

SMALL CARNIVORE CONSERVATION



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

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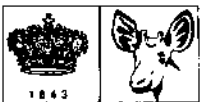
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SPECIES SURVIVAL COMMISSION



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



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

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:

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Field observations of Large-spotted civet *Viverra megaspila* in Laos with notes on the identification of the species

J. W. DUCKWORTH

Introduction

The genus *Viverra* includes four Asian species: Malay civet *V. tangalunga*, Large Indian civet *V. zibetha*, Malabar civet *V. civettina*, and Large-spotted civet *V. megaspila*. The African civet *V. civetta* is now usually placed in the monotypic genus *Civettictis*. The forests of Madagascar support a species rather similar in appearance, Madagascar civet *Fossa fossana*, but this is not closely related to the *Viverra* group.

V. tangalunga and *V. zibetha* are widespread species, common and ecologically tolerant throughout their ranges (the southern part of the Malay Peninsula, the Greater Sundas and the Philippines, and eastern India, Nepal, Burma, southern China, Indochina and the Malay Peninsula respectively). *V. megaspila* and *V. civettina* are closely related and frequently considered conspecific (as *V. megaspila*; Lekagul & McNeely, 1977), and were formerly placed in their own genus (*Moschothera*). Their distributions are widely disjunct, and in contrast to the other two species, they are scarce and little known. *V. civettina* is restricted to southwest India (the Western Ghats and Travancore) and is acutely threatened (Rai & Kumar, 1993). *V. megaspila* has a more extensive range encompassing Burma, Thailand, Vietnam, and Malaysia (Wilson



Oldest figure of a Large-spotted civet. From: A. Günther, 1876. Proc. Zool. Soc. London

& Reeder, 1993); it is also mapped in Cambodia and Laos by Lekagul & McNeely (1977) and Corbet & Hill (1992).

The large-spotted civet is so infrequently seen that Lekagul & McNeely (1977) could trace nothing concerning the species' ecology or behaviour, even though they considered it rather common. This status was contested in Schreiber *et al.* (1989), who further stated that although widespread in peninsular Malaysia, it was also rare there. Overall, they categorised it as occurring in very low numbers and to be considered as threatened. They traced no records from protected areas. Although recorded from Huai Kha Khaeng Wildlife Sanctuary, Thailand, by Rabinowitz & Walker (1991), this was based on reports by staff; the species was not observed during intensive carnivore orientated fieldwork there. In a summation process judging each species' conservation priority, it received 8 of a possible 16 points; the most important action was the initiation of field studies of the species as so little is known about it (Schreiber *et al.*, 1989).

Laos is biologically very poorly known and, between 1950 and 1992, almost no reliable information was gathered concerning the status of small carnivores in the country. I attempted to survey nocturnal mammals at three sites in the southern provinces between October 1992 and July 1993 (Fig. 1), as part of a team surveying the birds and mammals of proposed protected areas (PPAs) in Laos. The natural vegetation cover across this area is semi-evergreen forest with extensive areas of mixed deciduous forest and, on the poorest soils, dry dipterocarp forest. Large areas of forest have been degraded by human activity or cleared outright for settlement and cultivation.

In general, fieldwork was hampered by the heavy hunting pressure (including the use of lamps by night) and the scarcity of wide paths traversing productive habitat. The main technique (detailed in Duckworth, 1992) was to walk slowly (about 0.5-1.6 km/h) using a headtorch to search for eyeshines and body shapes of animals, and to listen for vocalisations and the rustlings of disturbed vegetation; animals were illuminated with a halogen spotlamp (Nitech X-Cell; 100,000 candlepower). Only in one

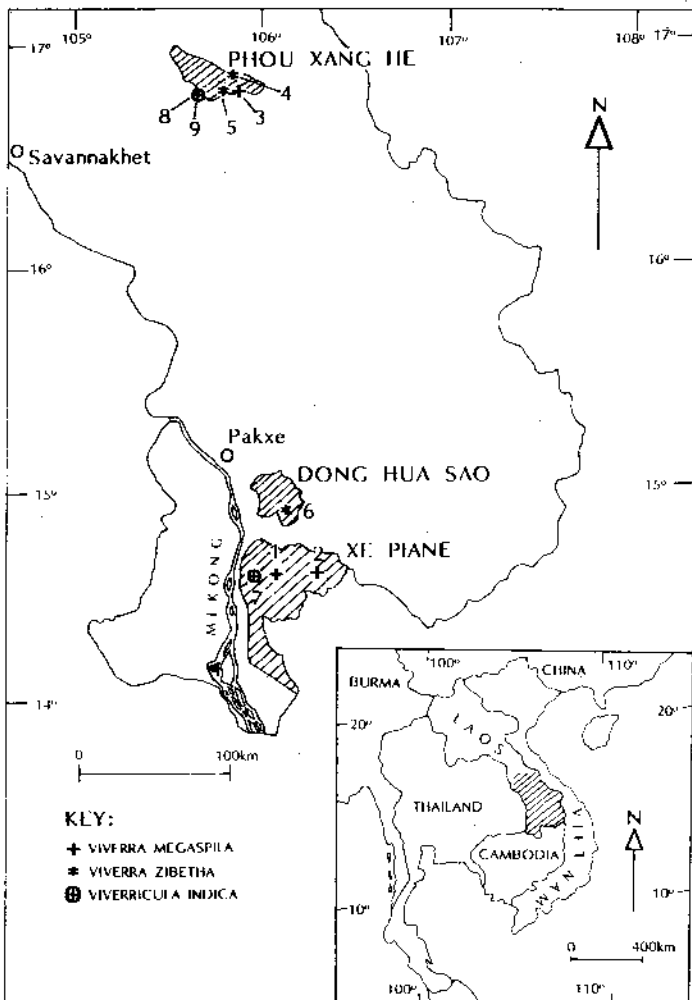


Fig. 1. Map of southern Laos, showing localities of civet sightings, numbered as in Table 1. Thick lines enclose the proposed protected areas surveyed. Inset shows region of Laos depicted.

area this was particularly productive: at Phou Xang He, there were several areas of relict primary forest along roads, possibly remaining because of the high density of undetonated landmines thereabouts. Because of the low success of this technique, and following the advice of numerous hunters, many nights were spent up trees overlooking hotspots such as waterholes, saltlicks, and fruiting trees. Such watches were performed mainly on moonlit nights. In a rough total of 215 hours walking and 29 nights up trees, six *Viverra* civets were recorded (Table 1). The three records of *Viverricula indica* have also been included, as this is the only possible confusion species.

Field identification

Civets of the two genera are easily distinguished from all other mammals of the region by their terrestrial habits, general shape, banded tails and by their black and white throat markings. It is easy to distinguish *Viverricula* from *Viverra*: compared with the latter, *Viverricula* is leaner and more slender (in some ways reminiscent of a genet (*Genetta*), with a very bushy, horizontal tail, shorter legs and a narrower, more "streamlined" head. Obvious differences in pelage include the lack of a dorsal crest and (of particular use in the field) the much less prominent throat markings of *Viverricula*.

The two species of *Viverra* are also easily separated, provided a reasonably close view is obtained. However, the existing literature does not stress the differences of most use in the field, so I therefore visited the skin collection at The Natural History Museum, London, to supplement my field experience (which includes all species discussed here except *V. civettina*). Skins were examined of 38 *V. zibetha* and 12 *V. megaspila*; the latter were from throughout the species' range.

Viverra civets are the most dog-like of the Viverridae, with long legs and rather canine heads and muzzles. All share a rather rolling walk which combines with their often almost pregnant-looking hindquarters to give a very distinctive mien. The two species in Indochina are similar in size and structure and, in the field, the observer should concentrate on pelage features. Both share a bold black and white marking arrangement on the foreneck and upper chest, a thick black erectile dorsal crest, a dark and light banded tail, and a pattern of dark spots, blotches or bars on a light body. The tail and body patterns are the most important features for separating the two species (Table 2).

Accurate observation of the tail pattern is the highest identification priority at each sighting, followed by the body

pattern, especially on the flanks. Contrary to the impression given by some previous works, in South-east Asia north of the isthmus of Kra, any *Viverra* with bold dark markings on the upperparts is probably *megaspila*, be they spots or bars. The illustration of *V. civettina* in Rai & Kumar (1993) gives a good impression of a *V. megaspila* where the spots have merged into heavy horizontal bars.

Habitat and behaviour

All individual large-spotted civets were on the floor when found and none was obviously disconcerted by illumination. Individual 1 was observed under natural light at dusk beside a stream. It came within 7 m of the observer and remained in the area for three minutes while it trotted across the sandy bed of a drying river and into a riverside bamboo thicket. Individual 2 was picked up as a moonlit shape walking beside a pool at 50 m range. After initial identification to genus, I illuminated it with the Nitech spotlight; it continued to amble slowly along a buffalo-path through the burnt grass layer, until after several minutes it left the glade and disappeared into the forest. Individual 3 was located by rustling sounds in thick bamboo beside a well-established road; I walked parallel to it for 7 m, separated by about 15 m, before it emerged onto the road for 30 seconds at 10 m range. It re-entered the bamboo grove and resumed foraging.

The three single *V. zibetha* seen were all located by eyeshine and were seen on open paths or roads within 20 m of the observer and then ambled back into the vegetation, where they resumed foraging.

From the sounds made by those at Phou Xang He, it seems that the two species forage in similar fashion to the African civet: by a slow walk accompanied by much side-to-side casting of the head as the animal searches through leaf-litter. Such rustlings were rather frequently heard at Phou Xang He, though the prevalence of undetonated mines prevented my leaving the path to identify the culprit(s). Pigs *Sus* and porcupines *Hystrix* also make similar noises, but some of the foraging noises were accompanied by decidedly carnivore whickering calls, suggesting that civets were common in the area.

Status and conservation

The foregoing sightings are too few to allow a firm assessment of the species' status. Only at Phou Xang He there were roads running through good habitat, and here 116 hours' walks were done. In this time there was only one sighting of *V. megaspila*. However, despite their productivity for arboreal mammals (Duckworth, in press), the roads were not conducive to

	Ref	site	date	time	co-ordinates	alt.	habitat
<i>Viverra megaspila</i>	1	XP	13 Feb	18h45	14°35'N, 106°02'E	200	good semi-evergreen forest
	2	XP	6 Mar	23h15	14°31'N, 106°21'E	80	good dry dipterocarp forest
	3	PXH	28 Mar	22h00	16°45'N, 105°53'E	200	degraded semi-evergreen forest
<i>Viverra zibetha</i>	4	PXH	13 Apr	19h15	16°40'N, 106°01'E	200	deg. mixed deciduous forest
	5	PXH	18 Apr	03h50	16°47'N, 105°53'E	200	degraded semi-evergreen forest
	6	DHS	19 Jun	00h45	15°00'N, 106°13'E	1100	good montane evergreen forest
<i>Viverricula indica</i>	7	XP	11 Feb	00h25	14°36'N, 105°57'E	400	good semi-evergreen forest
	8	PXH	18 Apr	20h10	16°42'N, 105°40'E	200	deg. mixed deciduous forest
	9	PXH	18 Apr	25h45	16°42'N, 105°40'E	200	mixed decid.-dry dipt. ecotone

Notes: there was very little nocturnal searching in DHS, and only in PXH were particularly suitable tracks found for walking. The ref refers to the number on Fig. 1; altitude (alt.) are in meters. Sites: XP, Xc Piane; PXH, Phou Xang He; DHS, Dong Hua Sao.

Table 1: records of *Viverra* and *Viverricula* civets in Laos, 1993.

Table 2: pelage features for distinguishing *V. megaspila* from *V. zibetha*

	<i>V. megaspila</i>	<i>V. zibetha</i>	
FLANKS	Boldly marked with black or very brown, usually as lines of spots but frequently the spots towards the rear of the upper lines run together to give one to three bars either side of the dorsal crest.	Rather hazily marked dark, as irregular wavy spots sometimes running together as horizontal bars. General appearance rather grizzled or rippled and especially nebulous-looking under torchlight.	FLANKS
TAIL	Dark dorsal stripe along entire length; pale rings thus broken at top and anyway rather sullied-looking. Distal half frequently appears entirely dusky.	No dark dorsal stripe, thus pale rings complete. These rings are very prominent along the length of the tail, as they are almost white and clear cut. They are still much narrower than the dark rings though.	TAIL

sighting terrestrial mammals, because of the thick growth of ruderals along their margins: the only other carnivore seen on the ground was a single Leopard cat *Prionailurus bengalensis*, and, though Muntjacs *Muntiacus muntjac* were frequently heard, none was seen. Sightings were essentially due to chance and it is unlikely that *V. megaspila* was unusual at the site. The small number of records is surprising, given that when observed, the species appeared unperturbed by torchlight. Considering the broad habitat choice (Table 1), it is likely that the species is neither critically threatened nor particularly localised in Laos. Further information is needed on the altitudinal range of the species.

The two sites where *V. megaspila* was observed all supported impressive complements of globally-threatened species, including the Gibbon *Hylobates (concolor) gabriellae* (Duckworth *et al.*, in prep.), Pygmy loris *Nycticebus pygmaeus* (Duckworth, in press), Douc langurs *Pygathrix nemaeus* (Timmins, in prep.), Asian elephants *Elephas indicus*, wild cattle and numerous birds (Evans *et al.*, in prep.; Thewlis *et al.*, in prep.). There is thus an acute need for effective conservation of the areas. The specific requirements of this civet are likely to rest primarily upon the preservation of adequate areas of forest coupled with fairly low hunting levels. It should be noted that at all sites shots were frequently heard by day and night, and that in the area of Phou Xang He where the *Viverra* civets were encountered, hunting had extirpated all diurnal primates. In some other areas, collection of the secretions from the perineal glands (known as "civet") poses a potential threat, but no evidence of this activity was found during these surveys (there were fairly extensive general and discursive chats with villagers about their knowledge of forest wildlife).

Laos is of particular importance for conservation of south-east Asian mammals because of its extensive remaining tracts of forests: although almost all the area is hunted to some extent, over large regions the basic fabric of the habitat is still fundamentally undegraded. This contrasts markedly with the situation in neighbouring Thailand and Vietnam.

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Ecology of the Central American Cacomistle, *Bassariscus sumichrasti*, in Costa Rica

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Introduction

Central America covers 541,190 km² and includes seven countries between subtropical Mexico and Columbia (Guatemala, Belice, El Salvador, Honduras, Nicaragua, Costa Rica, and Panama) (Vaughan, 1994). It is one of the most diverse cultural and biological regions worldwide (Leonard, 1986; Vaughan 1990, 1993), but also has one of the most rapidly expanding human populations. This human population is currently altering natural habitats at an unprecedented rate, affecting many wildlife species (Carrillo & Vaughan, 1994; World Resources Institute, 1994).

The status of the Procyonidae family is virtually unknown in Central America. The six procyonid species reported there include: Common raccoon (*Procyon lotor*), Crab-eating raccoon (*P. cancrivorus*), White-nosed coati (*Nasua narica*), Bushy-tailed olingo (*Bassaricyon gabii*), Kinkajou (*Potos flavus*), and the Cacomistle (*Bassariscus sumichrasti*) (Hall, 1981; Wilson, 1981; Novak & Paradiso, 1983; Emmons, 1990). Until five years ago, no scientific studies had been conducted on these species in Central America.

In 1989, professors and graduate students of the Regional Wildlife Management Program for Mesoamerica and the Caribbean (*) at the Universidad Nacional in Costa Rica began basic natural history research on both *Procyon* species found in Costa Rica (Carrillo, 1989, 1990; Carrillo & Vaughan, 1988, 1993), and the white-nosed coati (Vaughan & Saénz, 1993; Saénz, 1994). Our intention is to study the procyonid species found in Central America over the next decade, providing a solid data base for their conservation.

We are especially interested in understanding their role as seed dispersers and tropical tree reforesters, thus giving them economic value for their long-term conservation (Howe & Smallwood, 1982; Estrada & Fleming, 1986; Howe & Westley, 1988; Levey *et al.*, 1992). Graduate students from different Latin American countries have also begun studies of mustelids, including the Grison (*Gallictis vittata*) (Malavassi, 1991) and the River otter (*Lutra longicaudis*) (Spinola, 1994; Spinola & Vaughan, two articles in press).

Although the common and crab-eating raccoons, the white-nosed coati, and the kinkajou are observed in a wide variety of Central American environments and coexist with man (barring intensive land use and overhunting), the olingos and cacomistle are considered uncommon and secretive (Novak & Paradiso,

1983; Kaufmann, 1987; Emmons, 1990). Even mammal surveys and collections in countries such as Costa Rica where a lot of research is carried out rarely reveal these species (Goodwin, 1946; Vaughan, 1983; Timm *et al.*, 1989).

In February 1994, we began a study of a cacomistle population at 2,600 m elevation in Braulio Carrillo National Park, Costa Rica. The remainder of this report will discuss the cacomistle project and its dry season results (Feb. - May 1994). The project is scheduled for 24 months total, and an Argentinian graduate student will begin her M.S. thesis work on the population in December 1994. The objectives of these research projects were: a) to study their ecology (home range, activity patterns, distances moved per night, sleeping site locations, and diet) and b) to determine the cocomistle's role as a seed disperser and reforester in cloud forests.

Study site and study species

Braulio Carrillo Natl. Park forms part of the Cordillera Volcanic Central Conservation Area (CVCCA)(135,500 ha) in central Costa Rica (Vaughan, 1994)(Fig. 1). Considered one of Costa Rica's most rugged wilderness regions (Boza, 1992), the CVCCA is found between 100 and 3,200 m ASL, and includes the well-known La Selva Biological Station at its lowest elevation (Clark, 1994) and two active volcanoes (Poás and Irazu) at its higher elevations. It receives an estimated annual 4,500 mm of precipitation (Boza, 1992) and provides habitat to an estimated 6,000 plant species, 347 bird species, and 142 mammal species (Timm *et al.*, 1989).

The research site is based at the Barva guard station (Fig. 1) located 2 km north and 0.5 km east of the town of Sacramento (Timm *et al.*, 1989). It is on the pacific side of Volcan Barva at 10°07'N, 84°074W. The habitats surrounding the study site include: pasture, primary and secondary cloud forests, dominated by tree species of the Lauraceae and Fagaceae families.

The cacomistle is a nocturnal arboreal member of the procyonid family, ranging from southern Mexico to western Panama up to 2,000m ASL (Emmons, 1990) or 2,8000 m (Kaufmann, 1987). Little is known about its natural history, although its conspecific, the ring-tailed cat (*Bassariscus astutus*), found between southern Oregon in the United States to Oaxaca and Veracruz in Mexico (Kaufmann, 1987) has been studied in the southwestern United States (Towell & Teer, 1977, 1980; Brody & Koch, 1983; Yarchin, 1990).

Radio	Sex	Date (1994)	Tag Color	Body (cm)	Tail (cm)	Total (cm)	Tarsal (cm)	Neck (cm)	Weight (kg)	
005	F	14Feb	Black	44	45	89	8.5	13	1.45	
019	F	3March	Red	41	49	90	11		1.30	
029	M	5March	White	37	41	78	10	14	1.00	
041	M	5March	Green	39	46	84	11	11.5	1.10	
181	M	3March	Yellow	45	50	95	12		1.55	

Table 1: Capture data on Cacomistle (*Bassariscus sumichrasti*) in Braulio Carrillo National Park, Costa Rica (February-March, 1994)

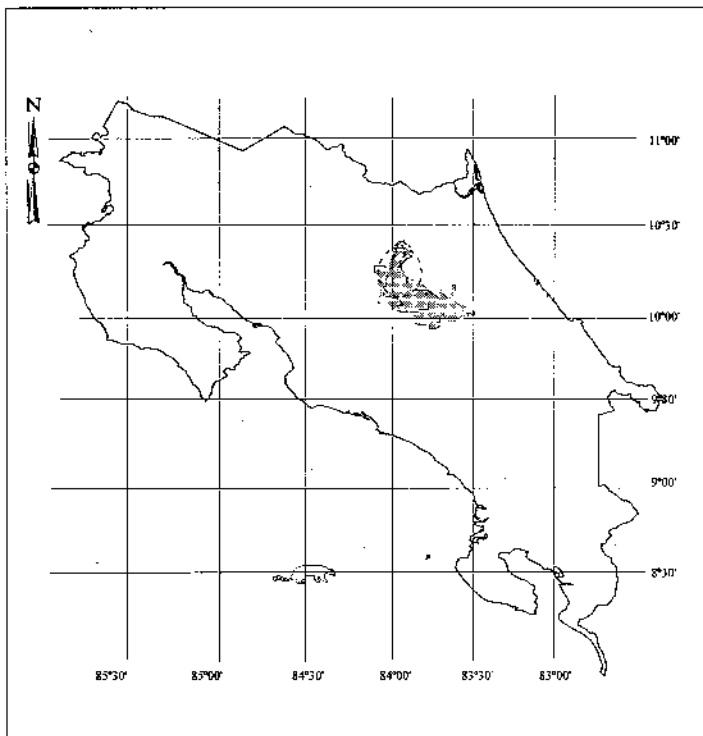


Fig. 1. Study site in Costa Rica

Methodology

- **Capture** - Cacomistles were preconditioned to enter live Havahart traps baited with brown sugar blocks over a 28-day period during February 1994. Five cacomistles were live-captured, and drugged with ketamine hydrochloride (11 mg/kg) and xylazine (1.5 mg/kg). Then each cacomistle was weighed, measured, and a MD-200 radiotransmitter (Telonics Electronics Inc., Mesa, AZ) with distinct tape color code placed around its neck. The procedure took between 15 and 20 minutes and the individual was left hanging in a gunny sack and released after recovering (usually 60-90 min).
- **Radiotelemetry** - Radiotelemetry data were taken with a LA12 receiver and H antenna (Telonics Electronics Inc., Mesa, AZ) from two predetermined tracking sites along the main trail connecting the Barva guard station with Laguna Barva. After determining that the cacomistle was a nocturnal species, individuals were tracked at 30-minute intervals for 12 hours, usually on consecutive two-night periods (18:00-24:00 and 24:00-06:00). For each frequency, the antenna was directed towards the strongest radio-pulse and a compass bearing was taken from each of two stations. A 45-90 degree angle between the stations was sought for telemetry analysis. Using the Telem 88 computer program, the compass bearings obtained and the (x,y) coordinate of each radiotelemetry station calculated from an aerial photograph, data were triangulated to determine cacomistle home range, movement and activity, and sleeping sites.
- **Home range** was determined by including 100% and 95% of the triangulated locations in the minimum convex polygon method (Southwood, 1962). For the 95% home range, 5% of the points farthest from the harmonic mean were eliminated.
- **Movement or distance moved** was calculated in meters between consecutive points and average total distance moved per night was determined. Chi squared tests were used to analyze movement in 6-hour periods.

- **Activity level** was recorded at the beginning of each 30-minute reading depending on the strength, length, and pattern of the radio-pulse. Individuals were noted as active (A) if the pulse was changing in strength and length and non-active (NA) if it was constant in duration. For analysis of activity levels, data were grouped into six 2-hour intervals and one interval for the 06:00 time period. Total active and non-active nightly readings were combined for each cacomistle. Replicated G tests (Biom: Goodfit) comparing active to non-active were carried out. The G value was analyzed using the Chi-squared test to determine statistical significance.
- **Sleeping sites** were recorded by triangulating between 10:00-15:00 hours from the trail system and then plotting it on a map. Trees were scanned with binoculars and by using the radiotelemetry receiver without the antenna and cable and with only the cable to determine exact location.

Results and discussion

- **Capture and radiotelemetry data** - Information on radiotelemetry data and animal measurements is shown in Table 1. The study group consisted of two adult females (#5 and #19), one adult male (#181), and two juvenile males (#41 and #29). However, adult male #181 wasn't radiotracked because he frequently moved out of tracking range. Juvenile males were classified as such because of their milk teeth, undescended testicles, and weight. Toweill & Toweill (1978) and Yarchin (1990) reported that with *B. astutus*, growth is so rapid that after three months of age, it is difficult to distinguish kittens from adults. A total of 753 radiotelemetry points were taken on the four individuals between March-May 1994, representing approximately 20 full nights of data on each individual.
- **Home range** - The 95% home ranges for males #41 and #29 were 22.5 ha and 16.5 ha, respectively, while the 95% home ranges for females #5 and #19 were 25.6 and 32.7 ha respectively (Fig. 2). The home ranges of two females didn't overlap, nor did the home ranges of the two males. However, the home ranges of #41 and #19 overlapped, as did those of #29 and #5. Yarchin (1990) found an average home range of 20 ha for four individuals of *B. astutus* in Zion National Park, Utah, USA. Brody & Koch (1983) reported home ranges of 49-233 ha for four males during four months in California, while Trapp (1978) found similar-size ranges in Zion. Toweill & Teer (1980) found two males with home ranges of 35 and 51.7 ha and three females with home ranges of 15.7-27.7 ha in Texas. In all of the above studies (and ours), neither males or females had overlapping home ranges with other individuals of their sex.

Individual and combined sexes	\bar{X} -distance moved 1800-0600
F(5)	2,549 m
F(19)	2,833 m
M(29)	2,502 m
M(41)	2,637 m
(F) average	2,691 m
(M) average	2,569 m
(Total) average	2,630 m

Table 2. Average distance moved (18:00-06:00) for each individual, sex and total population of Cacomistles (*Bassariscus sumichrasti*) in Braulio Carrillo National Park, Costa Rica (Feb.-March 1994).

- **Movement** - Average distance travelled nightly for each individual is shown in table 2. Female #19 moved the greatest distance (2,833 m), while male #29 moved the least (2,502 m). Average distances moved by the two females wasn't significantly greater than the distance moved by two males.
- **Activity patterns** - *B. astutus* is basically nocturnal and in 100 daytime sleeping site locations taken between 10:00-15:00, only once did we find a cacomistle active during daytime. Occasionally, we would find a study animal active during the late afternoon (17:00 h). Ringtails are rarely active in the daytime (Trapp, 1978; Toweill & Teer, 1980; Kaufmann, 1987; Poglayen-Neuwall & Toweill, 1988). Nightly activity compared in two hour intervals is shown in Table 3. Cacomistles were most active from 18:00-20:00. The results of the replicated G tests indicate that cacomistles were more active than inactive in all time period from 18:00-06:00. They were four times more active than inactive from 20:00-22:00, 22:00-24:00, 24:00-02:00, and 04:00-06:00. We found juvenile males active in close proximity to the adult females, which differs from Yarchin's (1990) results where his four study animals avoided each other.
- **Sleeping sites** were located over 70 occasions and differed most days. Exact den location wasn't determined, but they were high in trees, usually *Quercus* sp. Prior research on *B. astutus* determined that they locate dens for reproduction in caves, rock crevices, burrows dug by other animals, brush piles, hollow trunks, roots and limbs (Trapp, 1978; Toweill & Teer, 1980; Yarchin, 1990). Female #19 and male #41 slept in the same general area. Female #5 and male #29 slept in the same general area about 50% of the time. In 935 separate locations of ringtail den sites with radiotelemetry, no more than one adult was observed per den (Yarchin, 1990).

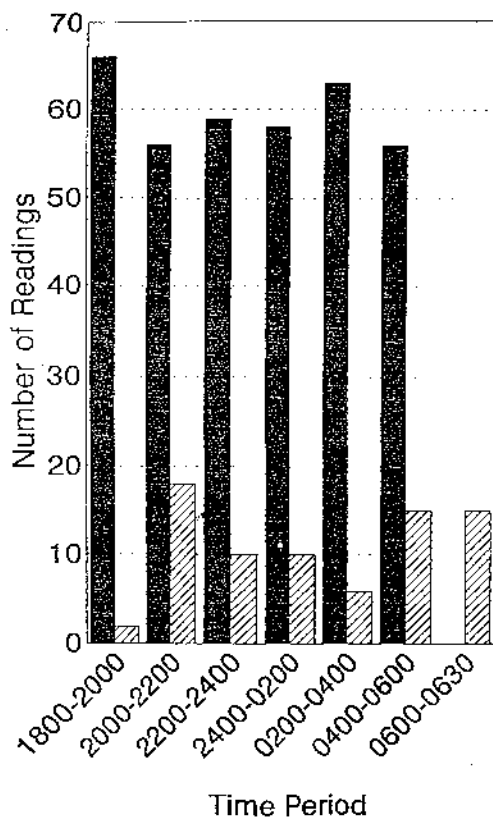


Table 3. Activity level (18:00-06:00) for Cacomistle (*Bassariscus sumichrasti*) population in Braulio Carrillo National park, Costa Rica (Feb.-March 1994). [Dark = active; light = not active]

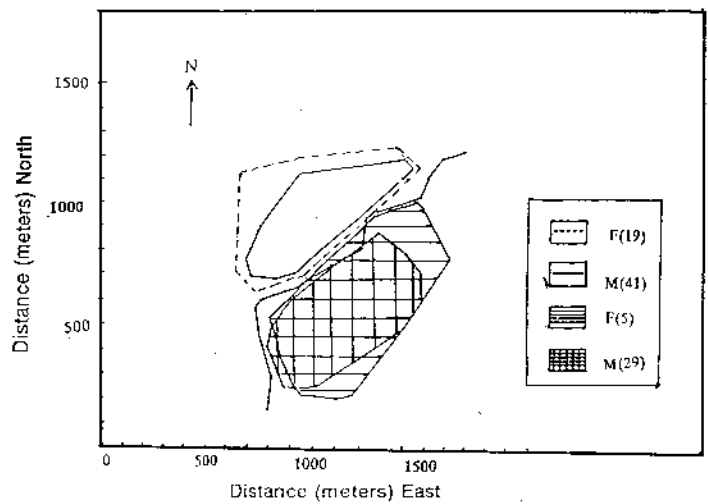


Fig. 2. Home range of four Cacomistle (*Bassariscus sumichrasti*) in Braulio Carrillo National Park, Costa Rica (Feb.-March 1994).

Future research

For management and conservation efforts, we are accumulating a 24-month data base on the cacomistle. Sleeping sites are difficult to determine and we will climb trees which often are 40 m high. Due to their irregular calling periods after midnight, we estimate that the population in the region may be 12-15 individuals. We are especially interested in determining the cacomistle's role as a seed disperser and reforester. However, the only collected faeces thus far were from trapped animals. To collect faeces, we plan to wait for individuals when they become active at sunset and place plastic sheets under sleeping trees. Over the study period, we will work with these aspects, collecting data from both wet and dry seasons, mapping out vegetation type use and strengthening our data base. We are surprised at the lack of fear these intelligent procyonids have of human beings. After release, a large male unassumedly jumped into a garbage can and picked up a cantelope rind, making off with it before some surprised observers. We were reminded of raccoon and coati behavior.

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*) PRMVS was created in 1987 as the first wildlife-biological conservation graduate program in Latin America. To date, 65 graduate students from 16 Latin American countries and the USA have studied there.

**Regional Wildlife Program
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Canine distemper epidemic in Serengeti lions

An epidemic of canine distemper virus (CDV) has affected approximately 20-30% of the population of 3,000 African lions (*Panthera leo*) in the Serengeti ecosystem of Tanzania according to Dr Melody Roelke-Parker (Tanzania National Park Service and Messerli Foundation, Switzerland) and Dr Craig Packer (University of Minnesota, USA). Documented losses in closely-observed prides from long-term behavioral studies varied from entire prides to a few lions in a pride. More than 50 lions from these research prides have died or disappeared since early February 1994. The first notable clinical signs were myoclonus (predominantly facial and foreleg twitches), ataxia, and seizures. Some lions had nasal and ocular discharge or non-specific signs of systematic disease. More than half of all lions with clinical signs died or vanished. Necropsy findings in eight lions were not remarkable and were predominantly associated with trauma and dehydration.

Characteristic histopathologic lesions of CDV were not noted in most cases (A. Pospischil, University of Zurich, Switzerland). However, typical CDV inclusions were noted in bile duct and epididymal epithelium (L. Munson, University of Tennessee, USA), and these inclusions were confirmed to be canine distemper viral particles by Immunohistochemistry (M. Appel, Cornell University, USA).

Canine distemper viral antigens also were identified by immunohistochemistry in other fixed tissues (A. Pospischil). Forty-five of 60 lions tested in the region had high serum neutralizing antibodies to canine distemper virus (M. Appel), indicating that exposure was widespread in the population. **Other carnivores in the ecosystem also have been reported to be affected.** The full impact of this epidemic on the ecosystem has yet to be determined.

Until recently, canine distemper virus only rarely infected individual felids in zoos. Since 1992, however, there have been four epizootics of canine distemper virus affecting predominantly African and Asian felids in US zoos. The extent of the morbidity and mortality in these recent outbreaks, including the current epidemic in the Serengeti suggest that CDV has acquired increased pathogenicity for felids. There was no evidence of co-infection with other pathogens, and no link with feline immunodeficiency virus (FIV) exposure in the Serengeti lions (S.J. O'Brien, National Cancer Institute, USA).

Controlling the Serengeti epidemic through vaccination of wildlife is neither safe nor feasible, because currently available modified-live CDV vaccines can induce disease in carnivores other than domestic dogs. Current recommendations to contain the epidemic are to vaccinate domestic dogs in the perimeter of and within the serengeti, and to continue disease surveillance of susceptible species at the site. The SSC Veterinary Group would appreciate receiving information on any sightings of tremors, seizures, or unexplained deaths in **wild cats or other carnivores in any country.**

Contact Dr Michael Woodford (Washington, D.C., USA; Fax 202-331-9448) or Dr Linda Munson (Knoxville, TN, USA; Fax 615-974-5616). We can provide a list of samples to collect for diagnostic procedures as well as pathology, serology, and virology services for field veterinarians and wildlife ecologists, if tissue or serum samples are available from a suspected epidemic.

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CVM, 2407 River Dr., Knoxville, TN 37996, USA**

The European polecat (*Mustela putorius*) in Turkish Thrace

Cengiz KURTONUR¹, Boris KRYŠTUFEK² and Beytullah ÖZKAN¹

Introduction

The European polecat, *Mustela putorius* Linnaeus, 1758, is very poorly known in the southern half of the Balkans; there being only two records from Greece (Crucitti & Tringalli, 1984; Wolsan, 1993). Kryštufek & Petkovski (1990) concluded, on the basis of six localities, that the species is quite widespread within Macedonia, and Markov (1959) reports it from Bulgaria, inhabiting forest edges, the vicinities of villages, and the banks of rivers. Despite this, the majority of authors have not mentioned its presence in European Turkey (e.g. Van den Brink, 1968; Gepther & Naumov, 1967; Corbet, 1978; Görner & Hackethal, 1987; Corbet & Harris, 1991, etc.), although there are some published records from this country, albeit of a very fragmentary nature. Kumerloeve (1967, 1970, 1975) reports three localities (summarized by Wolsan, 1993), and Dogramaci (1989) mentions the Belgrade Forest near Istanbul as representing a further polecat locality.

Results and discussion

Recently we had the opportunity to examine five polecats (four skulls and five skins) from European Turkey. The specimens are stored in the collections of the Department of Biology,

TUBD No.	87/100	91/320	92/170	93/121
Sex	male	male	male	female
W	800	1,100	----	----
HB	555	400	470	410
TL	145	125	160	135
HF	60	60	61	60
E	25	27	26	26
CbL	65.0	65.6	67.2	59.0
PL	66.0	66.0	68.2	59.3
ZyB	42.2	42.3	44.1	34.4
EctB	22.9	23.9	26.7	19.8
IC	18.2	18.5	---	15.5
PB	14.9	16.3	18.4	14.3
MB	37.3	36.3	38.4	32.8
MxTRL	19.4	19.3	20.4	18.2
RB	17.7	17.2	---	14.1
BcH	25.0	25.8	25.2	22.4
MdL	42.5	41.4	42.8	35.1
HRM	20.6	20.7	21.4	16.2
BL	43.5	44.6	40.7	---

Table 1. Morphometric characteristics of polecats from European Turkey: W, weight; HB, head and body length; TL, tail length; HF, hind foot length; E, ear length; CbL, condylobasal length; PL, profile length; ZyB, zygomatic breadth; EctB, ectoorbital breadth; IC, interorbital constriction; PB, postorbital constriction; MxTRL, maxillary tooth-row length; RB, rostrum breadth on C¹-C¹; BcH, braincase height per bullae; MdL, mandible length; HRM, height of ramus mandibulae; BL, length of baculum. For definitions of skull parameters see Buchalczyk & Ruprecht (1977). All dimensions are in mm, weights in grams

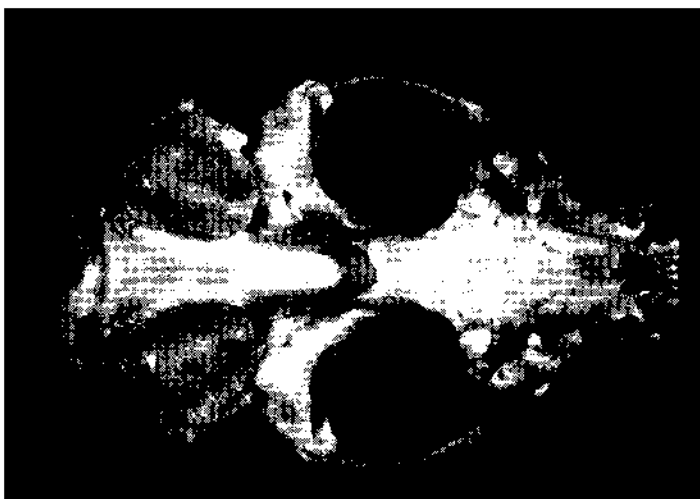
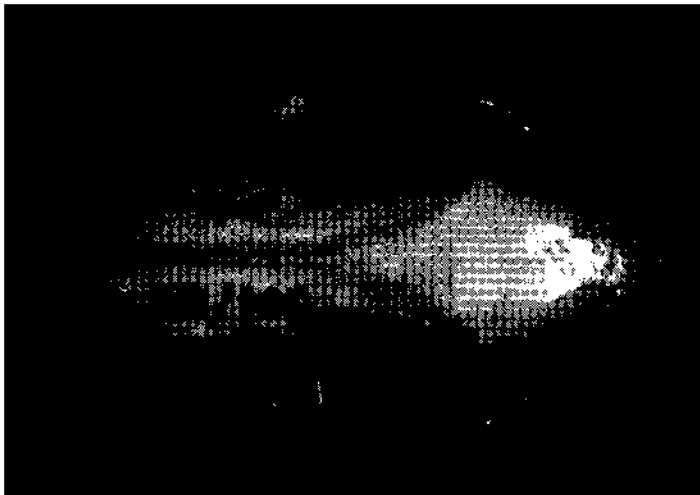


Fig. 1. Skull of the male European polecat from Edirne, European Turkey (87/100) in a (a) dorsal and (b) ventral view. Note narrow postorbital constriction (a) and shape of interpterygoid fossa and pterygoid processes (b)

University of Trakya, Edirne (TUBD) and the Slovene Museum of Natural History, Ljubljana (PMS). All the skins are dark, and could be ascribed without any doubt to *Mustela putorius*, rather than to *M. eversmanni*. However, one of the skulls (TUBD 87/100) had very narrow postorbital constriction (Fig. 1), in this respect resembling the Steppe polecat, *M. eversmanni*. In this specimen the ratio of the postorbital constriction with the condylobasal length as the denominator and multiplied by 100, amounted to 22.9, thus being within the range reported for *M. eversmanni* (20.1-24.9; Miric, 1976). As a result, we subjected our material to Discriminant Function Analysis (DFA). Seven skulls of *M. putorius* from Slovenia (PMS) and the former Czechoslovakia (National Museum, Prague) served as standards for these two species. Because of the significant sexual dimorphism present in polecats (Buchalczyk & Ruprecht, 1977), only males were used in DFA. Three specimens from European Turkey were compared with this reference material. Two of them (TUBD 91/320 and 92/170) were considered to belong to *M. putorius*, whilst the identity of specimen TUBD 87/100 was uncertain. Two measurements (IC, RB; see table 1) were excluded to increase the Turkish sample size.

The first discriminant function (DF1) explained 92.91% of the variance in the original data set, and DF2 and DF3 explained a further 3.74% and 3.35% of the variance, respectively. Reference specimens of *M. putorius* and *M. eversmanni* formed two clearly distinct clusters when the data were projected onto the first

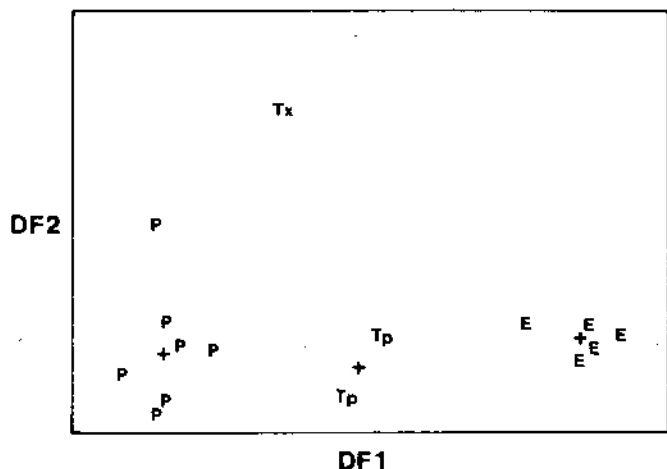


Fig. 2. Projection of four groups of polecats on the first two discriminant functions. Crosses indicate group centroids. P: *M. putorius*, E: *M. eversmanni*, Tp: *M. putorius* from European Turkey, Tx: specimen TUBD 87/100

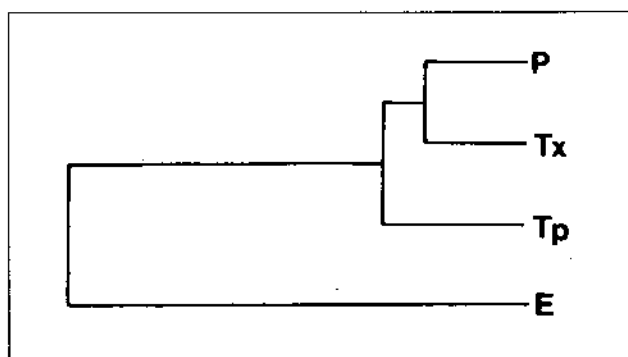


Fig. 3. UPGMA dendrogram summarizing relations between four groups of polecats as indicated in Fig. 2. See text for additional information. Cophentic correlation coefficient $r=0.815$.

two discriminant functions (Fig. 2). All three Turkish specimens were placed closer to *M. putorius* than to *M. eversmanni*. Next, an Euclidian Distance Matrix was calculated from the group centroid scores of the three discriminant functions and subjected to UPGMA clustering. Turkish polecats clustered with *M. putorius* (Fig. 2), and show no affinities with *M. eversmanni*. This, together with the coat colour indicates, that postorbital constriction alone is not very reliable as a diagnostic character for *M. putorius* in the extreme southern border of the species' distribution range. Of the other diagnostic characters listed by Wolsan (1993), the shape of the pterygoid processes, together with the width of the inter-ptyergoid space, also classified specimen TUBD 87/100 with *M. putorius* (Fig. 1). Consequently, all our specimens from European Turkey have been allocated to *M. putorius*.

Mustela eversmanni was reported recently from Macedonia, the determination being based mainly on the postorbital constriction (Milenkovic, 1990; see also SCC No. 7:16, 1992). Milenkovic's record suggests a considerable shift of *M. eversmanni*'s distribution range towards the south, but this was not considered by Wolsan (1993) in his distribution map for the species. We are of opinion that the determination of this particular record should be reconsidered, taking into consideration the cranial variation observed within Thracian polecats.

The polecat has been recorded from eight localities in European Turkey (Fig. 4). This is a considerable number in

comparison with the other south balkan countries. The records derive from all the vegetation zones of European Turkey, but it does seem, that the species is linked closely with human settlements. According to our observations, polecats frequently enter poultry houses, and the majority of our specimens were collected in such places. On the basis of data obtained in 1969 from the major furrier's shops in Istanbul, Kumerloev (1975) considered the polecat to be fairly common in the Istanca Mts. and the hilly regions of Thrace. Unfortunately, local people from Demirköy do not distinguish between the polecat and the Stone marten (*Martes foina*), and use the name 'sansar' for both taxa. A 1994 inspection of local hunters in this area indicated that all the skins they held belonged to the latter species, thus suggesting that the polecat is not so commonly seen in European Turkey.

According to the 1993-94 Hunting Rules (the 1994-95 Hunting Rules are not yet published) the hunting season for the European polecat in Turkey is from 15 October until the end of February. Hunting is permitted only for three days per week (wednesday, saturday, and sunday), and hunters may take only one animal per day. Other carnivores with the same hunting regime are *Mustela erminea*, *Mustela nivalis*, *Martes foina*, *Martes martes*, *Vormela peregusna*, *Meles meles*, and *Vulpes vulpes*.

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We thank Dr Milos Andera (Natl. Museum in Prague) for loan of the skulls of *Mustela eversmanni* and Huw Griffiths (Leeds) for critical comments on an earlier draft and linguistic corrections.

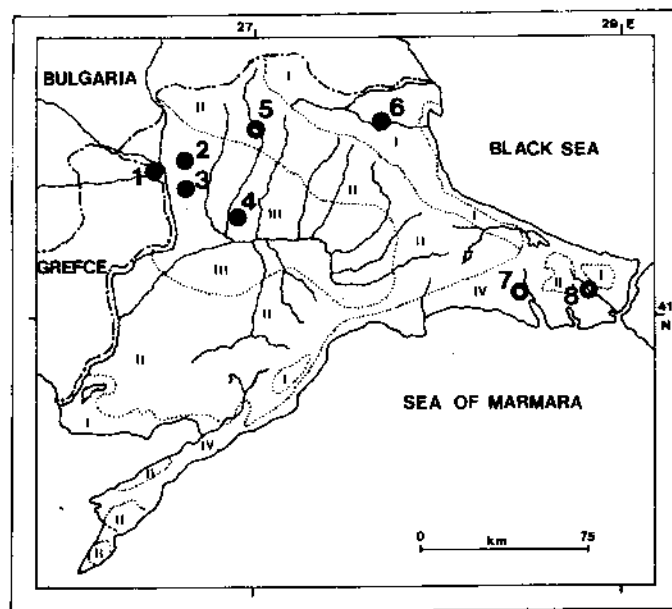


Fig. 4. Geographic distribution of the European polecat, *Mustela putorius*, in European Turkey. Closed circles indicate localities from which material was examined in this study (see text for the acronyms of collections). Vegetation zones: I, humid forests; II, dry forests; III, steppe; IV, maquis and pseudo-maquis. Localities: 1, Edirne, Karaagac (TUBD); 2, Edirne (TUBD); 3, Edirne, Sazlidere (TUBD); 4, Babaeski (TUBD); 5, vicinity of Kırklareli Kumerloev, 1970); (6, Demirköy (Kumerloev, 1967; PMS); 7, near Catalca (Kumerloev, 1967); 8, Belgrade Forest near Istanbul (Dogramaci, 1989)

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Polymorphisms in the European polecat, *Mustela putorius*, in France

In numerous papers dealing with the wild European polecat, *Mustela putorius* L., the eclecticism of its habitat choice has often been emphasized. Changes in habitat use are mainly influenced by trophic factors (Lodé, 1994) but, throughout Europe, polecats are known to exploit such diverse habitats as forest, woodlands, farmland, marshes, ponds, watercourses, seashores, the Russian steppes, farmbuildings, and rubbish tips (Blanford, 1987). Moreover, polecats exhibit important polymorphisms in body size and hair colour (Kratochvil, 1952; Saint-Girons, 1973).

Of 134 adult polecats collected in France (96 animals killed on the roads and 38 live-trapped), 3.7% (n=5) had a dark facial pattern with no white hair on the face, whilst 40.3% (n=54) only had a dark mask over the eyes, the forehead and the cheeks remaining white (Table 1). In 21.6% (n=29) of the polecats studied, only two light spots of hair were visible on the face above the eyes, and 34.3% had a dark forehead. However, in each case the snout was white coloured, and the underfur varied from yellowish to light brown. Although young polecats have a uni-

formly dark face when only two months old, the facial pattern can lighten with age, and varies little after four months (Lodé, 1989). Here, the ages of the animals were estimated from examination of the pattern of tooth attrition and from the weight of the baculum (Walton, 1968). No differences were found between males and females ($X^2 = 2.71$, $p > 0.05$), but the variation of the facial pattern was also associated with large differences in weight and body size (the darkest individuals being the smallest). Some "dark" animals looked almost like *Mustela lutreola* from their external pattern, and this could lead to some confusion.

Furthermore, this polymorphism is related to habitat use. The data available show that "dark" polecats are found significantly more frequently near forest watercourses and wooded ponds ($X^2 = 29.3$, $p < 0.001$). This relationship between phenotypic divergence and habitat utilization may represent a new illustration of Gloger's rule in mustelids. (Gloger's rule: Individuals of many species are darkly pigmented in humid climates).

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Facial Pattern	mask		dark		n
	dark stripe only	dark forehead	2 light spots	dark face	
% males	35.8	35.8	24.2	4.2	95
Mean weight	1,580g	1,560g	1,400g	970g	
% females	51.3	43.6	15.4	2.6	39
Mean weight	980g	980g	850g	650g	
% total	40.3	34.3	21.6	3.7	
Habitats					
- wooded stream	5.8	8.6	31.0	80.0	14.9
- marsh	38.5	56.5	55.2	20.0	47.8
- farmland	56.7	24.8	13.8	0.0	44.8
n =	54	46	29	5	134

Table 1. Frequency of occurrence of different facial patterns in *Mustela putorius* from France

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Status of the Spotted skunk (*Spilogale putorius*) in its northeastern range, north-central United States

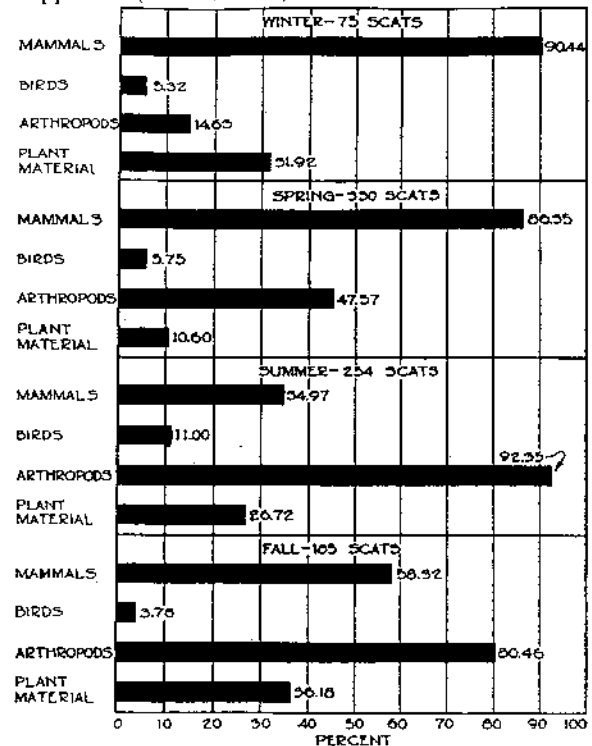
Pamela J. BOPPEL and Charles A. LONG

The Spotted skunk, *Spilogale putorius*, may be in peril throughout the northeastern part of its geographic range. This skunk is small with an average weight for the female of only 482 g and the male 680 g (Crabb, 1944). The length of the skull seldom exceeds 50 mm (Hazard, 1982). The spotted skunk has a complex pattern of white spots and stripes on a black coat. This coat coloration varies greatly from individual to individual and between geographic races (Van Gelder, 1959). The eastern spotted skunk, also known popularly although inaccurately as the civet cat, is a relative of the much more common and wide-ranging Striped skunk (*Mephitis mephitis*). *Spilogale putorius interrupta* (Rafinesque) is the subspecies of the great Plains (Fig. 1), and is slightly larger and has less white coloration than the western *Spilogale putorius gracilis* (Van Gelder, 1959). Some taxonomists consider the two spotted skunks as full species. The former breeds in April and the latter in autumn, and both kinds have been taken in the same trap line in Wyoming (Long, 1965).

The eastern spotted skunk has two anal glands capable of spraying an acrid musk for defence (Hazard, 1982 and others). When threatened, this skunk stands on its forelimbs, and arches its tail over the head so that both anal glands and head are facing the intruder. This defensive "hand-stand" posture may accommodate a more accurate aim or simply be a form of warning display (Johnson, 1921).

Spilogale feeds mainly on rodents and young rabbits in the winter and spring. The main foods during summer and fall are arthropods. Plant material is important throughout the year (Fig. 2). A few birds are eaten. Often these skunks will feed on corn

Fig. 2. Spotted skunk food. Percentage of scats in which various items appeared (Crabb, 1941).



during the winter while living about farm buildings, and they consume rats and mice in appreciable quantities (Crabb, 1941).

In northern states they den up for the winter (sometimes in small groups) but emerge to forage for food on mild days (Polder, 1968; Hazard, 1982). Dens may be above ground or burrows. Often the skunk reworks a ground squirrel's burrow. Usually four to six young are cared for, only by the mother.

The population status of this eastern skunk is in question throughout its range (Kaplan & Mead, 1991). It is listed as endangered in Missouri, and threatened in Iowa (where it is rare in western counties) and Kansas. It has been listed as "special concern" in Minnesota (since 1984) and also similarly listed in Nebraska. It is considered "rare" in North Dakota and Oklahoma (Wires & Baker, 1994).

The habitat associated with *S. p. interrupta* has not been extensively analyzed. In Minnesota it is generally found in open grasslands with sufficient cover such as fencerows, thickets, and riparian woodlands (Nordquist & Birney, 1988). Wires & Baker (1994) categorized sightings in wetlands/riparian 9; woods, forest edge, near creek 20; farmland 17; park preserve 4; urban 8; and roadside 4.

The first record of the spotted skunk in Minnesota was reported in 1914, in Winona County of southeastern Minnesota. By 1945, the animal was taken regularly by trappers throughout the southern half and the upper northwest corner of Minnesota (Swanson et al., 1945). The number of Minnesota spotted skunks trapped or sighted has declined steadily ever since. In 1946, the population was probably at peak abundance, with 19,446 harvest-

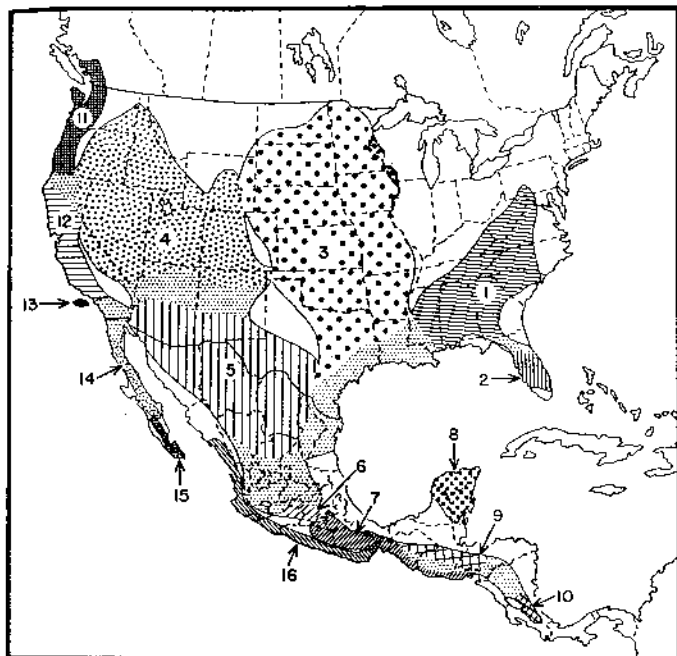


Fig. 1. The distribution of the species and subspecies of *Spilogale*. Lightly dotted areas are zones of intergradation. 1: *Spilogale putorius putorius*; 2: *S. p. ambarvalis*; 3: *S. p. interrupta*; 4: *S. p. gracilis*; 5: *S. p. leucopariu*; 6: *S. p. angustifrons*; 7: *S. p. tropicalis*; 8: *S. p. yucatanensis*; 9: *S. p. elatu*; 10: *S. p. celeris*; 11: *S. p. latifrons*; 12: *S. p. phenax*; 13: *S. p. amphiala*; 14: *S. p. martirensis*; 15: *S. p. lucasana*; 16: *S. p. pygmaea* (Van Gelder, 1959).

ted. In the next year fewer than 3,000 were trapped. In recent years few have been reported by trappers and fur buyers. In 1992, only eleven skunks were caught by five trappers (Wires & Baker, 1994).

A study was conducted recently to determine the current status of the spotted skunk in Minnesota. trapper records from 1988-1992 were reviewed, fur buyers were surveyed, museum and university animal collections were surveyed, and a "wanted" poster was distributed for other possible sightings by hunters, farmers, and the general public. The survey revealed that in the past five years there were only 72 possible sightings, 43 of which were verified. These ranged from sight records to road kills and actual specimens. Their results have prompted a recommendation that the species be upgraded to threatened status in order to better protect it in Minnesota (Wires & Baker, 1994).

Only two specimens have been collected in Wisconsin, probably among immigrants from Iowa or Minnesota. The first animal was taken on November 19, 1946, in St. Croix County of extreme western Wisconsin by a fox trapper (Scott, 1951). The second specimen was collected in November 1955, by Robert Ward in Jefferson County of southwestern Wisconsin, a place near the Illinois border, but also close to Iowa. He subsequently attempted to capture another utilizing the same den, but apparently it set off the box trap and vacated the area (Iwen, 1958). These *Spilogale* apparently dispersed into southern Wisconsin from southern Minnesota and northeast Iowa when populations were high there. It is doubtful that either specimen had escaped or was released from captivity. In 36 years, no other spotted skunks have been reported in Wisconsin. The Mississippi, St. Croix, and possibly other Wisconsin rivers have restricted immigration into Wisconsin, and now the Minnesota and Iowa sources are themselves in peril. *Spilogale* seems extirpated in Wisconsin. It easily could be re-introduced into state prairie areas.

The Jefferson County specimen of Wisconsin most likely did not come from Illinois, south of Wisconsin, because there have been no valid specimens ever taken from Illinois despite the well known established populations in neighboring Iowa (west of northern Illinois). Bones, mainly skulls, were collected from a cave in Monroe County of Illinois dated up to 8,500 years B.P. (Hoffmeister, 1989). Indians possibly brought the skulls from Iowa to Illinois across the Mississippi River (Van Gelder, 1959). In any case, the species was never long established east of the Mississippi River.

The northern expansion of the geographic range of the spotted skunk in the first half of this century into Minnesota and Wisconsin has been attributed to land use by humankind. Land use is drainage of wetlands for farming, providing den sites in and under sheds, barns and other outbuildings, plating hedges, creating woodpiles, providing accessible stored food of corn, grain, and thereby increasing numbers of injurious house mice (*Mus musculus*) and Norway rats (*Rattus norvegicus*) (Van Gelder, 1959). Trends toward fewer farms, removal of fences, construction of mammal-proof farm buildings, continuous corn cultivation, and elimination of brushy cover have made many areas in the Midwest less suitable as habitat for the spotted skunk (Hazard, 1982). To this can be added the obvious devastation of nature by urbanization southward of Minneapolis (for example, Edina, MN, where *Spilogale* was once abundant).

Spotted skunks are declining in Iowa and Minnesota, have disappeared altogether in Wisconsin, and are unknown in Illinois.

Little is known about the habitat requirements essential for preservation of this little skunk. An extensive habitat study is necessary to assess the needs and halt this drastic decline. One study is currently underway to determine the current status of the spotted skunk across the Great Plains (Dijak, 1994). Hopefully improved habitat conditions and greater protection will result.

Because of their taxonomic relationship to the striped skunk (*Mephitis mephitis*), the spotted skunks have a reputation as a disgusting pest that stinks terribly, kills chickens, and transmits rabies. In reality, this beautiful, smaller, and more agile species has a much lower incidence of rabies than its striped counterpart. It kills many rats and mice that are more of a problem to farmers than are the skunks (Hazard, 1982). It is one of the most beautiful mammals in the region.

Acknowledgments

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Reproductive behaviour of the Small Indian civet (*Viverricula indica*)

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Abstract

We observed a series of sexual behaviours in captive civets during their reproductive period. It was revealed that civets have two periods of oestrus per year: most occurred in spring (Feb. - Apr.) and a small number occurred in autumn (Aug. - Sept.). The Small Indian civet marks with civet oil and frequently makes a "da, da, da,..." sound when in heat. Olfactory stimuli and calling are important for mate selection. We also analysed the sexual behaviours playing important roles in successful copulation.

Introduction

The small Indian civet (*Viverricula indica*) is widely distributed throughout both forest and shrub-grass hill regions, wherever there are sufficient long grasses or thickets to provide daytime refuges. It occurs from the River Yangtze to Hainan Island, Yunnan and the Himalayan foothills, and through southern Asia from Nepal to India. This species likes to live in places which are situated not far from villages, and it is rare that civets live deep in the huge mountain forests (Gao Yaoting *et al.*, 1987). Despite its abundance, little attention has been paid to this civet by research workers.

Charles-Dominique's (1978) field study of the Two-spotted palm civet (*Nandinia binotata*) includes information on the length of the breeding season, litter sizes, and the age of sexual maturity, and Tsui *et al.* (1974) report seasonal histochemical changes in the testes of the Masked palm civet (*Paguma larvata*). Nevertheless, the civet's solitary, nocturnal habits, coupled with its timidity, make observations in the wild difficult so that little is known of its behaviour.

The civet oil that the small civet secretes is a very famous product, used in perfume manufacture. "Civet" was recently also found to be an effective drug for the treatment of muscle damage. The species is a Category II Protected Animal in China and is protected by the Chinese government. In order to produce more civet oil for commercial use, some civet farms have been established in southern China to produce "civet". However, the birth rate of the small Indian civet is very low in captivity because of our limited knowledge of its reproductive behaviour. The objectives of this paper are to summarize our findings on the copulatory behaviour of civets, and to provide basic statistics on their reproduction. These data can be helpful in captivity breeding programmes.

Methods

Since June 1989, we have maintained 20 civets in the animal farm at East China Normal University, Shanghai, and have monitored the sexual behaviour and reproductive period of the species. The animals were housed singly in adjoining cages. Each cage consisted of a wooden box of 60 x 60 x 45 cm and iron net cages of 100 x 100 x 60 cm (two cages constituted one unit, and these were easily separated if desired). Their diet included fish, rice, vegetables, mice, rabbit meat, and vitamin and mineral supplements, prepared according to an analysis of feeding habits (Wang Psychao, 1976). The nutritional content of the food is shown in Table 1.

Table 1. Nutritional content of feed for small Indian civets

	proteins	lipids	carbohydrates	ashes	vitamins & minerals
contents	30%	13.75%	52.75%	3.5%	suitable amount

Each cage was provided with natural lighting and water. The animals were fed at 17:00 every day. Between December and January, the male animals were allowed to interact briefly with females for several days a week to detect oestrus. Animals were maintained singly at all other times. Pairs were allowed to live together when the male and female were on heat.

Because of its nocturnal habits an infrared telescope was employed to observe bouts of reproductive behaviour (courtship calling was recorded by SONY tape recorder). A clock-controlled automatic recording device was used to record activity frequencies and scent marking.

Results

I. ACTIVITY

Although the small Indian civet is a solitary animal, captive civets of opposite sexes coexist peacefully during anoestrus. During the reproductive season, only oestrus males and females will live together peacefully. Otherwise, if an oestrus civet meets an anoestrus civet, a wild attack will occur and damage will be caused.

The reproductive season of the small Indian civet occurs twice each year. Most occurred between Feb. and Apr., and only few in Aug. - Sept. In small Indian civet this was usually preceded and accompanied by a number of changes in the animal's general behaviour. In heat the civet increased its tendency to contact other individuals. Both animals then showed increased locomotor activity after feeding at around 20:00 - 21:00. They would commence to persistently walk 'round and 'round in their enclosure, or frequently run in and out of the box after feeding, and displayed more anxiety. We recorded the locomotor activity frequencies of three females and two males by measuring the number of passes through the doors of the cage (Fig. 1)

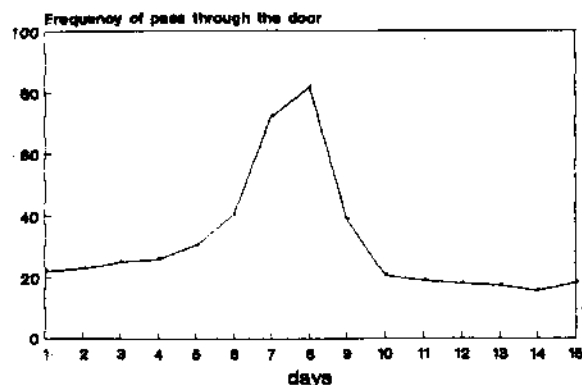


Fig. 1. Locomotor frequency of civet during the period of oestrus

Fig. 1 shows that locomotor frequency increases during the period of oestrus. The peak frequency was over 80 times/night, decreasing afterwards. Copulation usually occurred in the day when the civet was most active. The activity pattern includes

walking 'round, searching, scent marking, running in and out of the box, sniffing and rocking, etc. Scent-marking and partner searching are most pronounced during the period of oestrus.

2. SCENT-MARKING

The large perfume gland is situated between the anus and the vulva or penis. The inner pockets, which contain the secretion, are enclosed by antero-posteriorly elongated lips, these being everted when the secretion is applied. The animals can mark any object, but they like to make marks on vertical features. During marking the animal raises its tail vertically, everts the lips of the gland, and presses it firmly against the object. This is accompanied by a rhythmic, lateral oscillation of the pelvis, but about 18% of marking behaviour may not be accompanied by pelvic oscillation, only by a raising of the tail and pelvis, so everting the scent gland.

The gland is larger in the male than in the female. Although both sexes scent-mark, the male does so much more frequently. Scent-marking frequency varies between days and the season. The temporal distribution of scent-marking observed was as shown in Fig. 2.

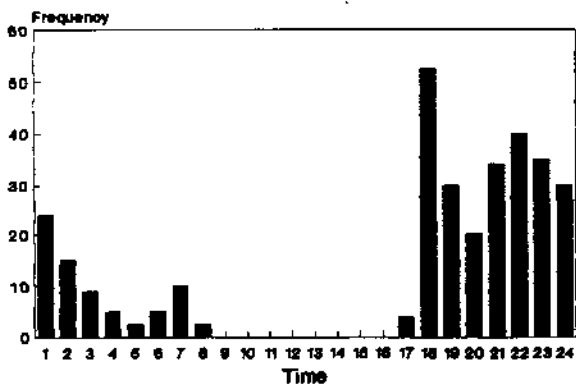


Fig. 2. Time distribution of scent-marking by the civet during oestrus

Scent-marking behaviour only occurred at night, during which three activity peaks were detected. The first and the second peaks occurred between 18:00 - 19:00 and 21:00 - 23:00, respectively. The other peak occurred before dawn. The seasonal fluctuation in the pattern of scent-marking was as Fig. 3. Scent-marking was most common in spring, during the season of oestrus.

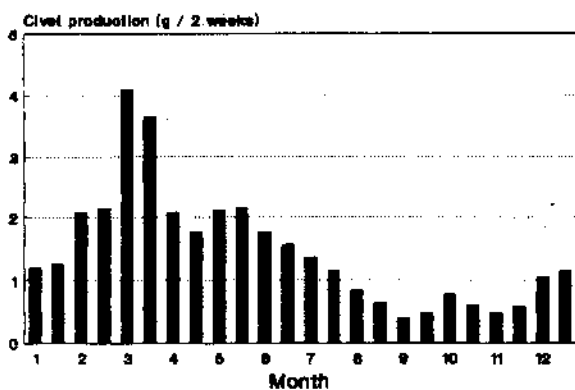


Fig. 3. Seasonal fluctuations in civet production by the small Indian civet

When females and males displayed signs of oestrus, both showed an increased frequency of scent-marking. Over a 10-day period, in which 10 hours of observations were made in the evenings, the male and female both exhibited increasing frequencies of marking activity.

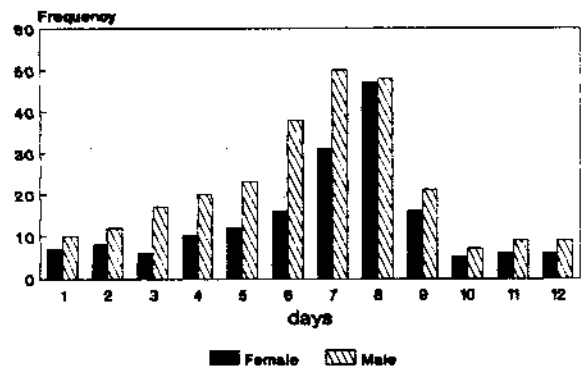


Fig. 4. Scent-marking frequency variation in the small Indian civet during oestrus

As Fig. 4 shows, the male's marking activity increased first, then the female followed. This pattern may reflect a relationship with the gradual hormonal changes which characterise the cycle of oestrus. The peak in scent-marking activity was at the height of oestrus, and then decreased after mounting occurred. It is of interest that the site of marking differs between the male and the female. The marking sites of the oestrus female were limited to her own cage; she never went out to mark other places, even though the cage door was open. In contrast, the marking sites of the oestrus male may be on any objects which he encounters. Most marking sites were in the cage of the other male (Table 2).

Table 2. Frequency of marking at different sites in the oestrus male (two males, five days)

Sites	Male cage (wooden)	Female cage (wooden)	Own cage	Cement wall	Brick	Iron net
Marking frequency	121	63	32	12	52	15
(%)	41	21.4	10.8	4.1	17.6	5.1

A very low percentage of the male civets' scent-marking was in its own cage (10.8%). We suggest that scent-marking behaviour may represent a territorial behaviour during the period of oestrus.

3. COURTSHIP CALLING

Although a rather silent animal in general, civets have several distinct vocal signals:

- The scream: a screaming cry was given several times by the female in the course of serious fights with the male (usually during oestrus periods). The oestrus male will attack any anoestrus individual who tries to move into his territory. The attacked civet will make a 'screaming' sound.
- Threat calling: a threat call was given by stressed civets. This is the 'last ditch' threat vocalization, normally given when the animal is terrified or approached by strange people.
- Courtship calling: a sexual call "da da da..." was given by a male as an oestrus female approached. The oestrus male ran quickly and made calls to search for the oestrus female. Stopping at the female's box, he sniffed the female's scent-marking site and made the courtship call. If he found the oestrus female, he waited at the door and called. Sometimes he stretched his head into the female's box to sniff. One or two minutes later, he would enter the female's box if she had made no response. At that time the oestrus female usually ran out and made a circuit of the cage, the male following and trying to mount her. If she was not ready, she would bite the male, whilst making a sharp call. The male also makes a sharp, loud sound as a response.

Courtship calling only occurred in the oestrus period, usually between Feb. and Apr. In the autumn, a few male civets also make the courtship call, but the period is very short. The courtship call of the male usually lasts seven days, the overnight frequency distribution of courtship was as shown in Fig. 5. Mounting usually occurred between 21:00 and 22:00.

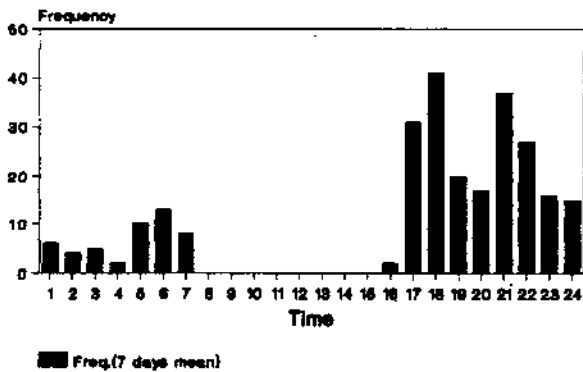


Fig. 5. Time distribution of courtship calling in the civet during oestrus

4. COPULATION BEHAVIOUR

During heat, both locomotor activity and courtship increased. Female receptivity was finally shown by her breaking into a run, so inciting the male to pursuit by approaching him and running closely beside him. When the female laid down abruptly, mounting usually occurred. Sometimes the female made a circuit of the cage and incited the male to follow, the female running very fast, as if wanting to bite her own tail. The male sniffed the female's anal area and tried to mount her, but usually she didn't accept immediately and incited the male to chase her. The male often made mounting attempts several times before the female was ready to accept him. All courtship chasing occurred at night. When the oestrus female was ready for copulation, she moved off and the male ran after her. She then sank down, so that she was lying almost prone, with her body fully extended, however, as the male approached she would run off again. Finally she lay with her hindquarters slightly raised and permitted mounting. His fore-paws were placed on either side of her shoulders, supporting most of his weight, while his hind legs made treading movements on either side of her flanks, and pelvic thrusting took place. After a few moments she gave a low "miau" and then moved forward slightly. This time the male moved with her and gripped the fur between her shoulder blades. The female then moved forward again and the male dismounted, pelvic thrusting was fast at this point. Females almost always terminate the mount by departing quickly. When the male followed, the female turned and snapped at him.

Discussion

Although the civet is solitary in habits, nocturnal and timid, the oestrus male must search for the female during the reproductive season. The home range of the small Indian civet is about 3.4 - 5.1 ha (Sheng Helin & Xu Hongfa, 1990), so the male must search a large area to find an oestrus female. It is conceivable that it is very difficult to find the female in the thickets and tall grass. The range of the civet's vision is very short in the environment in which they live, so courtship calling and scent-marking provide the best way of finding each other.

Scent-marking is an effective means of communication between the male and female. During oestrus, the labia of the perineal gland became firmer and enlarged. The vulva, situated in the middle of the glandular pouch, secreted a profuse mucus

which, together with the perineal gland secretions, was presumably responsible for the strong odour. When the female makes scent-marks, the hormone, mucus and civet are deposited on the object. The male can detect the oestrus female by sniffing these objects. Before mounting, the male also sniffs the female's anal area and assures whether the female is in oestrus. Wemmer (1981) suggests that the copulatory vocalizations of the female binturong are of insufficient amplitude to attract males, but that its modulation in response to copulatory events suggests a function as an excitation indicator providing feedback to the male. Hamilton & Arrowwood (1978) suggest that the copulatory vocalization of certain primates may mutually stimulate sex partners, or incite male competition. In the small Indian civet, courtship calling not only stimulates female sexual excitement, but also stimulates sexual excitement in other males. In our civet breeding cage, when a male commenced courtship calling, the other male became more active and showed signs of oestrus one or two days later.

The mating posture is very similar to that of the African civet (Ewer & Wemmer, 1974). Ewer suggests that this posture is an adaptation to arboreal mating. Here it would be clearly necessary for the female to lie flat on the branch, clasping it firmly with her forelimbs. Neckbiting by the male was also a characteristic posture. They explain that the usual male method of mounting with clasping is not unlike the felid method of attacking prey, but with the fore paws planted firmly on the ground and taking most of the weight, is completely different from the attacking position. The felid mating posture may therefore serve to remove the danger of the male's accidentally switching from mating to attack, so treating the female as prey instead of as a sexual partner. In view of the specialized nature of the advantage, reducing the chance of error is obvious. We agree with this suggestion, but we think that neck-biting is very common in carnivores: the mother carries her young with a neck-bite, but never damages them. In these situations, the animal only grasps the neck fur with the teeth, and no damage results. Carnivores bite the prey using their teeth to cut or break the neck vertebrae, so here neck-biting is very different.

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Natural distribution and ecology of mustelids and viverrids in Manipur, north-eastern India

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Manipur, lying between latitudes 23°83' and 25°68'N and longitudes 93°03' and 94°78'E, sustains diverse forest ecosystems having many faunal and floral biotopes. Many of the biota of Manipur are found to be endemic to the region, and a few are peculiar to the State. Manipur shares a border of 352 km with Myanmar (Burma) in the east, and the eastern half of Manipur, includes the Manipur Valley and is an integral part of the Chindwin-Iravati river system of Myanmar. This is important as little is known about the country's wildlife (Schreiber *et al.*, 1989). Hence faunal studies in Manipur offer the useful potential for extrapolation to the wildlife of Myanmar.

This paper deals with studies on the natural distribution and ecology of mustelids and viverrids of Manipur and attempts to highlight only those aspects of the ecologies of the animals which are either hitherto unknown, or otherwise add to the recorded information on the subject. The study was made by the author in his capacity as Deputy Conservator of Forests and Wildlife for over four years, with the purpose of collecting and updating information on the rare, threatened and endangered mammals of Manipur. As the mustelids and viverrids of Manipur show great allotropic variations from mainland Indian species, special interest was taken on the group. Though the study was not done on a regular basis, the author had the advantage of staying for long periods in each of the 13 centres of study (shown on Fig. 1) and the resulting interviews with the local tribal communities (who are also traditional hunters) has resulted in the gathering of very reliable information. Besides, as Director of Manipur Zoological garden, the author designed and erected special enclosures for

small carnivores, and had the privilege of handling and studying most of the animals described, and of breeding a few of them in captivity.

Observations on mustelids

The small to medium-sized Mustelidae fall into four sub-families of which three are represented in the Indo-Malayan realm (Corbett & Hill, 1992). In Manipur these sub-families (namely Mustelinae, Melinae, and Lutrinae) are represented. The following is a brief review of the ecological status of each species in Manipur, both in the wild, and in captivity.

1. YELLOW THROATED MARTEN (*Martes flavigula*)

Habitat: Usually found in dense tropical forests in the western part of Manipur, as well as in the Teak-Gurjan type forests in the Indo-Myanmar border areas. They are also seen at relatively high elevations (ca. 1,000 m ASL) on hill slopes that sustain *Castanopsis-Quercus griffithii* associated with *Schima wallichii*.

Feeding ecology: Omnivorous. Birds, reptiles, rodents, and other small mammals, fruit, sugarcane, and honey.

Habits: Though crepuscular, can be active during bright daylight. The animal is very agile and an excellent climber, and also extremely noisy for a mustelid.

Though convincing evidence is not available, there appears to be a restricted breeding season for the species (March, April). They are not shy animals and can be bred easily in captivity. A pair are expected to breed in the Manipur Zoological Garden.

2. FERRET-BADGER (*Melogale* sp.)

Habitat: These animals occur in the ombrophilous broad-leaved forests of Manipur lying in the sub-montane belt (>1,000 m ASL) and in the sub-tropical pine forests (1,200 to 1,500 m ASL).

Feeding ecology: Carnivorous. Frogs, lizards, and large insects. Also partial to earthworms.

Habits: Only one case of giving birth was observed, resulting in two cubs in the month of July. Insufficient information is available to arrive at conclusions on its breeding habits.

Though heavily exploited for its fur in China (Corbett & Hill, 1992), they are only killed for food in north-eastern India. Further taxonomic studies are needed to confirm whether the animal found in the region is *Melogale moschata*.

3. HOG BADGER (*Arctonyx collaris*)

Habitat: Shares the habitat of the ferret-badger in Manipur.

Feeding ecology: Omnivorous. Tubers, roots, leaves, and small animals. Of the five specimens studied in captivity, four had a preference for chopped meat, but all five relished earthworms.

Habits: Crepuscular. Only the sense of smell is highly developed. Has a restricted breeding season and gives birth to two to five cubs during April or May. Other aspects of reproduction are not known.

This animal is hunted for food. Not being agile, it falls easy prey to tribal hunters. As the tribal communities attribute a medicinal value to the fat of this animal, it is persecuted and thus threatened with extinction. Reliable tribal informants claim that

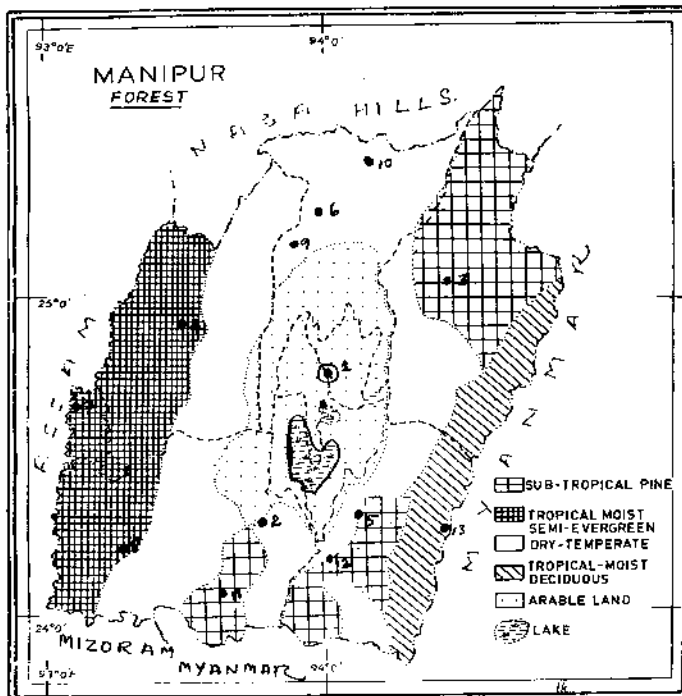


Fig. 1. Important forest types of Manipur. Full circles indicate centres from which information was gathered: 1, Imphal; 2, Churachandpur; 3, Ukhrul; 4, Tamenglong; 5, Chandell; 6, Senapati; 7, Jiribam; 8, Thonlon; 9, Kangpokpi; 10, Tadubi; 11, Singak; 12, Chakpikarong; 13, Moseh.



Common palm civet (*Paradoxurus hermaphroditus*).



Small Indian civet (*Viverricula indica*). [Photos: V. Ramakantha]

there are two types (subspecies?) of hog badger within Manipur: the one being the fairly large animal displayed at the Zoo, and the second variety being smaller with dark spots on its body. This needs further investigation.

4. COMMON OTTER (*Lutra lutra*)

The author has observed otters in the Barak, the Makru, and Jiri Rivers in the western parts of Manipur, in the Logtak Lake in the Central Valley, and in the Lokchao River in the Indo-Myanmar border areas in eastern Manipur. The common Indian otter has not been recorded by Prater (1971) to occur in these parts, or, for that matter, in any area except in Kashmir and southern India. This is the first confirmed report on the occurrence of *Lutra lutra* in Manipur. The animal is being exhibited in the Manipur Zoological Garden.

Habits and observations: The cubs make a snorting noise when disturbed or scared, a low grunt similar to the vocalisation of a dog, and a screeching noise when hungry. The author recovered two otter cubs from the Turet River (in the Indo-Myanmar border area) and one from western Manipur in the month of May. It can be said that young are born in the months of February or March. Cubs were observed to be diurnal, sleeping soundly during the night. As the animal is persecuted by man, the activity of the animal when adult is restricted to the hours of darkness, extending into the early mornings. It has been observed that otters are losing their traditional habitat at a rapid pace in Manipur. Blasting dynamite in water for the purpose of fishing by local people is depriving the animals of their food. About 40 km² of floating mats of vegetation of the Kabul Lamjao National Park alone remain as a safe breeding ground for the species. Though there have been very reliable reports and records by the Wildlife Wing of Manipur regarding the occurrence of the clawless otter (*Aonyx cinerea*) and the smooth Indian otter (*Lutra perspicillata*) in Manipur, the author has had no opportunity to confirm these claims.

Observations on viverrids

Seventeen species of the family Viverridae from 11 genera have been recorded in the Indo-Malayan realm, but in Manipur only six species have been recorded so far.

1. LARGE INDIAN CIVET (*Viverra zibetha*)

In the approximately two decades of existence of the Manipur Zoological Garden, no animals have been exhibited. This elusive animal is seldom seen in the State, however, there are reliable reports of this animal's existence within Manipur. Recently (in

1993) a skin of this species was recovered from a village on the Indo-Myanmar border area and Dr Ullas Karanth identified the skin as that of *Viverra zibetha* (based on a photograph sent to him). However, the head and body length is 965 mm, which seems too large for *Viverra zibetha*. This needs further investigation. No further information is available on this animal.

2. SMALL INDIAN CIVET (*Viverricula indica*)

This animal is wide-spread within Manipur, occurring in both the Central valley and the surrounding mountains. However, it has yet to be reported from elevations beyond 1,500 ASL. The art of the extraction of civetone is unknown amongst the resident tribal communities, but the animal is occasionally hunted for food.

3. COMMON PALM CIVET (*Paradoxurus hermaphroditus*)

This is the commonest of viverrids in Manipur, sharing the habitat of the small Indian civet. The animal is quite distinctive from the southern Indian form in both its summer and winter coats; the spots on the flanks being larger and clearer, but the buff colouration is restricted to a small portion of the ventral surface, whilst the legs and the fore-limbs are generally black. Though the animal climbs well, it is helpless during the day (the author has witnessed people capturing this animal with ease during the day). It frequents human habitations and is occasionally hunted for food.

Feeding ecology: Frugivorous, but does hunt and eat birds and other small animals. I have noted a case of intra-specific aggression leading to cannibalism in the Manipur Zoological Garden.

4. MASKED PALM CIVET (*Paguma larvata*)

Widely distributed within Manipur, and found even above 2,000 m ASL. One cub was hand reared for two months by the author, and this animal now has a mate in the Manipur Zoological Garden.

5. BINTURONG (*Arctictis binturong*)

Reported from only the ombrophilous forests of western Manipur, the author has confirmed its existence by the recovery of a skin from a tribal hunter in the Senapati District. Nothing else could be discovered about this animal. It is extremely rare, being declared a Schedule I animal in India.

6. SPOTTED LINSANG (*Prionodon pardicolor*)

The Manipur Zoological Garden has reared the spotted linsang, and the former Chief Wildlife Warden, Mr. Tomchou Singh, has recorded observing the species in the tropical forests of the Jiribam-Tamenglong area. On one occasion in 1990 the author sighted a buff coloured animal with dark blotches on the body on

a tree on the way to the Shiroy Hills in the Shiroy-Karom Hill ranges of Ukhrul District. This Schedule I animal is also threatened with extinction in Manipur.

Conclusions

It is of interest to note that Prater's Book of Indian animals (1971) which has remained a primary reference source indicates, although in a vague sense, the possible occurrence of the small Indian Mongoose (*Herpestes auropunctatus*), the crab-eating mongoose (*H. urva*), and the Himalayan weasel (*Mustela sibirica*) in Manipur. However, this author has not sighted these animals in Manipur, and there are no records of their occurrence in the State.

The tropical, moist forests of Manipur host a large number of rare and threatened taxa, including mustelids and viverrids. However, large portions of the forests are subjected to slash and burn cultivation by the resident tribal communities. Although the stringent Indian Wildlife (Protection) Act of 1972 and Manipur (Protection) Rules of 1974 are applicable in the State, there are practical difficulties in enforcing them in the inaccessible, interior hills of Manipur. In addition the fact that the local inhabitants take pride in their tradition of hunting complicates the matter, particularly as they no longer use traditional modes of hunting, but instead use sophisticated modern weapons. One saving grace is that most hunting of these small carnivores is carried out for food alone and, with the exception of the hog badger (which is persecuted for medicinal use) no mustelid or viverrid is perse-

cuted for fur, civet, etc. Despite this however, top priority needs to be given to ensuring effective protection to all the Reserved Forests of the State, thus ensuring the preservation of their biota for posterity. It is laudable that efforts are being made to breed the area's rare and endemic fauna in captivity at the Manipur Zoological Garden. A considerable portion of this small zoo has been developed for the conservation of mustelids, viverrids, and other small carnivores of the State.

Acknowledgements

I thank Sally R. Walker for editing and publishing reports on a few of the animals dealt with in this article in Zoo's Print. I also thank Ullas Karanth, Roland Wirth, and H. Van Rompaey for help guidance on the subject.

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Badger conservation and legal protection

Badger populations throughout their Eurasian range are of course fundamentally related to food availability, but in many countries the actual density is in fact determined by human pressures from habitat disruption, traffic, or hunting (Griffiths et al., 1993). Indeed, reintroduction programmes may be useful where numbers have been decimated by hunting or rabies control in the past (Hancox, 1990, 1993a).

The true reason for full legal protection, including core habitat 'nest sites' as in birds, is often misunderstood. And yet the evolution of sociality in badgers is clearly linked to a den-site clan-based structured population, with cooperative excavation of setts, bedding provision, and territorial and clan defence. And within clan unity is maintained by mutual musking and grooming, and multiple mating bonding, as in apes, naked or otherwise (Hancox, 1993a). Hence individual survival and the chance to pass on genes to future generations is linked to clan membership, and access to all important main breeding setts, with very few cases of badgers breeding above ground (Hancox, 1993b).

Curiously, there are only some six European countries which embody setts in the legal protection for badgers:

- Albania: specifies "destruction of lairs and hiding places"
- Belgium: "disturb or destroy nest or lair"
- Holland: Byelaws on "disturb or breakdown of any excavation made by badgers"
- Great Britain: "damage, destroy, obstruct access to any entrance, disturb a badger in its sett, cause a dog to enter a sett"
- North Ireland: "damage or destroy, obstruct access to any structure or place wild animals in Schedule 5 uses for shelter or protection"
- South Ireland: "wilful interference or destroying the breeding place".

Of course, the legal protection afforded to any carnivore is an uneasy blend of concessions to sporting interests and practicable laws. But it is rather ironic that in Britain, dogs used by badger diggers are seldom confiscated by the courts, and elsewhere dogs may kill cubs underground when allegedly in pursuit of 'legal quarry' such as porcupines (Italy) or raccoon dogs in northeastern Europe. Similarly, the multi-entranced/multi-chambered structure of setts is beautifully designed to ensure adequate ventilation, as shown by early artificial setts where bedding in blind chambers went mouldy, and in comparable smoke source experiments with prairie dog burrows and smoke emergence from downwind exits. It is hence ludicrous as in Britain to legally allow to 'stop up' setts, to prevent foxes 'going to ground', and one court prosecution over excessive stopping and the suffocation death of the entire clan was successful in 1993. Clearly, legal protection for badgers in most countries needs improvement.

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A sighting of a Masked palm civet (*Paguma larvata*) on Java

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A medium-sized viverrid identified as a Masked palm civet *Paguma larvata* was seen on 13 July 1993 in the Cibodas Botanic Gardens at 1,350 m ASL at the base of Taman Nasional Gunung Gede-Pangrango (06°47'S, 106°59'E), Java, Indonesia. This species has not been previously recorded on Java.

The animal was first sighted 1.5 hours after dusk, and was watched for 10 minutes by both authors. It was detected when its bright red eyeshine was picked up in the beam of a Petzl headlamp, and was subsequently observed at a range of 5-10 m using a Nitech spotlight and 7x42 and 10x40 Zeiss Dyalot binoculars. It was initially observed sitting on a large branch approximately 1 m above the ground, on the edge of a small but dense row of trees with an extensive scrub understorey. When disturbed it climbed slowly higher, up to a height of about 4 m where it crouched down facing the observers before moving down and away into the trees. The animal was clearly a civet. Its most distinctive feature was its creamy-white face. This extended from between the eyes, up onto the forehead, and then on behind the eyes and round to below the ears, meeting below the chin. The rest of the face appeared black. No other markings were apparent elsewhere on the animal, which appeared to be a uniform warm brownish colour. The ears were rounded. The legs were fairly short and the overall build quite stocky. The tail was long (although shorter than the head-body length), noticeably thick (but not bushy), and all-dark.

Several other species of viverrids are known from Java, namely Small Indian civet *Viverricula indica*, Banded linsang *Prionodon linsang*, Small-toothed palm civet *Arctogalidia trivirgata*, Common palm civet *Paradoxurus hermaphroditus*, Binturong *Arctictis binturong*, and Javan mongoose *Herpestes javanicus* (Wozencraft, 1993). Of these, only the two other palm civets are structurally similar to the animal in question, and both of these show considerable differences from *P. larvata*. *A. trivirgata* lacks a mask and has a noticeably longer tail, while *P. hermaphroditus* shows distinct dark dorsal striping and lateral spotting. Although *P. hermaphroditus* shows a similar head pattern, neither species is likely to have an extensive and distinct white mask (Payne *et al.*, 1985; Nowak, 1991; pers. obs.). GCLD has field experience of both *A. trivirgata* and *P. hermaphroditus* from Borneo (Wilkinson *et al.*, 1991).

P. larvata, along with the other members of the subfamily Paradoxurinae (palm civets), is largely nocturnal, arboreal, and solitary (Roberts, 1977). It is mainly found in forest and brush country (Roberts, 1977). The Cibodas Botanic Gardens consist of areas of extensive lawn, interspersed with patches of trees and small streams. They are bounded on three sides by cultivation, but back onto the extensive submontane and montane forest of the National Park with the forest edge at 1,400 m (Andrew, 1985). Small Indian civet *Viverricula indica* and Leopard cat *Felis bengalensis* were also recorded in the botanic gardens during a total of three hours of spot-lighting the same night.

P. larvata is known to occur from Kashmir to the Malay Peninsula, and on the Andaman Islands, Taiwan, Hainan, Sumatra, and Borneo (Nowak, 1991). The other species of Sundaic Paradoxurinae have similar extensive Oriental ranges, and none of the

other species occurring on Sumatra and Borneo are not also known from Java (Payne *et al.*, 1985; Wozencraft, 1993). It is thus feasible that *P. larvata* occurs naturally on Java, although the probability of its having gone undetected hence far seems very small.

Speculation as to a more probable explanation for this record points to a recent introduction to Java, either unintentional or deliberate. The latter seems more likely, as the species is known to have been deliberately introduced to central Honshu, Japan (Corbet, 1978), and a number of other civets including *P. hermaphroditus* have been deliberately introduced outside their natural ranges as rat-catchers (Groves, 1976).

Less than 10% of the original forest cover remains on Java (RePPPProt, 1990). The Javan subspecies of the small-toothed palm civet *Arctogalidia t. trilineata* is classified as Indeterminate by IUCN and has not been recorded since 1978 (Schreiber *et al.*, 1989), and if *P. larvata* is in fact native to Java, then it too warrants conservation attention on the island.

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Gunung Gede was visited in the early stages of the Cambridge Flores/Sumbawa Conservation Project 1993, the full credits for which are given in Butchart *et al.* (1993). Our thanks go to BirdLife Indonesia and the Biological Sciences Club, Jakarta for providing so much help while we were on Java, and especially to Stuart Butchart, James Lowen, Charles Davies, Gunawan Dharmaputra, and Pak Alo Sahu who worked with us in the field throughout the project. Finally we are grateful to James Lowen, Roland Kays, Greg Anderson, and professor John Gittleman for their helpful comments and advice on the paper.

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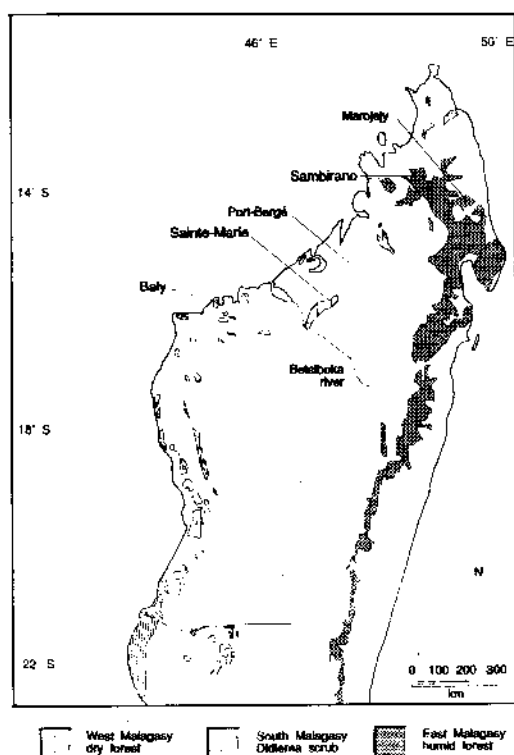
Eupleres goudotii in west Malagasy deciduous forest

Frank HAWKINS

The Fanalouc, *Eupleres goudotii* Doyère, 1835, is a peculiar carnivore in the family Viverridae, endemic to Madagascar. Two subspecies are known, *E. g. goudotii* in east Malagasy rain forest, from far south (Andohahela; J. C. Durbin, pers. comm., 1992) probably as far north as Marojejy (Safford & Duckworth, 1990), and *E. g. major*, known from the Sambirano region of rain forest, and as far south as the marshes near Port-Bergé and Sainte-Maire, the latter on the northern fringes of the Ankarafantsika massif (Kaudern, 1914-15a; Albignac, 1973). All sites are shown in Fig. 1.

The fanalouc is generally found in primary or secondary forest, frequently near marshes (Albignac, 1973). It is nocturnal or crepuscular, and subsists largely on earthworms. It has a pointed snout, large rear limbs and strong front legs, the toes of which are equipped with long strong claws for digging (Albignac, 1973). The tail is short but bushy, and the fur dark brown. Head-body measurements range from 455-650 mm, and weight of adults from 1.5-4.6 kg; in all measurements *E. g. major* is the larger subspecies by about 25-50% (Albignac, 1973).

Eupleres has always been considered a species limited to dense humid forest and marshes (Kaudern, 1914-15a; Albignac, 1973). It therefore came as a surprise to find one in rather degraded primary deciduous forest 4 km N of Baly (16°04'S, 45°16'E), 120 km W of Mahajanga (Fig. 1), at 16:00 on 12 February 1994. The forest was typical of western deciduous forest in this area (White, 1983; Nicoll & Langrand, 1989), growing on a sandy lateritic substrate at an altitude of about 10 m ASL. It was about 1 km from an area of flooded *Bismarckia nobilis* palm savanna, and 3 km from an area of salt-marsh.



My local guides said that the name for this animal was 'Jabady', a name frequently used for small carnivores including *Viverricula indica* (pers. obs.) and *Fossa fossana* (Safford & Duckworth, 1990). Other local names for this species include 'Ridarida' and 'Fanaloka' (Kaudern, 1914-15a, b; Albignac, 1973). Near Baly, local taboos ('fady') against eating the animal may prevent hunting, but knowledge of or adherence to this taboo was patchy.

The animal's pelage was colored dull rusty-earth, more grey on head and tail; the formidable claws on the front feet were held so as not to touch the ground. In comparison with three sympatric carnivores, it was considerably larger and bulkier than *Galidia elegans* or the introduced *Viverricula indica*, but much smaller than *Cryptoprocta ferox*.

Albignac (1973) implies that greyish tints in the pelage are characteristic of the Sambirano subspecies *E. g. major*, the form which might be expected near Baly (Fig. 1).

This is the westernmost record of this species by around 200 km, and is the first record of the species from west of the Betsiboka River, a very important biogeographical barrier to many other of bird and mammal species (Jenkins, 1987; Nicoll & Langrand, 1989; Langrand, 1990).

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Fig. 1. Current forest cover in Madagascar and sites mentioned.

The ecology of the small carnivores in the Nilgiri biosphere reserve in western Ghats, South India

Ajith KUMAR

The Ministry of Environment and Forests, Government of India has granted funds to Drs. Ajith Kumar and N. Sivaganesan of the Salim Ali Centre for Ornithology and Natural History to conduct a three-year study on the ecology of small carnivores in the Nilgiri Biosphere Reserve. The reserve covers Silent Valley National Park, Mudumalai, Bandipur, Mukurthi, and Wynad Wildlife sanctuaries, Nagarhole National Park and the forests surrounding these protected areas, covering a total of 5,000 km² in the states of Karnataka, Kerala, and Tamil Nadu.

The Nilgiri Biosphere Reserve has a relatively high diversity of small carnivores representing almost all the species found in peninsular India. The civets are represented by the Small Indian civet (*Viverricula indica*), Common palm civet (*Paradoxurus hermaphroditus*), and Brown palm civet (*P. jerdoni*). The Malabar civet (*Viverra civettina*), one of the most endangered species in India, has not been confirmed from the Reserve. The mongooses are represented by the Indian grey mongoose (*Herpestes edwardsi*), the Ruddy mongoose (*H. smithi*), the Indian brown mongoose (*H. tuscus*), and the Stripe-necked mongoose (*H. vitticollis*). Otters have also been reported from the area although the species remain to be confirmed. The Nilgiri marten (*Martes gwatkinsi*) is another mustelid present in the Reserve.

Among the small cats the species definitely known to occur in the area are the leopard cat (*Felis bengalensis*) and the Jungle cat (*F. chaus*). It is very likely that two other species, the Fishing cat (*F. viverrina*) and the Rusty spotted cat (*F. rubiginosa*) are also present in the area. The former is present in Sri Lanka and the latter has been sighted in the Anamalai Hills and Cardamom Hills. Thus with 11 confirmed species and another 4 likely to be present, the Nilgiri Biosphere Reserve harbours a full complement of all the species found in peninsular India, a reflection of the rich and varied habitat types found in the area. The small carnivore community also has a high degree of endemism with the Malabar civet, brown palm civet, brown mongoose, stripe-necked mongoose, and the Nilgiri marten being endemic to the Western Ghats.

Most of the small carnivores have received very little conservation and scientific attention, especially in India with almost no field studies on them. Even information on distribution is still very scanty with considerable range extension of species being reported even now. The sighting of rusty spotted cat in central Kerala in 1992 and in Anamalai Wildlife Sanctuary in 1994 are examples. The objectives of this project are set in the background of almost total absence of any quantitative data on small carnivores in India. The major goal of the project, therefore, would be to gather baseline information on them which would allow a realistic assessment of the conservation status of these species based on a proper understanding of their distribution, abundance, and ecology. The objectives of the project are:

1. To assess the variation in the distribution and abundance of different species of carnivores with reference to different habitat types
2. To assess the prey base and dietary overlap of the various species
3. To assess the impact of habitat disturbance and other human activities on different species
4. To suggest measures for the long term conservation of small carnivores in the Nilgiri Biosphere Reserve

A variety of methods would be used to collect data. Data on the distribution and abundance would be collected from selected areas of the reserve representing all the major habitat types and human impact patterns. Camera traps, scats, and direct sightings would be used for this purpose. The ecological studies would last for two and a half years and would consist of scat analysis and tracking of radio-collared animals. Funds have been obtained for 10 radio collars. It is planned that 3-4 species would be radio-collared in the same area. The habitat attributes which are of relevance to the distribution and abundance of small carnivores would also be measured, using standard techniques such as belt transects, quadrats, and regular and random points.

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BBC search for small mustelid film locations

The BBC television series 'Wildlife On One' is planning a programme about four species of mustelids: stoats (*Mustela erminea*), weasels (*M. nivalis*), polecats (*M. putorius*), and pine martens (*Martes martes*). We are keen to find locations where these species can be seen regularly with a view to filming them. We are particularly keen to hear from anyone studying them in the field or keeping them in captivity. Please contact Miles Barton, Wildlife On One, BBC Bristol BS8 2LR (Tel. 0272 732211).

Erratum

In "The stone marten" (Newsletter No. 10, p. 20) the first line of the fourth paragraph should read: "The study of the diet is based on the analysis of 1430 scats" (instead of 140 scats!).

Sightings of Spotted linsang *Prionodon pardicolor* and Black-striped weasel *Mustela strigidorsa* in Lao PDR

Both of these enigmatic species have recently been found during a survey in the Nam Theun National Biodiversity Conservation Area (18°05'N, 105°20'E) in the Annamitic Mountains of central Laos. At ca. 3,500 km² it is the largest of the country's newly declared reserves. Both sightings were in primary hill evergreen forest at 1,000-1,100 m along a newly-cut road intended for logging traffic. The survey was conducted by scientists from the Wildlife Conservation Society, in conjunction with the National Office of nature Conservation and Watershed Management.

The weasel ran across the road in broad daylight on 15 April 1994. The linsang was seen on 12 April during a few hours spent walking the road at night with headlamp and spotlight. It was detected by eyeshine and watched for about a minute sitting on a thin broken off tree, about 3 m above the ground, before running off along the fallen part of the trunk. The Viverrid and Mustelid Action Plan (Schreiber *et al.*, 1989) indicates that there are exceedingly few records of either species, and that the linsang

has not been found before in any protected area. Another spotted linsang was seen in a private zoo at Lac Sao, a town just west of the reserve.

The four month survey of the reserve also produced an exceptional variety of other rare birds and mammals. It is hoped the government will take steps to stop the logging and destroy the road as soon as possible before the remote core of the reserve is opened up to exploitation.

Reference

- Schreiber, A., Wirth, R., Riffel, M. & Van Rompaey, H. 1989. *Weasels, civets, mongooses and their relatives. An Action Plan for the Conservation of Mustelids and Viverrids.* IUCN, Gland.

Tom EVANS, William BLEISCH
and Rob TIMMINS

European Mink Conservation & Breeding's Committee Biannual Meeting Tallinn, Estonia, 22nd July 1994

PARTICIPANTS

EMCC members: Tiit Maran (Chair, Estonia), Mati Kaal (Tallinn Zoo, Estonia), Leif Blomqvist (Helsinki Zoo, The Nordik Ark, Finland/Sweden, also representing Jukka Lahtinen, Ähtäri Zoo, Finland), Roland Wirth (IUCN MVP SG, Germany), and Heikki Henttonen (Finnish Game Research Institute, Finland).

OBSERVERS

Arnd Schreiber (Ruprecht-Karls-Universität Heidelberg, Zoologisches Institut, Germany), Francesco Rocca (Parco Faunistico "La Torbiera", Italy), Andrea Crosta (Parco Faunistico "La Torbiera", Italy), Seppo Turunen (Helsinki Zoo, Finland), and Daisy Wirth (Germany).

NON-PARTICIPATING EMCC MEMBERS:

Vladimir Fainstein (Vice-chair, Tallinn Zoo, Estonia), Pekka Pamilo (Uppsala University, Sweden), Jukka Salo (T. H. Nässling Foundation, Finland), James Dolan (San Diego Wild Animal Park, USA), and Jukka Lahtinen (Ähtäri Zoo, Finland).

The EMCC chair gave a review of the activities and the expenditures of the last two years. There have been four types of action during this period: (a) field work in Estonia, (b) efforts to effectuate the captive breeding programme, (c) advertising the problems of European mink conservation to the public, and (d) preparing the contracts with experts from the CIS (Commonwealth of Independent States: Russia and Belarus) for surveying the status of the species.

The drastic change in number of the European mink in Estonia is well-documented. The failure of the attempts to increase the number of founders in the captive stock is caused mainly by the rapid decline of the European mink population in Estonia, which makes live-trapping of European mink in the wild highly unlikely there.

The rapid decline takes place also in the CIS. Therefore supporting the field surveys is of utmost importance. The first report already received sheds a little light on the actual status of the mink (published in Small Carnivore Conservation No 10, 1994).

The first studbook as well as the folder on the European mink were published in 1993. Both have been distributed among the institutions interested in the European mink breeding programme.

The activity and financial report for the last two years were approved by the Committee. The objectives for the next two years were outlined:

- It was decided that **cooperation with the experts and institutions in the CIS** should be intensified. The action there should have two aims: (1) to obtain new founders for the captive breeding programme, and (2) to support *in situ* conservation and research of the species, especially in the Central Forest Biosphere Reserve which lies within the supposed core area of the range.
- **The memorandum of understanding (MOU)** on the breeding loan of the European mink should be prepared and sent out to the zoos having shown interest in participating in the breeding programme. It is expected to give an estimate about the space available for minks in Europe. The zoos participating in the breeding programme should also support the *in situ* conservation of the species. Together with the MOU also the **keeping standards and keeping guidelines** will be prepared during this year and sent out to the breeding centers interested in keeping the minks. The support to CIS experts (Katchanovsky & Sidorovich) working on the field research and conservation of the European mink should be continued whenever possible (Tiit Maran).
- The possible **cooperation with the "Wildlife Conservation Research Unit"** at the Oxford University (UK) was welcomed.
- The necessity to arrange a **training course** at the Black ferret breeding facilities in the USA was expressed. The course is planned for two or three persons directly involved in the breeding of minks (Roland Wirth).
- The possibilities to support field research and conservation in Russia was discussed. Helsinki Zoo will provide a microchips tagging system on loan basis to the EMCC to allow tagging of the European minks in the field (Leif Blomqvist). Various types of field equipment necessary for field research still have to be looked for.

NEW MEMBERS OF THE EMCC

In the EMCC Managing Committee (MC) Dr Pekka Pamilo and Dr Jukka Salo were replaced by Francesco Rocca (Parco Faunistico "La Torbiera", Italy), Vladimir Spitzen (Moscow Zoo, Russia), and Seppo Turunen (Helsinki Zoo, Finland).

Dr V. Katchanovsky (Central Forest Biosphere Reserve, Russia) and Dr V. Sidorovich (Belarus) were added to the Board of Experts of the EMCC. Tiit Maran was re-elected to the post of the chair and Seppo Turunen was elected as vice-chair of the EMCC.

Tiit Maran, European Mink Conservation &
Breeding Committee, Tallinn Zoo,
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News from Colombia

Particularly exciting news comes from PROYECTO CUSUMBO, which has succeeded in the first ever live study of the Dwarf or Mountain coati *Nasuella olivacea*, with a solitary male radio-collared for more than one month at Reserva Biológica Carpanta. A distribution is also being prepared of the many signs found, particularly the many faeces now analysed, and "snouting pits" left from foraging for subterranean food items.

THE COLOMBIAN WEASEL PROJECT has just ended its first twelve months of work in Colombia. Two weasels were sighted (unidentifiable to species) at Parque Regional Natural Ucumari last November, then at the end of the first week of trapping, in February, a subadult male Longtailed weasel *Mustela frenata* was captured at that site. Then followed four days of radio-tracking his activities in a den site, open marsh land, and forest, after which contact was lost. He was retrapped two days later, a further 2 km away. An adult male *M. frenata* was later trapped and released live by workers on an adjacent farm. Over the next six months the trapping operations moved through three further sites: Parque Nacional Natural Tatamá; El Alto del Galápagos; and Parque Nacional Natural Cueva de los Guacharos. No further weasels were encountered however, until August, when a subadult male *M. frenata* was trapped live near the last of these sites, by a farmer.

The project has yet to encounter the Colombian weasel *Mustela felipei*, but trapping continues near the holotypic locality, thanks to the staff of Parque Nacional Natural Purace. There is also the good news of protection of other natural areas where *M. felipei* may be found, such as the Serranía de los Paraguas, which includes El Alto de Galapago. We hope to support Elizabeth Mesa (Universidad Nacional) to study Colombian *Mustela* species for her undergraduate field thesis. Further developments are planned in our search for *M. felipei* in Colombia, and in Ecuador where *Mustela africana stolzmanni* has again been found just 600 m ASL below the 1923 *M. felipei* locality, by Dr Luis Albuja of the Politécnica Nacional, Quito.

A surprising number of mustelids and procyonids are received - as confiscated or unwanted pets - by Colombian zoos. The most frequent are coatis *Nasua nasua*, kinkajous *Potus flavus*, and tayras *Eira barbara*, though occasionally grisons *Galictis vittata* and raccoons *Procyon cancrivorus* and *lotor* can arrive. Many of these have been returned to the wild, and biologists at the Cali and Santafe (Medellin) zoos wish to develop facilities for expanding and monitoring this.

Lastly, even some viverrid news! We are looking into a verbal report that some years ago in the northern department (region) Cesar, mongooses were introduced into plantations of African oil palms for control of rats and snakes, and as in similar cases elsewhere, are now themselves 'out of control'.

Acknowledgements

The COLOMBIAN WEASEL PROJECT was generously supported by the Sir Peter Scott Action Plan Fund (SSC and the Government of Oman), Birdlife International/FFPS/British Petroleum, the Foundation for Community Conservation, the Peoples Trust for Endangered Species, the Percy Sladen Memorial Fund, the Royal Geographical Society/the Ove Arup Foundation, the British Embassy in Bogota, the C. J. Cadbury Charitable Trust, the A. S. Butler Charitable Trust, the Russell and Mary Foreman 1980 Charitable Trust, Park Davis, Salter Abbey Ltd., Cambridge University Press, T. & A. D. Poyser Ltd, and many thoughtful individuals.

COLOMBIAN WEASEL PROJECT (& general info)

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Civet and civetone

Apropos the article "Trade in civetone from the Indian small civet *Viverricula indica* from Malabar, India" by R. S. Lal Mohan (*Small carnivore Conservation* April 1994), I would like to point out certain misconceptions in the views of R. S. Lal Mohan. The crude secretion of the Small Indian civet is called "civet", whereas civetone is only one amongst several different ketone compounds in the secretion. Myself and Dr M. Balakrishnan of Kerala University have analysed the secretion of the civet and have identified civetone (9-cycloheptadecen-1-one) amongst other ketone compounds in the secretions of the small Indian civet.

In collaboration with the 'Zoo Outreach' organisation of Coimbatore I have surveyed civet holdings throughout the State of Kerala, publishing the results Status and management survey of Small Indian civet in captivity, Pp. 1-6 in *Zoo's Print*, Sept. 1993). Among the 1,050 civet holdings surveyed throughout Kerala State, the majority are in the Malabar area. Here the civet's average longevity in captivity is 8 to 10 years and its maximum age was 14 years. Captive breeding is not done in the civet holdings due to the ready availability of re-placement stock from the wild. It is not correct to state that civets do not breed in captivity; we have captive bred this animal successfully.

In the Malabar area it is common practice to place 'bamboo reeds' in civet cages, facilitating gland rubbing and allowing the collection of its secretions.

Metal or aluminium rods are not used commonly. In Tirupati, Andhra Pradesh, sandalwood rods are placed in the cage. In the Malabar region the usual material for the cage's construction is coconut hardwood or arecanut hardwood. The dried gland, similar to "muskpod", is called "Meruchatta" ("chatta" meaning a cover of skin"). The 'Jawad' or Malabar civet is a critically endangered animal. Artificial insemination is not undertaken on this wild animal anywhere in Kerala.

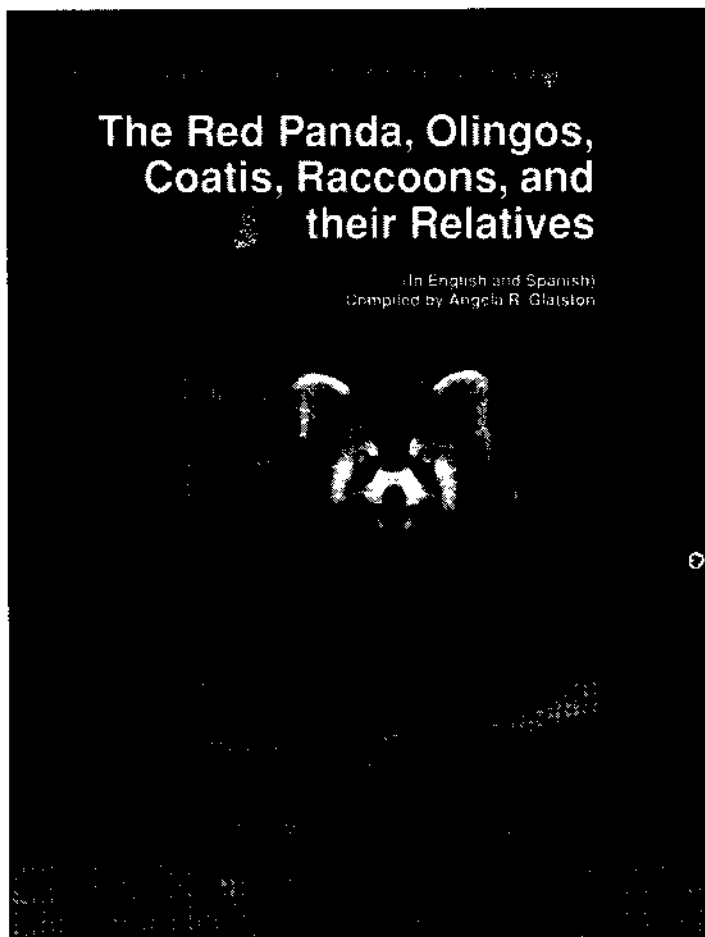
Our survey revealed viral diarrhoea and parasites to be the major causes of death in the civets held under captive conditions. Paraplegia is not common, as Lal Mohan has pointed out. Recently the Forest Dept. Govt. of Kerala has started issuing ownership certificates to civet farmers. The establishment of husbandry practices (Xavier, F. & Balakrishnan, M. 1993. Captive civet cats: Husbandry and management. *Proc. V Kerala Sci. Congr.* pp. 434-436) and scientific captive breeding practices for civets will make civet farming more profitable in the Kerala State.

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Recent publications

An Action Plan for Procyonids & Ailurids

Glatston, A. R. 1994. *The Red Panda, Olingos, Coatis, Raccoons, and their relatives*. IUCN, Gland. 103 pp. £10.00, US \$20.00. In English and in Spanish. Available from the IUCN Publications Services Unit, 219 Huntingdon Road, Cambridge CB3 0DL, UK.



After a prolonged gestation period the IUCN SSC Conservation Action Plan for Procyonids and Ailurids has at last been published. This Action Plan was initiated in 1984 and one of the major reasons why it has taken so long to complete has been the lack of published research material on the species comprising these taxa. The comparative absence of field studies and survey data have resulted in a dearth of information on numbers, actual distribution and habitat requirements. This has meant that much of the information contained in the Action Plan has in fact been derived from indirect evidence. For example, where high levels of deforestation have been reported in the countries comprising the range of a largely arboreal or forest dwelling species, it is assumed that the species is threatened, even if direct proof of the fact is not available.

Another factor which has complicated the compilation of this action plan has been the lack of familiarity which field workers and other local informants have with these species. In a number of cases species were misidentified or confused with other species in the wild. This led to doubts regarding the reliability of some of the data which were received and meant that extra verification was necessary.

As a final point the collection of data was also hampered by taxonomic problems. At one end of the spectrum the inclusion of the red panda into the brief of a specialist group dealing with the procyonids raised scientific hackles to such an extent that one scientist refused his help. At the other end of the spectrum the various opinions on the subspecific status or otherwise of the various taxa of olingo made the exchange of information on these animals extremely confusing and further delayed production.

The main thrust of the Procyonid and Ailurid Action Plan is to stimulate more interest in these taxa. On the one hand, more concern is required from governments and conservation organisations in order to ensure that adequate consideration and financial support is given to the preservation of these species in the wild. On the other hand, greater attention is needed from the scientific community and the interested laymen to ensure that more data on these species are collected as regards status, habitat requirements, distribution and so forth. In the absence of such support and information we will not be able to take the appropriate measures to ensure the long term protection and conservation of these interesting groups of animals.

(A. Glatston)

Badgers

Hayden, T., ed. *The badger*. Royal Irish Academy, Dublin. 211 pp. Available from the RIA, Dawson Street, Dublin, Irish Republic.

This long-awaited volume represents the papers given at a seminar on badgers held at the rooms of the Royal Irish Academy in Dublin during two days in March, 1991. The reason for this interest in the species and its ecology is the high (and continued) level of prevalence of bovine tuberculosis (caused by the bacterium *Mycobacterium bovis*) in Irish cattle, and ongoing interest in the badger as a probable (?) wildlife reservoir for the disease. It is not surprising, therefore, that many of the papers presented at the meeting have a strongly applied aspect, with various aspects of the possible ways in which badger and cattle ecologies interact, the prevalence and pathology of *M. bovis* in badgers, and the general epidemiology of the disease, all featuring in many of the articles. Despite this, "pure" ecology is germane to such research, and many of the papers also report upon aspects of badger biology that are of more general interest. Importantly, these papers include preliminary reports of the results of the badger surveys of both the Irish Republic (Smal) and the North (Feore *et al.*) although, in the latter case, details are presented in abstract form only.

Most workers prominent in badger research within the British Isles presented papers at the meeting, although the work of some (e.g. Hans Kruuk) appears in abstract only. Despite this, there is a wide variety of interesting and valuable contributions. These include articles on badger setts as an ecological resource (Roper), long-range migratory movements (Sleeman & Mulcany), badger recolonisation of vacated habitats (Cheeseman *et al.*), morphometric and genetic variation (Lynch *et al.*), ageing techniques (Il-Futuri *et al.*), morphological studies of the badger baculum and kidney (Whelton & Power, Elgadi & Hayden), and reproductive studies (Wheelan & Hayden). The more "applied" papers include topics such as possible routes of disease communication (Brown *et al.*, Benham), the development and testing of TB vaccines for badgers (Stanford & Mahmood, McCarthy), and TB pathology (Fagan), epidemiology (Flanagan), and diagnosis (Nolan & Goodger). The review articles include Wheelan on the badgers' legal status in Ireland, Dolan on the TB situation, and an "overview" provided by the editor (Hayden) in his concluding remarks.

As always, the exact nature of the link between the badgers and TB in cattle remains obscure, but a few new ideas are proposed, both with respect to methods of transmission and (more importantly) how this can be controlled (non-lethal methods of TB management being important considering that badgers are supposed to be a protected species in both the North and the Republic of Ireland). Although few of the findings presented will do much to revolutionise our view of badger ecology, or to resolve the TB issue, this volume does present a body of research that represents the first comprehensive account of the biology and ecology of the badger in Ireland, and further serves to emphasise the species' ecological plasticity in different parts of its range.

One problem with the RIA volume is that it has been a very long time in preparation (three and a half years). As a result of this, some of the details of the TB situation in Ireland have changed since the papers were written. Nevertheless, the volume provides a well-rounded view of the TB problem,

and does actually manage to give comparatively complete illustrations of many aspects of the species' ecology. The only thing that I find a little unfortunate is that some of the contributions have only appeared as abstracts; although this is not surprising for the survey results, one does get the impression that some of the other papers have been retained for submission to more "high profile" journal publications.

These are minor points, however. Most people with a genuine interest in the hadger will find the book worth having, and it also represents an excellent background text for students of wildlife management, veterinary and agricultural science, and pure, applied and agricultural zoology. The presentation of the volume is of a high standard, and the text seems to be largely free of typographic errors and incorrect or missed references. Certainly, at a price of ca. £15 the volume is easily within the range of most people (students included), thus representing considerably better value for money than many similar publications currently available for student use.

(H.I.Griffiths)

Semi-aquatic Mammals

Schröpfer, R., Stubbe, M. & Heidecke, D., eds. 1992. *Semiaquatische Säugetiere. (Materialien des 2. Internationalen Symposium Semiaquatische Säugetiere, Universität Osnabrück. 9.6 bis 12.6.1992)*. Martin-Luther-Universität Halle-Wittenberg Wissenschaftliche Beiträge, Halle (Saale). 468 pp. Price DM 35. Available from Prof. M. Stubbe, Institut für Zoologie, Domplatz 4, 06099 Halle, Germany.

This publication is a compilation of the papers given at the second symposium on semi-aquatic mammals, held at Osnabrück in July, 1992. Although German is the chief language of the proceedings (as suggested by the title), of a total of 45 contributions, 11 are entirely in English, and only eight entirely lack either a summary or abstract in English.

One might think that a volume such as this could be too broad-based to be useful, but this is most certainly not the case. The geographical range of species covered is restricted to the Palaearctic and, with the exception of a single paper on a water shrew from Tibet, all papers deal with elements of the European fauna. As one might expect, as wetlands and other semi-aquatic habitats are under intense pressure everywhere, this volume strongly emphasises those species considered to be either vulnerable or a source for concern. For example, the European beaver is the subject of 13 articles, nine more deal with the Eurasian river otter, and six articles report the biology and/or ecology of either the European or the American mink (or both). Most of the remaining papers deal with rodents or insectivores - marine mammals such as Cetacea and pinnipeds (seals, etc.) being excluded entirely. Two further articles report on English-language-based symposium satellite meetings: one on the conservation of European mink, the other on the protection of the beaver.

As mustelid-based articles (including those on otters) account for almost half of the contributions in this volume, *Semiaquatische Säugetiere* is of immediate interest to the readers of *Small Carnivore Conservation* (even if otters do fall outside our area within the IUCN).

Although species conservation biology represents the underlying theme throughout the proceedings, the articles themselves are quite broad-based in terms of scientific approach. Using a very loose classification, the various contributions can be divided between general ecology (20 papers), pathology, parasitology and ecotoxicology (7), evolutionary and population biology (6), applied conservation biology (8), and bioacoustics (1). The evolutionary/population biology papers include the results of studies as diverse as the application of craniometric analysis to the study of beaver and otter populations, and the application of PCR and DNA fingerprinting to the study of European mink populations.

Overall, this is an informative work that draws upon the expertise of authors from eleven different countries. The inclusion of studies from the western states of the former USSR is particularly welcome, providing access to work published in the Russian literature and thus generally unavailable to English-speaking scientists. Although the volume is useful for anyone with a general interest in European mammals, the coverage on beavers is particularly good and there are also some valuable papers on European mink.

Semiaquatische Säugetiere certainly provides many insights into the problems of mammal conservation in mainland Europe, notably those due to conflicts of interest between mammal protection and agro-industry. This is particularly the case when the species involved are not viewed entirely positively, and local and national economies are fragile.

This book has been published as one of the Martin-Luther University's *Wissenschaftliche Beiträge*, best known to zoologists for the *Populationsökologie* series, which so far has included volumes on mustelids, small mammals, bats, and raptors and owls. To my mind, this is by far the best of these publications to date, and the quality of the binding, printing and photographic reproduction are far better than in earlier volumes.

Furthermore, editorial control seems to have been tightened, thus ensuring a higher scientific standard, and also better internal continuity of style. In general I feel this to be an interesting, and informative work. The price (ca. UK£ 14) is fair, the volume nicely produced, and thus well worth adding to the library.

(H. I. Griffiths)

Forbidden science

Milton, R. 1994. *Forbidden science*. Fourth Estate, London. 264 pp.

Paradoxically, this book will probably be ignored by most scientists, but ought to be compulsory reading for anyone involved with science teaching, research, and applied technology in any fields including conservation. Although scientists are trained to believe they will be pursuing absolute objective truth, in fact all observation is subjective and 'made to fit' prior experience hence reducing cognitive dissonance. It is hence astonishing how often major new discoveries are ridiculed as impossible or hoaxes, including flying machines by *Scientific American* two years after the Wrights first flew, and cold fusion energy by *Nature* magazine. In fact, as Milton points out rather uncomfortably for "Science", the top of the hierarchy exercises censorship and an Orwellian 'thought or paradigm policing' as to what gets published, gets grants, and what is 'Acceptable Science'. As to practical conservation, Schaller's 1993 *Last Panda* revealed how pandas were needlessly rescued into captivity, a third then dying, even though good data could have prevented socio-political bungling by the bureaucrats.

My own interest in what Thomas Kuhn called 'scientific revolutions', and how a Gestalt shift in perceived 'Wisdom' is hard to achieve, relates to the 23 years old Great Badgers and TB Debate. The Ministry of Agriculture have backed themselves into a corner over this, and are now exercising all the traditional options for a cover-up and face saving measures: -more 'research', an 'Expert Consultative' tame panel, and extensive disinformation and media manipulation. It would be very funny if it was not so sad, but the very simple pivotal error being perpetuated is that cattle are removed before they can pass on TB to other cattle or badgers, so badger culls are 'sensible'. And yet it's been known that all TB cattle are potentially infectious from the outset, since at least 1915...as reiterated in the 1930-1940s, again in *New Scientist* (24 Oct. 1885 'Kissing cows'), and more recent work in Ulster. The circumstantial badger/cattle 'link' is that cows have been giving badgers TB all along, in a nicely graded series of counties (not just a southwest problem area). This could be proved very rapidly given the political will and honesty. But it's easier to carry on with the pseudoscientific bluff and more research and culls (see *Animal Welfare* 3:253). It is hence amusing also that certain journals have refused to allow a right of reply on cows giving badgers TB, including: *New Scientist*, *Trends in Microbiology*, *Biological Conservation*, *BBC Wildlife*... the peer review system is a highly efficient way of stifling a truly objective debate on these issues. It is also rather amusing that a number of eminent international zoologists are allowing their names to be used on the TB Panel and elsewhere, so that Ministry policy is by definition 'respectable', and most of the major 'Conservation' Organisations are also giving tacit support to the ongoing farce. The badger TB culls and 'research' programme cost some £ 2-3 million a year, but that is a cheap price to pay for 'political correctness', and provided no one points out that The Emperor Has No Clothes On...all will be well indefinitely. Badgers and TB are hence a beautiful case of the Forbidden Science paradigm!

(M. Hancox)

Regional Studbook for Wolverine

Captive breeding wolverine *Gulo g. gulo* (L., 1758) for conservation - a summary of Leif Blomqvist's *Regional Studbook for Wolverine. Volume 1*. (The Bohus Breeding Centre Trust, Bohus, Sweden, 1994).

The wolverine faces more severe threats than any other European mustelid (see *Small Carnivore Conservation* 6:8-10). This is a product of its fearsome reputation in folklore, and of its persecution by trappers, farmers and reindeer herders.

Leif Blomqvist reviews what is currently known of the status of the nominate form of the wolverine in the wild (there are three Eurasian subspecies, and four more in North America), and discusses the history of the species in captivity. In Europe, wolverines are seen rarely in zoos outside Scandinavia; only Bremerhaven, Tallin, Riga, Bern, and Hagenbeck hold stock at present, and only the last two have a pair. Furthermore, wolverines have a poor history of breeding in captivity. Only 39 captive births were recorded between 1915-1933 worldwide, and 31 of these were in either Denmark, Sweden or Finland. The purpose of the regional studbook is to attempt to promote the successful captive reproduction of wolverines in Scandinavia which, it is hoped, will lead to a Europe-wide breeding plan.

Blomqvist calls the history of the wolverine in the wild "depressing". The Norwegian and Finnish governments both paid bounties for wolverines until 1982 (Sweden ceased in 1969), and bounty payments show a steady decrease in the species' numbers throughout the century, and most notably since the 1960s. Although classed as "vulnerable" throughout Scandinavia and hence protected in law, the killing of wolverines was still permitted where domestic animals (e.g. sheep or reindeer) were considered to be threatened, despite the fact that all three states paid compensation for wolverine kills. In Norway and Sweden, killing under licence has virtually ceased since 1982 and 1969, respectively. But in Finland, the Finnish Game & Fisheries Research Division state that prior to protection in 1983, an average of 13 wolverines were killed legally each year, and three more were found killed by means other than hunting. Since then, the number of wolverines dying by such means has risen to eight per annum. Thus, in the first eight years since its protection, 68 wolverines have been killed in Finland alone. Intriguingly, the Finnish game-bag statistics also imply increases in wolverine abundance, whilst the number of reported sightings is actually decreasing!

Despite protective legislation, wolverines are hated by many, and particularly by Lap reindeer herders. Although there have been no claims of damage in recent years, and problem wolverines have been translocated to the south, illegal den hunting and hunting from snow scooters continue. Although the animal is one of the most endangered members of the fauna of Lapland, between 1978-1922 wolverines have increased by 85% in those parts of Finland south of the reindeer herding areas.

A direct contrast is afforded by the situation in North America (e.g. see Hatler, D. F. 1989. *A Wolverine Management Strategy for British Columbia*. BC Environment Ministry Wildlife Bulletin No. B-60). Here wolverine populations started to increase after bounty payments were abandoned, and predator control with poisoned baits was banned. However, there are now some signs of slow recovery in parts of Scandinavia. Sweden classifies the species as Category II (vulnerable) with a population of between 100-150 head, whilst Norway and Finland still list wolverines as Category I (immediately endangered) with national populations of 150 ± 30 and 81-90, respectively. The situation in Rusland is less clear, but there are supposed to be approximately 80 wolverines in Karelia, 160 on the Kola Peninsula, 400 in the Archangelsk area, and maybe as many as 900 in the Komi Region.

The wolverine studbook aims to register all captive wolverines originating from Scandinavia, and to create appropriate conditions for a co-operative captive breeding programme. The data considered cover the period from 1963 until October 1993, and the SPARKS (Single Population Analysis and Record Keeping System) database has been used to collate these data, and to calculate inbreeding coefficients, age pyramids, and fertility and mortality rates.

The first successful breedings of wolverine were at Copenhagen Zoo between 1915-1917, and Skansen Zoo (Stockholm) in 1917 and 1944-1945. Outside Scandinavia, successful breeding has occurred at Novosibirsk (1979, 1990), Cold Springs (1965, 1978, 1980), Bismark Zoo (1973), Winnipeg (1965), and Los Angeles (1991). In the 22-year period of study for the Studbook, 22 wolverines were taken from the wild, 48 (19.29) were captive-born (25 litters at 6 zoos), 35 animals died, three females escaped, and one pair was transferred (from Finland to Bern). Wild-caught animals originate from Finland, Sweden and European Russia, most having been taken from dens as cubs (and so their exact ages are unknown).

Since 1970, 77 (35.32) wolverines have been kept in Scandinavian zoos, 38% (16.13) being wild-caught, and 62% (19.29) captive-bred. Of stocks origina-

ting in the wild, 38% bred in captivity (compared with 21% of the captive-bred animals). However, 39.5% of current zoo stock consists of captive-bred animals in age classes 0-2 (i.e. below reproductive age). Between 1970-1993, 48 (19.29) cubs were bred in 25 litters, 28% as single animals, 48% as twins, 20% as triplets, and with one set of quadruplets (4%), giving a mean litter size of 1.9 wolverines per litter. However, "den-building" by the mother inhibits cub observation and as some cubs may be killed and eaten, real mean litter sizes may be larger. Helsinki Zoo has had six litters under controlled conditions, and here the mean litter size is 2.5 wolverines per litter, comparing favourably with data from field studies which suggest a figure of 2.5 young per litter ($n = 248$). Juvenile mortality (<30 days) is around 14%, infant mortality (<6 months) average 22.78%, although this varies considerably between zoos (range = 0-43%). Mortality of young in their first year is high in both sexes (11%), but decreases thereafter, not rising again until 11 years of age.

Less than 10% of males are fertile at 2-3 years of age, but fertility doubles annually from an age of six onwards. Females can reproduce about one year earlier, so that 20% of 2-3 year-olds have bred. Females breed until 12, and males are still fertile at 14. Growth rate for the captive population is currently 1.04 (males) and 0.98 for females, indicating a decline in the female captive population if current trends continue. Animals held in captivity at present have a broad-based age pyramid: although 7 (19%) are in the higher age classes (>10 years) and will soon be lost to the population, 13 (36%) are within age classes 4-11 which are the most reproductively active. The current captive sex ratio is 0.8:1.

Inbreeding represents a greater problem than demography. The current zoo population was founded from only 11 known animals, 14 more wild-caught animals having either died without issue or escaped before breeding. However, the present zoo population does encompass four more potential founders (wild-caught animals that have not yet contributed to the gene-pool). An optimum situation would be one in which each of the 11 founders had contributed equally to the captive population, but differential reproductive success has acted against this, so that three of the founders have actually contributed to the gene-pool by 26%. The over-represented founders and their descendants refer to the Finnish zoos at Ähtäri and Helsinki. Ähtäri started breeding in 1982, and has succeeded in all subsequent years except one, whilst Helsinki's breeding pair (which includes a female from Ähtäri) is the most successful to date, having produced 13 cubs in six litters. Unfortunately, only two of the captive-bred animals currently in stock are not related to one of these three founders, and one of these has gone to Basle. Aside from this over-representation of the founders, 11 animals (29%) are inbred with a mean inbreeding coefficient (F) of 0.16. Furthermore, two animals at Helsinki are highly inbred, with F values of 0.3125. The prevalence of inbreeding can only increase in the near future as all zoos have at least one sex descended from one of the three over-represented founders.

Over the last 10 years captive stock has increased from 17 to 36 wolverines, with eight (3.5) proven breeders alive in October 1993. This allows an estimation of effective population size (N_e) as being currently equivalent to only 29.7% of the captive population. Despite this, the effective population size is the largest in the history of the Scandinavian breeding programme, so the captive population of wolverine is in a position to be genetically and demographically managed. The most severe threats to the success of this programme are the unequal representation of the three founders, and the small number of animals having actually contributed to the gene-pool. Any management plan must therefore seek to equalise founder representation, and attempt to breed from all potential and under-represented founders. However, several of these animals are descended from lineages that are under-represented, but are alternatively over-represented in other lineages. It is therefore inevitable that an increase of these animals will also increase the representation of some unwanted lines.

At a congress at Ähtäri Zoo in 1987, wolverine management was accorded a high priority amongst the native Scandinavian fauna because of the species' critical situation in the wild. It was agreed that no new animals would be purchased from outside Scandinavia, and to try to establish a healthy, self-sustaining population within Scandinavian zoos, leading to Blomqvist's keeping of a Scandinavian wolverine studbook. In the last few years Finland has transferred several wolverines to Sweden to try to establish new breeding pairs, and internal transfers have been organised within Sweden. Overall, however, the carrying capacity of Scandinavian zoos is too low to maintain a viable population with a suitable level of genetic diversity. In order to release space for under-represented wolverine lineages, transfers to zoos in Britain and continental Europe are planned for animals from over-represented lineages.

As co-ordination of efforts such as these is essential for their success, the wolverine will become included in the European Endangered Species Programme (EESP) and a request for the establishment of an EESP studbook was made in spring 1994. The final goal of the EESP wolverine programme is a self-sustaining, vital captive population for educational and research purposes, and eventually for re-release in parts of Scandinavia that are wolverine-depleted.

(Huw Griffiths)

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