# SMALL CARNIVORE CONSERVATION

The Newsletter and Journal of the IUCN/SSC
Mustelid, Viverrid & Procyonid Specialist Group

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SPECIES SURVIVAL COMMISSION

Spotted linsang *(Prionodon pardicolor)* from Vietnam - Photo by K. Baranauskas.

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We are particularly grateful to Walter Rasmussen for reading the manuscripts and improving the English style.

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The aim of this publication is to offer the members of the IUCN/SSC MV&PSG, and those who are concerned with mustelids, viverrids, and procyonids, brief papers, news items, abstracts, and titles of recent literature. All readers are invited to send material to:

**Mustelid, Viverrid & Procyonid Conservation**
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**Belgium**

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# Small Carnivore 'Camp' Workshop Report

In February the MV&PSG held two consecutive workshops, the first on Conservation Assessment and Management Plan (CAMP) followed by a European mink Population and Habitat Viability Assessment (PHVA), both at Rotterdam Zoo. The workshops, which ran from the 11th to the 13th and 13th to 14th respectively, were organized in collaboration with the IUCN/SSC Captive Breeding Specialist Group (CBSG) and lead by its chairman, Dr Ullie Seal.

The workshops, announced in the October 1992 Newsletter, were well attended with delegates from several different institutions and countries:

- MV&PSG members: John Carnio, Shelagh Heard (Canada), Tiit Maran (Estonia), Don Moore (USA), Paul Robinson (UK), Viatcheslav Rozhnov (Russia), Harry Van Rompaey (Belgium), and Roland Wirth (Germany);

- delegates from various institutions and observers: Koen Brouwer (Holland), Alfredo Cuaron (Mexico), A. de Jongh (Holland), Eladio Fernandez-Galiano (France), Ajit Kumar (India), C. Maizeret (France), Roland Melisch (Germany), Dumitru T. Murariu (Rumania), Claus Reuther (Germany), Barbel Rogoschik (Germany), Jordi Ruiz-Olmo (Spain), M.-C. Saint Girons (France), Rudiger Schröpfer (Germany), Vadim Sidorovich (Belorus), T. Tew (UK), Pat Turley-Foster (USA), P. van Bree (Holland), and Daisy Wirth (Germany).

In addition to tackling the business at hand, the workshops offered a rare and welcome opportunity for SG members to network informally, beginning with a welcome reception on the 10th at the Zoo. The CAMP workshop was formally opened on the morning of the 11th with a welcome from the director of Rotterdam Zoo, Drs A.H. Dorresteijn and followed by Roland Wirth, chairman of the MV&PSG who set the CAMP process in context. Roland also warned those involved in the process that, having worked with Ullie Seal on previous CAMPs , there would be late nights until the task was completed!

The aim of a CAMP workshop is to provide strategic guidance on intensive conservation action for threatened taxa. During the CAMP people thus had to assess the conservation status of **all** species and subspecies (if necessary) of the groups in question, which was no easy task considering the taxonomic chaos of the small carnivores! This problem aside, Ullie Seal was able to guide the process expertly drawing from his experiences running CAMPs for a number of bird and mammal orders over the past two years.

The time-consuming task of considering all taxa was completed by the participants working in small groups, divided up according to their region of expertise (America, Africa, Europe, and Asia). While dividing on this basis was not perfect given that many people possessed specialist knowledge on a family or group rather than an area, it was workable. However, some participants had to make several visits abroad to other "continents" so that individuals could share their expert knowledge or offer input elsewhere when the need arose! Pat Turley-Foster did a great deal of travelling to ensure the otters were well attended to, while Roland Wirth went from group to group sharing his encyclopedic-like knowledge of the small carnivores.

Conservation status was determined by applying the Mace/Lande criteria of assessing extinction threats, thereby assigning each taxon to a category (Critical, Endangered, Vulnerable, Safe). In addition to and based on these extinction threats, each group attempted to identify and recommend management, research, captive breeding, and information-gathering priorities for each taxon they examined. While at the start of the CAMP most participants appeared very reluctant or concerned about the validity of assigning population numbers to species about which very little is known, and making educated guesses at the threats they are under, it became clear that this was a necessary first step in the aim to eventually establish accurate information.

The two and a half day workshop was therefore the starting point of what will be a long process. Once the information generated is compiled into a draft CAMP document, it will be circulated and reviewed by wildlife managers, researchers and institutions internationally, with the intention that they correct and expand it. The draft CAMP document should also be reviewed at regional review sessions conducted at CBSG meetings and workshops, utilizing local expertise. Thus, this workshop was the first step in the production of a document which will continuously evolve as new information becomes available, changes occur, and priorities shift.

While some groups worked on the CAMP material until the last day, those with a special interest in the European mink began the PHVA on the 13th, again under the guidance of Ullie Seal. Tiit Maran reports on this PHVA in this number.

Generous thanks are due to Dr Angela Glatston who did a magnificent job organizing all the logistics and ensuring the workshops ran without problems. Participants were able to work steadily throughout the day without any worries and were guaranteed a constant supply of coffee and nourishment to keep their energy going.

The MV&PSG also extends its gratitude to Drs Dorresteijn, the Director of Rotterdam Zoo for the ongoing support which the Zoo has demonstrated for our group. Not only does Rotterdam Zoo contributes significantly to the Newsletter, but it gave generously of its funds, resources, and staff time in organizing and hosting these two very important workshops. On behalf of all those who participated in the workshops and those who will be involved in further activities relating to the CAMP and PHVA, we are deeply indebted to Rotterdam Zoo for its visible assistance and commitment to small carnivore conservation.

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## PHVA Workshop on the European mink

A "Population and Habitat Viability Assessment Workshop" for the European mink was held in Rotterdam Zoo from 13 to 14 February 1993. Experts from countries that still have European mink in the wild as well as representatives of several nature conservation organizations and academic institutions were present: Jordi Ruiz-Olmo (Spain, Direccio General del Medi Natural), Dr M-C. Saint Girons (France), C. Maizeret (France, GRECE), Dimitru T. Murariu (Rumania, "Grigore antipa"), Tiit Maran (Estonia, Tallinn Zoo), Dr Vadim Sidorovich (Belorus, Institute of Zoology), Dr Viatcheslav Rozhnov (Russia, A.N. Severtzov Institute of Evolutionary Ecology & Morphology of Animals), Roland Wirth (Germany, IUCN), Dr Ullie Seal (USA, CBSG), Don Moore (USA, Burnet Park Zoo), Drs. Koen Brouwer (Netherlands, EEP Headquarters), Dr Angela Glatston (Netherlands, Rotterdam Zoo), Paul Robinson (UK, Southport Zoo), John Carnio (Canada, Metro Toronto zoo), Dr P.J.H. van Bree (Netherlands, Instituut voor Taxonomische Zoölogie), Claus Reuther & Barbel Rogoschik (Germany, Aktion Fischotterschutz e. V. Otterzentrum), Dr T. E. Tew (UK, Joint Nature Conservation Committee), and Prof. Rüdiger Schröpfer (Germany, Osnabrück University).

It was stated that almost everywhere the European mink's status is worsening quickly. The total number of individuals were estimated to be less than 30,000 (1,000 in Spain, 2,000 in France, 200? in Rumania, 150-200 in Estonia, 150-200 in Belorus, and more than 25,000 in other states of CIS). During the last 3 to 5 years the wild populations of Estonia and Belorus suffered a very rapid decline and are expected to die out within the next five years. In the whole of the eastern range the distribution is fragmented. In Finland, where the European mink was thought to be extinct since at least 15 years, a wild specimen was caught in April last year. In Spain, the European mink's distribrution seems to spread into the south.

The main causes of decline were estimated to be the impact of the American mink, habitat loss, pollution, and human interference. But it seems that the clear mechanism of decline is not yet known; especially the role of the American mink needs further investigation. The necessity to continue the coordinated captive breeding programme was expressed by the workshop. Concerning the status of the European mink in eastern Europe, the results of the workshop showed that a detailed survey as well as follow-up monitoring in all eastern countries, but also studies on several aspects of its biology, are urgently needed. The idea to start with a global coordinated project for conservation and research of the European mink in eastern Europe was put forward.

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## Lesser known bibliography of rare mustelids

Recently Schröfer & Paliocha (1989) and Youngman (1991) undertook great efforts to complete bibliographies on the European mink. The authors rediscovered unique historical sources and provided us with a reference collection updated for the whole of western Europe. Challenged by these publications I returned to my uncompleted 1989 bibliography of rare mustelids with the idea of updating it for all the area of the former Soviet Union and East Europe. The majority of publications that originated from the area is still unknown to foreign researchers: Schröfer & Paliocha (1989) do not list a single recent Soviet publication.

The goal of my work is to break the isolation based on the language barrier (Mustelidae researchers study mustelids, not foreign languages) and on the local character of many publications. I believe that it is very important that every single paper on endangered species is taken notice of. It is only later that some may be considered as trivial and the others selected as valuable ones.

My intention is to record all original papers, proceedings, books, popular articles, field guides, and game publications that mention rare mustelids and were published after 1980. The species of my interest are: European mink, Steppe polecat, Marbled polecat, Honey-badger, and Otter. The area covered is the former Soviet Union, Poland, Slovakia, Czech Republic, Hungary, former Yugoslavia, Bulgaria, and Romania. The bibliography will include the English translation of the title, journal name, publisher, year, and other typical details, and in addition: species mentioned, language, and short English abstract (when possible).

To much of my surprise the work on the bibliography is proceeding faster than anticipated. As of Jan. 31, 1993 the bibliography consisted of 230 entries, and was accompanied by about 40 short English abstracts. A brief analysis of the first 200 titles has shown that the majority came from the former Soviet Union. The most extensively covered species was the otter (114 entries) followed by the European mink (52), marbled polecat (28), steppe polecat (27), and honey-badger (5).

The compilation of the bibliography involves more desk work than I would desire. Fortunately every time I am getting bored I encounter some exciting news that keeps me running for the next few hours. My last finding was the proceedings abstract by Sauckiy (1989). We all read about the European mink introduction to the Kuril Archipelago, but it was something new to me to learn that a similar introduction was carried out in Tajikistan. Here 62 European mink were released near the mountain river Shingidara in 1988, and their tracks were registered 8 months later.

I hope to complete the bibliography during 1993. It will be sent out for comments and supplements in the summer of 1993. It would be a great help if any of the newsletter readers could send me abstracts or copies of articles that should be included in the bibliography.

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# Observations on procyonids in Paraguay and adjacent regions

Daniel M. BROOKS

## Introduction

Paraguay harbors a varied representation of the carnivore assemblage (Redford & Eisenberg, 1992). Although basic ecological information has been provided for most Paraguayan terrestrial carnivore taxa (e.g., Berrie, 1978; Brooks, 1991, 1992), there are still exceptions -notably the procyonids. Ecologically, procyonids exhibit a wide range of guilds, spatially (ranging from largely terrestrial to almost entirely arboreal) and dietarily (all species are omnivorous, consuming varying quantities of plant and animal matter); dietary items vary considerably (e.g., crustacivory [Ojeda & Mares, 1991], nectarivory [Emmons & Feer, 1990], etc.), and stenophagy is common in some areas (Redford *et al.*, 1989). Of the seven genera identified by Nowak (1992), two are extant in Paraguay.

Herein, basic ecological information is provided for the Crab-eating raccoon *(Procyon cancrivorous)* and the South American coati *(Nasua nasua)* in the Paraguayan Chaco, and a portion of Brasilian South-Atlantic rain forest. Additionally, speculations are made on status and potential threats of these species in the region where they were studied. The preliminary nature of these results cannot be overemphasized, as the data sets were conservative.

## Methods

Methods have been described elsewhere (Brooks, 1991, 1992). The central study site, Estancia Toledo (22°33'S, 60°30'W, 35 km W of the Mennonite Colony of Filadelfia, Boqueron, Paraguay), was surveyed for an entire year (August 1989- August 1990). The Iguacu region (Ziman & Scherer, 1976) of Parana, Brasil, where coatis were observed, was surveyed in late January and early February of 1990.

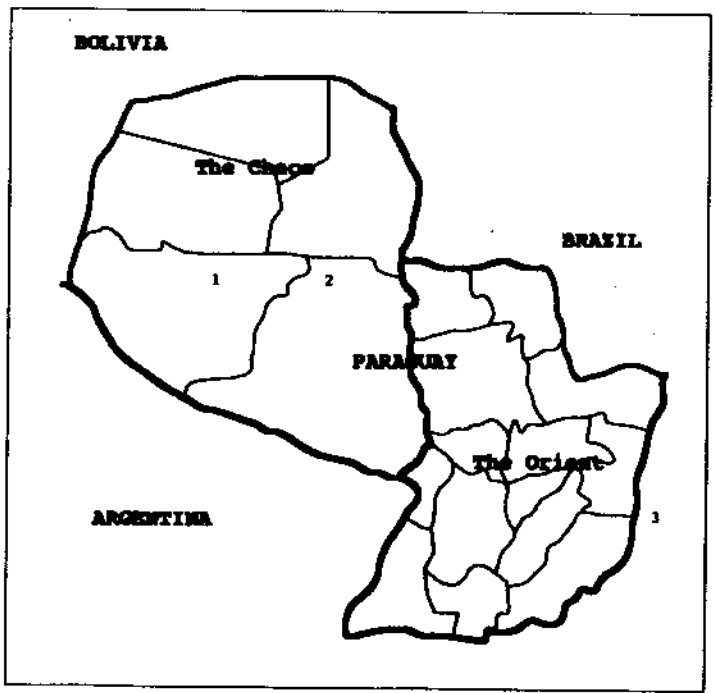


Fig. 1 - 1. Estancia Toledo
- 2. Eastern Chaco, xeric forest (Kure-f Rd.)
- 3. Iguacú N.P., Paraná State

All locales and areas were driven to by vehicle, and surveyed on foot. Opportunistic sightings of live individuals and tracks were logged proximal to areas associated with. Fig. 1 illustrates the region, with recordings. Habitat in the Paraguayan Chaco (west of the Paraguay River) has been described elsewhere (Brooks, 1991, 1992). Less stochastic than the Chaco, but more seasonally defined than the South-Atlantic rain forest, the majority of the Oriental (east of the Paraguay River) consists of rolling savannah, punctuated with tropical forest. The eastern Oriental is essentially an extension of the historically vast, contiguous South-Atlantic rain forest.

### CRAB-EATING RACCOON *PROCYON CANCRIVOROUS*

*Habitat association*

The occurrence of this species in the central (xeric) region of the Chaco, where the majority of available water is from man-made cattle pondlets, indicates that this species is not "...restricted to waterside habitats such as swamps, rivers, streams, and beaches". (Emmons & Feer, 1990). Live individuals were observed to be active on the ground.

*Social structure*

Sightings of live individuals (N=2) were both solitary. Speculation that pairs may bond shortly during the breeding season was based upon increased frequency of tracks of more than one individual in the same area during the austral winter. Thus it is probable that animals are solitary, except during the breeding season when they come together to reproduce.

*Daily activity*

Although live individuals were observed to be active diurnally, tracks were frequently found early in the morning in areas where they were not present the previous evening, suggesting that this species is active nocturnally as well. Because of this, no firm conclusions could be made on *P. cancrivorous* activity patterns. However, it is interesting to note that tracks of one individual extended for more than 4 km along an unused dirt road.

*Seasonal activity*

Although Estancia Toledo was surveyed every month for an entire year, signs of *P. cancrivorous* were present only from April to September (mid-autumn to early spring). The reason for this may be due to increased activity during the cooler part of the year (that is, metabolic constraints -thermoregulation through increasing activity). To test this hypothesis, monthly variation of abiotic factors (temperature, rainfall, cloud cover, and relative wind velocity) were each paired with relative abundance of *P. cancrivorous* following Sokal & Rohlf (1981). Temperature significantly correlated negatively ($n=12$, $r=-.9302$, $P<0.05$), concordant with the hypothesis that *P. cancrivorous* increases activity during the 'cooler' part of the year.

*Status and threats*

Although *P. cancrivorous* does not share the plasticity of its North American congener with regards to human development, the species does not appear to be seriously threatened (based upon

frequency of sign). A potential threat to this species may be unregulated hunting for pelts and sport.

### SOUTH AMERICAN COATI *NASUA NASUA*

*Habitat association*

This species was scarcely encountered in the Chaco, and never encountered at Estancio Toledo. *N. nasua* probably occurs more frequently along riverine gallery forest, which has a higher canopy and is more stratified than xeric chaco forest. In the eastern Chaco a group of two individuals was observed in xeric forest (22°30'S, 59°13'W), in the vicinity of one of many vast, salinated lagoons, which most likely serve as seasonal runoff reservoirs from the Paraguay River.

Groups encountered in Parque Nacional do Iguacú0, Parana, Brasil (25°35'S, 54°28'W) were associated with multistratal primary broadleaf rain forest. Activity of all live individuals took place on the ground during time of observation (Fig. 2)

*Group composition*

All recorded groups comprised 2-5 individuals. Seasonal group composition has been described in detail for the Central American coati (e. g. Russell, 1981). All groups constituted individuals of two color phases (approximately 50% reddish-brown and 50% grizzled-gray).

*Daily activity*

During time of observation, Chacoan individuals were active crepuscularly (early dawn), while individuals from Iguacu were active diurnally (mid morning).

*Status and threats*

*N. nasua* was observed associated solely within forested habitat. If this species is stenoecious with regards to macro-habitat selection, it may be threatened with deforestation of habitat. However, *N. nasua* has reportedly been associated with a variety of habitats, not restricted to forest (e. g. Emmons & Feer, 1990; Redford & Eisenberg, 1992). Despite multiple surveys in unforested habitat, signs of *N. nasua* were never encountered. It is possible that the high activity level which characterizes this species reduced chance of encounter (i. e. individuals in the Chaco disappeared deep into the forest without a trace, the moment my presence was realized).

Long regarded for their acrobatic antics, coatis are well known among South American people, and are frequently kept as pets. The impact of the pet trade upon wild populations is unknown. If feasable and properly managed, coati 'farming' may stimulate local economy and provide a means to avoid taking coatis from the wild unsustainably.

Fig. 2 Terrestrially active coati associated with multistratal rain forest

## Summary


The purpose of this paper was to provide basic ecological information, while assessing status, and potential threats for the crab-eating raccoon and the South American coati in the Paraguayan region. The study took place from August 1989 to August 1990; the central study site was Estancia Toledo, located in the central Paraguayan Chaco. All opportunistic sightings were recorded.

Terrestrially active *P. cancrivorous* were associated with xeric chaco shrub. It is probable that this species is solitary, except during the breeding season. No firm conclusions were established regarding daily activity patterns of *P. cancrivorous*, although one individual's tracks extended for over 4 km. Activity increases during the 'cooler' part of the year; signs of *P. cancrivorous* were present only from mid fall to early spring. *P. cancrivorous* does not appear to be seriously threatened in the central Paraguayan Chaco.

Terrestrially active *N. nasua* probably occurs more frequently along riverine gallery forest in the Chaco, and were associated with multistratal rain forest in Parque Nacional do Iguacu. Groups comprised 2-5 individuals, of which approximately 50% were reddish-brown, and 50% were grizzled-gray. Chacoan *N. nasua* were active crepuscularly, while Iguacú individuals were active diurnally. If this species is associated only with forest, it may be threatened with deforestation of habitat. The impact of the pet trade upon wild populations is unknown.



**Acknowledgements**

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# Notes on the viour, activity, and feeding of the Spotted linsang *Prionodon pardicolor*) in captivity

German V. KUZNETZOV and Kazimieras BARANAUSKAS

The Spotted linsang (*Prionodon pardicolor* Hodgson, 1842) is a rare species of viverrid from Indochina ranging up to Nepal. The rarity of the species means that any observations of its behaviour are of special interest.

Between February 1988 and August 1989, a female spotted linsang from Vietnam was observed in an enclosure measuring 2 x 3 x 2.2 m. The enclosure was furnished with tree stumps and vertical trunks and boughs (1 - 15 cm diameter). Hollowed logs (hiding holes) were placed on the floor at heights of 0.5, 1.0, 1.5 and 2.0 m. The floor of the enclosure imitated forest litter. The temperature of the enclosure ranged from 20°C at night to 25°C during the day, and was maintained by a thermostatically controlled heater. A 12:12 hour light:dark photoperiod was maintained to imitate conditions at the locality where the spotted linsang lived in the wild. During observations of the linsang, the duration of all forms of activity and behaviour within a 24-hour period were timed, visual observations totalling 245 h. It was determined that activity of the female spotted linsang was of the polyphase type, but it was most active during the night. During an average 24-hour period, the linsang was active for 7.8 hours (32.5%) and passive (*i.e.* at rest or sleeping) for 16.2 hours (67.5%).

The linsang preferred a height 1 m above the floor (18.1 h, 75.7% per 24 h), was at other heights for 2.2 h (9.7%) of the time, and on the floor for 3.3 h (14.6%). Behavioural reactions of this species are also interesting. Within a few minutes of being introduced to the enclosure, the linsang started to mark a territory, leaving urine and excrement in open places. If startled or sensing danger (e.g. by the sudden appearance of a human or by some other disturbance) the linsang squeaked, whilst "drumming" with one or other foreleg on the surface of any object it was on at that moment. In the enclosure the animal liked to ascend and descend boughs at high speed, and often changed direction in midrun. Wilst bough-climbing, the linsang usually made jumps of 30 - 50 cm, and sometimes of up to 1 m. When tree-climbing, the long tail served as a brake. When the animal descended quickly from the trunk to the floor, it seemed to "flow" down the trunk, holding onto boughs and the rough bark of the trunk. At that moment the animal pressed its belly and the lower part of its tail to the trunk, and then jumped down onto the floor. When moving on the floor, the linsang held its tail horizontally, although it sometimes raised it up almost vertically. During rest and sleep, the animal usually wound its tail around its body. We noticed that the element of play was always a component of the linsang's behaviour, comprising between 0.4 - 1.4% per 24 hours.

When the linsang saw a Yellow-necked mouse (*Apodemus flavicollis*) or Bank vole (*Clethrionomys glareolus*) on the floor, it slowly descended from the tree and jumped silently to the floor from a height of half a meter. Then the animal waited for the right moment, and snapped at the neck of the prey with its teeth. When dealing with larger prey (e.g. young rats), the animal rushed upon it with a jump, and then, holding the prey with its paws, fell on its side and killed the prey in this position. When replete the animal usually did not persecute rodents and lay up. During each 24-hour period the linsang ate, on the average, about 100 g of food (its own weight was 600 g) -equivalent to four yellow-necked mice or six bank voles. The spotted linsang digested 76.5% of animal food. Its favourite food was small passerine birds, which were eaten almost completely, with the exception of the wing-feathers and the stomach. The linsang always ate on the floor, never climbing a tree with its prey. Neither did it hide food remains, and only rarely returned to them.

Despite the fact that little is known about the behaviour of this species under natural conditions, on the basis of our observations we can characterize the spotted linsang as a species that mainly inhabits the lower shrub layer. Our observational data revealed that during 24 hours, the linsang spent about 85% of its time at heights of up to 1 m. This together with the appearance of the animal: the long tail, the structure of the claws, its colouration and habits, show that the spotted linsang is well adapted to the pursuit of prey (small birds and rodents) in the shrub layer.

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# Preliminary data on the use of space and activity of the European mink (*Mustela lutreola*) as revealed by radio-tracking

Santiago PALAZON and Jordi RUIZ-OLMO

The European mink is, without doubt, one of the most threatened mammals in Europe, and is probably the species which displays the most marked distributional regression within the area (Schreiber *et al.*, 1989). Concern over this issue led numerous researchers, groups and administrative bodies to pay particular attention to the species' conservation (see Ternovsky & Ternovskaya, 1989; Schröpfer & Paliocha, 1989; Maran, 1990; Camby, 1990; Braun, 1990; Sidorovich, 1991). Thus the Council of Europe has promoted the compilation of a report summarizing the data accumulated on the species (Saint-Girons, 1991) and has approved a Recommendation to the Member States (which today only affects French and Spanish populations; see Mustelid & Viverrid Conserv., 5:15).

The aforementioned report emphasises the deficiencies in the available information with regard to the species' distribution and trophic ecology (see also Camby, 1990; Sidorovich, 1992). Behavioural information is virtually non-existent, leading Saint-Girons (1991) to say only the following on the subject: "European mink live along watercourses and near lakes and marshes whose banks are covered by dense vegetation....They live in holes dug in the banks by itself or by other mammals. For example, it frequently uses those of the muskrat, a newcomer in western Europe, but it can also be discovered in reed beds, hollow trees and even piles of driftwood".

Camby (1990) goes no further than to suggest that: "Le vison s'installe dans les terriers situés dans la berge et entre les racines des arbres de la ripisylve. Il peut indifféremment creuser lui-même ses refuges, ou utiliser, après les avoir agrandis, des abris aménagés par d'autres espèces (rongeurs)..." and here he confines himself to quoting the only estimated data which are available on its home range (Novikov, 1939; Novikov, 1975; Danilov & Tumanov, 1976).

Recently, Maran (1989) carried out the first studies on this animal's activity and gregariousness in captivity, although it remains to be seen whether these data coincide with the norms for wild mink.

## Material and methods

During the period from December 1991 to February 1992, trapping was carried out on different rivers in Navarra Province (northern Spain), on which the species was known to be present: these habitats had Eurosiberian or sub-Mediterranean characteristics (oak and beechwood). Two types of trap were used: 60 toothless-jaw traps (VICTOR & COIL, USA; 12 cm in diameter, protected by leather, cloth and sticking plaster, and equipped with a 35 cm long spring, a chain and a karabiner), and 20 box traps (given to C. Maizeret and L. Lafontaine for the Franco-Spanish project).

Trapping was carried out at 10 different locations at altitudes ranging between 475 and 560 metres. There was a total of 1627 trap nights; 1227 involving toothlees-jaw traps, and 400 using box traps. During the entire period no European mink were captured, and the only information gathered consisted of a single

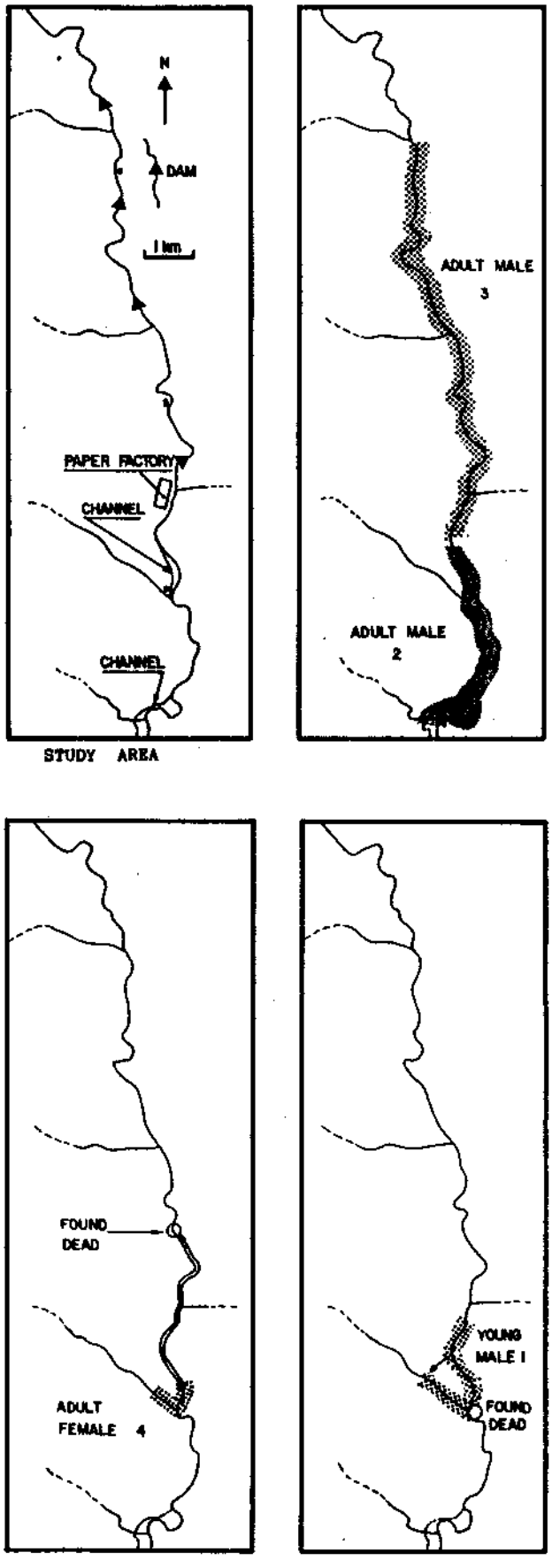


Fig. 1. Home ranges of the four mink studied

trail of tracks from one individual. On the other hand, 12 genets *(Genetta genetta)*, 3 beech martens *(Martes foina)*, 1 weasel *(Mustela nivalis)*, and a buzzard *(Buteo buteo)* were captured. Box traps seem to be better than toothless-jaw traps.

To the south of the trapping area, there is an American mink *(Mustela vison)* farm, equipped with good security precautions to prevent accidental escapes, and with no escaped minks having been observed to date. Nevertheless, at a nearby poultry farm, mink came regularly to eat chickens, young turkeys and ducklings, etc. Since this locality was outside the known distributional range of the European mink, and in a dry area (total annual rainfall ca 400-600 mm), surrounded by fields of cereals and asparagus, the *a priori* possibility of this being due to the European species was rejected. Because of this, it was decided to trap the American mink in order to confirm their presence, and to erradicate them.

It was therefore a complete surprise when European mink were caught with only a few box traps (initially only six). Six different individuals were captured in this way on 1.25 km of riverbank. Some were recaptured several times. Four of the mink were fitted with radio-transmitter collars (URMENETA, Navarra, Spain), weighing 20 g and broadcasting on 150,000-151,000 MHz [two adult males (ML02 and ML03) weighing 820 and 720 g, one female (ML04) weighing 460 g, and one young male (ML01) weighing 610 g]. Tracking was carried out using a CE-12 CUSTOMS ELECTRONICS receiver (URBANA, Ill., USA).

## Results

The four mink (ML01, ML02, ML03, and ML04) were tracked and monitored for 25, 58, 4, and 8 days respectively. The female (ML04) and the young male (ML01) were found dead after 14 and 51 days of the collar being attached. Both were killed deliberately. The female, pregnant, with five embryos in the early stages of development (and whose weight had risen by 50 g to 510 g) was found dead beside a fishing spot, on the first day of the fishing season and almost certainly killed by a fisherman. The young male was discovered in an advanced state of decomposition (skin and bones), on the riverbank just opposite the poultry farm where it was first captured; it was not possible to firmly establish what caused its death. The radio transmitters of the other two mink eventually failed.

Fig. 1 represents the home range of the four mink. For the two adult males, this comprised 6.1 km of river in ML02 and 8 km in ML03, although the latter was only monitored for four days, after which its trail was lost. During this time their home ranges did not overlap.

The female, however, exploited a much smaller area around the farm (ca 0.5 km of river-course). Nevertheless, during the last days she moved upstream, being found 4.2 km from the farm, representing a home range of 4.5 km.

Finally, the young male (ML01) also remained linked to the environs of the farm, on a total of 3.1 km of river-course. On one of the nights when monitoring was carried out, a movement of 0.7 km across holm oak wood and farmland was detected, in an area stretching from the river to a small stream which merges downstream of the river, level with the farm.

As for habitat, in all cases (except the one mentioned above), mink were found in fluvial habitats. Male ML03 always

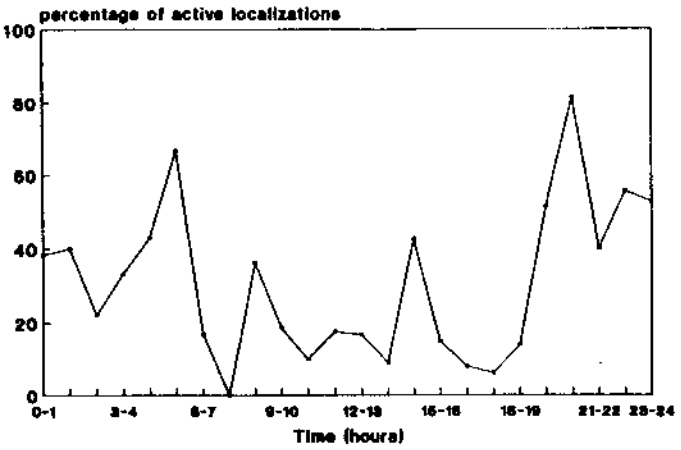


Fig. 2. Percentage of active radio-localisations in the four mink, considered together.

used the river. ML02 mainly used the river, but was also found in an irrigation canal and a small stream entering the right bank of the Ega River. In addition to the river, female ML04 and the young male ML01 made considerable use of a small open brook with helophytic vegetation. All the female's burrows were situated in this area.

Male ML02 also used burrows in the helophytic vegetation of a small stream and of the canal. The burrows of the others were located in roots and bramble patches on the banks of the river.

Regarding the animals' activities, Fig. 2 shows the percentage of radio locations with associated signs of activity (n=421 radio locations with such information, *i.e.* 38.2%). Some kind of activity was detected throughout the whole day, with a higher level being registered at night (45% of the nocturnal radio locations were active, especially during the first hours of the night and the twilight period of the morning). In any case, data are still scarce.

## Conclusion

One of the most manifest observations is the rather fearless behaviour displayed by this species: three of the specimens were captured repeatedly in the same area, and with the same type of trap. Moreover, two of them were almost certainly killed by humans, and another was observed on two occasions by the authors. Without a doubt, this was favoured by their daytime behaviour and their none-too-elusive charater. This aspect will need to be taken into consideration when managing their populations.

The European mink's practice of entering farms to eat domestic animals (behaviour which we have also observed repeatedly in American mink in the NE of Spain; unpublished data) had not been described in the consulted literature (Saint-Girons, 1991; Camby, 1990). This fact may be important for its conservation, since the damage caused can lead to its persecution by the farmers affected.

As for the occupation of space, this mustelid appears to display a high level of movement for its size which is greater, for example, than the American mink (Birks & Linn, 1982; Linn & Birks, 1980; Lodé, 1991; personal data). This may mean that the species is far more vulnerable (possibly linked to a less well-developed knowledge of its territory), but at the same time

endowed with a greater capacity for colonizing new areas (Schröpfer & Paliocha, 1989; Ruiz-Olmo & Palazon, 1991). The data obtained here appear to surpass the average 2.4 km of river used by the European mink in Karelia (Danilov & Tumanov, 1976).

Regarding activity, in general our data coincide with Maran's (1989), with the mink displaying activity throughout the whole day, but being more active at night. On the other hand, there are some differences between the data collected by Maran (1989), principally regarding the second half of the night where the mink in northern Spain are somewhat less active. In contrast, the mink we studied displayed greater activity in the dawn twilight hours. Nevertheless, there seems to be a greater coincidence in the start of nocturnal activity with the animals' apparent inactivity during dusk.

Studies are to be continued, which will provide further information applicable to the conservation biology of this mustelid.

**Acknowledgements**

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**Servei de Proteccio i Gestio de la Fauna**
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## More on the European mink

The aim of the "Groupe de travail sur la répartition du Vison d'Europe" is to 1) complete the actual data on the distribution 2) determine the ecological needs of the European mink.

In January, February, and April 1992 traps were used in four areas of Brittany, six areas of southeast France, and two areas of the Basque part of Spain. Eighteen European and two American mink were caught. As 76% of the European mink were caught during the first 10 days it seems that this species is rather easy to trap.

Of the two kinds of traps used, the metallic ones proved more reliable than the wooden ones. Only in a few cases fresh fish was used; mostly oily preserved sardines were employed. The general trapping programme plans three trapping campaigns for each area.

Several of the trapped mink showed slight lesions on the lips and/or front feet; to avoid this, improvements are planned (especially on the metallic traps).

The trapped males weighed between 820 and 1,050 g; the females between 520 and 670 g. The distinctive white patch showed little variability: the patch on the upper lip only extends from the lip to the snout, and the patch on the lower lip barely goes beyond the chin.

**Etude de la répartition du vison d'Europe. Document N°1: Présenta[illegible] des résultats de la première année d'étude. Novemb[illegible]2. Groupe de travail sur la répartition du Vison d'Europ[illegible]**

# The conservation status of the badger *Meles meles* (L., 1758) in Slovenia

Boris KRY,TUFEK

The Eurasian badger is widely distributed in Slovenia (Kry™tufek, 1991), being rare or absent only from the mountains and deforested plains under intensive cultivation.

In the spring of 1990, the badger population was estimated at 4,302 animals (official statistics of the Hunter's Association of Slovenia). Slovene game-bag statistics (badgers killed/year and spring population estimates) are derived from the operation of revier hunting. Population estimates are based on "direct" counts which provide only a rough estimate of actual badger density. For this reason, the annual number of badgers killed is frequently considered to be more accurate as an index of population density in Slovene game management practice.

In 1990, 782 badgers were killed legally, i.e. 18.2% of the estimated spring population. The average animal density was 0.251 badgers per km$^2$, of which 0.034 animals were killed per km$^2$. Only the area of the country under hunting management was taken into consideration (17,169.98 km , i.e. 84.8% of the total area of Slovenia).

Badger densities and the number of badgers killed per area unit are not regularly distributed in Slovenia (Figs. 1 & 2). In 1990, relative to their spring densities, the percentage of badgers killed was between 2.9 and 57.7 % in the different regions. This most probably reflects defects in the estimation of spring population sizes.

However, the correlation between the estimated badger density and the number of badgers killed per area unit is positive and significant ($r=0.821$, $P< 0.001$). This suggests that the annual badger-bags do reflect estimated densities.

The number of badgers hunted per year has decreased during the last 30 years, although the number of registered hunters has increased during the same period (Fig. 3). The correlation between the two variables is significant and negative ($r = -0.789$, $P< 0.001$). Consequently, the number of badgers killed per hunter per year has also declined (Fig. 4). Adamic (in Griffiths, 1992) ascribed declines in the Slovene badger-bag since 1975 to the advent of rabies. Rabies appeared in Slovenia in the 1970's, and probably increased badger mortality and reduced population densities, although this was not actually studied in Slovenia.

The decrease (if genuine) would be expected to be small as, over the last twenty years, no single article or note on a decrease in badger numbers has appeared in "Lovec", the journal of the Hunters' Association of Slovenia.

In the period between 1980-1990, the Faculty of Veterinary Science at Ljubljana screened 30,316 mammals for rabies, including 896 badgers (2.96%). Of these, 195 badgers were rabies positive (i.e. 21.8% of all badgers, but only 0.64% of the total number of animals was tested).

Fluctuations in the number of badgers sent for examination suggest an epidemic of rabies amongst badgers, with an outbreak at the beginning of the 1980's.

On the other hand, the outbreak of rabies drastically reduced hunter interest in badgers; Slovene hunters are well-informed of the dangers involved in handling carnivores in areas infected with rabies. Only certain vaccinated personnel are allowed to skin carnivores, and the head of each skinned animal must be tested for rabies. If the animal is rabies positive, the skin has to be destroyed. All this leads to additional expense, whilst the commercial value of the badger's skin is insignificant.

There are also other reasons for the loss of interest in badgers by hunters. The trophy cult is an important motivation for Slovene hunters. However, badgers are not regarded as a trophy species, despite the existence of formalized standards for awarding medals for both skulls and skins. The most important game species in Slovenia is the roe deer (42,736 hunted in 1990 compared to 782 badgers), so the badger-kill only equalled 1.83% of the roe deer game-bag. In the first half of this century the den hunting of badgers

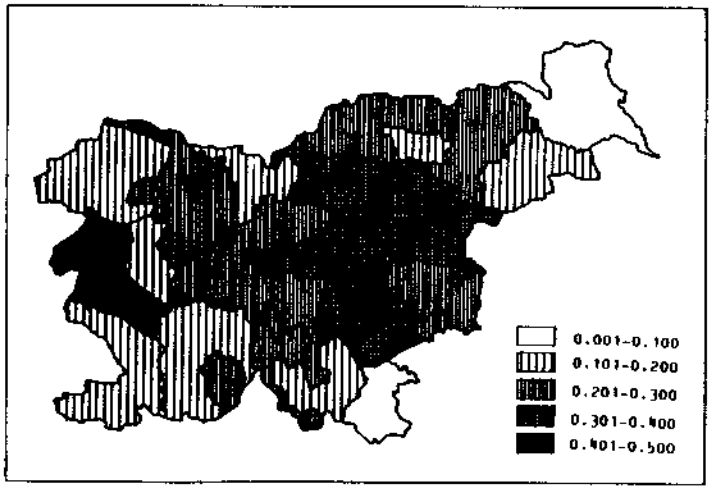


Fig. 1 Population density of badgers (animals per km$^2$) in different hunting districts of Slovenia in spring 1990 (based on the official statistics of the Hunters' Association of Slovenia).

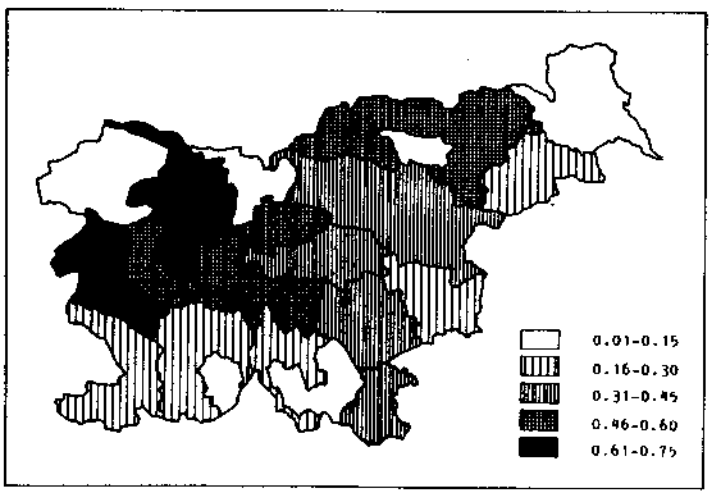


Fig. 2 Badgers hunted per 10 km$^2$ in 1990 in the hunting districts of Slovenia (based on the official statistics of the Hunters' Association of Slovenia).

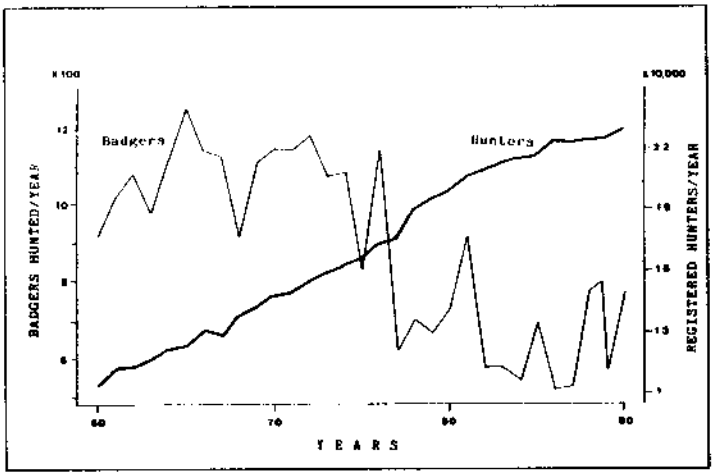


Fig. 3 Trends in the badger game-bag and the numbers of registered hunters in Slovenia between 1960 and 1991.

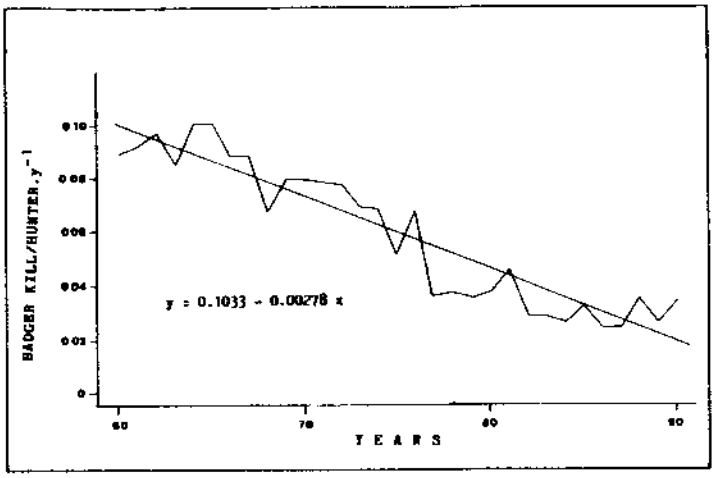


Fig. 4 Decline of the badger kill per hunter per year in Slovenia between 1960 and 1991.

(and red fox) was popular, even though much of Slovenia is unsuitable for this type of hunting, one third of its area being karstic. Den hunting requires well trained dogs, which are owned by very few hunters. Since the outbreak of rabies in the 1970's, den hunting has been prohibited.

## Threats

In 1990 there were 22,971 registered hunters in Slovenia, equal to a density of 1.34 hunters per km$^2$, of hunting territory. In spite of the large hunter population, and the fact that their numbers have been increasing over recent decades, the pressure of hunters on badgers (expressed either as badgers killed per hunter per year, or as badgers killed per year) decreased.

One important reason for this decrease is the lack of acceptance by hunters of the badger as a trophy species. Popularization of the standards for bronze, silver, and gold medal standard badger skins and skulls is thus highly undesirable, and contradicts nature conservation efforts.

In the first half of this century badgers were persecuted as crop pests. Although crop damage has diminished in importance, badgers continue to be killed by both hunters and farmers for crop protection. Since hunters must pay for the damage caused to crops by game, this acts as an incentive for the removal of species which are of no special importance for trophies.

Nonetheless, badgers are not widely persecuted for the damages they cause. Some fifty years ago the badger was listed as one of the predators that should be controlled to improve roe deer numbers (Sustersic, 1951). However, there is no mention of such measures in more recent literature (e.g. Simonic, 1976).

Diseases other than rabies do not appear to threaten the badger population of Slovenia. Since 1986, only four cases have been recorded by the Faculty of Veterinary Science in Ljubljana: canine distemper (1 case), anaemia (1 case), and pasteurellosis (2 cases). With regard to rabies, an oral vaccination programme has commenced recently in Slovenia.

The influence of passive anthropogenic mortality (Griffiths, 1992) upon badger populations is not known. Road traffic casualties have been recorded, but are supposedly rare. Landscape changes and the effects of xenobiotics are also believed to effect badgers, but these have not been studied yet.

## Protective measures

Badger hunting is permitted, but only for registered hunters, in the period between August 1st and January 31st. Snares and other traps are prohibited and the badger must be killed by rifle. Hunting is regulated throughout the country. Under rabies control legislation, badgers (and other carnivores), can be killed in infected areas at any time. This is undoubtedly one of the great disadvantages of the current legislation.

The old beliefs that carnivores are harmful, and that their numbers should be kept as low as possible, are still strong amongst Slovene hunters. The Hunters' Association of Slovenia does educate its members on the role of the carnivores in ecosystems, and on the need for their conservation. Besides organizing regular courses for its members, the Association also edited a book on mustelids living in Slovenia (Kry™tufek *et al.*, 1986) and provided it, free of charge, to each of its 22,000 members. Despite such efforts, a recent call by the Nature Conservancy authorities for the total protection of all Slovene mustelids was rejected by hunters.

**Acknowledgement**

Huw Griffiths (University of Leeds) is thanked for his comments on an earlier draft of this manuscript.

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# The European mink - Why is it declining ?

Roland WIRTH

A European mink *Mustela lutreola* PHVA Workshop was held in Rotterdam, the Netherlands on 13-14 February 1993, supported by Rotterdam Zoo, the Peter Scott IUCN/SSC Action Plan Fund and CBSG. Mink researchers from Estonia, Belorus, Russia, Rumania, France, and Spain were present, as well as biologists and conservationists with an interest in the species from seven other countries.

Interest in the serious plight of the European mink has risen considerably over the five years, but despite this the exact causes of the decline of the species still remain unclear and were the focus of much discussion during the workshop. Although there is no doubt that the introduced (and still spreading) American mink *Mustela vison* contributes to its European cousin's plight, the importance of its impact on the decline of *Mustela lutreola* populations and in what way it interferes with the European species is an issue of considerable controversy.

While most mink experts feel that wherever American mink appear, the European mink is doomed to disappear sooner or later, at least one researcher, Dr. Viatcheslav Rozhnov from Moscow, thinks that the problem is more complicated than that. He suggests that the European mink has been in a slow decline (for as yet undetermined reasons) for quite some time. According to his theory it is this slow and hardly noticeable thinning out of European mink populations which allows the American mink to spread into new areas so rapidly, and once it is well established there, to compete out the remaining European minks.

Another still unresolved question in this context is the impact which the Polecat *Mustela putorius* may be having on the European mink. Polecats have occurred in sympatry with European minks for a long time, but do hybridize occasionally. Although generally rare, these hybrids are nevertheless frequent enough to have a name of their own in the Russian fur trade. In an area with a European mink population in Estonia where American minks have recently established themselves, Estonian biologist Tiit Maran unexpectedly captured three European mink x polecat hybrids. Although this may have just been coincidence, the question nevertheless arises whether the invasion of the American mink has anything to do with the sudden appearance of European mink x polecat hybrids. Is there a complex interrelationship between *M. lutreola*, *M. vison*, and *M. putorius*, that needs the presence of both the latter species to wipe out the former?

It has been pointed out that the American mink has also been introduced to the Russian Far East, where the Siberian weasel *Mustela sibirica* occurs. This species is extremely similar to the European mink in terms of body size and ecological requirements, but seems to survive well, or even increase, in the presence of introduced American mink populations (Rozhnov, 1993).

Interestingly enough, the Siberian weasel, which in many ways can be seen as the ecological counterpart of the European mink in the east, is said to occur in sympatry with the latter species in a small area east of the Ural. Whether this is indeed a stable zone of sympatry, or whether gradual replacement of one species by the other is going on, seems not to have been studied. Likewise, more information seems to be needed to confirm that the population size of the Siberian weasel is indeed not threatened by the spread of the American mink in the Russian Far East.

What is evident is, that there is a complicated picture of competition, interaction and/or coexistence of *M. lutreola*, *M. vison*, *M. putorius*, and *M. sibirica* in various combinations of species pairs and trios, which is at present not only poorly understood, but may also easily be influenced (in a positive or negative way) by human habitat modification.

Studying the interaction of these four species in all possible combinations of pairs and trios in the wild and in captivity could provide a major hint on how to manage viable populations of the now highly endangered European mink despite continuing (and apparently uncontrollable) expansion of *M. vison* in Europe. Such would be extremely fascinating research projects for universities, and it is hoped that action is taken soon, before time is running out for one of Europe's most endangered mammals.

**Reference**

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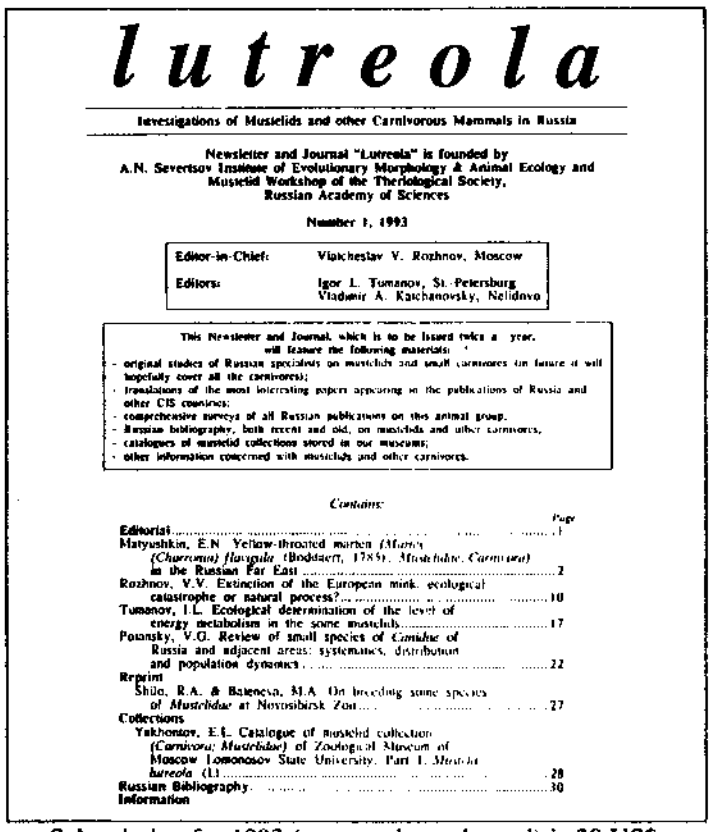

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Number 1, 1993

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# The current state of research into thè status of the European mink (*Mustela lutreola*) in Belarus

Vadim E. SIDOROVICH

The European mink still inhabits north-eastern Belarus (Sidorovich, 1991). Here this rare species lives in a variety of waterbodies, mainly small rivers between 10 and 100 km long, and brooks between 2 and 10 km long. The European mink also inhabits medium-sized rivers, glacial lakes, brooks less than 2 km long, agricultural and forestry canals inhabited by beavers, and groups of pools in bogs.

Myself and Tiit Maran (Estonia) are investigating the quality of various waterbodies in terms of their importance for European mink in Belarus and Estonia. This work will also investigate the significance of various environmental factors in determining the suitability of various waterbodies for European mink. These factors include the abundance of small rivers and brooks, their flow rates, and the number of meanders present.

The activities of beavers provide improved conditions for the European mink, as the mink uses the beaver dam and lodge during winter. In addition, beaver ponds often contain many fish, as well as other sources of food for mink. Relatively high, steep banks also favour European mink. These banks contain large numbers of beaver burrows which the mink use for shelter. Furthermore, in winter when many rivers are ice-bound, these bank structures allow better access to the water for semi-aquatic carnivores. Waterbodies within the swamped floodplain also encourage European mink.

The number of European mink in Belarus currently equals approximately 150 individuals during the middle of winter (*i.e.* before the reproductive period) and rises to between 300 and 400 by mid-summer. However, the total number of the species is decreasing in Belarus, and complete disappearance is forecast within 5 to 10 years.

In Belarus the following approach is used to investigate the problems that have led to the decrease in mink numbers. Many investigators have proposed hypotheses to explain this, usually based on their knowledge of the species under stable conditions, and emphasizing potentially unfavourable environmental factors. There are obvious pitfalls associated with this approach, and a better understanding can be gained by direct, detailed investigation of the different ecological aspects of mink population decrease. To do this it is necessary to examine all potentially unfavourable factors that may affect the species, even if intuition suggests that some of these factors are of minor importance.

We have selected a declining population in Belarus for detailed investigation. The population inhabits the upper waters of the River Lovat in Gorodok District, in the Vitebsk Region of north-eastern Belarus. Since 1986 we have studied the dynamics and abundance of European mink in this area. This has involved the examination of those factors which determine the exploitation of various waterbodies by the species -particularly feeding and interspecific competition (including the species' interactions with the American mink, the polecat, and the European river otter). We have also collected data on the age and sex structure of the population, and on reproductive biology. We also examined several possibly unfavourable factors, including interspecific competition (Sidorovich, 1992), water polution and other anthropogenic transformations of the habitat (Sidorovich & Maran, in prep.), and levels of helminth infestation (Sidorovich & Bychkova, in press).

Following six years of investigation, we conclude that the main threat to the European mink in Belarus is the effect of the American mink. The mechanisms by which this has come about are highly complex, and include:

1. Reproductive regulation in American mink which, when undergoing population expansion, can greatly increase their reproductive rate (Sidorovich, in press).
2. The superior strength and greater agression of the American mink (Maran, 1989).
3. The greater trophic plasticity of the American mink (Sidorovich, 1992).

All the remaining unfavourable ecological factors appear to be of minor significance.

In Belarus, the European mink is disappearing from waterbodies where large numbers of American mink occur. This process usually happens rather rapidly -within approximately 5 to 7 years. Water polution and other anthropogenic effects that might have significantly affected population levels have had no observable effect.

Furthermore, there is no marked interspecific competition with the polecat (Sidorovich, 1992). Increases observed in the levels of helminth infestations in European mink populations probably also have no significant effect (Sidorovich & Bychkova, in press).

These represent our preliminary results with regard to the problem of decreasing European mink numbers in Belarus. In the future we plan to study the problem in more detail.

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# Pine marten *Martes martes* on the Island of Elba

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The presence of the Pine marten is recorded on the following Mediterranean Islands: Majorca and Minorca (Alcover, 1979; ICONA, 1966), Corsica (Verbeek, 1974; Cholley, 1982), Sicily (Toschi, 1965), Sardinia (Schenk, 1976, Hutterer & Geraets, 1978), and Elba (Lanza, 1970; Vigna Taglianti, 1988).

The island of Elba (42°47'N, 10°16'E) is located in the Northern Tyrrhenian Sea approximately 5 miles from the Italian mainland and 27 miles from Corsica. The occurrence of pine marten on this island was mentioned in literature only in the first half of the 19th century. Until now, however, there is no paleontological evidence of the occurrence of the taxon among the late Pleistocene fossil fauna of the island (cf. Azzaroli *et al.*, 1990). Our research was undertaken to outline the distribution and the feeding ecology of the species in order to offer a starting point for future studies.

The present work is based on an interdisciplinary methodology including contacts with Corpo Forestale dello Stato and examination of available material from museum and private collections (12 specimens).

The distribution as well as the feeding habits of the pine marten were studied collecting scats in three different areas of the island during the winter of 1992: Monte Calamita, Monte Capanne, and Punta Nera. These areas were selected because the island habitat types were well represented. Monte Calamita is characterized by shrublands and conifer plantings; Monte Capanne is covered with chestnut woodlands and Mediterranean maquis, Punta Nera is characterized by rocky, coastal shrubland.

The pine marten seems to be widespread in the whole island territory, from sea level at Punta Nera on the western coast to the highest peak of Monte Capanne as documented by our observations of marten scats. On the island of Elba, coastal garrigues and shrublands represent a part of the species habitat in addition to wooded areas which are not common among the continental population.

The pine marten also occurs in urban and suburban areas. According to local people, the presence of the pine marten was frequently reported near residential areas. A living specimen was also captured on 8 March 1992 in the village of Marciana.

A preliminary analysis of 80 scats revealed a prevalence of mammals (89.36% frequency of occurrence) on insects and birds (respectively 8.51% and 2.13%). Among mammals the rats (*Rattus rattus* and *Rattus norvegicus*) are the most common item in the winter diet of the pine marten (52.13%). The predation on rats is occasionally recorded on the mainland (Marchesi & Mermod, 1989). The Wood mice (*Apodemus sylvaticus*) are the second most important food category (31.91%). Leporidae seem to reveal a very low frequency of occurrence (1.06%).

On the mainland the predation on hares and rabbits is essentially reported on juveniles during springtime (Goszczynski, 1986). The Lesser toothed shrew (*Crocidura suaveolens*) is the only insectivore preyed upon; according to the literature this species is not preyed upon at all on the mainland.

The ecological habits of the pine marten seem to change in insular conditions and in the absence of competitors, as already observed by Clevenger (in press) on the island of Minorca (Balearic Islands).

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# Delayed implantation in badgers and other mustelids: A review

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A delay of variable length occurs between fertilization of the egg and the implantation of the resultant embryo within the womb and the start of 'true gestation' in a wide range of mammals, so that overall gestation is longer than might be expected when compared to even closely related races or species. This embryonic diapause has been recorded in marsupials, bats, shrews, rodents, armadillos, carnivores including bears and various mustelids (Table 1), and perhaps pandas, several seals and sealions, and the roe deer alone amongst hoofed animals. This odd assortment of species, together with the presence or absence of a post-partum oestrus, and several oestrus cycles, seasonal or aseasonal breeding led Asdell, one of the pioneer students of reproductive physiology, to describe the problem as defying analysis!

A considerable amount of data is now available from captive and field studies within the mustelids however, and the reproductive strategies may now be more easily understood in relation to ecology, sociobiology, and life history criteria such as body size, longevity, and period of time to puberty or weaning/ independence of young.

Badger breeding biology in particular encompasses much of the range of variation (Tables 1 & 2; Hancox, 1987). Although delayed implantation may have evolved several times amongst marsupials and placental mammals, or been lost secondarily within specific groups, the pivotal function of diapause is that mating time and births can vary independently in relation to seasonally favourable conditions. The mongoose/civet line hence remains essentially in the old world tropics, whereas the mustelids were able to colonize the temperate holarctic and even into S. America, thanks to facultative delayed implantation. Ferret-badgers lack a diapause and remain in southeast Asia, but other badgers have varied delay strategies.

Ratels are particularly interesting since they range from the semi-deserts of Namibia to the steppes of Russia and into India/ Nepal. Autumn mating and spring births are reported from the transcaspian USSR, but the captive breeding from Bekesbourne was not so seasonal, with births in February, March, April, July and October, and known matings in October-November. And whereas the European badger shows a neat seasonal reversal with August births at Melbourne Zoo instead of February ones in England, the ratel is less clearly seasonal: -neonates in December in Zambia, a lactating sow in November in Botswana, matings in February, June and December in S. Africa, and births or mating linked to the rainy season and availability of honey in Central Africa.

The martens all show delayed implantation, but only one species ranges into the tropics (Table 1), and similarly the otters show considerable variation, adapted to local conditions. Thus Sea otters may breed aseasonally, but with a tendency to April-June births in the Aleutians or December-February births in California, and *Lutra canadensis* may have spring births for much of its range, but autumn births related to flood conditions in Florida. The 'tropical' otters too vary, with Giant otter births in the dry August-October period, Clawless otter births being aseasonal in West Africa, but in July-August in Zambia and March-April in Uganda.

Table 1. Summary of mustelids known to have delayed implantation

| Species | Mating season | Total gestation (months) |
|---|---|---|
| Stoat (*Mustela erminea*) | spring-summer | 10 |
| Long-tailed weasel (*M. frenata*) | summer | 6 - 11 |
| European & American mink (*M. lutreola/vison*) | spring | 1 - 2 |
| American, Stone, Pine marten, Sable (*Martes americana, foina, martes, zibellina*) | summer | 7-10 |
| Fisher (*M. pennanti*) | spring | 10-12 |
| Wolverine (*Gulo gulo*) | summer | 9 |
| Honey badger (*Mellivora capensis*) | aseasonal/seasonal | 5-6 |
| Hog-badger (*Arctonyx collaris*) | spring-autumn | 5-9 |
| Eurasian badger (*Meles meles*) | spring-autumn | 1 - 12(15) |
| American badger (*Taxidea taxus*) | summer | 7 |
| Striped skunk (*Mephitis mephitis*) | spring | 2 - 2 |
| Spotted skunk, western (*Spilogale putorius*) | autumn | 7-8 |
| N. American otter (*Lutra canadensis*) | spring | 8-12 |
| Sea otter (*Enhydra lutris*) | aseasonal/seasonal | 4-12 |

Much of the variation in reproductive strategies stems from the suite of factors determining female fecundity or output of young per year or in a lifetime. The smaller species may be short-lived, attain puberty early, and are able to rear and wean young to independence rapidly. Thus, two litters a year may be usual in weasels (*Mustela altaica* and *nivalis*), domestic ferrets and Short-clawed otters. Similarly other smaller species with a gestation of 1-2 months may be able to produce a second replacement litter if the first is lost (*Mustela altaica, M. eversmanni, M. putorius, M. sibiricus, Ictonyx, Poecilogale, Mephitis, Pteronura*, and surprisingly *Enhydra*). Most mustelids only have one litter a year, however, often 2-6 young, but with only a single pup in Sea otter and much parental care, or a dozen young in other species (even 18 in a litter of stoat and polecat).

A second suite of partly interlinked factors is probably determined by the sociobiology of the species within any given ecosystem. Many mustelids are rather solitary, and males have no role in rearing young apart perhaps from the defence of a territory shared for a time with the female. In such species the most successful male reproductive strategy may be via a post-partum oestrus which hence occurs during lactation. This occurs in

Table 2. Zoological collections breeding badgers: American, ferret, hog, honey.

| | |
|---|---|
| *Taxidea taxus*: | USA: New York Central Park (Harlow private collection). |
| *Melogale personata*: | THAILAND: Bangkok. |
| *Arctonyx collaris*: | MYANMAR (Burma): Rangoon; CANADA: Toronto; CHINA: Beijing; GERMANY: Duisberg; GREAT BRITAIN: London; USA: Milwaukee. |
| *Mellivora capensis*: | GREAT BRITAIN: Bekesbourne; ISRAEL: Tel Aviv; JAPAN: Nagoya, Yokohama. |

European badgers, rodents, as well as being the obvious solution for pinnipeds in which the sexes only meet once yearly on the birth/mating grounds. Delayed implantation under these circumstances may also be a device to prevent sneak (kleptogamic) mating by subdominant males, and perhaps the ultimate in this vein is the stoat in which the male may mate his daughters before they are weaned and even before their eyes open!

Males may be fertile all year round in European badger and sea otter, although peak spermatogenesis may be limited to 3-4 months in many species. And the lack of a post-partum oestrus may hence be permissible, and under hormonal control linked to lactation. Hence a post-weaning rut in large species e. g. American badger and wolverine. Amenorrhoea in man is a 'natural birth control' device, as well as ensuring the spacing of children. By contrast, a number of species may have several oestrous periods following giving birth, including stoat, mink, American and pine marten, hog and European badger, N. American otter. The case of mink is apparently unique, since secondary ovulations may yield additional cubs in a litter from more than one father (superfoetation).

Tom Hayden and Rosemary Whelan in Ireland have recently shown that badgers may in up to 6% of sows increase litter size by polyoestrus, but probably a more fundamental aspect of secondary matings is that immature sows can become pregnant via autumn matings, and mating may serve also as a social bonding ranking mechanism as in baboons and monkeys. European badgers are the most social of the group, and polyoestrus is most marked in the highest density populations (Hancox, 1988). Hog-badgers are probably similarly social, and captive matings were noted in April, May, July, August, and September prior to the February births. Similarly amongst martens, most are solitary, but male and female may be in contact to a greater extent in fisher and sable, whilst family groups may remain together to some extent in American and Yellow-throated martens. European otters are amongst the least social of the group, and lack delayed implantation, the N. American otter may be slightly more social and has diapause. The remaining otters are more social, with male participation in rearing young in *Lutra maculicollis* and *L. perspicillata*, *Aonyx*, *Pteronura* and *Enhydra*, and family groups notably in Short-clawed and giant otters.

The bewildering range of variation in reproductive strategies within the mustelids is hence a reflection of the breeding and sociobiological flexibility of the species in adaptation to local ecological conditions.

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## Biological assessment of Rawa Danau Nature Reserve, Java

On 16 November 1921 the Rawa Danau area was gazetted a Nature Reserve, while the surrounding hills were gazetted 59 years later as Gunung Gede Nature Reserve. Rawa Danau is the last area of freshwater swamp forest left in Java after centuries of converting similar areas into paddy fields. It extends over an area of 2,500 hectares bordered to the north and to the east by the Gunung Tukungh Gede Nature Reserve (1,700 hectares together). The Rawa Danau Reserve has already been pointed out in the "National Conservation Plan for Indonesia" (FAO, 1982), the"Directory of Asian Wetlands" (1989), and in the "Indonesian Wetland inventory" (Silvius *et al.*, 1987) as a very important natural heritage on the island of Java.

This survey report was made bearing in mind that the Rawa Danau Nature Reserve is still subject to threats, both by illegal human activities, and by the possible construction of a dam at Curug Betung, the natural outlet of Rawa Danau. Also, as the bulk of past surveys was concerned with vegetation, hydrology or avifauna, the present survey primarily focussed upon mammals. It is our wish to show, by means of this survey report, that the area is still worth conserving, perhaps even more than realized before, owing to the discovery of some rare wildlife species. Among the viverrids and herpestids observed were:

***Paradoxurus hermaphroditus* Common palm civet**

Local names: Careuh, Luwak, and Musang (used for several viverrids).

One poisoned male was presented to the AWB team while we were staying at Kampung Baru. It had been poisoned with Temik (Aldicarb = active ingredient), a poison commonly used in the area for pigs and orchard raiding species such as the common palm civet. *P. hermaphroditus* is known to be omnivorous and nocturnal, and occurs in various habitats such as forests, gardens, and towns. It is believed to be a very important agent of plant dispersal. Previous reports stated that *P. hermaphroditus* occurs at Gunung Tukung Gede (PHPA, 1982) and Rawa Danau (UI, 1989; Gamma Epsilon P.T., 1991) and according to local information it is still quite common throughout Rawa Danau and Gunung Tukung Gede.

***Herpestes javanicus javanicus* Javan mongoose**

Local name: Ganggarangan

One individual was encountered at 11.00 hours for five seconds, rushing from the swamp forest fringe to a paddy field in Sukatani. Farmers in Kaloncing, Seklok, Sukatani, and Panangkalan blame the Javan mongoose for frequent diurnal raids on their poultry. Remarkably, this animal is poorly known to the farmers of Kampung Baru.


**Melish, R., Jus Rusila Noor, Griesen, W. & Widjanarti, E. 1992. Biological assessment of Rawa Danau Nature Reserve and an evaluation of present and proposed resource use. Draft (in print)**

# A summary of ongoing research into morphometric variation among mustelids

John M. LYNCH

An animal species may be defined as a collection of actually or potentially interbreeding natural populations, which are reproductively isolated from other such groups (Mayr, 1963). Phenotypic homogeneity among these groups over the entire distribution of the species is rarely observed due to heterogeneity and discontinuities in the environment or, simply, due to isolation by distance. Biological form and its diversity have been studied by evolutionary biologists for many years, using many different techniques. Furthermore, the study of both geographic and temporal variation in form has allowed the testing of hypotheses concerning many aspects of the Neo-Darwinian synthesis (for review, see Rohlf & Bookstein, 1990; Reyment, 1991).

Morphometrics has been defined as the 'formal treatment of our ideas about dissimilarity of geometrical form among biological objects' (Rohlf & Bookstein, 1990). Morphometrics based on the multivariate (i.e. considering many variables simultaneously) treatment of linear measurements has been traditionally called 'multivariate morphometrics'. Such methodology has been used in the examination of many aspects of mammalian evolution. For example, the effects of domestication, sexual dimorphism (Wiig, 1986), hybridisation between taxa (Kitchener *et al.*, 1992), the systematic status of taxa (Wilson *et al.*, 1991), archeological problems and geographic variation in relation to environmental and genetic factors (Reyment, 1991).

There is great morphological, ecological, and behavioural variation within the Mustelidae. For example, body weight varies from 30 g in the Least weasel *(Mustela nivalis)* to over 45 kg in the Sea otter *(Enhydra lutris)*. Members of the family occupy nearly every habitat, including fresh and salt water, and have diversified into a number of dietic specialists feeding mainly on smaller food. In general, piscivorous mustelids are heavier than carnivorous or omnivorous species, perhaps due to their aquatic lifestyle (Gittleman, 1985).

With the exception of the Eurasian badger *(Meles meles)*, mustelids lead an almost solitary existence outside the breeding season, yet have evolved extremely diversified life-history tactics (Gittleman, 1986). It is through this considerable ecological, morphological, and behavioural diversity that such closely related species can coexist in the same region. Given this high degree of variation within the family, it is somewhat surprising that there has been little systematic examination of morphologic variation within and between mustelid populations.

In early 1990 a study was begun by the Mammal Research Group (UCD) which attempts to collect basic data on cranial variation within selected mustelid species. Herein, I would briefly like to outline some of this ongoing research, and in particular, illustrate the use of cranial morphometry in the examination of (i) the recent history of Irish mustelids, and (ii) sexual dimorphism in the otter.

There exists some confusion as to the means by which mammals recolonized Ireland after the last glacial period. Multivariate techniques have been used to examine cranial variation between Irish, English, and Scottish mustelid populations, testing various hypotheses concerning the origin of the Irish populations (Lynch & Hayden, 1993). A hypothesis was formulated that proposed relic status for Stoat *(Mustela erminea)* populations, and immigrant status for badger populations. Little evidence was found for colonization via a landbridge between North Eastern Ireland and Scotland (the previously held method of colonization), and it was thus held that badgers may have been introduced to Ireland by man some time during the past 10,000 years. Some colloborative evidence for this hypothesis is given in Griffiths (1992). Preliminary data suggest a genetic basis to the variation between badger samples (Lynch *et al.*, 1992).

To date, there has been no examination of either morphometric or genetic variation between Irish and the other European otter (*Lutra lutra)* populations. Ongoing multivariate analyses of sexual dimorphism in six European otter populations indicate that dimorphism is greatest in Irish otters (Lynch *et al.*, unpubl.). In this regard, sexual dimorphism in Irish otters is of particular interest, and an analysis specific to Irish otters has been carried out (Lynch & O'Sullivan, in press).

Dimorphism was separated into (i) differences due to size (i. e. including shape variation due to size changes -allometry), and (ii) non-allometric shape differences. While size clearly separated the sexes, shape differences accounted for nearly 87% of the variation between the sexes (Lynch & O'Sullivan, in press). Thus, the larger male cranium is not simply a 'scaled-up' version of that of the female, but has size-independent shape differences, which primarily relate to the breath of the area between the orbits. We suggest that these differences may allow resource partitioning between the sexes, and that the degree of dimorphism may be influenced by historic as well as current environmental factors.

The studies outlined above form part of a larger quantification of variation within the Mustelidae. Data are continued to be collected, and I would be very grateful if any reader can provide information on any substantial collections of European mustelids. In particular, data on the otter, badger, polecat, ferret, stoat, and American mink would be very gratefully received.

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## New zoo and civet project planned in India

Plans are under way for a new zoo in Coimbatore, a large south Indian industrial city. The new zoo was conceived by a group of Coimbatore industrialists who have formed a Registered Society, the Coimbatore Zoological Park Society. They are the same group, by and large, who have been helping Zoo Outreach Organization for the last eight years. Being situated on degraded land in the biosphere area adjacent to natural forest, and central to many protected areas, the possibilities for using this facility to strengthen *in situ* conservation efforts are myriad. In design the zoo will incorporate the innovative style developed in India by the Indian Forest Service. In activity, the zoo will be a holistic conservation centre, starting with flora and fauna which require immediate conservation, developing research projects around special species and habitats and allowing the zoo to evolve around them. One of the projects we intend to carry out is "Exhibiting and breeding civets".

The Malabar civet, *Viverra civettina*, suspected to be extinct until 1987, even now has not been sighted. Researchers have found fresh skins which indicate that the animal still survives. Very little systematic work has been done with any species of Asian civet, so if a Recovery Programme for the Malabar civet should become possible, we would not know to manage the rescued animals in captivity! Even the captive husbandry of the Small Indian civet, *Viverricula indica*, is not known as it has not been kept systematically in any zoo.

The Zoo Outreach Organization and the Society for Conservation of Species and Populations are sponsoring a field research project on the small Indian civet, not in the wild, but how it is being kept (illegally) by individuals in villages for benign collection of 'civet'. Our researcher has collected nearly 200 interviews with persons who are keeping (and occasionally breeding) the small Indian civet. Our report will evaluate this activity and recommend appropriately to the wildlife authorities. It is possible that this could be an opportunity for sustainable use that is not being properly focused. Being associated with the embryonic Coimbatore Zoological Park, we will combine this research with their zoo in the following way:

A policy decision to focus on civet species of the area has been taken. An exhibit will be included in the zoological park which will provide area both for exhibiting and breeding civet species. A research programme will be undertaken to systematically breed the small Indian civet, which is not particularly endangered, so that the basics of civet husbandry and management can be established.

To develop this programme, the literature from other countries' facilities which have kept civet species will be studied along with information from our Research Project on the practical experience of individuals who have been keeping the small Indian civet for 'civet' collection. In developing breeding technology for this species, we hope to improve the husbandry so that even local people who keep the animal for 'civet' collection can have self-sustaining collections instead of the present practice of collecting and keeping the animals without propagating them in captivity.

In the exhibit itself, there is a problem in that civets are nocturnal animals and do not move about much in the light. To combat this exhibition problem and to enhance the educational potential of the exhibit, we propose to have two viewing enclosures. One will exhibit the animal as it lives in the wild in a semi-natural setting and another will show the animal in a typical Kerala village house, kept in a small cage in the compound. Educational graphics will explain the problems and potential of this practice. In this way, visitors who miss the animal in the natural enclosure can have a look at it in the Kerala village. The animals will be interchanged so that no individuals have to spend a long time in a cage. Off-exhibit facilities in the same complex can hold other individuals which may or may not have a turn in the viewing area.

Ultimately we hope to promote systematic breeding and exhibition of civets in other zoos and even find means to manage the genetic material of the zoo captive population interactively with the population kept by the musk collectors. In this way we will gain expertise in the husbandry and management of the more common civets which will enable us better to meet the challenge of a recovery programme for the Malabar civet if and when required.

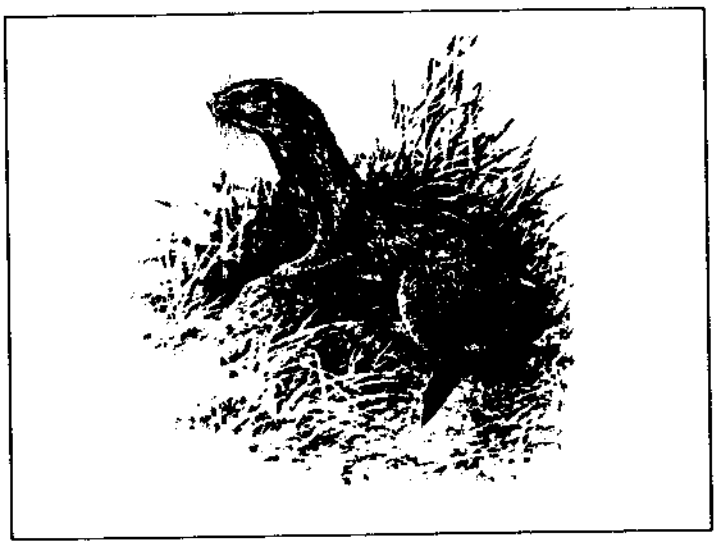
**Sally Walker, Zoo Outreach Organization**
**Convenor, C.B.S.G., India**

## Colombian Weasel Project

The Colombian weasel *Mustela felipei* was identified by Schreiber *et al.* in their 1989 Action Plan, as "probabbly the rarest carnivore in South America", and a top priority species requiring urgent study. A team of British and Colombian biologists now plan to address this need with the first ever intensive field study of the species, beginning in September 1993 at Alto de los Galapagos in the Western Cordillera of the Colombian Andes where the species was most recently found (in 1986 by Dr Michael Alberico of Valle University, Cali).

Efforts shall be concentrated on live trapping and radio tracking, with particular emphasis on relating this to habitat preference and population parameters. It is also intended to analyse diet (from faeces), ectoparasites, and DNA (for study of phylogenetic relationships and population genetics). Assessment of the conservation status of the Colombian weasel in the area will include studying threats posed to the species and its habitat by human land use. This will be particularly centred upon informal interviews with local people. Regular forest users such as hunters and fishermen may also provide a unique insight into the Colombian weasel's habits, which could assist the ecological studies. At the end of the initial eight month study, results will be discussed in Colombia and abroad to develop any recommendations needed to secure the species' future in the study area. Regarding the wider conservation status of the Colombian weasel, the data will be used for initial predictions of population distribution and density, and more accurate estimation of range and rarity of the species as a whole (using data available on habitats and land use throughout the northern Andean countries).

The development of a long-term programme to locate and study other populations of the Colombian weasel will be started, with reconnaissance of future study areas in Colombia and Ecuador, based on the experience and understanding of the species so far. Plans will be discussed and equipment deposited with local researchers to encourage their involvement in this process. The Colombian Weasel Project was developed particularly through collaboration with the Mustelid, Viverrid & Procyonid Specialist Group, and with the Small Carnivore Taxon Advisory Group of the Federation of Zoological Gardens of Great Britain and Ireland Joint Management of Species Programme. £ 3,000 have already been secured towards the £ 10,000 budget for this first stage of the project: any further donations or funding or equipment would be most gratefully received. Anyone wishing to discuss the project further or to request a copy of a detailed proposal, please contact Dave Fawcett.



We are also raising funds through sales of **T-shirts** featuring this attractive drawing of the Colombian weasel by Guy Troughton, printed in black on 'environment friendlier' unbleached cotton, size 'extra large'. Price £ 8 sterling each. (UK orders should include advance payment. Overseas orders will be billed on delivery to include excess postage costs). Please consider ordering a bulk number to sell on our behalf!

**Dave Fawcett, Colombian Weasel Project**
**1 Wootton Way, Cambridge, CB3 9LX, UK.**
**Tel. +44-223-68590**

## Request for veterinary information

I write to you as chairman of the Veterinary Group to ask for your assistance in supplying us with a list of any diseases which are perceived by any of your members to be a threat to the wild populations of the taxa in which your group has a special interest. We are also anxious to receive details of the causes of any morbidity or mortality of which your members may be aware. Reference to reports, scientific papers, newspaper articles, etc. relating to disease in all its aspects as it may affect your Group's interests are also of concern to us and we would be grateful if you would be kind enough to draw our attention to any such publications or send us photocopies for our database, if you have them. Please also inform us of any specialist wildlife disease diagnostic laboratories of which you are aware.

In return, we hope to be able to offer you the service for which our Group was formed. We would particularly like to draw your attention to the extreme importance of obtaining veterinary advice whenever wild animal capture, translocation, reintroduction or restoration projects are components of your Action Plans.

The risk of the transmission of important diseases of humans, domestic livestock, and other wild animals when wild or captive-bred animals are translocated, even over short distances from one ecozone or biotope to another, can be considerable and must be minimized by appropriate screening, quarantine, and where necessary, vaccination.

**Michael H. Woodford**
**Chairman Veterinary Group IUCN/SSC**
**500 23rd Street, N.W., Apt. B-709**
**Washington D.C. 20037 USA**

# Abstracts

## First record of the Marbled polecat for Saudi Arabia

The Marbled polecat, *Vormela peregusna* (Güldenstaedt, 1770), has a wide geographic distribution ranging from Romania and former Yugoslavia to Mongolia, western Pakistan, and western China.

A live specimen was collected recently from near Turayf (31°43'N, 38°35'E), northern Saudi Arabia. This locality is about 295 km E of Ain Al Fawar, the southernmost record in Jordan, and about 170 km ESE of an unconfirmed sighting record from Shaumari Wildlife Reserve. The habitat around Turayf is semi-arid and the elevation is about 849 m with an annual rainfall averaging 150 mm. Several subspecies are recognized and the new specimen is referred to the northern Arabian subspecies, *V. peregusna syriaca* Pocock, 1936.

**Nader, I. A. 1991. First record of the Marbled polecat *Vor-mela peregusna* (Güldenstaedt, 1770) for Saudi Arabia (Mammalia: Carnivora: Mustelidae). *Fauna of Saudi Arabia* 12:416-419.**

## Checklist to the land mammals of Java

Since Sody (1927-1938 in Becking, J. H.[1989]) and Dammerman (1929, 1931) no recent checklist to the mammals of Java was available. Chasen (1940) published a handlist of Malayan mammals, which was supplemented by Ellermann & Morrison-Scott (1955). van der Zon (1979) and van Strien (1986) compiled valuable checklists for Indonesia and the Autralasian Archipelago respectively.

Cranbrook (1987) published a checklist to the land mammals of South-East Asia. Although these checklists are quite accurate for Indonesia, there was a real need for a current comprehensive list for Java, first, to facilitate literature research for scientific purposes, and second, to act as a reference list for field reports coming from the various parts of the island.

For PHPA rangers and officers working only in Java and not on any other island it is especially difficult to deal with the huge selection of mammals in the publications mentioned above. Until now mammals not occurring in Java like *Neofelis nebulosa, Felis marmorata,* and *Macaca nemestrina* can be found in the monthly reports sent to the head offices of PHPA. On the other hand, some scientific names used for PHPA reports are already old and invalid. Nowadays there is also a demand from EIA consulting companies as well as from tourists interested in the mammal fauna of Java.

It is therefore hoped that this checklist can act as a useful guideline to the mammals of Java.

At the moment of this publication there are at least 158 mammal species recorded for Java, with 19 endemic to the island. The highest endemic percentage of species within an order is held by the primates with 50 percent, followed by rodents (22 percent), even-toed ungulates (17 percent) and bats (11 percent) -not including introduced species to 100 percent.

At least 12 species have been introduced to Java through human activities, all of them originating from continental Asia and none from east of Java. Two carnivores and four ungulates have been domesticated but they may also occur in the wild. Hence they may cause some confusion while patrolling or taking plastercasts for footprints. The Muridae comprise the most important group of introduced animals as they live mainly commensal with humans. Thus they are known as crop pests and/or vectors of infectious diseases.

Mammals have been put in systematic order as in Honacki *et al.* (1982), including information for each species about Indonesian protection status (1991), CITES listing and IUCN "Red List of Threatened Animals" (1990).

Being a pure checklist, this publication does neither give any information about the distribution of mammals on Java, nor does it describe whether a species is rare or common on the island. Subspecies have only been included when specifically mentioned in the IUCN "Red List" (1990). No change has been made since the IUCN "Red List" (1988) concerning any mammals of Java.

As some species have different vernacular names, the English names have been compiled rather than selected. Indonesian names are given under the species section and have been added as a separate index. A full reference list is added as an appendix.

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# Recent publications

## The velvet claw

Macdonald, D. 1992. *The velvet claw*. BBC London. 256 pp.

This book provides much background information to accompany the superb television series which presents an overview of the 236 species and 8 families of carnivores living today. It is a fitting 'interim report' on some twenty years research by the author, and incorporates much of the latest information on fossil forebears, DNA and other biochemical evidence of phylogenies, and a wealth of data on basic ecology and behaviour of the better known species.

The book attempts to provide a unifying theme by exploring the origins of sociality within the varied evolutionary lines, and amplifies the earlier hypothesis on resource dispersion suggested in a classic paper in Nature (301:379). This was based originally on fox studies in which a basic territory ought to contain some 24 scrap-producing households and several worm-rich patches in Oxford suburbia. Such a territory could accomodate an adult pair and 2-3 daughters without excessive competition, so that Macdonald's 'Running with the fox' explained a structured social dispersion in high density fox populations. Extending such hypotheses to other carnivore families is feasible, and amplify two earlier explanations of sociality in pack hunters such as lions and wolves where group hunting and defence of prey may be more efficient, or group guarding from mostly aerial predators is essential in diurnal insectivorous mongooses or omnivorous coatis.

Whilst such ideas are very persuasive, there is an ever present difficulty in that many benefits may be secondary rather than causal: -cooperative hunting, guarding of prey, shared guarding of territory or clan or cubs from infanticidal conspecifics or predators, altruistic helping of injured or sick companions, warmth saving in communal denning in skunks, raccoon dogs or badgers, shared lactation and synchronous breeding in lions, domestic cats, coatis, badgers, some canids, mongooses and brown hyaenas. Recent studies of lions for example indicate that group hunting does not become more efficient beyond a group size of 4-5, and there are more mouths to be satisfied and there is a limit to how many can get round one carcase! Besides, it is clear that coalitions of male lions or cheetahs are not hunting cooperatively but are instead engaged in cooperative defence of females.

The fundamental issue with sociality in groups as varied as carnivores, rodents, or primates, is that helpless young need protracted parental care, and the overall 'fitness' of males and females may be attained by different strategies. Many such groups exhibit stable territorial matrilines more or less adjusted to food availability, whereas the male component of the population may be dispersed as monogamous, one-male or multi-male 'harem-holders' with various degrees of polygyny. Much will depend on the male's ability to monopolize females and guarantee paternality by such devices as 'copulation lock' in canids or reproductive inhibition by the alpha pair. Reproduction is the key to sociality, not food since predators often take only 5-10% of the available prey biomass whether they are Schaller's The Serengeti Lion, or worm specialist badgers.

*(review by M. Hancox)*

## Hair of West European mammals

Teerinck, P. A. 1991. *Hair of West European mammals. Atlas and identification guide*. Cambridge University Press, Cambridge. 224 pp. £31.00.

A most unusual work. This book provides a thorough treatment of the hair morphology of the mammals of northwestern Europe. The small carnivore species included are: *Procyon lotor*, *Mustela erminea*, *M. vison*, *M. putorius*, *M. nivalis*, *Martes martes*, *M. foina*, *Meles meles* and also *Lutra lutra* (although not *Mustela lutreola* nor *Genetta genetta*).

The book consists of basic general introductions to hair growth and form, and details of the techniques used in the collection, preservation, and examination of hairs and hair samples. This is followed by painstakingly constructed keys to the various hairs of the different species (including Chiroptera) and illustrated with over 280 line drawings.

The remainder of the book consists of the individual species accounts (*i.e.* the atlas). Each species is accorded two full pages, and each is fully illustrated by photographs. These show the major hair types of each species illustrated whole, longitudinally and in serial section. The final section of the book includes a short bibliography, and a glossary of Linnean binomial names, accompanied by their equivalents in English, German, Dutch, Danish, and French.

Overall, the treatment of the subject is both thorough and scholarly, and without any detectable omissions. Teerinck has undoubtly created a bench-mark work, which will provide an invaluable reference for interested workers in ecology, conservation, and wildlife biology.

*(review by H. Griffiths)*

## Tracks of animals

Romanowski, J. 1990. *Tracks of animals*. KAW, Warsawa. 135 pp. (In Polish)

A field guide to the tracks and other signs of Polish mammals and birds. The chapter on mammals includes information on distribution, habitats, diet, and behaviour. Mustelid species dealt with are *Meles meles*, *Lutra lutra*, *Martes martes*, *M. foina*, *M. putorius*, *M. vison*, *M. erminea*, and *M. nivalis*.

The book is illustrated with drawings, monochrome and colour photographs of tracks, feeding signs, and droppings. The black and white silhouettes of animals help to identify sections on most species. The text is entirely in Polish, only the index gives Latin names.

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