

# SMALL CARNIVORE CONSERVATION



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

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Adult female Libyan striped weasel (*Poecilictis lybica*) - Photo: Marian Batkiewicz

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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:

**Small Carnivore Conservation**  
**c/o Dr. H. Van Rompaey**  
**Jan Verbertlei, 15**  
**2650 Edegem**  
**Belgium**

# The distributions of small carnivores in the Nilgiri Biosphere Reserve, southern India: A preliminary report

T.R.K.YOGANAND & Ajith KUMAR

## Introduction

This project on the distribution, ecology and conservation aspects of small carnivores in the Nilgiri Biosphere Reserve was introduced in an earlier issue of Small Carnivore Conservation (Kumar, 1994). The major goal of the project is to provide baseline data on the abundance and distribution of small carnivores in the different habitat types of the Reserve, and to make an assessment of the impact of human activities upon them. The second major objective of the project is to study ecological aspects of some of the small carnivore species by using radio-telemetry.

The study would cover 13 species: four species each of mongoose (common mongoose, *Herpestes edwardsi*, ruddy mongoose, *H.smithi*, brown mongoose, *H.fuscus*, and stripe-necked mongoose, *H.vitticollis*), civet (small Indian civet, *Viverricula indica*, common palm civet, *Paradoxurus hermaphroditus*, brown palm civet, *P.jerdoni* and Malabar civet *Viverra civettina*), lesser cats (leopard cat, *Felis bengalensis*, jungle cat, *F.chaus*, fishing cat, *F.viverrina*, and rusty spotted cat, *F.rubiginosa*) and one species of marten (Nilgiri marten, *Martes gwatkinsi*).

The three year project began in October 1994, with funding from the Ministry of Environment and Forests, Government of India. The project was scheduled into two phases, the first phase being the survey of the Reserve to study the distributions and abundances of small carnivores, a project which would be executed in the first year. The second phase would be the ecological study. This report contains the work done as part of the first phase of the project.

This article reports the work done during the first six months of the project (October 1994 to March 1995). During this period a habitat classification of the Reserve was made and survey sites were selected to represent the various habitat types and human impact patterns. Survey methods were developed, field tested and improved, and surveying in four of the selected sites was completed.

## Survey sites

Nilgiri Biosphere Reserve encompasses the Nilgiri Mountains and the adjoining areas of the Western Ghats. The altitude ranges from 250 m to above 2,500m, and the annual rainfall varies from over 5,000mm, to less than 500mm. The Reserve includes a whole range of vegetation types: 1. tropical montane evergreen forest (Shola-grassland); 2. tropical wet evergreen forest; 3. tropical semi-evergreen forest; 4. tropical moist deciduous forest; 5. tropical dry deciduous forest; and 6. tropical dry thorn forest. The human influence pattern on the habitat also varies much among the various parts of the Reserve. Plantations of teak, eucalyptus, etc., after conversion of various forest types at a range of altitudes, adds to the diversity of the Reserve. A distributional study of the small carnivores, as proposed in this project, will involve surveying the various habitat types for their presence and relative abundance.

Of the 14 major areas in the Reserve, 12 were selected for this survey, covering all six major vegetation types and grades of human disturbance (Table 1).

## Survey methods

The rich and diverse small carnivore community of the Reserve has remained under-recorded owing to the difficulties involved in sighting them. A survey could be made possible only by a combination of methods, including information from direct sightings and estimations from indirect evidence.

## DIRECT SIGHTINGS

Most small carnivores occur at low densities, and are nocturnal and solitary. Therefore, direct sightings cannot be relied on to make an assessment of their distribution and abundance. However, during the survey, the various habitats in the selected areas were extensively walked to get direct sightings. Vehicular transects were done, mostly at night, wherever possible. At probable haunts of the various species, such as water holes, fruiting trees, etc., stationary observations were made for long periods of time. Automatic camera traps were set up in different habitats near probable sites such as water holes and scat-marking sites to get photographs of the animals. The traps were baited with dry fish, rodents, peanut butter, fruits, etc., to attract the animals.

Table 1: Major forest areas, their altitude, vegetation types and disturbance levels in the Nilgiri Biosphere Reserve.

SNo	Locality	Altitude (m)	Major vegetation types	Human disturbance
1 #	Nagarhole NP	700 - 1000	Moist & dry deciduous.	Moderate
2	Bandipur NP	700 - 1000	Moist & dry deciduous.	Moderate
3 #	Wyanad WS	700 - 1200	Moist & dry deciduous.	High
4 #	Mudumalai WS	700 - 1000	Moist & dry deciduous.	Moderate
5 #	Sigur RF	700 - 900	Dry deciduous & dry thorn.	Moderate
6 #	Talamalai RF, Minchikuli.	700 - 1000	Moist & dry deciduous.	Moderate
7 #	Moyar valley	250 - 350	Dry thorn.	High
8 #	Nilgiri SE slopes (Pillur)	250 - 1500	Moist & dry deciduous.	Moderate
9 #*	Siruvani hills	500 - 1800	Wet & semi-evergreen, moist deciduous.	Moderate
10 #*	Upper Nilgiri, Mukkurthi NP	2000- 2500	Montane evergreen (Shola-grassland)	Low
11	Attapadi plateau	600 - 1000	Moist, dry deciduous & dry thorn.	High
12 #*	Silent Valley NP	700 - 1700	Wet evergreen.	Low
13 #*	New Amarambalam RF	250 - 1800	Wet evergreen, semi-evergreen.	Moderate
14 #	Nilambur kovilakam RF	1000- 2400	Wet evergreen, semi-evergreen.	High

# - proposed survey sites; \* - survey completed;  
NP - National Park; WS - Wildlife Sanctuary; RF - Reserve Forest

## INDIRECT EVIDENCES

Transects were laid in various habitats in the study area to quantify indirect signs of small carnivore presence. The main evidence of animal usage is the presence of scats, either excreted or marked for intra- and inter-specific communication. The animals mostly used bridle paths and less-used roads for scat marking. Therefore, most of the sampling was done along these roads and paths.

The scats found on the transects were collected for later identification by thin-layer chromatography, and for analysis of feeding ecology. Presently scats were assigned to various groups - cats, civets, mongooses, martens - depending on various characteristics such as size, shape, marking site, contents, time of deposition, etc. At each scat location a number of habitat parameters were recorded including vegetation types, proximity to streams and distance along the transect. Other signs, e.g. pug marks, were recorded and traced for later identification by comparison with known pugmark tracings. The sampling effort in different habitats, measured as the length of the transect, roughly reflects the proportion of the habitat type in that area.

## Survey results and discussion

Of the 12 areas chosen for surveying, four areas were completed between October 1994 and March 1995. The Siruvani Forest area, which is highly diverse in habitat types and, by virtue of its proximity to Head Quarters (Coimbatore), was where most of our survey methods were field tested and improved upon. The other completed areas are: New Amarambalam Reserve Forest, mainly selected for its vast areas of semi-evergreen vegetation occurring due to the past influence of humans; Silent Valley National Park, with extensive wet evergreen forests, and where human disturbance has been minimal; Mukkurthi National Park in the Upper Nilgiris Plateau, at an altitude of above 2000 m, with the last remains of a unique vegetation type consisting of a stunted montane evergreen forest (sholas) and grassland community.

The survey results based on scats is constrained by the tentative identification of the scats. Personal observations show that there is a large possibility of misidentification of the scats of cats and mongooses. Another constraint is that the relative abundance of scats in an area is assumed to be indicative of the abundance of animals.

The defecation behaviours of the various groups of animals are largely unknown, and the rates of defecation, sites of scat-marking, communication systems, and other characters, may

Table 2: The abundance of scats (n/km) of small carnivores (mongooses, civets, cats & Nilgiri marten) in eight vegetation types surveyed in the Nilgiri Biosphere Reserve.

Habitat type	Trans-dist (km)	Mongoose	Civet	Cat	Marten	Total
Scrub	4	0.25	0.25	0.25	0	0.75
Dry deciduous	23	1.52	0.39	0.87	0	2.78
Moist deciduous	15	0.07	0.27	0	0	0.34
Semi-evergreen	17	0.18	1.83	0.06	0	2.06
Wet evergreen	50.8	0.14	3.04	0.14	0	3.31
Shola-grassland	30.5	0.07	0	1.12	0.23	1.41
Grass land	7.5	0	2.93	0.67	0	3.6
Plantation	34	0.03	0	0.32	0	0.35
Mean		0.28	1.09	0.43	0.03	

vary among these different groups. The results of this survey shall be viewed whilst bearing these constraints in mind. Such constraints might be partly resolved during ecological studies using radio-telemetry.

A total of about 400 km. were walked, 182 km of which were for the estimation of scat abundance. We had only five sightings of four species (two of common palm civet, one of leopard cat, one of brown mongoose, and one of ruddy mongoose). A total of 357 scats were collected, of which those of civets constituted the majority (62%), followed by lesser cats (22%), mongooses (14%) and Nilgiri marten (2%). Overall, civet scats were found at rate of 1.09 scats/km, those of cats at 0.43 scats/km, of mongooses at 0.28 scats/km, and of Nilgiri marten at 0.03 scats/km.

Amongst the different vegetation types, the grasslands of Silent Valley had the greatest abundance of scats (3.6 scats/km), followed closely by wet evergreen forests (3.31). This is followed by dry deciduous (2.78), semi-evergreen (2.06), shola-grasslands (1.41), scrub (0.75), the plantation (0.35) and moist deciduous forests (0.34). Small carnivores seem to be very rare in plantations, with no scats being found in two of the three areas sampled.

There are differences amongst vegetation types in the abundances of the various species. In dry deciduous forests, mongooses were the most abundant species (1.52 scats/km.), whereas civets were the most common species in the wet evergreen forests (3.04 scats/km.), hill top grasslands (2.93 scats/km.) and semi-evergreen forests (1.83 scats/km.) Lesser cats, which were rare in all vegetation types, were the most common species (1.12 scats/km.) in the higher elevation shola-grasslands. The Nilgiri marten was found only in montane evergreen forests and in the associated grasslands of Mukkurthi, and also had a low abundance (0.23 scats/km.). The scrub forests of the plains had low small carnivore abundances, with no species being dominant.

The study so far shows some differences in the abundances of the four species groups in the various vegetation types, with civets being more common in wetter and closed forests, mongooses and lesser cats being more common in the open and drier forests, and the Nilgiri marten being confined to montane shola-grasslands. However, the tentative classification of scats into species groups, upon which the above conclusions are based, needs to be confirmed using TLC. A clearer picture of the species' abundance patterns would also be possible then.

## Acknowledgements

The funds provided for this project by the Ministry of Environment and Forests of the Government of India are gratefully acknowledged. We would like to thank the Forest Departments of Tamil Nadu and Kerala for granting us the necessary permissions, and for assistance in conducting the field work. Our sincere thanks are also due to those people who assisted us in the field.

## Reference

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**Salim Ali Centre for Ornithology and Natural History, Coimbatore - 641 010 India**

# A new location for the White-tailed mongoose, *Ichneumia albicauda* (Cuvier, 1829), Farasan Kabir Island, Red Sea, Saudi Arabia

David J. SIMMONS

## Introduction

*Ichneumia albicauda* has been recovered from two main areas of Arabia: Oman (Gallagher, 1992) where it is uncommon (Harrison, pers. comm.) and the southwestern area of Saudi Arabia where Nader *et al.* (1975) described it as being common in the locality of Jizan. Harrison & Bates (1991) also mention it occurring in Yemen. It also occurs throughout much of Africa including N. E. Africa where there are a number of records from Somalia, Eritrea, Egypt, and the Sudan (Simmons, in prep.). Jennings (1984) visually identified *I. albicauda* on Farasan Kabir. The known distribution of this species in Arabia is still incomplete.

In 1991 Nader & Al-Safadi reported the first record of *Bdeogale crassicauda* in Arabia. The juvenile female specimen was recovered from Yemen. This species has a patchy distribution and until recently was known only from East Africa. Therefore it was important to separate *B. crassicauda* and *I. albicauda* on cranial evidence to avoid misclassification of the Farasan skull.

## Material & method

On 13 July 1993 a disarticulated, clean skull (BMNH 1995.54), minus mandible was discovered by the author on the south east coast (16°42'S, 42°12'E) of Farasan Kabir Island. The skull was found approximately 1 m above the high tide strand line.

The skull was of an adult, which was shown by the fully erupted teeth and fused basioccipital/basisphenoid sutures. The teeth exhibited relatively light wear suggesting a fairly young adult. This suggestion is corroborated by the incomplete orbital rings which are only complete in older adults (Rosevear, 1974). The animal is a female, indicated by the limited development of the sagittal crest.

Dimensions in millimeters are: greatest total length 84.6; condylobasal length 83.1; greatest zygomatic breadth 44.2; width of braincase at posterior end of zygomatic arches 28.2; postorbital constriction 16.4; maxillary toothrow 31.6; ORB 17.2. The dimension ORB is the diameter of the orbit taken in a vertical line from the centre top of the orbital ring to the centrebottom of the orbital ring.

Reference material is given below:

*Bdeogale crassicauda*: BMNH 51.338, Liwale District, Tanganyika; BMNH 1.11.11.1, Mlanje, Nyasaland; BMNH 10.7.16.8 Mlanje, Nyasaland; BMNH 10.10.14.8, Kenya; BMNH 70.1021, Fort Jameson District, Zambia; BMNH 65.2618, Luwale Boma, Tanganyika; BMNH 6.6.5.8, Zanzibar Island; BMNH 73.878, Nairobi, Kenya.

*Ichneumia albicauda* (Arabia): BMNH 89.4.2.1, Muscat, Oman; BMNH 88.10.24.1, Muscat, Oman; BMNH 94.3.9.2, Khode, near Muscat, Oman; BMNH 88.10.24.2, Muscat, Oman.

An additional 32 *I. albicauda* skulls from N. E. Africa were studied for reference purposes. All were from the BMNH collections.

## Diagnostic features

### EXTERNAL CHARACTERISTICS

External characteristics may be a poor method of distinguishing *I. albicauda* from *B. crassicauda*. The white tail of *I. albicauda* may not be a reliable indicator. A small proportion of *I. albicauda* specimens in the BMNH collection have black tails (pers. obs.) although none of these specimens was from Arabia. Tail length may be a better indicator, with an upper limit of 300 mm for *B. crassicauda* being diagnostic (Taylor, 1987). In comparison, the author calculated a mean value of 365 mm for three Arabian *I. albicauda* specimens in the BMNH collection. Head and body length is similar, but *I. albicauda* is a little larger (mean 555 mm, Harrison & Bates, 1991) than *B. crassicauda* which should be less than 500 mm. Ear lengths have similar ranges.

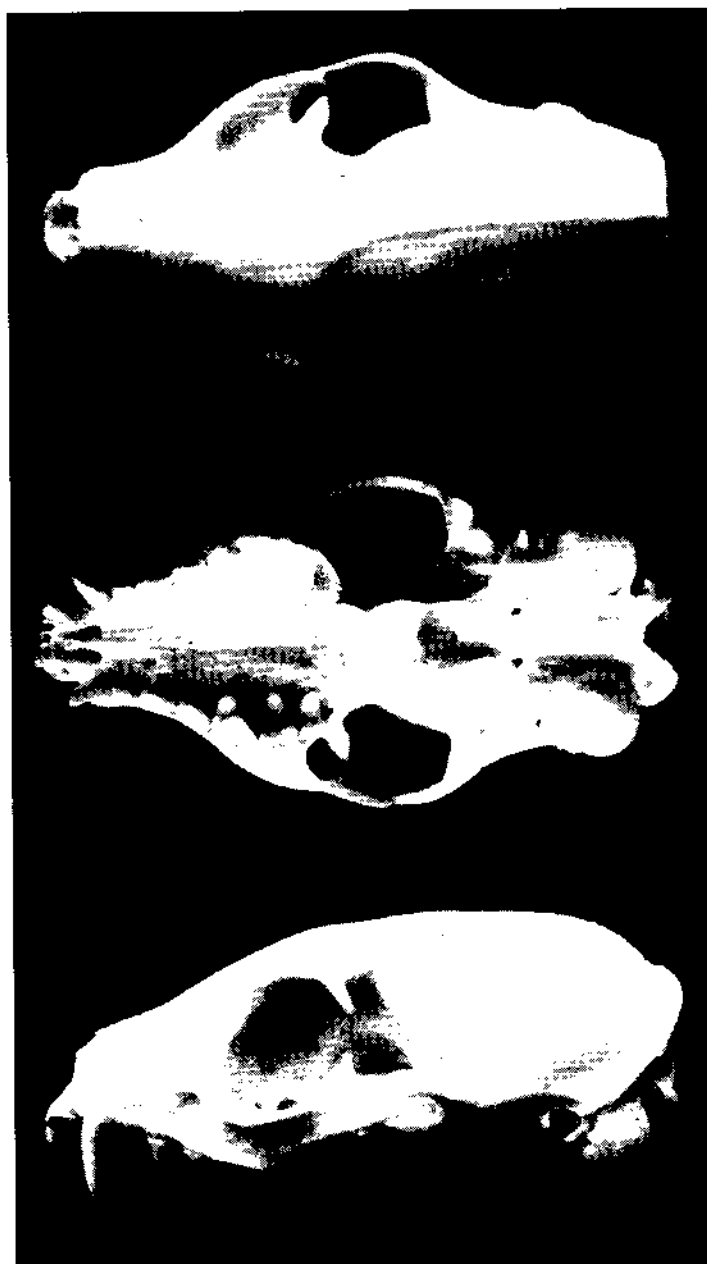


Fig. 1. Dorsal, ventral, and lateral view of the Farasan skull

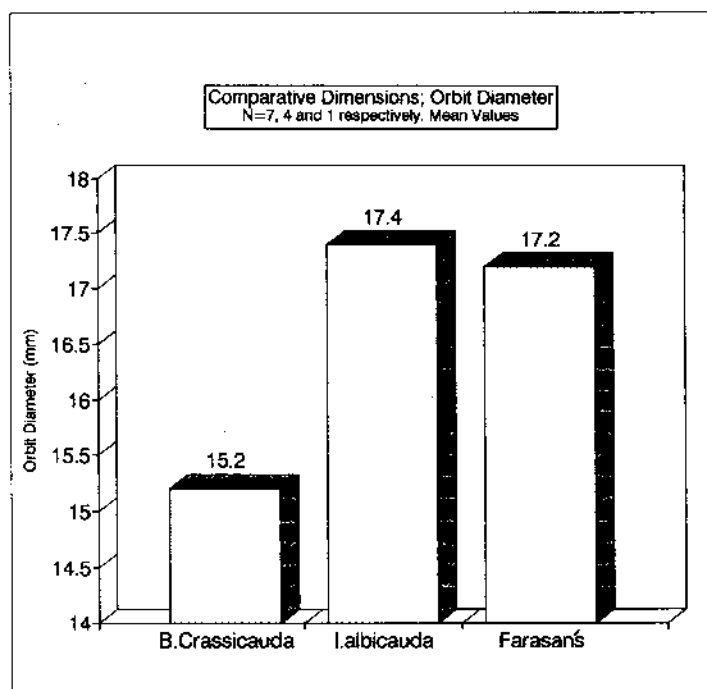


Fig. 2. Comparative dimensions of the orbit diameter

### CRANIAL CHARACTERISTICS

Standard cranial measurements are very similar for the two species and do not give adequate grounds for easy differentiation. Below, specific cranial features that separate the two species are presented.

**Tympanic bullae:** The very strong inflation of the posterior chamber of the tympanic bullae of *I. albicauda* provides the clearest diagnostic feature (Fig. 1). The bullae of *B. crassicauda* are relatively flattened and show considerably less inflation of the rear chamber. The result of this feature is that the basioccipital of *I. albicauda* is much narrower than that of *B. crassicauda*. The Farasan skull has the diagnostic strong inflation of *I. albicauda*.

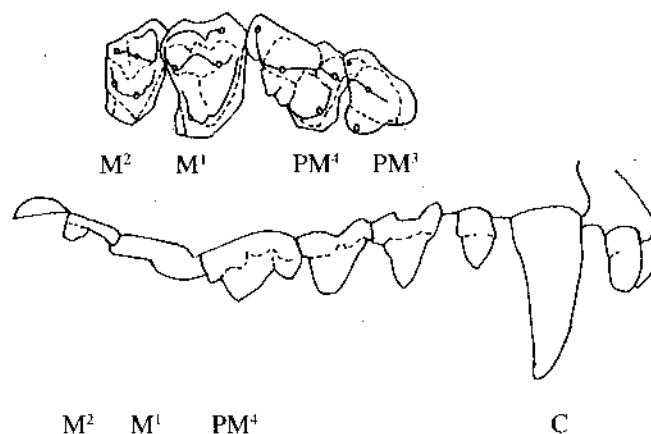
**Zygomatic arches:** The zygomatic arches of *B. crassicauda* are angulated at their posterior roots. This is not the case with *I. albicauda* where the zygoma curves inwards more evenly in a more gentle curve.

**Orbits:** Orbit diameter (Fig. 2) is larger in *I. albicauda* (17.4 mm) than in *B. crassicauda* (15.2). The orbit diameter of the Farasan skull (17.2 mm) is much closer to *I. albicauda* than to *B. crassicauda*.

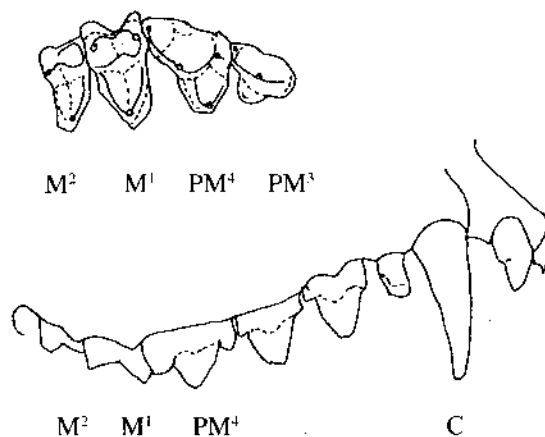
**Maxillary cheekteeth:** Fig. 3 shows the maxillary toothrow P<sup>4</sup>, M<sup>1</sup>, M<sup>2</sup> from BMNH specimens of *B. crassicauda*, *I. albicauda*, and the Farasan skull. It is clear that the teeth of the Farasan skull match those of *I. albicauda*. P<sup>4</sup> is diagnostic. The posterior edge is notably indented unlike *B. crassicauda*. Similarly, M<sup>1</sup> is distinctive.

**Canines:** Fig. 3 shows the upper C of the two specimen skulls and the Farasan skull. A consistent dental feature of *B. crassicauda* mentioned by Skinner & Smithers (1990) is the shape of the upper canine which is nearly straight and has clearly defined shearing edges on the anterior and posterior surfaces of the tooth. In contrast, the shape of the upper C in *I. albicauda* is slightly curved and pointed and lacks the distinctive shearing edges of *B. crassicauda*. The Farasan skull does not have such dagger-shaped canines, but again strongly resembles the slightly curved and pointed canines of *I. albicauda*.

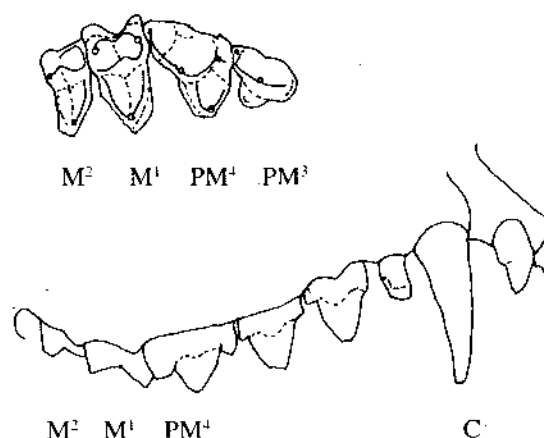
*Ichneumia albicauda* 1949.574



*Ichneumia albicauda* 1995.54  
(Farasan skull)



*Bdeogale crassicauda* 1965.2618



10 mm

Fig. 3. Occlusal and lateral view of teeth of specimens of *Ichneumia albicauda*, *Bdeogale crassicauda*, and the Farasan skull

## Remarks

On the dental and cranial evidence given above and based on observations by David Harrison (pers. comm.) I suggest that the Farasan skull is *I. albicauda*. Dental characteristics of *I. albicauda* and *B. crassicauda* are sufficiently different to allow identification. Cranial differences, particularly of the tympanic bullae are also diagnostic. However, due to the relatively small sample sizes this diagnosis cannot be unequivocal and some of the features used to differentiate the two species and identify the Farasan skull may prove to be inconsistent as more specimens are collected.

An interesting aspect of this skull is its small size compared to other Arabian *I. albicauda* specimens. Any comments on the taxonomic status of the Farasan skull must be tempered by the fact that all measurements are from a single specimen. There is obviously a large size range with this species. Generally speaking Arabian and N. E. African specimens are considerably smaller than East African specimens.

The Farasan skull is smaller than the minimum size range of Arabian skulls, but very few have been recovered. Further samples of Farasan and mainland Arabian individuals will reveal if subspecific status of the Farasan population is merited.

How Farasan Kabir was colonised remains a mystery. Either the animals were introduced, perhaps as a pest control measure, or they naturally colonised when the island was more accessible. However, on the evidence of this skull, the sighting by Jennings (1984) and another unrecovered skull found on the islands by the author it seems probable that there is a population of white-tailed mongooses on Farasan Kabir. It has been suggested that the skull was washed ashore or carried to the islands by a bird of prey (Van Rompaey, pers. comm.), but as Van Rompaey himself states, this seems unlikely.

The similarity of Arabian *I. albicauda* skulls to those of *B. crassicauda* is worthy of mention. The record by Nader & Al-Safadi (1991) of a juvenile female *B. crassicauda* needs confir-

mation based on cranial features. The tail length of this animal exceeds the range given by Taylor (1987).

In conclusion, the occurrence of a population of *I. albicauda* on the Farasan Islands can only serve to enhance the conservation standing of the Islands.

## Acknowledgements

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15, Orchard Drive, The Sands,  
Durham DH1 1LA, UK

## Bovine TB in badgers

MAFF. 1995. *Bovine TB in badgers*. 11th report. Paperback.

The Ministry of Agriculture's latest glossy report notes a continuing dramatic increase in TB cattle herds but offers no explanations for this five-fold upswing since 1986 and expansion in blackspot areas. An equally unexplained drop in badger TB in the Glos. study area suggests the answer is not an increase in TB in badgers but one in cattle.

Previous issues of Small Carnivore Conservation pointed out that cattle are infectious at any stage of the disease (12:9), and that transfer from cattle to badgers is likely (10:19 and 11:25), and that Mad Cow replacements have simply stirred up the cattle TB reservoir since 1986. This is why cattle herd breakdowns are appearing in new areas, with no TB badgers initially, but badger TB re-established later on e. g. the Marlborough case.

The absolutely **pivotal** flaw in MAFF logic, in now claiming that only cows with gross lung lesions are infectious is simply

because they are confusing two sorts of cattle which do not show lesions. Fully two in three TB herd breakdowns in fact produce no TB cows nor TB badgers because they **do not have TB!** (false positive reactors). But the small minority of early TB cases without lesions are producing herd breakdowns but being misunderstood by MAFF (Clifton-Hadley, 1995; Hancox, 1994). The cost-effective management of cattle TB urgently needs better, faster blood tests to derestrict movement of cattle and farm business quicker (7:14).

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M. Hancox, 17 Nouncellis Cross,  
Stroud, Glos. GL5 1PT, UK

# Sighting of the Nilgiri marten (*Martes gwatkinsi*) at Eravikulam National Park, Kerala, India

M.D. MADHUSUDAN

The Nilgiri marten (*Martes gwatkinsi*) is a rare mustelid which is endemic to the forested tracts of the Western Ghat mountain range (which runs north-south along the western flank of the Indian Peninsula). Sightings of this species have been very few and, hitherto, there were no photographic records of the species, either in the wild, or in captivity. There is a remarkable paucity of reliable information on the distribution and status of this animal; it is listed under the 'indeterminate' category of threatened mammals by the IUCN (Groombridge, 1993). The exact taxonomic status of this animal is not clear either. For example it is regarded as a subspecies of *Martes flavigula* by Corbet & Hill (1992), whilst others (e.g. Prater, 1980) regard it as a separate species.

Prater (1980) notes that the species occurs in the well-wooded tracts of the southern Western Ghats. Interestingly, Wroughton (1919) records the possibility of a specimen in the collection of the Bombay Natural History Society as having come from Dharwad in north Karnataka. If true, this is very likely to represent the northern limit of its distribution. It is difficult to draw conclusions from the anecdotal accounts of the Nilgiri marten that are referred to in the following text, but if these are any indication, the animal presumably occurs at naturally low densities.

On 15 February 1995, at about 10 a.m., I sat in a shola forest (montane, stunted evergreen forest) at Rajamala in Eravikulam National park, Kerala (10°10'N, 77°00'E and 10°20'N, 77°10'E), photographing a Nilgiri langur *Presbytis johnii*. The monkey soon disappeared into the canopy. Around where the monkey disappeared, I noticed a dark shape in the crook of an *Isonandra candolleana* tree (about 10 m from the ground). I instantly identified the sleeping animal as a Nilgiri marten. The animal got up repeatedly to watch me, or to groom itself, but was not unduly perturbed by my presence. After I had watched it for nearly 90 minutes, the animal left, moving effortlessly through the canopy, and never descending to the ground.

I was taken aback by the large size of the animal. I had previously seen the Himalayan Yellow-throated marten (*Martes flavigula*) at Rajaji National park (near Dehra Dun in north India), and found that *M. gwatkinsi* is certainly larger. I estimate the total length of the animal to be close to four feet, with the tail being nearly as long as the body. The single available reference on the body morphometrics of the Nilgiri marten (Riley, 1913) gives a head-and-body length of 24 inches, a tail length of 16 inches, and a body weight of 4.5 pounds (the age and sex of the animal were not known).

I have no clue as to the food habits of this animal. However, given that the species (like other *Martes*), is as comfortable in trees as it is on the ground, it seems plausible that arboreal mammals and birds might constitute a significant part of its diet (Riley, 1913). Indeed, there are reports of the Nilgiri marten preying upon crows in the High Ranges of Kerala (Gouldsbury, 1949), and upon the Malabar giant squirrel (*Ratufa indica*) in the High Wavy Mountains of Kerala (Hutton, 1944). The patch of



Fig. 1. Nilgiri marten (*Martes gwatkinsi*) in Eravikulam NP, India. Photo: M. D. Madhusudan.

forest in which I sighted the animal was barely 5 ha in area, and surrounded by both tea and eucalyptus trees. *Martes gwatkinsi*, like many other small carnivores, might do well in the small patches of shola forests that dot the tea- or grassland-covered landscape around Eravikulam. Authentic local sources report an instance of the marten nesting in a solitary *Grevillea robusta* tree in the middle of an open tea plantation.



## Other small carnivores

Eravikulam, together with the estates that surround it, supports a diverse mustelid-viverrid community. In the course of my five-month study on the Nilgiri tahr at Eravikulam, I noted the presence of three species of mongoose: the ruddy mongoose *Herpestes smithii*, the stripe-necked mongoose *H. vitticollis*, and the endemic brown mongoose *H. fuscus*. There are also reliable accounts of a fourth species, the large grey mongoose, *H. edwardsii*, at elevations lower than 1,500 m ASL (J. Zacharias, pers. comm.). Amongst the civets, only the small Indian civet, *Viverricula indica*, has been seen in the area. However, the common palm civet, *Paradoxurus hermaphroditus*, which occurs sympatrically with *V. indica* over most of its range, might also occur here. Amongst the cats, there are confirmed sightings of leopard cat, *Felis bengalensis*, and jungle cat, *F. chaus*. Reports also note the occurrence of otters in this area. The common otter, *Lutra lutra*, and the clawless otter, *Aonyx cinerea*, could occur here, as has been reported for the High Wavy Mountains nearby (Hutton, 1949). No confirmation of the exact identity of the Eravikulam otters has been possible to date.

Even in the face of the poor information we have on the small carnivores of the Indian subcontinent, I would like to hazard that it is important not to neglect smaller, more disturbed, so-called 'marginal habitats' in any effort to conserve small carnivore species.

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**Wildlife Institute of India, P. O. Box 18,  
Dehra Dun 248 001, India**

## A request for information and samples from nocturnal mammals

We are writing to inform you about our long-term research on nocturnal primates in Africa and to ask for your help. It has become apparent that many nocturnal species have been overlooked because of their cryptic habits and appearance. Similar looking populations often have different communication systems which suggest that they do not recognise one another as members of the same species. We are trying to sample the extent of speciation in nocturnal mammals, especially bushbabies (galagos) which are found over most of Africa south of the Sahara.

To this end we have built up an extensive library of tape recordings of the animals and we have identified 'vocal fingerprints' that can be used to identify each species. It is also possible to compare populations using newly developed studies of DNA from skin or hair samples (pet animals or road-kills, etc.). Guard hairs should be pulled to obtain the follicles at the base and stored in a dry place, wrapped in clean paper. For such studies to be successful it is essential that the precise locality of origin is known.

In order to sample a wide area we are asking volunteers who have tape recordings of bushbabies and **other vocal mammals** or who may be in a position to record their local species, or know someone who could make recordings. We have prepared a number of specimen tapes giving examples of typical calls, and explaining how to recognise and sample the calls which are of most interest.

We will be pleased to send a copy if it is of interest to you. At this stage the quality of recordings that we receive is not

critical, since even relatively poor samples can still give a good impression of the extent of variation.

Bushbabies and **other mammals** can often be seen at night using a simple headband torch (4.5V. Petzl zoom or equivalent) which picks out the brilliant reflections from their eyes. Covering the torch with a red filter is sometimes effective if the animals are disturbed by white light and it allows the night vision of the observer to improve over time. Binoculars are also helpful at night by increasing the effective light -leading to useful and enjoyable sightings.

Naturally, we are in a position to refund any expenses you may incur on our behalf for tapes and postage, and your assistance will be duly acknowledged in papers and reports on our research. Without the help of naturalists in the fields we will be unable to sample many of the African forests, woodlands, and savannahs which we believe may harbour unusual representatives of the group, which may have evolved in isolation for long periods. Please bear us in mind should an opportunity present itself to (1) make tape recordings; (2) take hair samples from living animals or carcasses; (3) give descriptions of sightings, habitats, locations, etc. We will be very pleased to help on the technical side if possible.

We look forward hearing from you. With thanks.  
Simon Bearder and Paul Honess.

**Simon Bearder, School of Social Sciences, Oxford  
Brookes University, Oxford OX3 0BP, UK.**

# Breeding of the Libyan striped weasel *Poecilictis libyca* at Poznan Zoo, Poland

Hanna SITEK

The Libyan striped weasel is a little known carnivore from the arid areas of northern Africa whose biology and ecology have not been studied into any detail in the field. According to the available data, the species is nocturnal and spends its days in burrows and rock crevices. Its food consists of small mammals, birds, reptiles and invertebrates. The species appears to live singly in the wild. An Algerian female was found to have two fully developed foetuses when examined in May.

There are no records available about the keeping of *P. libyca* in captivity. In September 1993, a pair of this species was acquired by us from a private breeder in the Netherlands. According to the information available the animals were wild-caught in Libya. The age of our pair is unknown, but both appeared to be fully grown on arrival. For their maintenance we employed methods similar to those used in the maintenance of the Common zorilla, *Ictonyx striatus*.

The body length is about 25 cm, tail length 15-20 cm, weight 0.5 kg (female) and 0.6 kg (male). The back and sides are white with five parallel but irregular stripes. The belly and legs are black whilst the ears are black with whitish margins, and the tail is black, but grizzled with white. Striped weasels bear a definite resemblance to the common zorilla, both in their shape, and in their behaviour, although they are significantly smaller.

As the animals are getting-along very well, with no aggression having been observed, they are kept together permanently (apart from the breeding season). They use two kinds of enclosures. During the winter (when ambient temperatures fall below 5°C) they are kept in a cage of the following dimensions: 1 m x 1.5 m x 1 m high, with heating to about 15°C provided. The wooden floor is covered by gravel and sand. A simple den, 40 cm x 40 cm x 30 cm high, is provided for shelter. During the summer they are kept in an outdoor exhibition cage of 2.5 m x 1.5 m x 1.5 m high, with an adjoining wooden shelter 1 m x 0.7 m x 0.4 m high, which is further divided into smaller compartments with wooden partitions. The outside cage is furnished with a variety of plants, and with stones and branches located close to the ground. Inside the den there is a heating lamp which is switched on in rainy weather. The animals are moved outside when the ambient temperature exceeds 10°C.

Striped weasels are strictly nocturnal, and they spend the whole day in the den. They are very aggressive towards humans. During an attack they erect the fur along the back, raise the tail over it, and also rear the entire body, whilst uttering loud voices. During attack their movements are both very quick, and persistent, and they expel a fluid with a pungent odour. These animals also can 'play dead' when scared; after being recaptured from an escape, the male remained immobile with his eyes closed and his tongue extended for over two minutes.

The animals are basically ground-living, although able to climb on branches and the wire-netting of the cage. They do not destroy the plants in their cage, so the only signs of their nocturnal activity are the burrows and paths that remain visible in the cage.



Fig. 1. Three-weeks old Libyan striped weasel cubs, *Poecilictis libyca*. Photo: M. Batkiewicz

If removed from the den during daylight, they try to bury themselves immediately.

Our weasels are fed once a day, six days a week. The food consists of finely-chopped horse-meat or beef, with grated vegetables, line seeds and boiled cereals, plus Japanese quail, day-old chicks, mice, small rats, raw eggs, crickets and locusts used in turn - fruit is not taken. As a prophylactic against vitamin deficiencies in spring and autumn 'Polmamix M' (a vitamin and mineral supplement for fur-bearing animals) is added. During suspected pregnancy bone meal and cod-liver oil are mixed with the female's regular food. Thus far, there have been no veterinary problems with our animals.

Most mustelids breed during the spring. Therefore, although neither mating, nor significant behavioral changes were noted in our female, she was separated from the male in April. She was moved to a cage similar to the one described above on 21.04.1994, and on 23.05.1994, two new-born cubs were found in the den. They were severely hypothermic, and weak. The youngsters were removed from the den despite the female's attacking. However, she was probably primiparous, and unable to care for the cubs properly. The youngsters, both male, were immediately placed in a human incubator. One died after one hour, the second died the same evening, although we had tried to feed the second cub every two hours with 'Humana 1'. The autopsy didn't reveal the cause of death, although we suspect that hypothermia had taken its toll. The new-born cubs had the following measurements: body weight 5 g, body length 63 mm, tail length 12.4 mm, head length 20.4 mm, hind foot length 7.5 mm. The body was covered with very short, whitish fur.

On 01.07.1994 the female was reintroduced to the male. As the shortest known pregnancy in a mustelid is around 35 days, she had been separated on 21.04.1994. On 11.07.1994 two cubs were spotted in the den, apparently tenderly cared-for by the female. It therefore appears that *P. libyca* can repeat the oestrus and pregnancy within 40 days. The female was very aggressive during the rearing of cubs. To prevent excessive disturbance the den was only opened once a day, and only to briefly check on the status of the cubs. After three weeks the female was separated for a few

minutes to perform de-worming, to check the status of the cubs, and to take measurements. There were three cubs, all male, with body weights of 55, 55, and 60 g, respectively. Their eyes were still closed. Their bodies were covered by short, blackish-white fur, and they were unable to walk. The canines and incisors were well-developed in both jaws. Cubs were de-wormed with 'Flubendazole'.

After another ten days the cubs and mother were briefly separated again. Their body weights were 80, 85, and 90 g. Two cubs had fully opened eyes but the smallest had only partly opened its eyes. They were already moving around quite skilfully. At an age of five weeks they probably started to take solid food on their own. At an age of two months their average body weight was 250 g, and they differed from the adults in size only. At this age the

female moved them to an outside, self-made burrow. Even at this advanced age the female was still carrying her offspring by the neck. At an age of three months the offspring were separated from their mother, and she was reunited with the male.

When beginning with this virtually unknown species we had been anticipating some difficulties but on the contrary, this species appears to be easy to maintain, and successful breeding in the first year gives some promise for the future. In the meantime, youngsters have also been reared in the Netherlands, so there is a possibility to build up a viable population in captivity.

**Curator of Carnivores, Poznan Zoo, 61-063  
Poznan, ul.Browarna 25, Poland**

## Recent publications

### Martens, sables, and fishers

Buskirk, S. W., Harestead, A. S., Raphael, M. G. & Powell, R. A. 1994. *Martens, sables, and fishers: Biology and conservation*. London: Cornell Univ. Press (Comstock Publ. Ass.). 484 pp. Price £53.95 or US\$ 65.00.

Works providing detailed accounts of any particular group of small carnivores are uncommon, and this is no less the case for the martens (*Martes* sp.). Furthermore, what little we do have in the way of scientific writing on this small, but interesting mustelid genus, has often tended to emphasise the genus' significance as commercially important furbearers.

Despite the fact that *Martes* has only just over a handful of species (usually either seven or eight, depending upon your inclinations and viewpoint), it is of disproportionate importance to various human interest groups. At the basic level of natural history and aesthetics, these are shy, intriguing creatures, that move with beauty and grace through the remote landscapes of the northern forest belt. At another level, *Martes* are furbearers of considerable economic significance, so that fishers (*M. pennanti*), American martens (*M. americana*) and sable (*M. zibellina*) are trapped intensively in some places. Furthermore, in both North America and Europe, martens are sometimes viewed as indicators of undisturbed, native, natural coniferous forests and, to a certain extent, of environmental "health". At the other end of the spectrum, *M. foina* (the stone or beech marten) seems to have adapted to modern times by becoming increasingly synanthropic, sometimes becoming something of a "pest". Whilst the stone martens inhabiting the roofs of Prague's Charles University are much approved of for controlling the numbers of pigeons and rats, the hunting of poultry, and the bizarre habit of gnawing rubber automobile parts, have made them less popular elsewhere.

Until now, anyone wanting to read about the biology and ecology of the martens at a serious level has had little option other than to search through the primary research literature, sorting the wheat from the chaff as they go. Moreover, research articles dealing with *Martes* are often published in specialised journals, such as those dealing with fur production, game biology, or wildlife management, rather than in journals of general zoology or even mammalogy. What's more, those of us dealing with Eurasian species may face the additional problem of a multilingual literature. Not any more, however. This is because *Martens, sables, and fishers* does manage to provide a broad-based appreciation of most aspects of the biology and ecology of the martens, and so represents a very welcome compilation indeed.

According to the editor's preface, the idea of this book came from a series of discussions held at the Symposium on the Biology and Management of Fishers and Martens, with articles being solicited from the authors deemed most suitable by the editors, and contributions then being "referenced" as a quality-control exercise. The final volume contains 30 articles by 57 authors, these being divided between seven sections, each with a brief introduction by the appropriate editor. Although it is obviously impossible to detail all of these contributions here, the seven sections are as follows: (1) evolution and biogeography - five papers including two paleoecological studies and one on sexual dimorphism; (2) population ecology - three papers (one on *M. foina*) on spacing, habitat use and vulnerability; (3) management of populations - seven papers dealing with various aspects of American marten and fisher population management, and including work on the effects of trapping, the success of translocations, age/sex determination, and population monitoring techniques; (4) status and conservation of Holarctic *Martes* - five papers, one on the Nearctic forms, the others on the former USSR (*tsuensis*); (5) habitat ecology - four papers (one on European species) that deal with habitat selection and nutritional ecology; (6) managed habitats - four papers, one on *M. martes* in Boreal Scandinavia, the other dealing with the effects of different aspects of

forestry practice; (7) physiology and reproduction - two papers, one on trade-offs between size and shape, the other being a review of reproduction in the genus. The entire volume is rounded off with a single set of references (over 50 pages in its entirety) and an index.

There are two ways to produce a book like *Martens, sables, and fishers*. The first is to provide the standard set of tired chapter headings that we are so used to seeing in zoological books (reproduction, feeding, habitat selection, relationships with man, etc.), each encompassing blow-by-blow accounts of how these differ in the various species. The alternative is to contact a range of folk active in research upon the beasties in question, and to then select topics for them in such a way that they write using their current and past experiences and pass these on to their colleagues. The danger in the first method is that the end-product is usually boring and list-like. The danger in the second is that, as you tend to be on best terms with people interested in similar things to yourself, the scope of the eventual coverage can be a little narrow, and some subjects may slip through entirely.

My personal view is that a volume of the first type would not have been successful here and that, despite the risks of strategy two, Buskirk *et al.* have done a good job on the martens. Having said that, there are gaps, as you might expect. Should you wish to know about marten diseases or parasites, you'll not get far with this volume, neither will you be able to find out much about their anatomy or physiology (with the exception of reproductive physiology). What you do get, however, is a clear picture of how different congeneric species interact with their environments, and how they respond to changes in those environments. This is much more useful from the point of view of the successful management of populations that are trapped for their pelts, or the conservation of those whose habitat is harvested for timber.

Again, if looking for criticisms, one could gripe about the slant towards Nearctic *Martes*, with comparatively little being said about the well-known European species, whilst the rarer species of marten are barely discussed at all. In all fairness, however, there has been more consolidated study of *M. americana* and *M. pennanti* within the last decade than there has upon any other *Martes* sp. and, as regards the poorly-known species, well, these really are very poorly known so there isn't really a great deal to say about them! Moreover, much of what has recently been learned about *M. americana* and *M. pennanti* can be extrapolated to the other species, and in this sense the book works well. The research discussed here is right up-to-date, and the bibliography (which is very comprehensive) can provide a pathway into any aspect of the biology of these animals that one might wish to pursue. Furthermore, the contributions by the three Russian authors provide a noteworthy insight into the work undertaken in the former USSR to date, and of which western scientists are usually completely ignorant.

This volume is very much a child of its time, and the content is clearly appropriate to the martens of the late 20th century. After all, this is the century that we all live in, and these are the martens that we wish to conserve. I am favourably impressed with this book and, if you have a serious interest in the biology of *Martes* (or in the general conservation biology of small carnivores) this book is well-worth acquiring. Perhaps the only real problem is the price, although I'm now reconciled to the fact that I sometimes (but increasingly often) must pay £50 to get an academic book that I really want. It is clear that *Martens, sables, and fishers* is not intended for students, but £50 still represents a substantial cost to many private purchasers. Despite this, I believe that *Martens, sables, and fishers* will represent an excellent investment for many people working in a variety of fields in wildlife conservation and management. Overall, I believe that Buskirk *et al.* have done well, and a contribution such as this is long-overdue, and very welcome.

(review by H. I. Griffiths)

# THE SPOTTED LINSANG, *Prionodon pardicolor*

Harry VAN ROMPAEY

The genus *Prionodon* Horsfield, 1824 comprises two species, *P. linsang* (Hardwicke, 1820) and *P. pardicolor* Hodgson, 1841, the latter first mentioned in 1841. Both belong to the family Viverridae and subfamily Viverrinae, but Thomas (1925) places *pardicolor* in the genus *Pardictis*. Aside from differences in coat pattern, Thomas also remarks on cranial differences; *P. pardicolor* has a shorter, more parallel-sided palatal tube, non-expanded ecto-pterygoids, and bullae with an annular, swollen anterior with a large meatus, but a comparatively small, less inflated posterior part. Ellerman & Morrison-Scott (1966) place *P. linsang* in the subgenus *Prionodon*, and *P. pardicolor* in the subgenus *Pardictis*.

## LOCAL NAMES

**Linsang pyauk** (Burmese; U Tun Yin, 1967); **Nam-laniao** (Kachin, used for all civets; U Tun Yin, 1967); **Suliyu** or **Silu** (Lepcha) and **Zik-chum** (Bhutan)(Blanford, 1888-1891)

## DISTRIBUTION AND STATUS

The spotted linsang (Fig. 1.) (also sometimes known as the spotted tiger civet), is widespread over much of south-east Asia but uncommon to rare throughout. Its range includes: eastern Nepal, India (Sikkim, Assam, and Bengal), Bhutan, north-eastern Myanmar (Burma), northern Thailand, Laos, northern Vietnam, and southern China (western Sichuan, Yunnan, Guizhou and southwestern Guangxi)(Fig. 2.).

CITES status: Appendix I

## Nepal

Hodgson (1841), in his description of the species, states that it is 'sufficiently common in the mountains of Nepal, though not until the last three years known to me as a denizen of them'. In 1847 he finds 'the species very numerous in the eastern half of the sub-Himalayas, or Nepal and Sikkim'. In the 1970s four observations were made in Chitawan National Park (Sunquist, 1982).

**Museum specimens:** Both the BMNH and SMF hold specimens from Nepal, but none have any specification of locality.

## India

### SIKKIM

**Museum specimens:** The FMNH holds specimens from Phadamchen, Lingtam, and Jeluk (Lunglung); the MNHU from Lachen and Gangtok; the BMNH from Mandili; and the FMNH from Phadamchen, Lingtam, and Jeluk [while Sanborn (1932) also mentions a specimen from Sedonchen]. Selater (1891) mentions a specimen from Gumpah held in the Indian Museum, Calcutta.

The Mammal Survey of India, Burma, and Ceylon (1914-15) collected specimens from Chuntang (=Tsunthang), Dikchu, and Singhik (5 km north of Dikchu) (Wroughton, 1916a).

In the 1880s it was not considered rare in Sikkim (Blanford, 1888-1891). In the 1980s a specimen was caught in Lachung (Schreiber *et al.*, 1989; Anon., 1989).



Fig. 1. Spotted linsang (*Prionodon pardicolor*) from Vietnam. Photo by K. Baranauskas.

### ASSAM

**Museum specimens:** The BMNH holds a specimen from Dening (Mishmi Hills) (Hinton & Lindsay, 1926) and the FMNH has one from Karong.

### BENGAL

Jerdon (1874) collected a specimen from Darjeeling and Selater (1891) mentions two specimens from this area held in the Indian Museum, Calcutta.

### MANIPUR

Ramakantha (1994) reports the sighting of specimens in the forests of Jiribam-Tamenglong, and a possible sighting in the Shiroy-Karom Hill ranges of Ukhrul District.

## Myanmar (Burma)

**Museum specimens:** Thomas in 1891 mentions a specimen from Meteleo and in 1921 two specimens from Kachin Province in the collection of the Bombay Natural History Society. Selater (1891), cites a specimen from the Kakhien Hills in the Indian Museum, Calcutta. The AMNH holds specimens from Magwe and Hpawshi, near Gangfang (Anthony, 1941).

The Mammal Survey of India, Burma and Ceylon (1914-15) collected a specimen in the Chin Hills, 80 km west of Kindat (Wroughton, 1916b). U Tun Yin (1967) mentions five skins, collected in 1939 by R. Kaulback, from Nam Tamai Valley, Taron Valley, and Ratnampti in Myitkyina District (in BMNH). A skin, collected by Lord Cranbrook in 1931 in Jite, Tibet, is thought to have originated in Burma.

## Thailand

**Museum specimens:** The NMNH has a specimen from Lory Province.

The species is near its southern distributional limit in Thailand, and is considered to be very rare and localised (Lekagul & McNeely, 1977). The occurrence of the spotted linsang has not

been reported in any of Thailand's 'reserved areas' and there are few established reserves in the northern parts of Thailand where the species occurs (Humphrey & Bain, 1990). The Thai law, WARPA (Wild Animals Reservation and Protection Act, 1980, prohibits hunting, and regulates trade in this species.

## Laos

**Museum specimens:** The BMNH holds a specimen from Xieng Khouang (Thomas, 1927).

A specimen was observed in 1994 in the Nam Theun National Biodiversity Conservation Area in the Annamatic Mts of central Laos (Evans *et al.*, 1994)

## Vietnam

Thomas (1925) describes a new subspecies from a specimen from Ngai Tio, near the Vietnam-China border.

**Museum specimens:** The BMNH holds specimens from Chapa, Bac Kan, and Bao Ho; the FMNH and MCZ from Chapa; and the MNHN from Bac Kan and Hanoi (Thomas, 1928).

Pham-chong-Ahn (1980) found the species to be uncommon in northern Vietnam but, according to Vietnamese zoologists, the species may still have been common in 1988 as it was occasionally offered for sale in markets (Schreiber *et al.*, 1989).

## China

Shih (1930) mentions specimens from the Loshang and Chinsiu Districts, and Yaoshan in Guangxi Province. Li Guiyuan (1965) reports the spotted linsang from Sichuan. A single specimen has been captured on Mt. Ailao in central Yunnan Province (Schreiber *et al.*, 1989).

**Museum specimens:** The MNHU holds a specimen from Yaoshan, Guangxi Province. Searle (1991) mentions two mounted specimens in the museum of the Ba Bao Shan Reserve, Guangdong Province.

## HABITAT

Occurs in primary and secondary forests at elevations between 150 and at least 2,700 m ASL. In the Chitawan National Park in Nepal it was observed in a mosaic of lowland riverine forest and tall, dense grassland, as well as in an area of sal (*Shorea robusta*) forest interspersed with dense grasses (Sunquist, 1982). In Vietnam it occurs in moist, mixed and bamboo forests, and along mountain rivers (Pham-chong-Ahn, 1980).

A captive specimen spent about 85% of its time at heights of up to 1 m. This, together with its appearance (long tail, structure of the claws, colouration) and habits, seems an indication that it mainly inhabits the lower shrub layer (Kuznetsov & Baranaukas, 1993).

## DESCRIPTION

The spotted linsang resembles the banded linsang in its long, slender body, short limbs, elongated neck and head, and long tail. The ground colour ranges from dusky brown to bright buff. Two long stripes extend from behind the ears to the shoulders or beyond and two shorter stripes run along the neck. Three to four longitudinal rows of spots adorn the back; their size decreasing towards the belly. The fore legs are spotted to the paw.

the hind leg to the hock. The cylindrical tail has eight or nine broad, dark rings, separated by narrow, white rings. The feet have five digits and the area between the pads is covered with hair. The claws are retractile; claw sheaths are present on the fore-paws, but the hind-paws have protective lobes of skin. The pupil is vertical (Gray, 1869). Extensive descriptions of the rhinarium, ear, and feet are given by Pocock (1915).

The absence of scent glands in both sexes, the shortness of the perineal area, and the highly specialized dentition made Pocock (1933) place the genus *Prionodon* in the subfamily Prionodontinae.

The dental formula is I 3/3, C 1/1, P 4/4, M 1/2 = 38. M<sup>2</sup> is absent (in all of the 16 specimens examined). The teeth are described in detail by Pocock (1939).

A description of the brain is given by Radinsky (1975), and it weighs ca. 9 g (Gittleman, 1986).

Mean body lengths (in mm) and weights (in g) of six Vietnamese specimens (Pham-chong-Ahn, 1980)

	females (n=3)		males (n=3)	
	mean	range	mean	range
Head & body	355	310-380	424	397-450
Tail	336	300-375	373	345-399
Ear	32	25-36	30	25-34
Hind foot	55	45-65	68	65-75
Weight	583	550-650	1,173	1,100-1,220

Males would seem to be twice as heavy as females, whereas males of the banded linsang (*Prionodon linsang*) are only slightly larger than females (Van Rompaey, 1993).

The mean condylobasal length of the skull of 13 males was 68.8 mm (SD: 1.7; range: 65.1-71.1) against 64.7 (SD: 1.2; range 63.0-66.5) for 6 females. Although there is some overlap, sexual dimorphism is considerably greater than in *P. linsang*.

## HABITS

According to Hodgson (1842) 'the animals are said to have the manners of cats, to spring and climb with great power, to prey on small mammals and birds, and to frequent trees much in search of the former, as well as for shelter'. Little information has been added in the 150 years since Hodgson made these remarks. 'It is nocturnal, seems equally at home on trees and on the ground, and is considered as solitary; it dwells in hollows of decayed trees and is not gregarious at all' (Hodgson, 1847).

*Prionodon* has a bipedal stance, a walk-stretch, an arched-back stretch, and does bilateral head wiping (Wemmer, 1977). It does a 'head first' vertical descent, and has digitigrade hind feet and plantigrade fore feet (Taylor, 1988).

Kuznetsov & Baranaukas (1993) found the activity of a captive female to be of the polyphasic type, but she was most active at night. In an average 24-hour period she was active for 7.8 hours (32.5%), and passive (resting or sleeping) for 16.2 hours (67.5%). Territory was marked with urine and faeces. If startled, she squeaked, whilst 'drumming' with one fore-paw on the substratum. Jumps up to 1 m were observed. Small prey (mice and voles) were killed with a bite to the neck; larger prey (rats) were leaped upon, and killed whilst lying on her side.

## FOOD

According to Hodgson (1847) 'it preys chiefly on small birds, upon which it pounces from the cover of the grass'.

Pham-chong-Ahn (1980) found the remains of rodents, frogs, and snakes in the stomachs of six specimens examined in Vietnam. On three occasions a spotted linsang was seen feeding on the carcass of a tiger kill in Chitawan national Park, Nepal, indicating that the species is an opportunistic carnivore (Sunquist, 1982). It forages both in the trees, and on the ground.

A captive 600 g female ate, on average, about 100 g of food (equivalent to four Yellow-necked mice, *Apodemus flavicollis*, or six Bank voles, *Clethrionomys glareolus*), and digested 76.5 % of its prey. Its favourite food was small passerine birds which were eaten almost completely, except for the wingfeathers and the stomach. It always ate on the floor, did not hide food remains, and only rarely returned to them (Kuznetsov & Baranaukas, 1993).

## REPRODUCTION

*P. pardicolor* has two pectoral and two inguinal teats (Hodgson, 1847). According to Hodgson (1841, 1847) the 'times of breeding are said to be February and August, and the litter consists of two young twice a year'. In late February 1975 an adult male and an adult female fell into a well in Chitawan National Park in Nepal, and drowned. Such a close association suggests that mating activity was involved (Sunquist, 1982). A pair in Dusit Zoo (Bangkok, Thailand) was reported to have had a third litter (Nabhitabhata, 1990). In 1991 Hong Kong Zoological & Botanical Gardens held 4.2 *P. pardicolor*, of which 2.1 were born there (although 0.1 was conceived in the wild) (Searle, 1991).

## PARASITES

A flea *Xenodaeria telios telios* Jordan, 1932 was described from a specimen from Sikkim (Li Kueichen *et al.*, 1978).

## CAPTIVITY

According to Hodgson, who had a tame female, it was 'wonderfully docile and tractable, very sensitive to cold and very fond of being petted'. It was fed on raw meat, but refused fish, eggs, and fruits. It never uttered any sound, and was perfectly free from any odour (Hodgson, 1847).

Few spotted linsangs have been held in captivity. It has occasionally been kept in zoos, including those at Frankfurt (Germany) and Houston (USA). In 1987, only Bangkok Zoo and Hong Kong Zoo were known to have specimens. In 1994 a single individual was held in a private zoo at Lac Sao, Laos (Evans *et al.*, 1994).

## FOSSIL RECORD

*Prionodon* and the fossil genus *Palaeoprionodon* of the European Upper Oligocene (Teilhard de Chardin, 1915), both exhibit somewhat advanced carnassial specialization: a long metastyle blade on  $P^4$ ,  $M^1$  much smaller than  $P^4$ , and  $M^1$  with the talonid reduced or vestigial (Gregory & Hellman, 1939).

## TAXONOMY

### *Prionodon pardicolor pardicolor* Hodgson, 1842

*Prionodon pardicolor* [sic] Hodgson, 1842. Calcutta J. Nat. Hist., 2:57. Cotypes: BM-43.1.12.10 and BM-43.1.12.11. Type locality: Nepal.

*Viverra perdicator* Schinz, 1844. Syn. Mamm., 1:366. (Error for *pardicolor*)

*Prionodon pardochrous* Gray, 1863. Cat. Hodgsons Coll. BM, p. 4, *nom. nud.*

Distribution: Nepal to northern Myanmar (Burma)

### *Prionodon pardicolor presina* Thomas, 1925

*Pardictis pardicolor presina* Thomas, 1925. Proc. Zool. Soc. London 1925:499. Holotype: male skull and skin from Ngai-Tio (4,800' ASL), BM-25.1.1.33.

Distinguished from *P. p. pardicolor* by its greater size, slightly narrower lines, smaller spots, distinctly paler groundcolour (especially below), and a tail with dark rings less developed in proportion, not broader than the pale ones and more clearly tending to be broken along the ventro-medial line (Thomas, 1925). Osgood (1932) considers it a synonym of the nominotypical subspecies, and Corbet & Hill (1992) also found regional differences to be slight and that any variation was probably continuous. Pocock (1932), on the other hand, found that, because of the lighter colour and smaller, more oval, and less lineally arranged spots, *presina* may be retained as a valid subspecies.

Distribution: Thailand, Laos, Vietnam, and China.

## ACKNOWLEDGEMENTS

I would like to express my gratitude to R. Angermann (MNHU, Berlin), W. Fuchs (AMNH, New York), D. Hills (BMNH, London), H. Kafka (NMNH, Washington), J. Kerbis Peterhans (FMNH, Chicago), M. Rutzmoser (MCZ, Cambridge, Mass.), G. Storch (SMF, Frankfurt), and M. Tranier (MNHN, Paris) for graciously allowing me to study specimens in their museums.

## GAZETTEER

**Abbreviations:** ASS: Assam, India; BUR: Burma (Myanmar); BEN: Bengal, India; CHI: China; LAO: Laos; MAN: Manipur, India; NEP: Nepal; SIK: Sikkim, India; THA: Thailand; VIE: Vietnam;

Ailao, Mt., Yunnan, CHI, ca. 23°N, 101°E; Ba Bao Shan, CHI, ca. 25°40'N, 113°E; Bac Kan, VIE, 22°09'N, 105°50'E; Bao Ha, VIE, 22°10'N, 104°22'E; Chapa, VIE, 22°21'N, 103°50'E; Chitawan National Park, NEP, 27°30'N, 84°20'E; Darjeeling, BEN, 27°02'N, 88°20'E; Dening, Mishmi Hills, ASS, 28°00'N, 96°17'E; Dikchu, SIK, 27°26'N, 88°40'E; Gangtok, SIK, 27°20'N, 88°39'E; Gumpah, SIK, --; Hanoi, VIE, 21°01'N, 105°52'E; Hpawshi, BUR, ca. 26°05'N, 98°35'E; Jeluk, Lunglung, SIK, --; Jiribam-Tamenglong area, MAN, ca. 24°45'N, 93°00'E; Kachin Province, BUR, 28°10'N, 97°30'E and 28°50'N, 97°25'E;

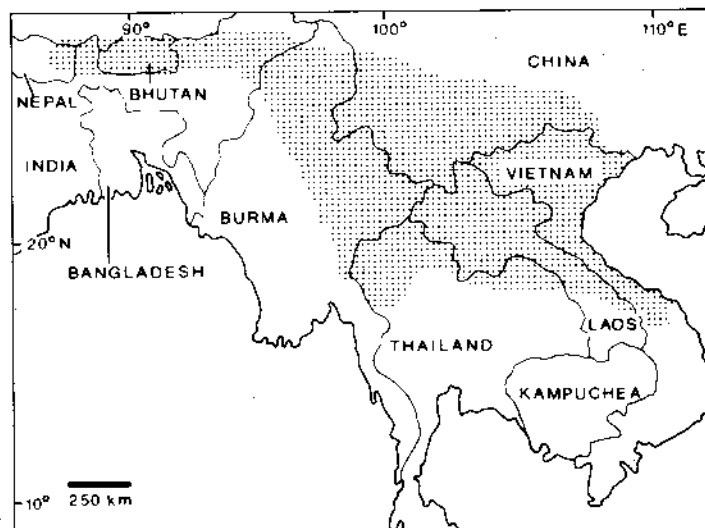


Fig. 2. Approximate distribution of the Spotted linsang (*Prionodon pardicolor*)

Kakhyen Hills, CHI, --; Karong, ASS, 25°18'N, 94°05'E; Kindat, BUR, 23°42'N, 94°29'E; Lachen, SIK, 27°46'N, 88°36'E; Lachung, SIK, 27°42'N, 88°48'E; Lema, SIK, --; Lingtam, SIK, --; Lory Province, THA, --; Magwe, BUR, 20°08'N, 94°55'E; Mandili, SIK, --; Meteleo, BUR, --; Mishmi Hills, ASS, ca. 28°25'N, 95°50'E; Myitkyina, BUR, 25°24'N, 97°25'E; Nam Gamai Valley, BUR, 27°42'N, 97°54'E; Ngai Tio, VIE, 21°48'N, 103°56'E; Phadamchen, SIK, --; Sedonchen, SIK, --; Tsunthang (former Chungtang), SIK, 27°38'N, 88°35'E; Xieng Kuang, LAO, 19°21'N, 103°23'E; Yaoshan, CHI, 36°58'N, 106°10'E.

#### MUSEUM ABBREVIATIONS

**AMNH:** American Museum of Natural History, New York, NY, USA **BMNH:** The Natural History Museum, London, UK **FMNH:** Field Museum of Natural History, Chicago, IL, USA **MCZ:** Museum of Comparative Zoology, Cambridge, MA, USA **MNHN:** Musée National d'Histoire naturelle, Paris, France **MNHU:** Museum für Naturkunde der Humboldt-Universität Berlin, Berlin, Germany **NMNH:** National Museum of Natural History, Washington, D.C., USA **SMF:** Forschungsinstitut & Naturmuseum Senckenberg, Frankfurt am Main, Germany.

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Jan Verbortlei, 15, 2650 Edegem, Belgium



# Stone marten (*Martes foina*) in southeast Wisconsin, U.S.A.

Charles A. LONG

A feral population of the Stone marten (*Martes foina*), native to western and southern Europe and ranging eastward into Manchuria and Mongolia, is now established near the urban centers surrounding Milwaukee, Wisconsin. The martens occur in several more or less wooded (white oak *Quercus alba*, bur oak *Q. macrocarpa*, sugar maple *Acer saccharum*, basswood *Tilia americana*, and shagbark hickory *Carya ovata*) uplands and wild areas in the Kettle Moraine State Forest, and in nearby woodlands of Walworth, Racine, Waukesha and probably Jefferson counties. Two exact localities include uplands at Lulu Lake, seven miles south of Eagle, in Walworth County, and Clover Valley, township of Whitewater, Walworth County. I have in hand photos of one mounted specimen from Park Headquarters, Kettle Moraine, a photo of a live-trapped specimen, and a picture of a marten photographed overhead in the tree canopy. In addition to this mount, Spencer Chapman has a taxidermy mount of a marten from Lulu Lake, town of Troy, Walworth County, an adult male, and there is a frozen marten in the museum at the University of Wisconsin - Madison (Frank Iwen, in litt.).

Chapman told me he caught two last fall; one he released and the other specimen is the mounted male. George Bowman collected the marten in Clover Valley killed on the road, also last year. Ron Kurowski, Park Naturalist, reports (in litt.) a number of observations in the forest over the past few years. He believes the martens are breeding in the forest, mostly in Waukesha County. Mark Anderson (in litt.) mentioned about 20 carcasses brought into Wisconsin Department of Natural Resources for identification, in the past two years. Tom Becker, DNR Supervisor, confirmed the abundance of stone martens back over a period of years, perhaps even as early as the 1940s when a private fur farm in Burlington released the martens into the wild. Others have suggested about 1972 as the time of introduction or a few years earlier. Other trappers known to have collected martens include Don Gregoire of Whitewater and Pete Greeley from this three-county area.

Hoffmeister (1967) reported a feral stone marten from Blackberry Creek near Sugar Grove, Illinois, about 80 km south of Walworth County. Taken in 1965, this Illinois marten also may have dispersed from the Burlington game farm.

Stone martens often live near human habitations, nesting in rock piles, attics, hollow trees, and occasionally bird nests (Cavallini & Mazzoni-Della Stella, 1992; Ognev, 1931; and others), sometimes dwelling in unforested land. In southeast Wisconsin, where much wilderness was devastated by heavy land use, the stone marten may persist in proximity to human populations.

The stone marten seems established (for at least 20 years), is probably breeding naturally in woodlands and the State Forest, ranges throughout three counties and probably into Jefferson County as well, has raised no ecological problems yet, and if it kills cats (*Felis catus*) that may even favor songbirds. The fur is worth little on the market at present, and observed mortality is caused by trapping and automobiles. At present the species is not protected in Wisconsin.

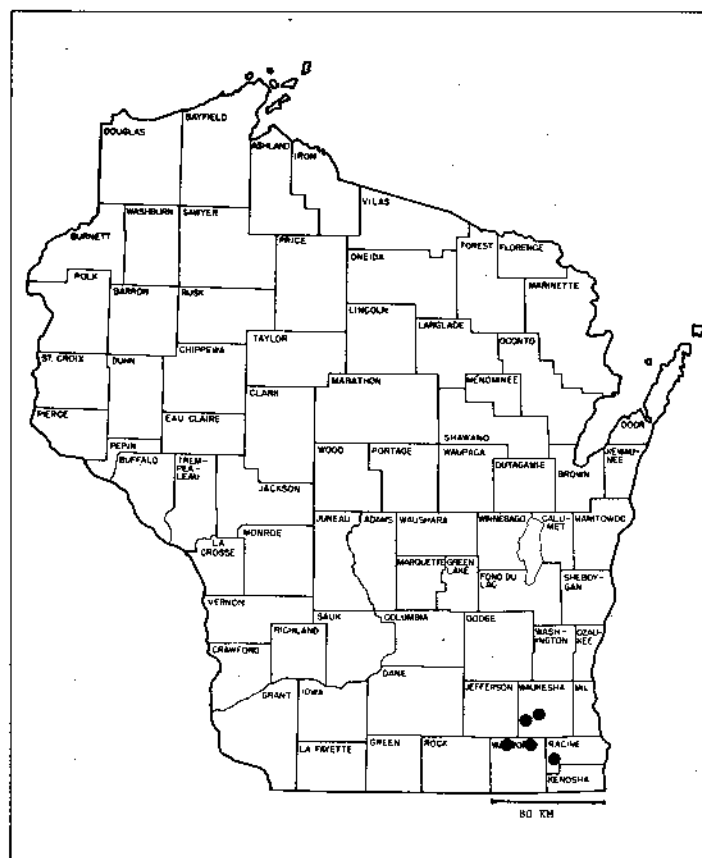


Fig. 1. Distribution of the Stone marten (*Martes foina*) in Wisconsin, USA

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**Departments of Biology & Wildlife Management,  
Curator Museum, University of Wisconsin -  
Stevens Point, Stevens Point, WI 54481, USA**

## Information wanted

I am planning a study on the effects of hunting on the population structure of *Nasua nasua*. Up to now I have no bibliography on this species and for this reason I am requesting information on, and addresses of other researchers working on related subjects.

We are also working on a review of all that is known at present about *Galictis*. References and, if possible, copies of papers would be appreciated.

Please contact: Ms Teresa Tarifa, Casilla 5597, Correo Central, La Paz, Bolivia.



# How to recognise mink: towards a biological test? (Preliminary results)

Marc ARTOIS<sup>1</sup>, Claudine MONTGELARD<sup>2</sup>, and Anne-Marie BAUTZ<sup>3</sup>

One of the causes put forward to explain the disappearance of the European mink (*Mustela lutreola*) is competition with American mink (*M. vison*) which have returned to the wild. The selective capture and elimination of feral mink could help the native species to survive. This fact means that it is necessary to devise an efficient test to discriminate between the two in order to tell the two species apart. Several criteria usually enable us to do so (when the animal is available for direct study) e. g. the absence of a white edging to the upper lip in the feral mink, and the biometry of the skull and baculum. On the basis of such criteria it appears that the European mink is present, but declining noticeably south of the River Loire, into Spain, and along the Atlantic coast. The situation is less clear north of this limit, particularly in Brittany which was invaded by a colony of escaped feral mink. The survival of the European mink in this zone depends on the delimitation of those sectors where they are still present, followed by elimination of the feral American mink.

In the southern part of the area in France, it is still possible to make mistakes in the recognition of the different species, especially when individual animals bear unusual markings.

The work presented here is one of the first stages of an overall study that aims to:

- define the distribution of the two species
- give trappers a definite means of recognising the animal they have in their trap.

At our present state of knowledge the latter is not always possible. We thus set out to study the feasibility of a biological test which would allow us to distinguish between the two species definitely.

According to Corbet (1978), the Russian subspecies of the European mink is superficially similar to the feral mink. However, the work of Soviet authors (Graphodatsky *et al.*, 1976) shows considerable differences in the karyotypes of the two species. This agrees with the results of Couturier & Dutrillaux (1986) which show that the karyotype of the feral mink is quite remote from that of other Mustelidae, in particular the ferret (*M. putorius furo*). Within the *Mustela* species group, the American mink (*M. vison* Schreber, 1777) appears to be quite distinct from the other species (*M. lutreola* Linnaeus, 1761, *M. putorius*, *M. siberica*, etc.). We thus deduce that possible hybridisation events between the two species are unlikely and would result in sterile offspring.

A more recent review of the classification of carnivores (Wayne *et al.*, 1989) based on the use of various molecular techniques, observed molecular divergences between three species of *Mustela* (*M. frenata*, *putorius*, and *vison*) of between 2.5 and 4.5%, which places them at between 5 and 10 million years (but only if we accept that the time of divergence is placed correctly on the molecular time-scale for Carnivora). We can think, therefore that in general there is a considerable degree of genetic difference between the two species, and that it will not be too difficult to demonstrate this by means of appropriate techniques.

This interim report presents the results obtained from two biological techniques: protein electrophoresis and immunology. For the purposes of comparison, the tests were not only carried out on the two species of mink, but also on the ferret (*M. putorius furo*).

## Experimental animals

Six captive-bred ferrets and six American mink, and also one wild female mink (captured on the River Ciron under the authorisation of the French Ministry of the Environment). The animals were kept in cages held at the Research Station of the CNEVA Nancy in Atton for the period of the tests.

## Methods

**SDS acrylamide gels:** Blood was collected in a heparinised tube and diluted with an equal volume of a 8.5% solution of NaCl and then centrifuged. A sample of the plasma was then taken and diluted in a buffer solution. The proteins were measured, precipitated and then submitted to electrophoresis. The residue of red corpuscles was treated in the same way.

**Immunological test:** The principle of this test is based on the specificity of the reaction between antibodies and the antigen towards which they are exposed. The marker used was albumin. The immunological technique we used was the dot-blot test. This involves placing a drop of serum (containing albumin) from the animal to be tested onto a sheet of cellulose nitrate. The latter is then incubated in different solutions, eventually giving a coloured reaction in the case of a positive test (Fig. 1).

## Results

Only plasma proteins showed any differences. Examination of the acrylamide gels (Fig. 1) showed the existence of a protein band which was clearly visible at 16 kD in the ferret/European mink group. This band is practically non-existent in feral American mink.

For high molecular masses, the ferret/European mink group shows a band of 180 kD, whereas feral mink show two: one at 205 kD and one at 175 kD. Similarly, the dense band of 28 kD

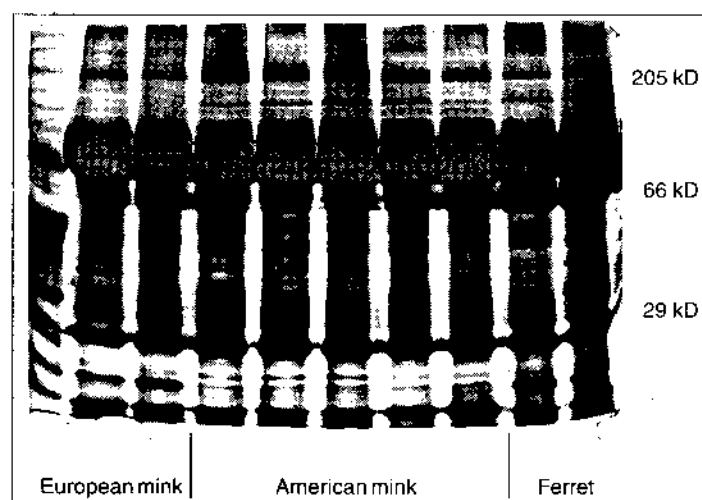
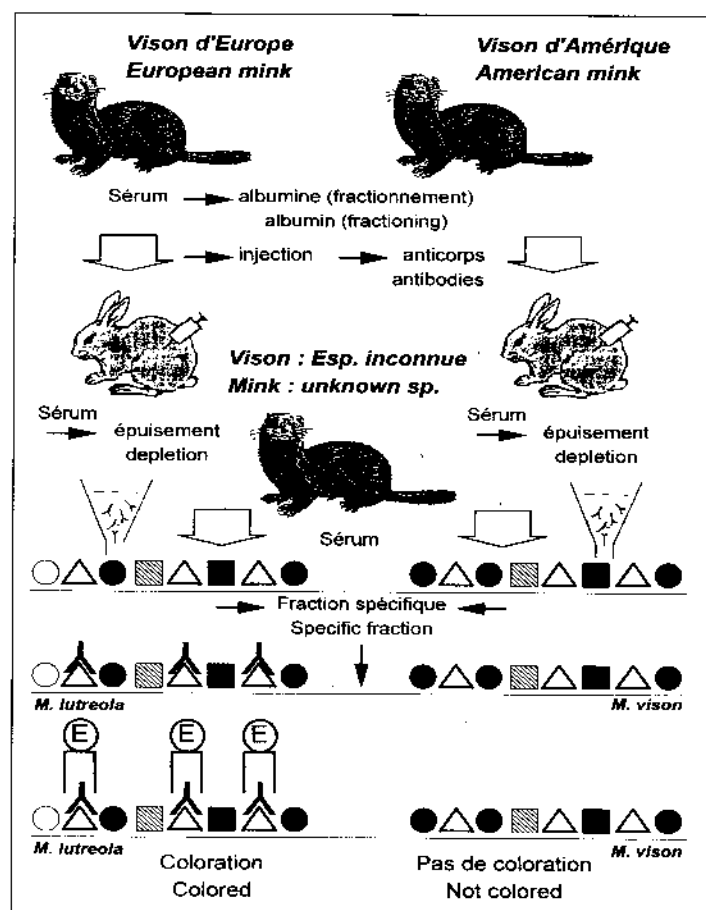


Fig. 1. Electrophoresis on acrylamide gels.



observed in the ferret/European mink group is replaced by two fine bands (at 56 and 60 kD) in feral American mink.

Making any distinctions within the ferret/European mink group would appear to be fairly difficult, however, it may be noted that between 100 and 205 kD mink, whether European or feral, show several bands which do not exist in the ferret, notably one at 125 kD.

The results obtained with ELISA using two depleted sera (one serum per mink) showed a reduction in reactivity by a factor of ten when heterologous albumin was compared to homologous albumin. In Western-blot and Dot-blot tests, this reduced reactivity is expressed as a near-absence of colouration when the depleted serum is added to the heterologous albumin (Diagram). The distinction between the two species would thus seem satisfactory.

## Conclusion

The results obtained at this stage of the study confirm the hopes invested in the techniques chosen: distinction between the two species of mink should be possible with both tests.

On the other hand, in the case of confusion occurring between mink and polecat, there is a definite risk of not being able to tell the two species apart.

These satisfying results must now be confirmed using samples from different individuals in order to measure the individual variability of the chosen criteria in *Mustela lutreola*. If such experiments prove to be satisfactory, it will then have to be determined which of the two techniques is the more easy to use in practical terms. Studies must be pursued in order to improve this new aid to European mink conservation, mainly by the addition of further samples from wild- or captive-born European mink.

## Acknowledgements

The authors would like to thank the DNP (Direction de la Nature et des Paysages), the EGP (Ecologie et Gestion du Patrimoine Naturel), the National Game Agency, and the Ministry of the Environment for their technical and financial aid, which was supported within the framework of the French Observatory for Mink.

We are particularly indebted to the guards of the ONC (Office National de la Chasse) for the capture of wild mink.

Mrs. Bailly (CNEVA Nancy) and her colleagues were responsible for the daily care of the mink during the study period. The French Society for the Protection of Mammals kindly agreed to deal with the administration of the contract, thanks to the dedication of its treasurer H. Maurin.

This work is dedicated to the memory of Mrs. M. C. Saint-Girons, president of the French Society for the Study and Protection of Mammals, who managed the Observatory of Mink in France with great enthusiasm, and who encouraged this study.

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<sup>1</sup>CNEVA Nancy, Domaine de Pixérécourt, B.P. 9, 54220 Malzéville, France

<sup>2</sup>Institut des Sciences de l'Evolution, Laboratoire de Paléontologie, Place Eugène Bataillon, 34095 Montpellier CEDEX, France

<sup>3</sup>Faculté des Sciences, Biologie de la Différenciation, B.P. 239, 54506 Vandœuvre Les Nancy CEDEX, France

## Zoo Animal Behaviour & Welfare

"Zoo Animal Behaviour and Welfare" will be held at Edinburgh Zoo on weekdays from Monday 15 July to Friday 26 July 1996. The closing date for registration is 31 May 1996.

The 1996 course will see the addition of a specialist veterinary module on 20 and 21 July, where veterinarians from The University's Royal (Dick) School of Veterinary Studies will update participants on the latest veterinary techniques.

For further information and details of registration, please contact: Hamish Macandrew, UnivEd Technologies Ltd, FREEPOST, 16 Buccleuch Place, Edinburgh, EH8 0LL, UK. Tel: 0131 650 3475 Fax: 0131 650 3474.

# Conservation implications of hybridisation between mustelids and their domesticated counterparts: The example of Polecats and feral Ferrets in Britain.

John M. LYNCH

Animal taxa frequently display natural hybridisation that yields fertile and viable hybrids (Templeton, 1989). The parent taxa are often recognised as separate species on the basis of their distinct morphologies and independence of their paths of genetic evolution. Thus, many animal species are members of syngameons, just as many plants are (Grant, 1981). Templeton (1989) defines a syngameon as 'the most inclusive unit of interbreeding in a hybridising species group' a category similar to the *Rassenkreis* (Rensch (1959)). Within these syngameons, demographic and ecological processes become increasingly important in defining 'species', more so than the usual morphological and genetic parameters utilised in conventional taxonomy. Gene flow between the 'species' may be slight or extensive, and their continued existence depends on ecological vicariance, occupying stable and distinct local habitats. If such a patchy environment is destroyed and replaced by a different ecosystem, the separate 'species' usually fuse through hybridisation. In spite of this potential for hybridisation, many of the taxonomic units within these groups represent real biological units in a morphological, ecological, genetic and evolutionary sense.

As researchers (e. g. Templeton, 1989; Harrison, 1990; Brombridge, 1992) note, the presence of syngameons presents difficulties for the traditional biological species concept (Mayr, 1942). The difficulties presented by this phenomenon are not, however, restricted to the realm of biological theory. Hybridisation can present particularly acute problems for conservation biologists. In particular, the release (whether accidental or intentional) of captive animals allows contact between members of a syngameon which may have been separated by geographical distance. This is particularly evident where wild carnivores come to contact with feral members of their domesticated congeners. Such hybridisation also leads to problems for legislators attempting to implement endangered species programs. For example, there has been a great deal of discussion surrounding the specific status of the Red wolf (*Canis rufus*). This has led to discussion as to the status of hybrid populations in general under the U. S. Endangered Species Act, with authors supporting and denying such populations protection under the Act, or indeed arguing about the methods for detection of hybrid animals (Fergus, 1991; O'Brien & Mayr, 1991; Wayne & Jenks, 1991; Dowling *et al.*, 1992a, b; Nowak, 1992; Phillips & Henry, 1992; Wayne, 1992; Ranker & Arft, 1994; Jones *et al.*, 1995).

Hybridisation also occurs between mustelid species, for example members of the Polecat (*M. putorius*) group. There are three wild polecat species -the European polecat, the Steppe polecat (*M. eversmanni*) and the Black-footed ferret (*M. nigripes*). While the latter form is confined to the mainland United States, the specific status of the first two (Eurasian) forms has long been debated and the question as to which of them is the ancestor of the domesticated ferret has been the subject of a number of studies. The two Eurasian forms have been considered conspecific (e. g. Ellerman & Morrison-Scott, 1951), but current opinion in Eastern Europe and Russia (where the two species are sympatric) is that they are separate species, which is backed up by karyological evidence (Blandford, 1987).

There is, however, evidence for hybridisation between both species where they are sympatric (Novikov, 1962; Grafodatskii *et al.*, 1978). The ferret (*M. p. furo*) is a domesticated form of uncertain origin, derived from either *M. putorius* or *M. eversmanni* or possibly both (Rempe, 1962). Recent studies of cranial variation between polecats, ferrets, steppe polecats and known polecat x ferret hybrids have shown that hybrids, *M. p. furo* and *M. eversmanni* specimens cluster together, perhaps indicating a mixed origin for the ferret (Fig. 1; see in addition, Lynch, 1993). This idea may be supported by the mosaic of characters that the ferret appears to have, being craniologically similar to *M. eversmanni*, yet karyologically identical to *M. putorius* (Ashton & Thompson, 1955). As Clutton-Brock (1992) notes, domestication is both a cultural and biological process, and it is not inconceivable that breeders utilised different wild stocks to obtain a 'better' ferret.

Domestication can be defined as the adaptation of animals to environmental circumstances defined by humans (Kohane & Parsons, 1989). In general, new characters are rarely produced, but existing ones are selected for (Berry, 1969). The skull of the ferret is a version of that of the polecat in which the palatal (and facial) region is foreshortened and the post-orbital constriction, zygoma, and mastoid region narrowed (Lynch, 1993). Similar differences occur between feral and farmed American mink (*M. vison*) (Lynch & Hayden, 1995). It may thus be possible that, upon escape from captivity, ferrets may return to a 'wild-type' skull as exemplified by that of the polecat, an idea originally proposed by Pocock (1932). This would lead to the conclusion that, if like mink (Lynch & Hayden, 1995), feral ferrets return to wild-type colouration after a number of generations in the wild (as found by McCann, 1956; Lavers & Clapperton, 1990), it would be practically impossible to phenotypically distinguish feral ferrets, polecats and their hybrids using coat and cranial characters.

The early history of the polecat in Britain is poorly documented, although historical evidence points to the species being widely distributed and abundant (Langley & Yalden 1977). Despite various pressures, populations maintained themselves until the middle of the 19th century, when numbers fell and their range contracted. This decline was correlated with an increase in the development of sporting estates rather than the decline in woodland (Langley & Yalden, 1977). The last record for Scotland was in Sutherland in 1912 (Ritchie, 1920). A few isolated populations may have survived in England until the 1930s, with the species flourishing in central Wales and the Marches. The First World war relieved persecution by gamekeepers and marked the beginning of the recovery of the polecat (and indeed the wildcat *Felis silvestris* and Pine marten *Martes martes*). The future of the species seems assured, with a dramatic population expansion from Wales resulting in 'polecat-like' animals appearing in the West Midlands (A. C. Kitchener, pers. comm.). However, these animals may turn out to be feral ferrets or introgressive hybrids between polecats and ferrets. Initial morphological studies (Pratt, 1995) indicate that these may indeed be 'pure' polecats, and further investigations are currently underway (Lynch, Kitchener & Pratt, unpubl.).

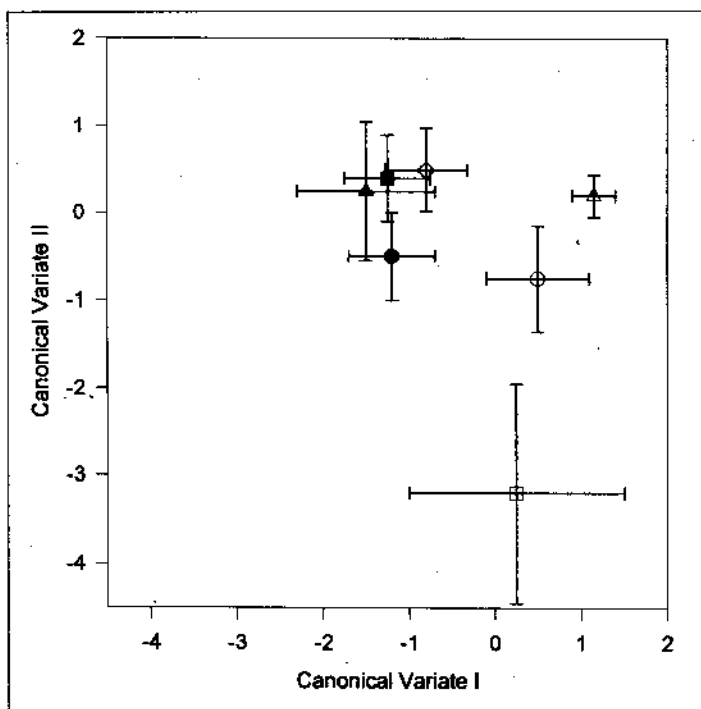


Fig. 1. Separation of *Mustela putorius* group specimens, on the basis of two canonical variates derived from six cranial measurements. The separation is highly significant (Wilks'  $\Lambda=0.174$ ;  $F_{(6,520)}=7.07$ ;  $P<0.0001$ ). Key: open triangle, Welsh polecats ( $n=55$ ); open circle, European polecats ( $n=13$ ); open square, Scottish polecats ( $n=3$ ); open diamond, polecat x ferret F1 hybrids ( $n=7$ ); closed circle, English ferrets ( $n=23$ ); closed square, Scottish ferrets ( $n=22$ ); closed triangle, steppe polecats ( $n=7$ ). All points represent group means with 95% error bars. Further details can be found in Lynch (1993).

The systematic status of the now-extinct Scottish polecat *M. p. caledoniae* remains uncertain. Tetley (1939) described the subspecies on the basis of one female and three male specimens, collected in Sutherland over a two year period in the early 1900s. These specimens are believed by some to be escaped ferrets or hybrids (Dadd, 1970; Blandford, 1987). Recent craniometric studies indicate the specimens to be morphologically unique, showing little affinity to ferrets, having relatively large bulky skulls with a disproportionally broad interorbital area (Lynch, 1993). It may be that the specimens represent the remains of the last surviving polecat population in the area, and may have undergone extensive cranial modification due to hybridisation or inbreeding. An examination of the genetic status of the *M. p. caledoniae* specimens using DNA fingerprinting of genetic material in bone may prove enlightening, and further morphological studies are currently underway (Lynch, Kitchener & Pratt, unpubl.).

The degree to which polecats, ferrets, and steppe polecats resemble each other morphologically and genetically may be indicative of the need to clarify the systematics of this group - which in the broadest sense form a syngameon. Ongoing genetic and morphological studies are examining the relationship between 'species' in this syngameon and hybridisation between *M. putorius* and *M. p. furo* in Britain (H. I. Griffiths, pers. comm.; Lynch, Kitchener & Pratt, unpubl.). There is a definite need to follow the morphological, genetic and behavioural changes that occur when previously captive ferrets become feral, and to assess their effects (if any) on resident polecat populations. As Clutton-Brock (1992) notes, domestication is a form of evolution. Similarly, hybridisation is not always a negative evolutionary force (Smith, 1992; De Marais *et al.*, 1992; Geist, 1992; Grant & Grant, 1992, 1994). Introgression between feral ferrets and polecats may be an evolutionary change which is of little consequence to whether we call a population one of polecats or not. In attempting to eradicate, or otherwise prevent, the process of hybridisation, we may be thwarting important evolutionary processes and decrea-

sing the potential for biological diversity in the future, especially in man-dominated environments (Cade, 1983). As Jones *et al.* (1995) note: "It seems to us that it would be necessary, as a first step, to make certain taxonomic decisions about hybrid populations and to draw meaningful taxonomic conclusions prior to justly applying the International Code [of Zoological Nomenclature] or promoting the legal preservation of biodiversity".

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Dept. of Zoology, Arizona State University,  
Tempe, Arizona 85217-1501, USA

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Great Britain

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Honeymoon Bay  
Vancouver Island, BC  
Canada V0R 1Y0

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Dept. Wildlife  
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USA

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Slovenia

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Salim Ali Centre  
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China

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China

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Paldiski mnt., 145  
200035 Tallinn  
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Belize Zoo & Trop. Educ. Center  
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Belize City  
Belize

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USA

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USA

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Sinton, TX 78387  
USA

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Bangkok  
Thailand

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101 Antananarivo  
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CSIC - Apdo. 1056  
41080 Sevilla  
Spain

Dr I. Poglayen-Neuwahl  
P.O. Box 85758  
Tucson, AZ 85754  
USA

Mr. C. B. Powell  
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R/S/ Univ. Science & Technology  
P.M.B. 5080, Port Harcourt  
Nigeria

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Dept. Zool., North Carolina State Univ.  
P. O. Box 7617  
Raleigh, NC 27695  
USA

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India

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ul. Browarna, 25  
61-063 Poznan  
Poland

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3029 Ordway Street  
Washington, D.C.  
USA

Mr. Don Reid  
Dept. Zoology  
Univ. British Columbia  
Vancouver, BC V6T 2A9  
Canada

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Zool. Inst.,  
Heidelberg University  
Im Neuenheimer Feld, 230  
6960 Heidelberg  
Germany

Mr. Miles Roberts  
Dept. Zoological Research  
National Zoo Park  
Washington, DC 20008  
USA

Mr. Paul Robinson  
41 Moss Lane  
Hesketh Bank  
Nr. Preston PR4 6AA  
Great Britain

Mr. Jerzy Romanowski  
Institute of Ecology PAS  
Dzianow L. near Warsaw  
05-092 Lomianki  
Poland

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A.N. Severtzov Institute  
Russian Academy of Sciences  
33, Leninsky Prospekt  
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Dr Hiroshi Sasaki  
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2-12-1, Ishizaka  
Dazaifu, Fukuoka 818-01  
Japan

Dr Arnd Schreiber  
Zool. Inst.,  
Heidelberg University  
Im Neuenheimer Feld, 230  
6900 Heidelberg  
Germany

Prof. Rüdiger Schröpper  
Universität Osnabrück,  
Biol./Chemie  
Barbara Strasse, 11  
4500 Osnabrück  
Germany

Dr Vadim E. Sidorovich  
Institute of Zoology  
F. Skoriny Street, 27  
Minsk 220072  
Belarus

Dr Chris Stuart  
African Carnivore Survey  
P.O. Box 6  
Loxton 6985  
Republic of South Africa

Dr M. E. Taylor  
Geomatics International  
3370 South Service Road  
Burlington, Ontario  
Canada L7N 3M6

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Univ. Wyoming  
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47058 Duisburg  
Germany

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Lewis-Clark State College  
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