *M. vison* traps regularly. The distribution of reduced-price cage traps to trappers in districts with mink populations (e.g. the Noyalo Marsh and Le Tour du Parc in the Département de Morbihan) is important, because 90% of all trapping is still carried out with jaw traps, which are a serious risk to the European mink. The threatened otter (*Lutra lutra*) would directly benefit from this project as well.

Cooperation in all such activities should be sought with the Office National de la Chasse and its suborganizations in the "départments".

Preparation of public education materials for use in local conservation magazines and in journals. Being frequently nocturnal and arboreal, many threatened mustelid and viverrid species are very rarely encountered, even in areas where they still are common. Even naturalists or conservation groups may not be

aware of their local viverrid and mustelid fauna. The preparation of popular publications for nature and conservation magazines, stressing the animals' ecological importance, is recommended in order to increase their public appeal. All experts involved in conservation activities and surveys should be asked to lend suitable slides and provide a short manuscript for educational purposes.

Objective 4

To promote captive breeding of mustelids and viverrids.

Foundation of a mustelid and viverrid propagation group. The captive breeding and management of mustelids and viverrids has been neglected by the world's zoos, the major exceptions being otters and diurnal and social mongooses. As a result of this situation, captive breeding techniques are less advanced for these two families than for many other mammal groups. Individual breeders of mustelids and viverrids are few and far between and sometimes have to stop breeding species which are not well-established in captivity because of a lack of possibilities to exchange breeding stock. In order to raise the profile of mustelids and viverrids in the zoo community, and to increase and exchange knowledge on their captive management, the foundation of a mustelid and viverrid propagation group is recommended, under the auspices of the IUCN/SSC Mustelid and Viverrid, and Captive Breeding Specialist Groups.

Priority species for captive breeding. Not a single species of the mustelid and viverrid taxa of conservation concern has been kept and bred in captivity over several successive generations. Only one, the fossa (*Cryptoprocta ferox*), is approaching this situation; it has been bred by three institutions in recent years on a more or less regular basis. The fossa, the black-footed ferret (*Mustela nigripes*), and the wolverine (*Gulo gulo*) are the three species on our list with the highest number—between 30 and 60 each—of captive individuals. The black-footed ferret is the only one which is subject to a well-planned captive breeding programme, the outcome of which will probably determine this species' survival.

In addition to the three above-mentioned species, there are only nine additional taxa on our threatened list with records of successful captive breeding (see Table 5). For each of these species (apart from the European mink), breeding success is known from a single institution only and there is no information available on reproduction in the second generation. An additional eight taxa are endangered subspecies that have conspecific forms with successful captive breeding records (Table 5). Assuming that experience with one subspecies can directly be applied to another, at least some data on the captive breeding of these taxa are available, though hardly ever in a published form.

Fifteen more threatened species have been kept in captivity at least once, although not successfully bred (Table 5). All these species have been represented in captivity only in small numbers, sometimes even by single individuals and, in the majority of cases, several decades ago.

Finally, there are an appreciable number of species which have probably never been kept in captivity at all (Table 5). In summary, we have a total of 30 threatened mustelid and viverrid species which have never been bred, or even held, in captivity.

We recommend the initiation of captive colonies of these species, particularly those which have never been bred in captivity, or for which experience in captive maintenance is insufficient. The initial aim would be to accumulate information on the captive management of these species, so populations could be small to start with. However, since we do not yet know which species and subspecies may need self-sustaining captive populations for their ultimate survival, demographic and genetic considerations should be applied as far as possible, even in these experimental breeding colonies. The international zoo community is challenged to provide more space for threatened mustelids and viverrids and to invest in sound breeding and research programmes (as outlined in Chapter 5.4).

While the Mustelid and Viverrid Specialist Group supports efforts to bring some animals of each of these taxa into suitable captive breeding institutions, we oppose the acquisition of these animals via the commercial animal trade. Attempts to obtain founder stock for captive populations must have the full consent of the authorities in the animals' countries of origin, and should be coordinated with other breeders. The Mustelid and Viverrid Specialist Group offers its support to coordinate such projects and to assist in the exchange of information.

Animals to be brought into captivity should contribute to the conservation of their species in the broadest sense, by making them subject to conservation-related research, public education, possibly fund-raising campaigns, and, finally, reintroduction schemes.

Table 5. The current status of captive breeding in mustelids and viverrids

A. Threatened mustelids and viverrids which have been successfully bred in captivity.

European mink (*Mustela lutreola*)
Black-footed ferret (*Mustela nigripes*)
Wolverine (*Gulo gulo*)
Grey-headed tayra (*Eira barbara senex*)
Pygmy spotted skunk (*Spilogale pygmaea*)
Large-spotted civet (*Viverra megaspila*)
Spotted linsang (*Prionodon pardicolor*)
Golden palm civet (*Paradoxurus zeylonensis*)
Malagasy civet (*Fossa fossana*)
Western fanaloue (*Eupleres goudotii major*)
Malagasy narrow-striped mongoose (*Mungotictis decemlineata*)
Fossa (*Cryptoprocta ferox*)

B. Threatened subspecies which have not been bred in captivity but which have conspecifics with successful captive breeding records.

Taiwan yellow-throated marten (*Martes flavigula chrysospila*)
Javan yellow-throated marten (*M. f. robinsoni*)
European marbled polecat (*Vormela p. peregusna*)
Ibiza small-spotted genet (*G. genetta isabelae*)
Kangean common palm civet (*Paradoxurus hermaphroditus kangeanus*)
Mentawai banded palm civets (*Hemigalus derbyanus sipora* and *H. d. minor*)
Javan small-toothed palm civet (*Arctogalidia trivirgata trilineata*)
Big-Thicket hog-nosed skunk (*Conepatus mesoleusus telmalestes*)

C. Species formerly or presently kept in captivity without successful breeding.

Tropical weasel (*Mustela africana*)
Indonesian mountain weasel (*Mustela lutreolina*)
Nilgiri marten (*Martes gwatkinsi*)
Javan ferret-badger (*Melogale orientalis*)
Kinabalu ferret-badger (*Melogale everetti*)
Malabar civet (*Viverra civettina*)
Abyssinian genet (*Genetta abyssinica*)
Giant genet (*Genetta victoriae*)
Brown palm civet (*Paradoxurus jerdoni*)
Sulawesi palm civet (*Macrogalidia musschenbroekii*)
Otter civet (*Cynogale bennettii*)
Eastern fanalouc (*Eupleres g. goudotii*)
Malagasy broad-striped mongoose (*Galidictis fasciata*)
Malagasy brown-tailed mongoose (*Salanoia concolor*)
Ansorge's cusimanse (*Crossarchus ansorgei*)

D. Threatened mustelid or viverrid species which apparently have never been kept in a zoological garden.

Colombian weasel (*Mustela felipei*)
Back-striped weasel (*Mustela strigidorsa*)
Tsushima marten (*Martes melampus tsuensis*)
Johnston's genet (*Genetta johnstoni*)
Aquatic genet (*Osbornictis piscivora*)
Mentawai palm civet (*Paradoxurus lignicolor*)
Hose's palm civet (*Diplogale hosei*)
Owston's palm civet (*Chrotogale owstoni*)
Lowe's otter civet (*Cynogale lowei*)
Malagasy giant mongoose (*Galidictis grandidieri*)
Sumatran collared mongoose (*Herpestes semitorquatus uniformis*)
Leighton's linsang (*Poiana richardsoni liberiensis*)
Liberian mongoose (*Liberiictis kuhni*)
Pousargues' mongoose (*Dologale dybowskii*)
Jackson's mongoose (*Bdeogale jacksoni*)

Objective 5:

Enhance the long-term survival chances of threatened mustelids and viverrids through protection and management of those protected areas which are of greatest value for their conservation.

Although the conservation and careful management of sufficient parts of the natural habitat is the most important approach in a conservation programme, our limited knowledge of the natural history of most threatened mustelids and viverrids renders detailed suggestions for habitat protection difficult. The restricted number of reserves with definite records of threatened mustelid and viverrid species (Chapter 5, Table 2) shows, however, that some protected areas are of outstanding value for these two carnivore families. Those which protect one or more threatened mustelid and viverrid species with a total priority score of more than 10 have been selected to be listed in Table 6 (scores are added in parentheses):

To these valuable protected areas, Gunung Kinabalu National Park (Sabah, East Malaysia) must be added because the threatened Kinabalu ferret-badger (*Melogale everetti*) is possibly endemic to this reserve. This park also protects the Hose's palm civet (*Diplogale hosei*), another threatened north Bornean endemic.

It is of the utmost priority to continue or, where necessary, improve the protection of the reserves already identified as of priority for mustelid and viverrid conservation (or to gazette the ones currently being planned). Their management should take into account the outstanding value of the areas for the survival of threatened mustelids and viverrids.

Other protected areas will probably turn out to be of similar, or even greater significance for mustelid and viverrid conservation than the ones named above, once field surveys have increased our knowledge of the distribution patterns of several species.

Table 6. The most important protected areas for mustelids and viverrids

Indomalayan Realm

India
Eravikalum-Rajamalai National Park (11)
Anamalai Wildlife Sanctuary (11)
Mudumalai Wildlife Sanctuary (11)
Brahmagiri Wildlife Sanctuary (11)

Indonesia
Gunung Gede-Pangrango National Park (31)
Ujung Kulon National Park (11)

Vietnam
Cuc Phuong National Park (12)

Malagasy Realm

Madagascar
Mananara Man and the Biosphere Reserve (48)
Masoala Reserve (planned; 38)
Réserve Naturelle Intégrale d'Andohahela (28)
Réserve Naturelle Intégrale de Tsaratanana (18)

Afrotropical Realm

Guinea
Réserve Naturelle Intégrale de Mont Nimba and the surrounding Man and the Biosphere Reserve (11)

Ivory Coast
Réserve Naturelle Intégrale de Mont Nimba (11)

Liberia
Mount Nimba Reserve (planned; 11)

Kenya
Arabuko-Sokoke Forest Nature Reserve (13)

Neotropical Realm

Mexico
Montes Azules Man and the Biosphere Reserve (11)
Sian K'aan Man and the Biosphere Reserve (11)
Reserva Ecológica Selva del Ocote (11)
Reserva El Triunfo (11)
Los Tuxtlas Biological Station (11)

Colombia
Cueva de los Guacharos National Park (12)

Appendix 1: Nations with Threatened Mustelids and Viverrids of Conservation Concern

Species or subspecies endemic to one nation are marked with an asterisk. Presumed but unconfirmed occurrence within a country is indicated by a question mark.

Palearctic Realm

Bulgaria
European marbled polecat (*Vormela p. peregusna*)

China
Siberian wolverine (*G. gulo sibiricus*)

Finland
European mink (*Mustela lutreola*)
European wolverine (*G. g. gulo*)

France
European mink (*Mustela lutreola*)

Japan
Tsushima marten (*Martes melampus tsuensis**)

Mongolia
Siberian wolverine (*G. gulo sibiricus*)

Norway
European wolverine (*G. g. gulo*)

Poland
European mink (*Mustela lutreola*) (?)

Romania
European mink (*Mustela lutreola*)
European marbled polecat (*Vormela p. peregusna*)

Spain
European mink (*Mustela lutreola*)
Ibiza small-spotted genet (*G. genetta isabelae**)

Sweden
European wolverine (*G. g. gulo*)

Turkey
European marbled polecat (*Vormela p. peregusna*)

U.S.S.R.
European mink (*Mustela lutreola*)
European marbled polecat (*Vormela p. peregusna*)
European wolverine (*G. g. gulo*)
Siberian wolverine (*G. gulo sibiricus*)
Kamchatka wolverine (*G. gulo albus**)

Yugoslavia
European marbled polecat (*Vormela p. peregusna*)

Nearctic Realm

Canada
American wolverine (*G. gulo luscus*)
Western wolverine (*G. gulo luteus*)
Vancouver island wolverine (*G. gulo vancouverensis**)
Black-footed ferret (*Mustela nigripes*) (?)

U.S.A.
American wolverine (*G. gulo luscus*)
Western wolverine (*G. g. luteus*)
Kenai peninsula wolverine (*G. gulo katschemakensis**)
Black-footed ferret (*Mustela nigripes*)
Big-Thicket hog-nosed skunk (*Conepatus mesoleucus telmalestes**)

Indomalayan Realm

Burma
Back-striped weasel (*Mustela strigidorsa*)
Large-spotted civet (*Viverra megaspila*)
Spotted linsang (*Prionodon pardicolor*)

Buthan
Back-striped weasel (*Mustela strigidorsa*)
Spotted linsang (*Prionodon pardicolor*)

China
Back-striped weasel (*Mustela strigidorsa*)
Large-spotted civet (*Viverra megaspila*)
Spotted linsang (*Prionodon pardicolor*)
Owston's palm civet (*Chrotogale owstoni*)
Lowe's otter civet (*Cynogale lowei*) (?)

India
Back-striped weasel (*Mustela strigidorsa*)
Nilgiri marten (*Martes gwatkinsi**)
Malabar civet (*Viverra civettina**)
Spotted linsang (*Prionodon pardicolor*)
Brown palm civet (*Paradoxurus j. jerdoni** and *P. j. caniscus**)

Indonesia
Indonesian mountain weasel (*Mustela lutreolina**)
Javan yellow-throated marten (*Martes flavigula robinsoni**)
Javan ferret-badger (*Melogale o. orientalis** and *M. orientalis sundaicus**)
Javan small-toothed palm civet (*Arctogalidia trivirgata trilineata**)
Kangean common palm civet (*Paradoxurus hermaphroditus kangeanus**)
Mentawai palm civet (*Paradoxurus lignicolor**)
Sulawesi palm civet (*Macrogalidia musschenbroekii**)
Mentawai banded palm civets (*Hemigalus derbyanus minor** and *H. d. sipora**)
Hose's palm civet (*Diplogale hosei*) (?)
Otter civet (*Cynogale bennettii*)
Sumatran collared mongoose (*Herpestes semitorquatus uniformis**)

Laos
Back-striped weasel (*Mustela strigidorsa*)
Large-spotted civet (*Viverra megaspila*)
Spotted linsang (*Prionodon pardicolor*)
Owston's palm civet (*Chrotogale owstoni*)
Lowe's otter civet (*Cynogale lowei*) (?)

Malaysia
Kinabalu ferret-badger (*Melogale everetti**)
Large-spotted civet (*Viverra megaspila*)

Hose's palm civet (*Diplogale hosei**)
Otter civet (*Cynogale bennettii*)

Nepal
Back-striped weasel (*Mustela strigidorsa*)
Spotted linsang (*Prionodon pardicolor*)

Sri Lanka
Golden palm civet (*Paradoxurus zeylonensis**)

Taiwan
Taiwan yellow-throated marten (*Martes flavigula chrysospila**)

Thailand
Back-striped weasel (*Mustela strigidorsa*)
Large-spotted civet (*Viverra megaspila*)
Spotted linsang (*Prionodon pardicolor*)
Otter civet (*Cynogale bennettii*)
Lowe's otter civet (*Cynogale lowei*) (?)

Vietnam
Back-striped weasel (*Mustela strigidorsa*) (?)
Large-spotted civet (*Viverra megaspila*)
Spotted linsang (*Prionodon pardicolor*)
Owston's palm civet (*Chrotogale owstoni*)
Lowe's otter civet (*Cynogale lowei**)

Malagasy Realm

Madagascar
Malagasy civet (*Fossa fossana**)
Fanalouc (*Eupleres g. goudotii** and *E. g. major**)
Malagasy broad-striped mongoose (*Galidictis f. fasciata** and *G. f. striata**)
Giant striped mongoose (*Galidictis grandidieri**)
Malagasy narrow-striped mongoose (*Mungotictis d. decemlineata** and *M. d. lineata**)
Malagasy brown-tailed mongoose (*Salanoia concolor**)
Fossa (*Cryptoprocta ferox**)

Afrotropical Realm

Angola
Ansorge's cusimanse (*Crossarchus ansorgei*)

Central African Republic
Pousargues' mongoose (*Dologale dybowskii*)

Djibouti
Abyssinian genet (*Genetta abyssinica*) (?)

Ethiopia
Abyssinian genet (*Genetta abyssinica*)

Guinea
Johnston's genet (*Genetta johnstoni*)
Liberian mongoose (*Liberiictis kuhni*) (?)

Ivory Coast
Johnston's genet (*Genetta johnstoni*)
Leighton's linsang (*Poiana richardsoni liberiensis*)
Liberian mongoose (*Liberiictis kuhni*) (?)

Kenya
Sokoke bushy-tailed mongoose (*Bdeogale crassicauda omnivora*)
Jackson's mongoose (*Bdeogale jacksoni*)

Liberia
Johnston's genet (*Genetta johnstoni*)
Leighton's linsang (*Poiana richardsoni liberiensis*)
Liberian mongoose (*Liberiictis kuhni**)

Sierra Leone
Leighton's linsang (*Poiana richardsoni liberiensis*) (?)

Somalia
Abyssinian genet (*Genetta abyssinica*) (?)

Sudan
Pousargues' mongoose (*Dologale dybowskii*)

Tanzania
Sokoke bushy-tailed mongoose (*Bdeogale crassicauda omnivora*) (?)

Uganda
Pousargues' mongoose (*Dologale dybowskii*)
Jackson's mongoose (*Bdeogale jacksoni*)

Zaire
Giant genet (*Genetta victoriae**)
Aquatic genet (*Osbornictis piscivora**)
Ansorge's cusimanse (*Crossarchus ansorgei*)
Pousargues' mongoose (*Dologale dybowskii*)

Neotropical Realm

Belize
Grey-headed tayra (*Eira barbara senex*)

Brazil
Tropical weasel (*Mustela a. africana** and *M. a. stolzmani*)

Colombia
Tropical weasel (*Mustela africana stolzmani*) (?)
Colombian weasel (*Mustela felipei*)

Ecuador
Tropical weasel (*Mustela africana stolzmani*)
Colombian weasel (*Mustela felipei*)

Guatemala
Grey-headed tayra (*Eira barbara senex*)

Honduras
Grey-headed tayra (*Eira barbara senex*)

Mexico
Grey-headed tayra (*Eira barbara senex*)
Pygmy spotted skunk (*Spilogale pygmaea**)

Peru
Tropical weasel (*Mustela africana stolzmani*)

In this appendix, the most urgent status surveys and ecological studies of threatened mustelids and viverrids are summarized in geographic order. A rough estimation of the relative priority of the single proposals has been provided in Chapter 6 (section 6.4).

To demonstrate some of the crosslinks with conservation problems of other organisms, we add, if appropriate, after each project recommendation a few remarks on their general conservation relevance. This should stress that the following activities would not merely further the preservation of mustelids and viverrids but that we also judge these appealing mammals as symbol targets of more comprehensive conservation approaches.

Palearctic Realm

Spain

Study of the endemic Ibiza small-spotted genet and endemic martens in the Balearic and Pityusic islands. Ibiza and Menorca each have a distinctive population of the small-spotted genet (*G. genetta*). It is sometimes thought that the species's occurrence there (as well as to the European mainland) is due to introduction by man. If so, these introductions have presumably originated from geographically separate populations and the genet has changed in morphological characters in its new European habitats. There is also an undescribed form of beech marten (*Martes foina*) on Ibiza and a subspecies of pine marten (*Martes martes minoricensis*) on Menorca, both of which are distinctive from mainland animals (Delibes in litt. 1987). The Menorca small-spotted genet is believed to be still common. However, the Menorca marten and the Ibiza small-spotted genet are classified as "Rare" by ICONA (1986). The Ibiza beech marten might have become extinct recently. Surveys are needed to assess the status of these animals and to draw up management recommendations.

General conservation relevance. Mallorca, Menorca, Ibiza, and the surrounding islets are very rich in endemic flora and fauna. For example, the radiation of their lizard fauna (*Podarcis*) is remarkable. The extant endemic vertebrate species are remnants of a richer, and largely exterminated fauna which even included an endemic bovid (*Myotragus*). Because of the flourishing tourist industry, stricter conservation safeguards are necessary.

For additional information, see the data sheet on the Ibiza small-spotted genet (*G. genetta isabelae*).

France

Implementing a conservation strategy for the European mink. The continued survival of the fragmented and small relict population of the European mink in western France will ultimately depend on the preservation of inter-connected wetland habitats of sufficient size. However, the immediate threats are from direct (albeit mostly unintended) persecution. This is so severe that the species will probably become extinct in the near future unless a successful public information campaign can be directed to hunters, trappers, and fish pond owners. The main immediate requirements are discussed in the paragraph on conservation education (Chapter 6, section 6.4).

For additional information, see the data sheet on the European mink (*Mustela lutreola*).

France/Italy

Status assessment of the Tyrrhenian pine marten. The taxonomy of the Mediterranean island populations of the pine marten is poorly understood. However, Hutterer and Geraets (1978) provided evidence for the distinctiveness of the Sardinian population (*M. martes latinorum*) from the mainland form, as well as from the Balearic pine martens. Other islands, such as Corsica (one published sighting), Sicily, and Elba also have *M. martes*, but insufficient material is available to allow definite taxonomic conclusions. Although the Sardinian marten does not seem to depend on high forest, and indeed inhabits macchia scrub, so little is known about it (and even less about the other island populations) that the gathering of data on its status and ecology might prove a rewarding task, particularly since the islands are frequently visited by tourist zoologists and naturalists.

General conservation relevance. Due to their high number of endemic species, the Tyrrhenian islands are frequently treated as a distinct biogeographical district. As far as endemism on the species level is concerned, they are outstanding within western Europe.

Greece

Collecting data on endemic mustelids of Crete and Rhodes. Very little is known of the following endemic subspecies of the Greek archipelago (Zimmermann 1953): a beech marten (*Martes foina bunites*), a least weasel (*Mustela nivalis galinthias*) and a badger (*Meles meles arcalus*) from Crete, and a beech marten (*Martes foina milleri*) and a badger (*Meles meles rhodius*) from Rhodes. The Crete badger (*M. m. arcalus*) is declining because of heavy persecution and poisoning (Lekagis in litt. 1988). All predators are considered vermin in this area, and to prevent their elimination, education campaigns for local hunters are to be initiated soon. Studies of their natural history are also required, and even records by visiting zoologists, such as photographs of skins seen in pelt shops (Niethammer and Niethammer 1967) are of interest.

General conservation interest. Apart from the Iberian peninsula and the islands of the western Mediterranean basin, Greece, and especially the Greek islands, are centres of species and subspecies endemism in Europe.

Romania

Evaluation of the conservation status of the Danube delta mink population. The reed beds and wetlands of the Danube delta are not only among the most important for waterfowl in Europe, but they also retain one of the largest populations of the European mink (*Mustela lutreola*) outside the U.S.S.R. Since there are occasional rumours of plans for large-scale development in this area, and in view of the fact that trapping apparently occurs at a high level, the parts of the delta that are of greatest importance for mink survival should be identified. The needs of the species should be considered in the planning of both reserves and development projects.

General conservation relevance. The Danube delta is one of the most famous wetlands in Europe. It contains valuable breeding colonies of waterfowl and is an important resting site for migrating birds.

For additional information, see the data sheet on the European mink (*Mustela lutreola*).

Yugoslavia/Romania/U.S.S.R./Bulgaria/Greece/European Turkey

Study of the marbed polecat and steppe polecat in their European ranges. There is a severe lack of knowledge and considerable confusion concerning the ecology of the marbled polecat (*Vormela peregusna*) and the steppe polecat (*Mustela eversmanni*), both of which inhabit the Eurasian steppe belt. Both are known to prey on small rodents, and are decreasing at the European fringe of their range; the European subspecies *V. p. peregusna* is considered threatened. The situation gives cause for

serious concern in the light of the fate of the Nearctic black-footed ferret (*Mustela nigripes*), another mustelid inhabiting prairie or steppe habitats. The decrease of the black-footed ferret to its present precarious state, with only a few captive individuals surviving, means that the European steppe-dwelling polecats are a priority for conservation-related investigations. Of particular importance is whether these species need large populations of the social suslik (*Citellus*), or of other rodents, to prey on and to find shelter in their burrows. Hardly anything is known of the ecological requirements of either of these polecat species in their European steppe habitats, despite the population declines that have been witnessed, and the extensive loss of steppe areas to cultivation. It is also important to find out whether these two species occur in reasonable numbers within the protected areas of the region.

General conservation relevance. Intensified agriculture has already diminished the last remnants of the European fringe of the Eurasian steppe biome. The great bustard (*Otis tarda*) is an example of large steppe species in urgent need of conservation.

For additional information, see the data sheet on the European marbled polecat (*Vormela p. peregusna*).

U.S.S.R.

Study and survey of the European mink. The European mink (*Mustela lutreola*) is declining almost everywhere throughout its range. Some of the most important populations survive in the districts of Kalinin, Smolensk, Kostroma and Jaroslawe in northern U.S.S.R. Full protection should be given to this species, more of its habitat should be reserved, and research is needed to define more accurately the exact distribution and threats to the animal in this country.

In addition to the northern (Russian S.S.R.), western (France) and central (Romania) mink populations, the distinctive Caucasian population needs attention. Virtually nothing is known of the status of Caucasian minks and surveys are required in this southeastern corner of the species's range.

For additional information, see the data sheet on the European mink (*Mustela lutreola*).

Japan

Monitoring the status of mustelids. A number of mustelid subspecies are endemic to one or another of the Japanese islands. So far, the Tsushima marten (*Martes melampus tsuensis*) has been identified as being of conservation concern. However, the status of populations of the Japanese marten (*Martes melampus*) on the larger islands should also be clarified, as should the status of the Hokkaido sable (*Martes zibellina brachyurus*).

Another mustelid of uncertain conservation status is the Japanese weasel (*Mustela sibirica itatsi*), sometimes treated as a full species.

For additional information, see the data sheet on the Tsushima marten (*Martes melampus tsuensis*) and Appendix 3.

Nearctic Realm

U.S.A.

Search for the Big-Thicket hog-nosed skunk. It is not known whether the Big-Thicket hog-nosed skunk (*Conepatus mesoleucus telmalestes*) is extinct or whether it still survives in or around the Big-Thicket National Preserve, Texas. A search for this subspecies is proposed in its comparatively small (former) range. The inclusion of the expertise of local skunk trappers would be useful for such a survey. If (re)discovered, the reasons for the scarcity of this skunk should be investigated.

For additional information, see the data sheet on the Big-Thicket hog-nosed skunk (*Conepatus mesoleucus telmalestes*).

U.S.A./Canada

Research aimed at preparing a comprehensive management plan for Nearctic wolverines. Before a comprehensive management plan for the wolverine (*G. gulo* ssp.) can be prepared, a number of unsolved problems must first be studied. This research should cover the species' ecology (home range sizes, migration patterns, possible food shortage in winter), and the question of how many subspecies occur in the Nearctic. If the described subspecies from the Kenai Peninsula (Alaska), Vancouver Island (Canada), and the U.S. west coast are valid, they would be among the rarest large mammals in North America and would deserve much more attention than has hitherto been the case.

For additional information, see the data sheet on the wolverine (*G. gulo*) and its appendix (on *G. gulo katschemakensis, G. gulo vancouverensis*, and *G. gulo luteus*).

U.S.A./Canada/Mexico

Conservation of the black-footed ferret and its habitat. The current efforts to rescue the black-footed ferret (*Mustela nigripes*) by captive breeding must be continued. In addition to this vital approach, further surveys are suggested throughout the prairie belt of the U.S.A., Canada, and northern Mexico to locate possible surviving populations of the species and potential sites for reintroducing progeny of the captive breeding programme.

General conservation relevance. The status of the black-footed ferret reflects the fate of the American prairies, which have largely been replaced or altered by farming and cattle ranching.

For additional information, see the data sheet on the black-footed ferret (*Mustela nigripes*).

Indomalayan Realm

People's Republic of China

Surveys and study of threatened mustelids and viverrids. As can be concluded from the number of fairly recent descriptions of endemic mustelid and viverrid subspecies by Chinese mammalogists, we lack a basic understanding of the taxonomy, distribution, and conservation status of these families in China. Ongoing research is needed throughout the country to learn more about all these aspects. It is already clear, however, that apart from the smooth-coated polecat (*Mustela eversmanni amurensis*), the tropical species should receive priority. Furthermore, a significant reduction in the currently excessive hunting pressure is urgent if the present diversity of wildlife in China is to survive.

General conservation relevance. Only a few popular species, such as the giant panda (*Ailuropoda melanoleuca*), the takin (*Budorcas taxicolor*), cranes (Gruidae), and pheasants (Phasianidae) have been the subject of large international conservation projects in China. During the current promotion of conservation in China, other organisms should not be neglected in reserve planning.

For additional information, see the data sheets on the large-spotted civet (*Viverra megaspila*), spotted linsang (*Prionodon pardicolor*), back-striped weasel (*Mustela strigidorsa*), Owston's palm civet (*Chrotogale owstoni*), and Lowe's otter civet (*Cynogale lowei*).

Taiwan

Survey of Taiwan to locate surviving populations of the Taiwan yellow-throated marten. The Taiwanese subspecies of the yellow-throated marten (*Martes flavigula chrysospila*) is so rare that it has already been thought to be extinct. Other endemic mustelids and viverrids are the

Taiwan weasel (*Mustela sibirica taivana*), the Taiwan ferret-badger (*Melogale moschata subaurantiaca*), and the Taiwan palm civet (*Paguma larvata taivana*). Little is known of the status of these species and efforts are needed to assess the effects of the considerable hunting pressure on these animals, and how hunting can be better controlled. The declaration of four national parks in Taiwan since 1982 is an impressive achievement, but it remains to be determined which of the endemic wildlife species of Taiwan are adequately represented in these protected areas.

General conservation relevance. Other endemic mammals benefitting from such a project include the Taiwan macaque (*Macaca cyclopis*), the Taiwan serow (*Capricornis crispus swinhoei*), the Taiwan clouded leopard (*Neofelis nebulosa brachyura*), and several rodents including two giant flying squirrels (*Petaurista lena* and *P. petaurista grandis*).

For additional information, see the data sheet on the Taiwan yellow-throated marten (*Martes flavigula chrysospila*).

India/Bhutan

Study of the viverrid fauna in the eastern Himalayan and sub-Himalayan regions. Numerous species of southeast Asian origin occur in northeastern India (to the north and east of Bangladesh) and Bhutan. These include several viverrids like the binturong (*Arctictis binturong*), the small-toothed palm civet (*Arctogalidia trivirgata*), and the spotted linsang (*Prionodon pardicolor*), while the masked palm civet (*Paguma larvata*) and the common palm civet (*Paradoxurus hermaphroditus*) range even further to the west (but may have endemic subspecies in eastern India). The conservation record in this area is relatively positive, at least in Bhutan and the Indian state of Assam, but little is known of the actual status of mustelids and viverrids (and of most other small or cryptic species of wildlife). Even less information is available on the other east Indian states. Surveys are needed for conservation planning throughout the region, particularly in Arunachal Pradesh, which still has much of its natural vegetation cover and which has received little attention from zoologists.

General conservation relevance. Bhutan and the adjacent parts of India have a rich and diverse fauna which is quite distinct from the rest of the subcontinent. Endemism at subspecies and species level is quite high in this region, as exemplified among larger mammals by the Himalayan clouded leopard (*Neofelis nebulosa macrosceloides*), the Manipur brow-antlered deer (*Cervus eldi eldi*), the golden langur (*Trachypithecus geei*), and the pygmy hog (*Sus salvanius*).

For additional information, see the data sheets on the back-striped weasel (*Mustela strigidorsa*) and the spotted linsang (*Prionodon pardicolor*).

India

Ecological study and survey of the Western Ghats endemic mustelids and viverrids. In the isolated moist forest belt along the Western Ghats in southwest India, the endemic Nilgiri marten (*Martes gwatkinsi*), and two endemic viverrids, the Malabar civet (*Viverra civettina*) and the brown palm civet (*Paradoxurus jerdoni*), the latter with at least two subspecies, are of particular conservation concern. Although all of them are likely to occur in several of the approximately 23 protected areas in the states of Kerala, Tamil Nadu, and Karnataka, each is reported with certainty from only one or two of them. The subspecies *P. j. caniscus* has not been confirmed from any reserve. Surveys and ecological research are needed to define more accurately the distribution and the conservation needs of each of these species. Another endemic viverrid, the stripe-necked or badger mongoose (*Herpestes vitticollis inornata*), is not considered as threatened (Karanth in litt. 1986), but would also benefit from this recommendation.

General conservation relevance. The isolated rain forests along the Western Ghats are extraordinarily rich in endemic flora and fauna. Endemic large mammals include the lion-tailed macaque (*Macaca silenus*), the Nilgiri leaf monkey (*Presbytis johni*), and the Nilgiri tahr (*Hemitragus hylocrius*). Extensive deforestation has already reduced these forests to a series of isolated patches. There is now a ban on clear-felling, but various development projects pose a continuing threat.

For additional information, see the data sheets on the Nilgiri marten (*Martes gwatkinsi*), the Malabar civet (*Viverra civettina*), and the brown palm civet (*Paradoxurus jerdoni*).

Sri Lanka

Assessing the status and the conservation needs of endemic viverrids. Sri Lanka's viverrid fauna contains one species and seven subspecies endemic to the island. While the diurnal mongooses of the genus *Herpestes* are almost all frequently recorded from the nation's extensive network of protected areas, and also from agricultural areas, the status of the endemic golden palm civet (*Paradoxurus zeylonensis*) remains somewhat mysterious. Definite records from reserves are confined to Sinharaja Man and the Biosphere Reserve, and Wilpattu and Gal Oya National Parks. The few data from Wilpattu suggest that population numbers may be fluctuating and that this elusive animal may be sensitive to drought periods. Information should be gathered on the status of the golden palm civet in all existing reserves, including the remaining patches of mountain forests.

A survey of *P. zeylonensis* should also include the very little known northern Ceylon brown mongoose (*Herpestes fuscus maccarthiae*) from the Jaffna area, which is apparently known only from the type specimen, and whose habitat does not include any protected areas.

General conservation interest. For the conservation of Sri Lanka's endemic natural heritage, the Sinharaja Forest and the mountain forest reserves (Horton Plains, Hakgala, Peak Wilderness) are priority areas. Agricultural development of the dry zone in the east and north of the island has caused some interference in the migration patterns of large herbivores, especially elephants, and their restriction to protected areas, though measures to establish corridors are being adopted.

For additional information, see the data sheet on the golden palm civet (*Paradoxurus zeylonensis*).

Burma

National survey of threatened mustelids and viverrids. No viverrid or mustelid species is included in a recent list of Burma's conservation priorities (Blower 1982). However, important populations of two species of concern, the spotted linsang (*Prionodon pardicolor*) and the large-spotted civet (*Viverra megaspila*), may occur in this country and a significant proportion of the few museum specimens of the back-striped weasel (*Mustela strigidorsa*) has been collected there, suggesting a Burmese stronghold. Surveys are recommended, particularly for the weasel, which is very poorly known throughout its range. A distinctively dark-headed subspecies of the masked palm civet (*Paguma larvata nigriceps*) has been described on the basis of only one specimen from Nam Tamai in Upper Burma. The proposed survey should also assess the validity and conservation status of this form.

General conservation interest. About 47% of Burma's total land area of about 680,000 km^2 was still under some kind of forest cover in 1980 (Blower 1982). About 102,000 ha are deforested annually, but very little is known of the country's wildife. Some widely distributed Asian species that tend to be rare through most of their ranges might still have sizeable populations in Burma. A greater recognition of conservation in the process of forest exploitation, together with the declaration of protected areas, would be of high international priority.

For additional information, see the data sheet on the large-spotted civet (*Viverra megaspila*), the spotted linsang (*Prionodon pardicolor*), and the back-striped weasel (*Mustela strigidorsa*).

Laos

National survey of threatened mustelids and viverrids. Hardly anything is known of this country's mustelids and viverrids. Owston's palm civet (*Chrotogale owstoni*) has been collected in parts of Laos, Vietnam, and south China, Laos probably being the species' stronghold. Lowe's otter civet (*Cynogale lowei*) has never been recorded from Laos, but might well occur there, and if so its chances of survival would be somewhat brighter. Surveys for these and several other more widely distributed species should be initiated now, while there is still a chance to plan a reserve network systematically, to include the distributional centres of the maximum number of endangered species. The current IUCN project aimed at planning such a network deserves continued strong support.

General conservation relevance. Surrounded by largely deforested countries, Laos is a noble exception, still having 46% of the country under forest cover (Sayer 1983). Moreover, human population density is presently low in Laos and it is thought that many wildlife species still occur in strong populations. However, very little is known, even about the large conspicuous species possibly surviving, such as the kouprey (*Bos sauveli*) or the Javan rhino (*Rhinoceros sondaicus*).

For additional information, see the data sheets on Owston's palm civet (*Chrotogale owstoni*), Lowe's otter civet (*Cynogale lowei*), the back-striped weasel (*Mustela strigidorsa*), the spotted linsang (*Prionodon pardicolor*) and the large-spotted civet (*Viverra megaspila*).

Vietnam

Survey of mustelids and viverrids. Northern Vietnam is one of the regions of highest priority for mustelid and viverrid conservation in the world (see Chapter 6, section 6.3). While one can assume that all the taxa of concern may also occur in some parts of neighbouring countries, Lowe's otter civet (*Cynogale lowei*) is recorded only from Vietnam, by just one old museum specimen. Other high-priority species are Owston's palm civet (*Chrotogale owstoni*), the large-spotted civet (*Viverra megaspila*), and the back-striped weasel (*Mustela strigidorsa*). The northernmost subspecies of the small-toothed palm civet (*Arctogalidia trivirgata millsi*) may also need attention, as relatively few specimens of it are known from a narrow belt reaching from Assam to south China and Tonkin. The binturong (*Arctictis binturong*) reaches its northeastern distributional limit in the Transhimalayan biogeographical province which includes northern Vietnam; the population was described as a new subspecies (*Arctictis binturong menglaensis*) in 1986 and it is thought to be threatened (Wang Ying-Xiang in litt. 1986).

General conservation relevance. Natural vegetation is under serious pressure throughout Vietnam and forest cover has decreased to only 21%. Hunting pressure is also high throughout the country. Although Vietnam has gazetted a number of reserves, the status and distributional limits of most wildlife species remain unknown, including endemic or near-endemic deer and musk deer taxa (Vietnam sika deer, *Cervus nippon pseudaxis*, Cao bang musk deer, *Moschus berezovskii caobangis*) and a surprising diversity of primates (Tonkin snub-nosed monkey, *Rhinopithecus avunculus*, and several subspecies of Francois leaf monkey, *Trachypithecus francoisi*).

For additional information, see the data sheets on the back-striped weasel (*Mustela strigidorsa*), the large-spotted civet (*Viverra megaspila*), Lowe's otter civet (*Cynogale lowei*), and Owston's palm civet (*Chrotogale owstoni*).

Thailand

Search for Lowe's otter civet and survey of native species. Thailand includes a broad ecotone between evergreen rain forest and seasonal forest types and the country's ecological richness is well reflected in a diverse mustelid and viverrid fauna. Among several rare species from Thailand included in this action plan, Lowe's otter civet (*Cynogale lowei*) poses a particularly pressing problem. Although it is known from only one record in north Vietnam, one recent observation (1986) indicates a possible occurrence of the species in northeastern Thailand (Phu Kradung National Park). Lowe's otter civet is probably confined to riverine habitats which are usually under heavy human pressure. From the very little information available, it can be concluded that this viverrid is one of the species of highest conservation priority in the world.

Any field survey in Thailand should also yield much-needed data on the status of several other species, particularly the back-striped weasel (*Mustela strigidorsa*), the spotted linsang (*Prionodon pardicolor*), the otter civet (*Cynogale bennettii*), and the large-spotted civet (*Viverra megaspila*).

For additional information, see the data sheets on Lowe's otter civet (*Cynogale lowei*), the otter civet (*Cynogale bennettii*), the back-striped weasel (*Mustela strigidorsa*), the spotted linsang (*Prionodon pardicolor*), and the large-spotted civet (*Viverra megaspila*).

Malaysia/Indonesia

Ecological study of the otter civet. The otter civet (*Cynogale bennettii*) is patchily distributed and is thought to be rare and declining throughout its range, which includes Peninsular Malaysia (and presumably adjacent Thailand), Borneo, and Sumatra. A better understanding of its ecological requirements would enable surveys to concentrate on the most suitable habitats. An investigation and surveys are needed because it is not known whether the species is adequately protected in any of the numerous conservation areas in the region.

For additional information, see the data sheet on the otter civet (*Cynogale bennettii*).

Evaluation of the conservation needs of Bornean endemic carnivores. One mustelid species, the Kinabalu ferret-badger (*Melogale everetti*) and one monotypic viverrid genus, Hose's palm civet (*Diplogale hosei*), are endemic to the mountain ranges of north Borneo. Records are confined to Sabah and Sarawak, the Malaysian parts of the island. Populations of unknown size of both species are protected in Gunung Kinabalu National Park, Sabah. However, without some research into their ecology, it remains uncertain whether this single protected area contains populations of sufficient size to ensure their long-term survival. Surveys are also needed to determine the status of both species in other mountain ranges where they are known or supposed to exist (for example, within Gunung Mulu National Park, Sarawak). The taxonomic validity of a third north Bornean endemic, Hose's mongoose (*Herpestes hosei*), is open to considerable doubt, since this taxon is merely based on one specimen, collected in the Baram District (Sarawak) 85 years ago. This specimen may have been an aberrant short-tailed mongoose (*Herpestes brachyurus*). Field workers should also try to collect information to solve this problem.

General conservation relevance. It is worth mentioning that two of Borneo's three endemic carnivore species are mustelids and viverrids (the ones mentioned above), the third being the bay cat (*Prionailurus badius*). All remain virtually unknown and, as a result of this neglect, the needs of this assemblage of endemic carnivores have not yet been addressed in the conservation planning of any of the Bornean states or provinces.

For additional information, see the data sheet on the Kinabalu ferret-badger (*Melogale everetti*) and Hose's palm civet (*Diplogale hosei*).

Indonesia

Survey and ecological study of the endemic mustelids and viverrids of Java. Java is a priority region for mustelid and viverrid conservation (see Chapter 6, Section 6.3) because it harbours several distinctive endemic subspecies and one endemic species, the Javan ferret-badger (*Melogale orientalis*). Investigations are recommended to assess the status and exact habitat requirements of the Indonesian mountain weasel (*Mustela lutreolina*) and the endemic Javan mustelids, the Javan yellow-throated marten (*Martes flavigula robinsoni*), and the two subspecies of the Javan ferret-badger (*Melogale o. orientalis* and *M. o. sundaicus*). The Javan small-toothed palm civet (*Arctogalidia trivirgata trilineata*) appears to be confined to undisturbed forests in moist western Java, where human population density is particularly high. Another possibly endangered taxon is the Muria small Indian civet (*Viverricula indica muriavensis*) which is confined to Gunung Muria in north central Java. However, insufficient specimens of this endemic subspecies of the small Indian civet are available at present to judge if it is valid.

The proposed surveys should also include an assessment of the status of the local populations of the binturong (*Arctictis binturong*) and the banded linsang (*Prionodon linsang*). Both these species depend on forests and are likely to be threatened in the Javanese part of their range.

General conservation relevance. The island of Java is among the most densely populated regions of the tropics, with hardly any lowland forests remaining. Natural vegetation is mainly confined to the volcanic mountains. A number of the latter are within protected areas, but most of these forest islands are rather small. From west to east there is a gradient of decreasing humidity in climate and so the mountain ranges are quite diverse in their vegetation. Java is very rich in other rare species which include the well-known Javan rhinoceros (*Rhinoceros sondaicus*). Endemics include the possibly extinct Javan tiger (*Panthera tigris sondaicus*), two more cat subspecies, the highly threatened Javan red dog (*Cuon alpinus javanicus*), at least six primate taxa, a pig species, several rodents, bats, and many birds. The magnificent Javan hawk eagle (*Spizaetus bartelsi*) is among the most seriously threatened birds of prey on earth (Meyburg 1986).

For additional information, see the data sheets on the Indonesian mountain weasel (*Mustela lutreolina*), the Javan small-toothed palm civet (*Arctogalidia trivirgata trilineata*), the Javan ferret-badger (*Melogale orientalis*), and the Javan yellow-throated marten (*Martes flavigula robinsoni*).

Survey of mustelids and viverrids in southern Sumatra. Our knowledge of the occurrence of the Indonesian mountain weasel (*Mustela lutreolina*) in Sumatra is based on only two records. Surveys are recommended to define the species' distribution on the island. A single aberrantly coloured weasel from Jambi, south Sumatra, had originally been described as a new species, *Mustela hamakeri*, but later it was suggested by Brongersma and Junge (1942) that it represents no more than an extreme colour variant of the more widespread Malayan weasel (*Mustela nudipes*). Field work around the type locality of "*M. hamakeri*" would help to settle this question. If the validity of this mysterious taxon can be confirmed, a study to determine its conservation requirements must begin immediately. The proposed field research in southern Sumatra should also aim to assess the distribution and abundance of the Sumatran collared mongoose (*Herpestes semitorquatus uniformis*), the otter civet (*Cynogale bennettii*), as well as numerous other viverrids and mustelids, such as the binturong (*Arctictis binturong*), the banded linsang (*Prionodon linsang*), and the endemic Sumatran subspecies of the masked palm civet (*Paguma larvata leucomystax*), and the hog-badger (*Arctonyx collaris hoeveni*).

General conservation relevance. Other endemic mammals of special conservation concern from the same region include an as yet undefined number of leaf monkey taxa (*Presbytis* spp.; see Eudey 1987) and the Sumatran rabbit (*Nesolagus netscheri*).

For additional information, see the data sheets on the Indonesian mountain weasel (*Mustela lutreolina*) and the Sumatra collared mongoose (*Herpestes semitorquatus uniformis*).

Identifying the conservation needs of endemic viverrids from the Mentawai Islands. A species of special interest is the Mentawai palm civet (*Paradoxurus lignicolor*), which is endemic to the Mentawai archipelago off west Sumatra, and thereby is one of only two viverrid species which have their total range within the borders of Indonesia. Apart from *P. lignicolor*, only one other viverrid, the banded palm civet (*Hemigalus derbyanus minor* and *H. d. sipora*) occurs in the archipelago. In addition to resolving the open question as to the number of subspecies of *H. derbyanus* on the Mentawais, studies of the natural history of the endemic palm civet are recommended. It should be clarified whether its biology resembles that of the common palm civet (*P. hermaphroditus*), which is very adaptable to human alterations of its habitat, or those of its more sensitive congeners, such as the golden palm civet (*P. zeylonensis*) and brown palm civet (*P. jerdoni*). Depending on such findings, further conservation recommendations should emerge, presumably also for the benefit of *H. derbyanus* which is a low density species in the remainder of its range.

General conservation interest. The Mentawai archipelago exhibits a large amount of biotic endemism, including four species of primates and an overall percentage of mammalian endemism of 65%.

For additional information, see the data sheets on the Mentawai palm civet (*Paradoxurus lignicolor*) and the Mentawai banded palm civets (*Hemigalus derbyanus minor* and *H. d. sipora*).

Survey of Bangka and Billiton Islands. Many endemic mammal subspecies have been described from Bangka and Billiton, two relatively large islands lying to the east of Sumatra, including the following viverrids: a subspecies of the small-toothed palm civet (*Arctogalidia trivirgata minor*, on both islands); two banded linsang subspecies (*Prionodon linsang fredericae*, on Bangka and *P. l. interliniurus*, on Billiton); two common palm civet forms (*Paradoxurus hermaphroditus simplex*, on Bangka and *P. h. canescens*, on Billiton); and a binturong (*Arctictis binturong kerkhoveni*, on Bangka). Although a taxonomic revision is hampered by the scarcity of museum material, it is likely that at least some of the forms listed above may prove to be "good" subspecies. Surveys on Bangka and Billiton are recommended, therefore, to assess the conservation status of the local fauna and to collect additional data on the taxonomy of various native species.

General conservation relevance. Bangka and Billiton are among the faunistically least known regions of Indonesia. Despite having a rich and diverse wildlife, both islands have been largely ignored by the international conservation community. Of particular concern also is the western bearded pig (*Sus barbatus oi*), which is classified as "Vulnerable" by the IUCN/SSC Pigs and Peccaries Specialist Group (Oliver 1987 unpubl.) and which is presumed to occur on Bangka.

Assessing the taxonomic and conservation status of viverrids endemic to small islands in the Indonesian Archipelago. A number of viverrids are endemic to only one or a few small islands in Indonesia (and, to a lesser extent, Malaysia and Thailand). Destructive changes of the environment will have particularly far-reaching consequences in such tiny distributional areas. At the same time, these islands constitute prime study sites for those interested in evolutionary biology. The permanent vulnerability of these populations should be stressed to local organizations and authorities, not the least in order to avoid a very serious danger arising from accidental or intended introductions of alien subspecies, particularly of the common palm civet (*Paradoxurus hermaphroditus*) which is a follower of man (and an appreciated pet).

General conservation relevance. In contrast to the situation in the Greater Sunda Islands and Sulawesi, where a number of important conservation measures have been proposed or implemented, the status of the faunas of the smaller islands in the Indonesian archipelago is poorly known.

For additional information, see the data sheet on the Kangean common palm civet (*P. h. kangeanus*) and Appendix 3.

Philippines

Survey of Palawan. The island of Palawan is well known for its interesting biogeographic composition of faunistic elements. The Palawan stink badger (*Mydaus marchei*) is endemic to the island and the nearby Calamian archipelago. It was thought to be reasonably abundant in 1976 (Grimwood 1976) but it is unknown what effect the current high rate of habitat destruction will have on its population. Probably of greater concern is the binturong (*Arctictis binturong*), which reaches its eastern distribution limit on Palawan and is the largest-bodied native carnivore species in the Philippines. Surveys are needed to determine the present status and long-term outlook of both species, as well as to collect further data to evaluate the taxonomy of Palawan binturongs. On the basis of somewhat limited material, a separate Palawan subspecies (*A. b. whitei*) has been described.

Malagasy Realm

Madagascar

Evaluating the conservation needs of Malagasy rain forest viverrids. Madagascar is among the most important areas for viverrid conservation (see Chapter 6, section 6.3). Ongoing field work by Nicoll and his colleagues has already greatly increased our knowledge of the distribution and present status of northern and eastern Malagasy rain forest viverrids. One of the major unsolved problems in the region is whether there are distinctive populations of the broad-striped mongoose (*Galidictis fasciata;* supposed subspecies *G. f. striata* and *G. f. fasciata*) and, if so, what the exact range and status of each one is. Further field work is recommended to determine whether all species and subspecies of concern are adequately protected in the present system of reserves and to identify focal areas outside of protected areas. East Madagascar contains some of the most valuable protected areas worldwide from the point of view of viverrid conservation. It is of particular importance that the planned reserve on Masoala Peninsula be gazetted (see Chapter 6, section 6.4).

General conservation relevance. The special interest of the Malagasy biota is self-evident. Efforts to reconcile human with conservation needs on the island are essential for the continued survival of the unique Malagasy fauna and flora, and should be supported without hesitation.

For additional information, see the data sheets on the Malagasy civet (*Fossa fossana*), the fanaloue (*Eupleres goudotii*), the Malagasy broad-striped mongoose (*Galidictis fasciata*), the malagasy brown-tailed mongoose (*Salanoia concolor*), and the fossa (*Cryptoprocta ferox*).

Ecological study of the mammal community in west Madagascar. The deciduous forests around Morondava, well-known for their peculiar baobab trees, have good populations of the narrow-striped mongoose (*Mungotictis d. decemlineata*). The giant Malagasy rodent *Hypogeomys antimena* is endemic to the region, and Madagascar's largest carnivore, the fossa (*Cryptoprocta ferox*) is reported to be at its highest population density here.

General conservation relevance. This area is threatened by cutting and burning of the vegetation cover. Management recommendations for the survival of the local floral and faunal communities would also benefit an important population of the critically endangered Madagascar fish eagle (*Haliaeetus vociferoides*).

For additional information, see the data sheets on the Malagasy narrow-striped mongoose (*Mungotictis decemlineata*) and the fossa (*Cryptoprocta ferox*).

Evaluation of the conservation status of striped mongooses endemic to the arid zone of Madagascar. The spiny bush regions of south Madagascar are world-famous for their high degree of botanic endemism and unique plant forms. Two viverrids, the narrow-striped mongoose (*Mungotictis decemlineata lineata*) and the recently described giant striped mongoose (*Galidictis grandidieri*), are the only carnivores endemic to this region. Both taxa are known merely from a few museum specimens, but locality records indicate that their distribution centres are around Lac Tsimanampetsotsa Reserve (Réserve Naturelle Intégrale No. 10). This is one of the largest (43,200 ha) but also the least known south Malagasy protected area. The Tsimanampetsotsa region comprises three distinctive geological and vegetation formations: coastal dunes, alkaline lakes, and karst formations with *Didiereaceae* and *Euphorbia* bush. Only the latter two of these are included in the reserve. The coastal dunes are not included, although they are seriously threatened by domestic goat browsing (Nicoll in litt. 1987). From available data there is no indication as to which habitat type is preferred by either *G. grandidieri* or *M. d. lineata*. An assessment of current range, abundance, and ecology of the two carnivores should focus on R.N.I. No. 10.

General conservation relevance. The suggested work would help in drawing attention to Réserve National Intégrale. No. 10, which currently receives no active protection, although it is a stronghold of various other Malagasy endemics.

For additional information, see the data sheets on the giant striped mongoose (*Galidictis grandidieri*) and the Malagasy narrow-striped mongoose (*Mungotictis decemlineata*).

Afrotropical Realm

Liberia/Ivory Coast/Guinea

Identifying the conservation needs of the Upper Guinea rain forest endemic viverrids. Three viverrids, the Liberian mongoose (*Liberiictis kuhni*), Johnston's genet (*Genetta johnstoni*), and Leighton's linsang (*Poiana richardsoni liberiensis*) are endemic to a small area in Liberia and to a varying degree in neighbouring areas of Ivory Coast and Guinea. Forest destruction threatens all of them and hunting pressure is severe, particularly on *Liberiictis*. A survey is needed to determine the status of the three taxa and whether populations of each occur in Sapo National Park (Liberia) or any of the other protected areas in Liberia, Ivory Coast, Sierra Leone, or Guinea.

General conservation relevance. The Upper Guinea forests are one of Africa's five most important centres of forest species endemism, and are very rich in other threatened wildlife. Examples include the white-breasted guineafowl (*Agelastes meleagrides*), the zebra duiker (*Cephalophus zebra*), Jentink's duiker (*Cephalophus jentinki*), the Diana monkey (*Cercopithecus diana diana*), and the sooty mangabey (*Cercocebus atys atys*).

For additional information, see the data sheets on Johnston's genet (*Genetta johnstoni*), Leighton's linsang (*Poiana richardsoni liberiensis*), and the Liberian mongoose (*Liberiictis kuhni*).

Ethiopia/Somalia

Search for the Abyssinian genet. The Abyssinian genet (*Genetta abyssinica*) is thought to be very rare, yet its exact area of distribution and

its habitat requirements are unknown. Indeed, it is not clear whether this genet inhabits closed mountain forests or arid lowland habitats. Many of the ecosystems in Somalia and Ethiopia have detiorated as a result of human activities and extended periods of drought. Surveys are urgently needed to locate the species and its habitat.

General conservation relevance. Both the Ethiopian highland forests and moorlands, and the arid zone of the Horn of Africa, have diverse endemic faunas, of which the best known are the endemic antelopes. The threats to these natural communities arising from human-induced forest destruction, desertification and droughts are notorious.

For additional information, see the data sheet on the Abyssinian genet (*Genetta abyssinica*).

Zaire

Ecological study of endemic viverrids. Among the viverrids of Zaire, two endemic species, the aquatic genet (*Osbornictis piscivora*) and the giant genet (*Genetta victoriae*), are possibly at risk on account of their restricted ranges, patchy distributions and low population densities. Both remain virtually unknown and further ecological studies are required so that their needs can be included in an overall conservation strategy for Zaire. Among the other viverrids, the status of the near-endemic Ansorge's cusimanse (*Crossarchus ansorgei*) needs attention, because it is hunted for food, as well as Pousargues' mongoose (*Dologale dybowskii*), which is almost completely unknown. Garamba National Park in north Zaire is the only protected area where the genus *Dologale* is known to occur.

General conservation relevance. Zaire has one of the richest viverrid faunas in the world with at least 20 species occurring in the country. None of these is thought to be immediately threatened with extinction, because in many places there is still good forest cover and the human population density is low. However, increasing development and population growth are already changing this situation.

For additional information, see the data sheets on the aquatic genet (*Osbornictis piscivora*), the giant genet (*Genetta victoriae*), Ansorge's cusimanse (*Crossarchus ansorgei*), and Pousargues' mongoose (*Dologale dybowskii*).

Angola

Search for Ansorge's cusimanse. Only one specimen of Ansorge's cusimanse has been collected in Angola, from a locality which is far away and probably isolated from the species' main range in Zaire. Comparisons with Zairean conspecifics suggest that the Angolan specimen may constitute an as yet undescribed taxon, a question which is currently under investigation (Colyn and Van Rompaey in press). Since the isolated forest regions of northern Angola are home to several threatened and endemic (but generally almost unknown) vertebrates, a survey is an important priority.

For additional information, see the data sheet on Ansorge's cusimanse (*Crossarchus ansorgei*).

Kenya/Uganda

Assessment of the status of Jackson's mongoose. Judging from the few available museum specimens, Jackson's mongoose (*Bdeogale jacksoni*) is confined to mountain forests of Kenya and the extreme east of Uganda. The Aberdare National Park is the only reserve known to protect this species. Surveys are desirable in the Kenyan highlands (which are frequently visited by mammalogists) in order to find out in which of the several montain forest patches this mongoose occurs, and whether it prefers any of the altitudinal vegetation zones. It would also be of interest to learn whether the species can survive in plantations of exotic trees, or whether it is restricted to natural forest.

For additional information, see the data sheet on the Jackson's mongoose (*Bdeogale jacksoni*).

Kenya

Survey and ecological study of the Sokoke bushy-tailed mongoose. Surveys are needed to determine the status and exact range of the Sokoke bushy-tailed mongoose (*Bdeogale crassicauda omnivora*) in Kenya. These should include all remaining patches of the coastal East African forests, particulary the little known forests between the Tana River and the Somali border (for example, Boni Forest), and also Shimba Hills. The Sokoke Forest has important populations of six threatened bird species, two of which, the Sokoke scops owl (*Otus ireneae*) and Clarke's weaver (*Ploceus golandi*), are endemic. It is also one of only very few known localities for the rare Ader's duiker (*Cephalophus adersi*) and is likely to be the major stronghold for the golden-rumped elephant shrew (*Rhynchcyon chrysopygus*). The Sokoke bushy-tailed mongoose has been recorded only in Sokoke Forest in recent times. While avifaunal surveys have been done with the help of the International Council for Bird Preservation (ICBP), an assessment of Sokoke's near-endemic mammals is still needed. The results of such a survey, together with existing conservation recommendations for this deteriorating forest patch, should be summarized by experienced ecologists, together with development experts and foresters, and made available to the Kenyan authorities by high-level representation.

Another coastal moist forest within the known historic range of the Sokoke bushy-tailed mongoose lies within the Shimba Hills National Reserve. This reserve is managed for the endangered northern sable antelope subspecies (*Hippotragus niger roosevelti*), a species that is dependent on open areas and grasslands. Management guidelines must be formulated in order to avoid accidental creation of new open grassland areas, detrimental to the closed forest communities.

General conservation interest. The outstanding value of the East African coastal evergreen forest patches, and of Sokoke in particular, has been repeatedly demonstrated (Kelsey and Langton 1984; Collar and Stuart 1985), but little conservation action has been implemented. The value of Shimba Hills National Reserve is often underestimated. From this area, where there are serious land-use conflicts (*Pinus caribea* plantations and logging versus indigeneous forest; see Sekulic 1981), a fruit bat (*Myonyteris relicta*) new to science was described as recently as in 1980 (it is endemic to Shimba Hills and a few Tanzanian forests). Moreover, this National Reserve is the only (or one of only two) protected area within the small ranges of a number of species of mammals: the lesser hamster rat (*Beamys hindei*), one of the rarest rodents in East Africa, and the elephant shrew subspecies *Petrodromus tetradactylus sultani* and *Rhynchocyon p. petersi*.

For additional information, see the data sheet on the Sokoke bushy-tailed mongoose (*Bdeogale crassicauda omnivora*).

Tanzania

Survey of viverrids in eastern Tanzanian forests. It must be confirmed if, and where exactly, the Sokoke bushy-tailed mongoose (*Bdeogale crassicauda omnivora*) occurs in the Usambaras. It should also be clarified whether a distinctive population of the servaline genet (*Genetta servalina*) occurs in some Tanzanian forest ranges (see Kingdon 1977), as is suggested by one highly aberrant skin collected near Dabaga, in the Uzungwa mountains, in 1932.

General conservation relevance. The forests in the Usambara, Uzungwa, and Uluguru mountains have long been recognized as important centres of biotic endemism. All these forests are seriously threatened by further

degradation and reduction in area, and efforts are underway to delimit better reserves. Yet, apart from primates, little attention has been paid to most of the smaller mammals. To address properly the needs of these species in developing a protected area system, surveys are suggested, and these should include the few remnant forests in the hinterland of Tanga.

For additional information, see the data sheet on the Sokoke bushy-tailed mongoose (*Bdeogale crassicauda omnivora*).

Neotropical Realm

Mexico

Survey of endemic fauna of western Mexico. Few conservation areas exist in western Mexico, and the pygmy spotted skunk (*Spilogale pygmaea*) is protected only around the biological station of Chamela (1,584 ha). Surveys are needed to identify sites where protected areas could be established for the conservation of the skunk and other endemic fauna and flora.

General conservation interest. This species belongs to the little known, yet diverse endemic fauna of the dry subtropical forests of western Mexico. Other endemic mammals of the region include the Omiltene rabbit (*Sylvilagus insonus*), several rodents such as the Magdalena rat (*Xenomys nelsoni*), Collie's squirrel (*Sciurus colliaei*), an endemic deer-mouse (*Peromyscus chinanteco*), the banana bat (*Musonycteris harrisoni*), and Merriam's shrew (*Megasorex gigas*).

For additional information, see the data sheet on the pygmy spotted skunk (*Spilogale pygmaea*).

Mexico/Belize/Honduras/Guatemala

Study of grey-headed tayra. The grey-headed tayra (*Eyra barbara senex*) is a rather large-bodied mustelid which presumably occurs at low densities. The forests which it inhabits in southern Mexico are rapidly being destroyed. Field studies on the ecology of the tayra are needed to determine whether the two Man and the Biosphere Reserves in the region protect viable populations of this animal, or what other areas should be conserved to ensure its survival. It is likely that the reserve currently being planned (Kalakmul in Campeche, Mexico) and the proposed international reserves in Central America (Kalakmul and El Peten, Guatemala and Mexico; Rio Azul in Guatemala, Mexico, and Belize) as well as the suggested protected areas in Guatemala (El Mirador, San Miguel la Pelotada, and Laguna del Tigre) will protect the tayra. Their establishment is to be supported (Cuaron in litt. 1988).

General conservation relevance. The rain forests of southern Mexico are of particular interest since they constitute the northernmost tip of the neotropical moist forest belt. Several species are endemic to this area, while others, being at the edge of their ranges, are represented by distinctive subspecies.

For additional information, see the data sheet on the grey-headed tayra (*Eyra barbara senex*).

Colombia/Ecuador

Search for and ecological study of the Colombian weasel. The Colombian weasel (*Mustela felipei*) is probably the rarest carnivore species in the Neotropics. Virtually nothing is known about its distribution, its status, or its ecology. Nevertheless, this weasel is thought to be seriously threatened due to its presumed restricted distribution and probable preference for riverine habitats. A survey is needed in the Cordillera Central to locate populations of the species and to make recommendations for its conservation. The latter would certainly include habitat conservation, ecological studies and probably captive breeding as a safeguard against extinction.

General conservation relevance. The forests of the Colombian and Ecuadorean Andes are famous for their plant and animal endemism. Conservation activities directed at one species such as *M. felipei* will probably benefit numerous sympatric species.

For additional information, see the data sheet on the Columbian weasel (*Mustela felipei*).

Brazil/Ecuador/Peru

Ecological study of the tropical weasel. The tropical weasel (*Mustela africana*) is distributed over an enormous range, but the few museum specimens and scarce encounters with the species suggest a patchy distribution and possible association with very specific habitats. An initial ecological investigation of the species seems to be a prerequisite to identify the habitat types to be screened during an extended follow-up survey.

For additional information, see the data sheet on the tropical weasel (*M. africana*).

Appendix 3: List of Possibly Threatened Mustelids and Viverrids

The following list contains a heterogenous assemblage of taxa. Most occur in a very restricted range, usually only one or a few small islands, or in isolated mountain ranges, and therefore may be of conservation concern. However:

a) not enough information could be obtained on their status to establish whether they are threatened, or
b) it remained unclear if these species or subspecies are taxonomically valid. Some are known from very few specimens only (which may have been aberrant individuals), the validity of others has been doubted (but not unambiguously disproved) in the literature, and still others have been described from several specimens but still not enough to exclude the possibility that ontogenetic or circumannual variations were the cause for the distinctiveness of a described new form.

We hope that this appendix will stimulate further work, and readers having information on the conservation status or the taxonomy of these populations are kindly requested to correspond with the authors of this Action Plan. References are only given for those taxa which have been dealt with in special publications.

Palearctic Realm

Mustelidae

Mustela amurensis	Northeastern China, eastern U.S.S.R. (Gao et al. 1987)
Mustela erminea baturini	Bolshoi Shantar Island (east Siberia, U.S.S.R.)
Mustela erminea karaginensis	Karaginski Island (off northeast Kamtschatka, U.S.S.R.)
Mustela erminea ricinae	Islands of Islay and Jura (Hebrides, United Kingdom)
Mustela nivalis galinthias	Crete (Greece)
Mustela sibirica asaii	Oshima and Izu Islands (Japan)
Mustela sibirica charbinensis	Kretowsky Island (in Sungai river, Manchuria)
Mustela sibirica quelpartis	Quelpart Island (Korea)
Mustela sibirica sho	Yakushima Island (Japan)
Mustela altaica raddei	Southeast Siberia, Mongolia
Mustela boccamela	Sardinia (Italy; Frechkop 1963)
Mustela eversmanni hungarica	Hungary, Romania, Yugoslavia
Mustela eversmanni tiaratus	Kansu and Shansi (China)
Mustela eversmanni admiratus	Chihli, Shansi (China; Pocock 1936c)
Martes foina bunites	Crete (Greece)
Martes foina milleri	Rhodes (Greece)
Martes foina rosanowi	Northwest slope of Chatyr Dag (Crimea, U.S.S.R.)
Martes foina ssp.	Ibiza (Spain)
Martes martes latinorum	Sardinia (Italy) (Hutterer and Geraets 1978)
Martes martes minoricensis	Menorca (Spain)
Martes martes notialis	South of Abruzzi (Italy)
Martes zibellina brachyura	Hokkaido (Japan)
Martes zibellina linkouensis	Heilungiang province (China)
Martes zibellina schantaricus	Shantar Island and Tugur-Uda region (U.S.S.R.)
Martes zibellina tomensis	Western slopes of Kusnezi-Alatau (U.S.S.R.)
Meles meles arcalus	Crete (Greece)
Meles meles altaicus	Coast of Lake Telezkoi (Russian Altai, U.S.S.R.)
Meles meles rhodius	Rhodes (Greece)
Meles meles heptneri	Caspian region (U.S.S.R.; Heptner and Naumov 1974)
Meles meles severzovi	Fergana basin (U.S.S.R.; Heptner and Naumov 1974)
Meles meles arenarius	Kazakhstan (U.S.S.R.; Heptner and Naumov 1974)

Nearctic Realm

Mustelidae

Mustela erminea celenda	Long, Dall, and Prince of Wales Islands (Canada; Hall 1951)
Mustela erminea fallenda	Horseshoelake (British Columbia, Canada; Hall 1951)
Mustela erminea haidarum	Queen Charlotte Island (Canada; Hall 1951)
Mustela erminea initis	Chichgoff Island (Hall 1951)
Mustela erminea kodiacensis	Kodiak Island (Alaska, U.S.A.)
Mustela erminea salva	Admirality Island (Hall 1951)
Mustela erminea seclusa	Suemez Island (Hall 1951)

Mustela frenata alleni	Wyoming, South Dakota (U.S.A.; Hall 1951)
Mustela frenata inyoensis	Aldvord (California, U.S.A.; Hall 1951)
Mustela vison evagor	Vancouver Island (Canada)
Mustela vison nesolestes	Prince of Wales Island
Martes americana atrata	Newfoundland (Canada; Skinner 1979; Stewart 1974; Snyder 1985)
Spilogale putorius amphiala	Santa Cruz, Santa Rosa, and San Miguel (off California, U.S.A.; Van Gelder 1959; Williams 1986)

Indomalayan Realm

Mustelidae

Mustela hamakeri	Jambi (southern Sumatra, Indonesia; Dammerman 1940; Brongersma and Junge 1942)
Mustela tonkinensis	Northern Vietnam (Björkegren 1941)
Martes flavigula hainana	Hainan Island (China; Hsu and Wu 1981)
Mellivora capensis inaurita	Foothills of southern Nepal
Mellivora capensis indica	Western India, southwest Turkestan
Melogale moschata hainanensis	Hainan Island (China; Zheng and Xu 1983)
Melogale moschata subaurantiaca	Taiwan

Viverridae

Viverricula indica muriavensis	Gunung Muria (Java, Indonesia; Sody 1931)
Prionodon linsang fredericae	Bangka Island (Indonesia)
Prionodon linsang interliniurus	Billiton Island, Indonesia
Arctogalidia trivirgata fusca	Tebing, Tinggi, Merbau, Kundur, and Sugi Islands (Indonesia; Van Bemmel 1952)
Arctogalidia trivirgata inornata	North Natuna Islands (Malaysia; Van Bemmel 1952)
Arctogalidia trivirgata macra	Domel, Langkawi and Terutau Islands (Mergui archipelago, Thailand; Van Bemmel 1952)
Arctogalidia trivigata minor	Bangka and Billiton Islands (Indonesia)
Paradoxurus hermaphroditus cantori	Penang Island (Malaysia)
Paradoxurus hermaphroditus exitus	Kwantung (China)
Paradoxurus hermaphroditus hainanus	Hainan Island (China)
Paradoxurus hermaphroditus milleri	Tioman Island (Malaysia)
Paradoxurus hermaphroditus pallens	Kisseraing Island (Mergui archipelago, Thailand)
Paradoxurus hermaphroditus parvus	Simular and Eugano Island (Indonesia)
Paradoxurus hermaphroditus pugnax	Sullivan Island (Mergui archipelago, Thailand)
Paradoxurus hermaphroditus sacer	St. Matthew Island (Mergui archipelago, Thailand)
Paradoxurus hermaphroditus senex	Domel Island (Mergui archipelago, Thailand)
Paradoxurus hermaphroditus padangus	Padang and Rupat Islands (Indonesia; Lyon 1908)
Paguma lanigera	South Tibet (Hodgson 1836; Pocock 1941)
Paguma larvata wroughtoni	Western Himalayas (Pakistan and India; Pocock 1941; Roberts 1977)
Paguma larvata tytleri	Andaman Islands (India; Pocock 1941)
Paguma larvata nigriceps	Upper Burma (Pocock 1941)
Arctictis binturong kerkhoveni	Banks Island (Indonesia)
Arctictis binturong whitei	Palawan (Philippines; Pocock 1933)
Arctictis binturong penicillatus	Java (Indonesia)
Herpestes hosei	(Parts of ?) Borneo (Bechtold 1939; Payne et al. 1985)
Herpestes palustris	West Bengal (India; Ghose, 1965)
Herpestes urva formosanus	Taiwan
Herpestes javanicus rubrifrons	Hainan (China)

Herpestes fuscus maccarthiae	Northern Sri Lanka (Phillips 1984)
Herpestes brachyurus parvus	Calamian Islands (Philippines)
Afrotropical Realm	
Mustelidae	
Mellivora capensis buchanani	Air region (Niger; Long and Killingley 1983)
Poecilictis libyca oralis	Red Sea coast of Sudan (Niethammer 1987)
Viverridae	
Genetta servalina cristata	South Nigeria
Genetta servalina ssp.	Uzungwa mountains (Tanzania; Kingdon 1977)
Genetta bini	South Nigeria (Rosevear 1974)
Genetta maculata insularis	Bioko Island
Genetta tigrina	Narrow coastal strip from Durban to Cape Town (South Africa; Schlawe 1980)
Genetta deorum	South and central Somalia
Genetta aequatorialis	Southern Sudan, southwestern Central African Republic
Herpestes naso almodovari	Cameroon south of Sanaga River, Equatorial Guinea
Herpestes ichneumon aithos	South Nigeria (Rosevear 1974)
Herpestes swalius	South and central Namibia (Watson and Dippenaar 1987)
Herpestes nigratus	Kaokoveld (Namibia)
Herpestes swinnyi	South Africa, Transkei (Watson and Dippenaar 1987)
Bdeogale crassicauda tenuis	Zanzibar (Tanzania)
Bdeogale crassicauda nigescens	Central Kenya (Sale and Taylor 1969)
Paracynictis selousi sengaami	Zululand (South Africa)
Neotropical Realm	
Mustelidae	
Mustela frenata macrophonius	Oaxaca (Mexico; Hall 1951)
Mustela frenata costaricensis	Costa Rica (Hall 1951)
Mustela frenata panamensis	Panama (Hall 1951)
Mephitis macroura eximius	Veracruz (Mexico)
Mephitis macroura richardsoni	San Raffael del Norte (Nicaragua)
Conepatus mesoleucus filipensis	Cerro San Felippe (Mexico)
Conepatus humboldtii	Patagonia (Argentina and Chile; Kipp 1965)
Eira barbara inserta	Nicaragua (Krumbiegel 1942)
Eira barbara sinensis	Costa Rica, Panama (Krumbiegel 1942)
Eira barbara trinitatis	Trinidad (Krumbiegel 1942)
Lyncodon patagonicus	Patagonia (Argentina and Chile)
Galictis vittata canaster	Southern Mexico to Panama (Krumbiegel 1942)

Appendix 4: Rationale for Species and Subspecies Recognition

There has been much discussion by conservationists as to the level of the taxonomic hierarchy at which efforts to preserve natural diversity should commence. This discussion has mainly been elicited by the question of whether to include subspecies in conservation planning or not. Basically, we are aware of three different approaches to this problem within the international conservation community:

- A priori decisions to exclude subspecies for various reasons, such as: a lack of unequivocal taxonomic information on the animal group concerned; the fear of an unmanageably large number of threatened taxa, if subspecies are considered; or the time-delay until the emergence of red data books which is implied by screening a large number of taxa.

- Recognizing all subspecies or even local populations not bearing a scientific name of their own, but which are distinguished for historical or cultural reasons. This approach is mainly restricted to smaller groups of popular animals, standing in the spotlight of public concern.

- An intermediate position, recognizing only subspecies which fulfil certain qualifications, such as easy identifiability in the field, or those which are popular for other reasons.

It was decided that another approach would best reflect the Specialist Group's philosophy: not to adopt an a priori general guideline but to evaluate each described form case by case and decide individually by using a changing set of arguments stemming from taxonomy, zoogeography, ecology, or behaviour. Occasionally we also considered arguments outside of science: urgency of action, sympatric occurrence of other endangered animals and plants (which may profit from increased conservation attention), as well as feasibility and likelihood of success of conservation projects in the respective countries.

The reasons for following this selection procedure are: only very few holistic taxonomic revisions are available; the classification is a mosaic of single investigations by different authors from different countries, assembled over nearly two centuries; and the concept of what constitutes a species or subspecies has changed considerably over this time. Even today, museum collections are often not sufficient to give a detailed idea of the ontogenetic or annual variability of many species. Moreover, skull biometrics and pelage characteristics have been the principal factors used for the classification of mustelids and viverrids; the investigation of behavioural, ecological, biochemical, physiological, and genetic aspects has only just begun, although such work may reveal needed information to clarify evolutionary and taxonomic relationships. Therefore, many discussions as to whether a taxon is "valid" or not appear to be premature and of little help when deciding which animals should be supported by conservation measures and which not. Any rigid philosophy, such as introducing field identifiability as a deciding character, or leaving taxa considered as subspecies out of red lists, appears to be justifiable only for pragmatic reasons. While this approach may not be objective, it is designed to serve the conservation requirements of the species.

While we accept the goal of conserving the broadest spectrum of genetic diversity in each species, one argument against recommending conservation activities for subspecies should be taken very seriously: in times of rapid destruction of natural diversity, efforts for marginally distinctive subspecies could divert much-needed funds from helping other threatened organisms. Projects to protect mammals and birds (approximately 4,000 and 8,500 species, respectively) receive by far the greatest share of the money spent on species conservation, although these two classes represent only a minute fraction of all described animal and plant forms (some 1.4 million species). If the numerous undescribed species of insects, arachnids, nematodes, and fungi are taken into account (thought by some to number 30 million species), the percentage is even smaller. In addition to the arguments given on page 70, subspecies have been included in this Action Plan for the following reasons:

- Many conservation projects are triggered by emotional and cultural interest rather than scientific reasons, which means that the more spectacular species in particular can be used to stimulate action. By focusing on the plight of a highly endangered mammal subspecies from an island, funds may also be made available for conserving lesser known but very important groups such as slime moulds, nematodes, or mites which may also be endemic to that same island, where they may form the bulk of the biological diversity, and are of enormous ecological importance. Long-term conservation is only feasible through habitat protection. Therefore those species not enjoying popular support will benefit from actions taken to conserve appealing species. This reasoning underlies many of the conservation actions by the IUCN Species Survival Commission whose activities have been largely directed towards higher vertebrates.

- Subspecies of mustelids and viverrids occurring in limited disjunct ranges (islands, mountains, or isolated forest blocks) frequently signal centres of endemism of other organisms. Thereby they can draw attention to hitherto neglected endangered ecosystems and centres of diversity.

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