SMALL CARNIVORE CONSERVATION

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

Number 23 October 2000

Short-tailed mongoose (*Herpestes brachyurus*) - Photo: H. Van Rompaey

The production and distribution of this issue has been sponsored by
"Columbus Zoo", Powell, Ohio, USA
"Central Park Zoo", New York, NY, USA
"Marwell Preservation Trust Ltd", Colden Common, UK
"Royal Zoological Society of Antwerp", Antwerp, Belgium and
the "Carnivore Conservation & Research Trust", Knoxville, TN, USA

CARNIVORE CONSERVATION & RESEARCH TRUST
...helping preserve nature from the top down

SMALL CARNIVORE CONSERVATION

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

•

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

Small Carnivore Conservation
c/o Dr. H. Van Rompaey
Jan Verbertlei, 15
2650 Edegem - Belgium
Harry.VanRompaey@ping.be
Harry.VanRompaey@tijd.com

Printed on recycled paper **ISSN 1019-5041**

Trophic characteristics in social groups of the Mountain coati, *Nasuella olivacea* (Carnivora: Procyonidae)

A. RODRÍGUEZ- BOLAÑOS, A. CADENA and P. SÁNCHEZ

This study identifies the dietary composition of the Mountain coati *Nasuella olivacea* (Gray, 1865). This coati is a rare and little-known mammal that inhabitats the high Andes mountains of Colombia, Venezuela and Ecuador. The study presents a climatic characterization and description of the typical vegetation of its habitat. Faecal analysis showed arthropod remains in 100% of the 54 samples collected, yielding a total abundance of 72%. The coati ingested a total of 12 orders of arthropods, of which 41% corresponded to Coleoptera, followed by Orthoptera, Myriapoda and Hymenoptera, amongst others. Minimal proportions of other categories such as vertebrates and fruits were present. We compared the diets of young and adult individuals within social groups and differences in the quantities and richness of the types of food ingested. Adults presented a wide trophic niche and diversity of feeding resources – apparently they eat small amphibians. Hundreds of holes have been found – evidence left by these animals of their digging in the ground looking for insects, which allows us to deduce that they present a specialised foraging behaviour directed towards their search for edaphic resources. The pattern of the trophic composition is remarkably different from the other species of coati that live in warm areas such as *Nasua nasua* and *Nasua narica*, and presents evidence for an adaptive process specialising *Nasuella olivacea* for life in the high mountains.

Introduction

The mountain coati, *Nasuella olivacea* (see back cover), is a small carnivore that inhabits areas above 2,000 m ASL in the Andean mountains of Colombia, Venezuela and Ecuador (Eisenberg, 1989). Although this animal was described 135 years ago, no field studies have been made, so its adaptative capabilities as well as its strategies to survive in restricted habitats such as the high Andean forest and highlands, are unknown.

Those high Andean forests and highlands where the mountain coati lives are foggy. Strong topographical gradients are present, the rain schedule is high and the soils are rich in organic substances and capable of supporting high invertebrate biomass (Garcia & Chamorro, 1994; Salamanca & Chamorro, 1994). Low ground habitats are preferred by the coati genus *Nasua*, which has been described as opportunistically omnivorous (Kaufmann, 1962; Kaufmann *et al*., 1976) because of its dietary composition: they eat diverse kinds of prey such as insects, spiders, land crabs, snails, amphibians, rodents and a wide variety of fruits (Russell, 1982).

This supports the idea that weather conditions are one of the causes of the kinds of prey available in a specific habitat, and which are less suitable for organisms living in the high mountains when compared with low altitude conditions. Thereby, in accordance with Sturm (1994) the colonisation of highlands by the plants and animals currently inhabiting them, had to occur at the same time as processes of adaptation to the extreme conditions presented by these biotypes. Hence, we are approaching the problem confronted in this paper: which kinds of food resources do mammals such as Procyonidae use in these habitats? Is there any kind of adaptation in order to exploit some kind of particular resource, possibly associated with the extreme conditions of the high mountains?

The coatis are the only gregarious species with social organisation in family Procyonidae (Russell, 1982). Their social organisation consists of groups formed by adult females and young from both sexes. The male adults can be described as solitary, except at mating times when some of them may be temporarily accepted into the social group. Other than at mating time, the males sometimes depredate upon young animals (Russell, 1981) and are aggressively separated by the females.

The sexual dimorphism found in the behaviour of the coatis seems to be a protection mechanism in order to avoid cannibalism of the young (Janzen, 1970; Russell, 1981; Newcomer & Farcy, 1985) or, as stated by Smythe (1970), an adaptive strategy within the social organization that allows solitary males to become more effective predators, while the group gathers to forage competitively; in this manner they create a distribution of resources among both sexes by reducing the niche overlap.

Field observations by one of the authors (Rodríguez, 1995) indicate that although the mountain coati is found in very different habitats than the other coatis of genus *Nasua*, its social behaviour is similar in that they also form social groups from which the male is excluded. The difference may lie in the size of the groups, since studies of their tracks and evidence from investigations of other mammals in the area report the existence of groups of 80 individuals or more (López-Arévalo & Montenegro-Díaz, 1993).

Area of the study

The study was carried out at the Biological Reserve of Carpanta located at 04°34'N and 73°41W in the east brach of the Cordillera Oriental in Colombia. Altitude-wise it covers a range from 2,400m to 3,340m, within which are found different ecosystems like high Andean forest, snow peaks, brush and high grasses (Leon & Palacios, 1993; Repizzo, 1993). The weather related antecedents for the zone (Repizzo, 1993) state that there are two bio-climatic regimes in Carpanta which correspond to the great macro systems of Andean high wood and moor and forest, respectively. The highest precipitation is present during the months of May to July while the least is observed during December, January and February.

Methodology

Climatic aspects for the period of the study: In order to characterise the weather during the period of study, three daily temperature readings were taken: at 7:00, at 13:00 and at 19:00h (including medium, maximum and minimum variables). Precipitation (in mm) and evaporation are according to data received from the Estación Sietecuerales at the Reserva Carpanta (weather station). The data collected were classified according to the

Thornwaite system (Eslava *et al.,* 1986) and the temperature analysis, evaporation and hydric balance according to Rangel & Rudas' methodology.

Dietary characteristics: A total of 54 excrement samples were collected between January and May, for the most part considered as the dry season in the Reserva Carpanta. During this period, natural paths were followed and coati excrement samples were collected. Other zones were also studied, e.g. moors, peat bogs, grasslands and communities of *Chusquea* sp. where coati excrement, skeletons or foot-prints were found. All samples were labeled and stored individually in plastic bags, noting the length, width, date and place where collected. To avoid fungus contamination because of the high ambient humidity, faeces were dried in an oven made with empty cans and heated near a stove. Finally, the exact weight of each stool sample was recorded.

To analyse excrement samples, each was submerged in an alcohol solution to disperse its parts (Korschgen, 1980) and all food items were identified with the help of a stereoscope. The components identified were classified into five principal categories: 1. vertebrates, 2. invertebrates, 3. fruits, 4. vegetable remains, 5. unidentified fragments (undetermined). The invertebrate category was quite diverse so it was necessary to establish sub-categories to represent each of the orders of arthropods identified (Whitaker, 1988).

The components of each faecal sample were examined and appraised (Korschgen, 1980; Putman, 1984; Whitaker, 1988) on a 1 to 10 scale, these values being calculated from the average dry weight of all the samples. The numerical estimates obtained were measures of frequency and volume and were converted into percentages in order to be able to compare samples.

The qualitative and quantitative criteria used to characterise the diet and compare the components among faecal samples were expressed following Whitaker's method.

1. Frequency of appearance: number of times certain food items appeared in each faecal sample.
2. Frequency percentage: number of coatis found to be eating a determined category.
3. Abundance or volume: of a determined food category, expressed as a percentage of total volume.

Comparison among diets: We held two suppositions as true in order to compare diets between young and adult individuals. First, that each excrement represented a different individual, and second that the samples collected came from animals that have a social organisation which forms groups with individuals of different ages. Using parameters such as abundance of the principal parameters in each of the samples, a grouping analysis was run with the Statistical Ecology Program, and the results were plotted in a dendrogram (Ludwing & Reynolds, 1988).

To support the tests applied, the data were subjected to a variance analysis in which the following parameters were kept in mind: the faecal samples were arranged in two groups, in the first the samples that showed weights below the average weight of the whole (presumed to be faeces from younger individuals), in the second group were samples with higher weights than the average for all the samples (presumed to be from adults). For the prior classification we also bore in mind the size (the length and width) of the stool sample when collected, since we support the idea that large excrements come from equally large digestive tracts -in other words, from adult individuals and vice-versa (Putman, 1984). For this comparison we utilised the abundance data from the invertebrate category in a one-way variance analysis, to confirm if there really was a difference between the diets of young and adult animals.

***The Simpson Diversity Index*:** To express the importance of the trophic niche of coatis, the Simpson Diversity Index was calculated using all the frequencies of all the food categories found in each sample. Furthermore, this index was used to compare the amplitude of the niche in young and old individuals.

Results

Climatic characteristics: According to the Thornwaite classification system, at the Reserva Biologica Carpanta the maximum average temperature is 18.15°C, with a high value of 19.5°C during February and March and a minimum of 15.2°C in September. The median temperature (of an isothermal type with an average of 12.2°C) reported a minimum value of 10.7°C in September. Likewise, the minimum temperature presented an average of 7.95°C, with a maximum of 8.8°C in June and a minimum of 6.9°C during January.

Evaporation was of a single mode type with a period of high concentration over the monthly median (119mm) between March and September and again in November. The largest restitution of water occurs during the month of April with 137mm and the least in February with 84 mm.

Graph. 1

Precipitation had a single mode bi-seasonal pattern with a monthly average of 9.3mm and a higher precipitation period from April to July. The highest was presented in June (17mm) and the month with the lowest precipitation was January (40.7mm).

The evapotranspiration was 641.4mm; the highest values being during April and August. There is no water shortage in the area. The value for excess water was 786.6mm, with a maximum (82.1mm) registered in April. The climatic classification for this station is ArB' which describes a super humid climate, with no shortage of environmental water, mesothermal and with a low heat concentration in the summer period (Thornwaithe, 1948, cited by Eslava *et al*., 1986).

Aspects of feeding behaviour: The faecal samples found were always associated with the same foraging places, which are distinguished by the great number of holes which coatis leave after grubbing for small animals. The faeces have a strong, penetrating odour that may last for months, even after samples have been dried. They are tubular in shape and normally black. The size may vary according to the age of the individuals that compose the group.

Characteristics of the diet: Five principal food categories were found: invertebrates, vertebrates, fruits, vegetable remains and undetermined food items.

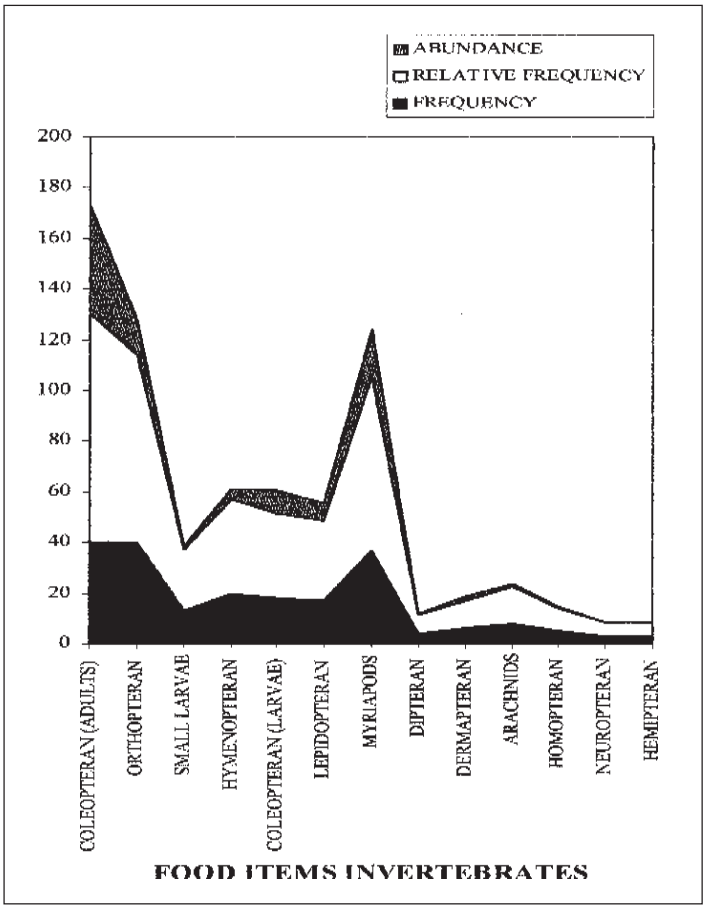
Within the principal food categories, invertebrates registered the highest frequency of occurrence (F=54) and were found in 100% of the excrement samples; likewise they represented 71.6% of the average abundance of all samples (Table 1). Food substances of an animal nature were present in 30 of the 54 excrement samples analysed, but at very low abundance (7.3%) (Graph 1).

The arthropods present in the samples taken were composed of different orders, among which were Coleoptera with a frequency percentage (F) of 90.07% and abundance (A) of 41.9%, followed in order of importance by Orthoptera with F=74% and A=13.6%, Myriapoda (F=68% and A=18.6%), Hymenoptera (F=37% and A=4.07%), coleopteran larvae (F=33% and A=9.16%) and other types of arthropods with lesser values (Graph 1).

The vertebrate category was represented by frog bone remains, which accounted for a frequency of 55% and an abundance of 6.85%. Coati hairs were present in 34 of the excrement samples; however, these were not considered in the analysis of the diet, since they do not constitute a food category and it is presumed that they were consumed accidentally during grooming (common among animal social groups).

The categories of fruit and vegetable residues showed high frequencies, (F=37% and F=41%, respectively) but with very low volume levels (A=7.7% and A=11.8%). Fruits were represented only by *Rubus* sp. and vegetable remains were always leaf fragments, Graminae roots or moss (Graph 1).

Comparison among diets: The grouping analysis (dendrogram) showed four groups (Graph 2) that are similar because of the presence of invertebrates, but that are differentiated from the other three by the characteristics described as follows: the first group (I) presents low abundance values or zero for the fruit category and in contrast the fruit category surpasses by 90% all other excrement samples positioned in this group. The



Graph. 2. Abundance and frequency of principal categories of the complete sample. And values for frequency (F), Relative Frequency (FR) and Abundance (A), within the principal category of invertebrates in the total sample.

diversity values observed in this group are low (between 0.1 and 0.3) and the average dry weight is less than the total average, that is, in this group we find the small faecal samples belonging to young individuals.

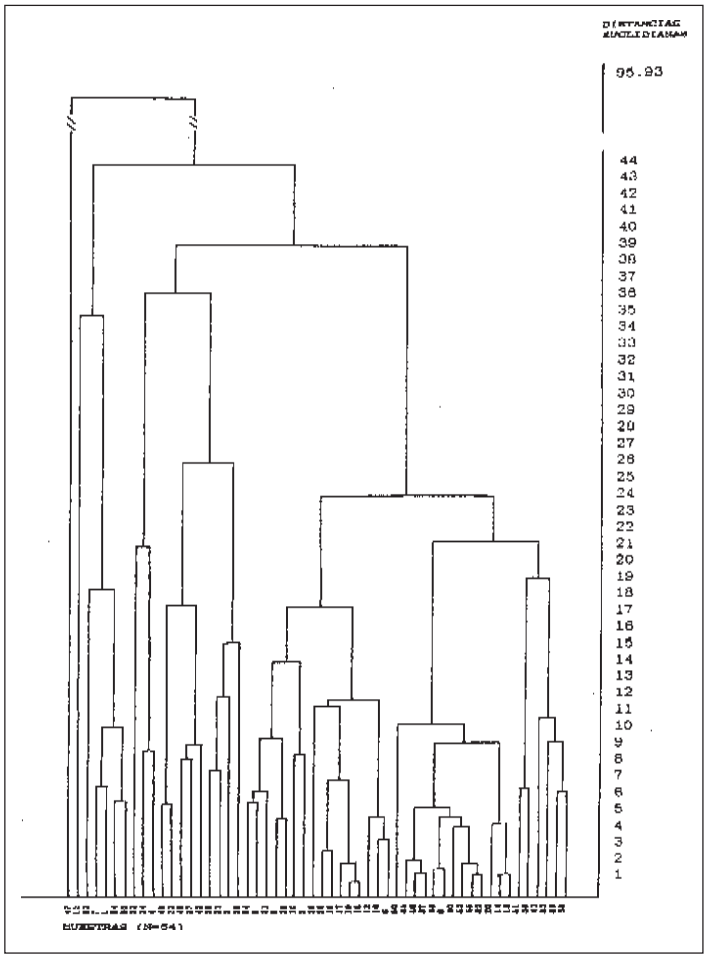
The second group (II) is made up of faecal samples with intermediate weights between the largest and the smallest. These presented diversity indexes between 0.3 and 0.5, coinciding with an augmentation in general of the dried weights of the samples.

Conversely, the 73% of all faecal samples gathered in the third group (III) surpassed the general average of dry weight (5.6g) and had diversity values between 0.5 and 0.6. Sample number 47 displayed a different pattern from the rest of the samples, which is evident in the dendrogram. When this sample was examined carefully we saw that it had a high level of abundance of *Rubus* sp. seeds (80%). For this reason it was set apart from the rest of the groups.

Variance analysis: The variance analysis applied to compare the small faeces group and the large faeces group, shows that the importance of animal foods is different in the two groups ($F=35.38$; $gl=1$; $P<0.0001$) – i.e. between young and adults.

Discussion

The data obtained indicate that the mountain coati is a specialist consumer of small soil and subsoil animals in the high Andean forest and moors (especially edaphic arthropofauna). The



Graph. 3. Similarity dendrograph for the 54 excrement samples collected from Nasua olivacea: *according to abundance values of the principal categories. In this case three similar groups may be appreciated: 1. The analysis grouped in this the excrement samples with low diversity values, lower dry weights than average samples (young coatis). 2. Grouping of intermediate dry weight diversity values. 3. The grouping of the excrement samples with the highest diversity values (between 0.5 and 0.6) and the largest size (adult individuals). Excrement sample No. 47 was removed from the rest because it presented an elevated and non-comparable quantity of* Rubus *sp. Seeds.*

prey they ingest is almost exclusively represented by insects and myriapods (representing 71% of their diet). These data support the work of Decker & Wozencraft (1991) who suggest that some anatomic characteristics of coatis (the reduction of the teeth, the development of the maxillofacial muscles, and the lengthening of the snout) may be adaptations that correspond to insectivory.

Limitation of the methodology: The analysis of faecal samples is a method that permits estimates of the trophic requirements of the species of interest without the need to sacrifice, manipulate or directly observe the animals. Nevertheless, the method has limitations in detecting the totality of food ingested initially by the animal. The identifiable remains in an excrement sample are no more than the fragments of those foods that are ingested totally, or that remain as normal residues of the digestive process. Annelids and some types of larvae constitute an important part of the diet of these animals since they abound in the humid soil of the Andean forests (Salamanca *et al*., 1994). For this reason, in this study the importance of these food types is probably underestimated since no hard parts remain to be identified after passing through the digestive tract (Putman, 1984).

Other aspects, such as the age of the faecal samples, the climatic period to which the specific diet refers, and the identification and differentiation of the samples from those of other mammals present in the study area, are critical in these types of investigations. In this study only fresh faecal samples were collected, and for this reason they are presumed to be representative samples for the climatic period of the study. As mentioned before, clear parameters were established for the identification of the samples, which allowed the recognition of the faeces of *Nasuella olivacea.*

Finally, evaluation parameters such as frequency have a descriptive function that allows investigation of the exclusive differences among trophic categories and among the excrement samples. The abundance data better represent the energetic contribution of each category, without relinquishing its descriptive nature. The abundance data do not overestimate an item's contribution since, in this case, we kept in mind the volumetric measure for each class of food and not just its presence or absence.

Dietary characteristics: The material for this study comes entirely from a dry season period at the Biological Reserve of Carpanta; consequently, the validity of the diet should be considered cautiously, bearing in mind that the composition of a diet generally changes according to the available resources regulated by the time of year.

To thorougly explain the predominance of invertebrates in the diet of coatis has its limitations, since no precise data are available for different seasons of the year. In any case, preliminary observations on this aspect allow us to formulate that the edaphic fauna resource available is the best the high mountain can offer mammals of the coati type; also it is reasonably stable and abundant which explains why these burrowing animals have developed specific strategies to exploit them. The mountain coati has a more elongated snout and a sharper nose than its closest relatives the coatis living at lower altitudes, *Nasua nasua* and *N. narica.* Their foraging behaviour is related to these characteristics since the coati spends a great deal of its available time searching for food, excavating the soil looking for small prey. In these activities, the long snout is particularly useful, together with the

Fig. 1. Sizes and forms of excrement samples of social groups Nasuella olivacea.

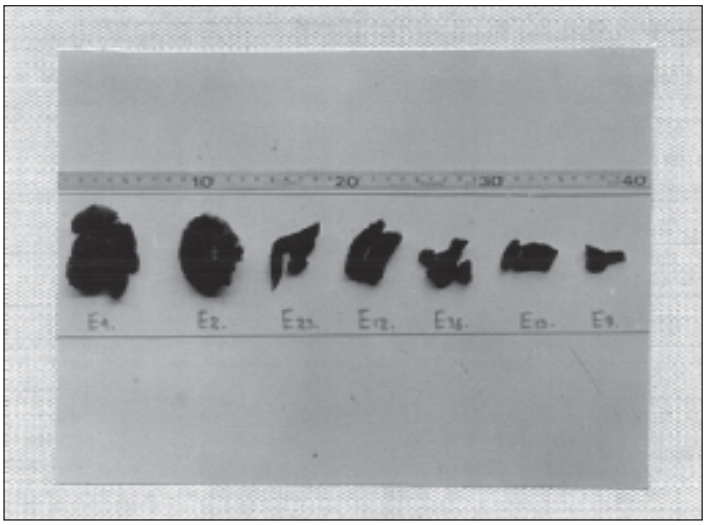


Table 1. Abundance and frequency values for all types of foods identified in the 54 Mountain coati, Nasuella olivacea*, faecal samples*

FOOD ITEMS	ABUNDANCE	FREQUENCY
Invertebrates	71,67	54
Coleoptera (adults)	41,9	40
Orthoptera	13.6	40
Small larvae	1.46	13
Hymenoptera	4.07	20
Coleoptera (larvae)	9.16	18
Lepidoptera	7.14	17
Myriapoda	18.6	37
Diptera	0.6	4
Dermaptera	1.6	6
Arachnids	0.9	8
Homoptera	0.2	5
Neuroptera	0.2	3
Hemiptera	0.16	3
Vertebrates	6.85	30
Fruits	7.74	37
Vegetable remains	11.18	41
Indeterminate	1.7	—-

strong front claws which are used to tear weeds and make way to the soil. For this reason it is very common to find holes left in bogs, forests, *Chusquea* sp. communities, and in the same grasslands where they sporadically come out to dig. On one occasion, whilst searching for faecal samples, the investigator was able to count more than 5,000 holes left by a group of mountain coatis in a moss-covered area of no more than $35m^2$.

The high Andean forest floor is characterised by its blanket of wet putrefying leaves, which favours the presence of numerous organisms that decompose the vegetable matter that falls from the trees, or which use it as shelter and food.

The trophic diversity, bearing in mind general food categories, is very limited which explains the dominance of the invertebrate category. The diversity of foodstuffs that mountain coati consume, classifies within the group of highest predominance.

As for the comparison between the diets of young coatis and adult individuals, the dendrogram and the variance analysis lead us to state that young coatis manifest a different diet from adults. The young, represented by small faecal samples, presented low diversity indexes, in other words it was found that they ingested a fewer assortment of foods. In contrast, adults seem to consume more diverse food types. This shows that adult individuals have a greater capacity of foraging and the young, probably due to their inexperience or lack of know-how, do not utilise the totality of resources available. These observations confirm those of Kaufmann (1962), who describes the foraging behaviour in the inner social groups of *Nasua narica*. This author observed the behaviour of these groups directly and found that young individuals approach their adult counterparts sniffing their snouts to determine the scent of the food they should search for. Thus it is possible to state that for these groups the breadth of their niche increases with age, and they are in a constant learning process that is seen within the groups and during the interaction of adults and young individuals at the moment of foraging.

Comparison with other coatis: Comparison in this sense is only possible with White-nosed coatis, *Nasua narica*, on which some studies of trophic ecology have been made (Kaufmann, 1962; Russell, 1982). The diet of the mountain coati differs from that of the above mentioned species in the proportions of animal and vegetable foods taken. In general, coatis living in lower altitudes are distributed in habitats that offer them a great variety of fruits; likewise, their trophic niche is much wider and they can spread out into larger areas. *Nasua narica* may consume up to 18 different fruits, while the *Nasuella olivacea* could consume only one of four fruits (the 54 excrement samples collected contained the remains of only one fruit).

The results gathered allow us to establish that the mountain coati's diet is quite limited, that is, their trophic niche is very narrow and the foods they consume most commonly are abundant in habitats of extreme environmental conditions, in which coatis have adapted over millions of years of evolution. These characteristics demonstrate the specialist nature of the mountain coati, but also, unfortunately, their vulnerability, since specialists are animals that are true to their habitat and depend a great deal on local conditions and small distributional areas. For the mountain coati to survive, it is imperative that we do not cut down trees in the forests they inhabit. The forest provides not only the leaves that enrich the soil with the insects which the coati feeds on; they also maintain hydric balance and provide shelter and food for other species like the raccoons, deer, borugos and other less common mammals that only inhabit the high mountain regions. There is also a need for more investigation to find out how these animals live in an hostile environment like that of the high mountain, what their group structure is like, how they coexist with other species, how they reproduce and how they can be included in future conservation plans.

Acknowledgements

So far a grant of 1,500 US$ has been donated by the WCS-NYZS, the Wildlife Conservation Society Division of the New York Zoological Society, GEA Ecological Group and the Division for the Environment FES of Colombia. Anyone who is interested in details of the MOUNTAIN COATI PROJECT IN COLOMBIA, write to: Abelardo Rodríguez-Bolaños, Apartado Aereo 8731, Santafé de Bogotá, Colombia.

e-mail: edax@uole.com or abelard36@hotmail.com

References

Decker, D. M. & Wozencraft, W. C. 1991. Phylogenetic analysis of recent procyonid genera. *J. Mamm.,* 72:42-55.

Eisenberg, J. F. 1989. *Mammals of the neotropics. The northern neotropics. Vol. 1. Panamá, Colombia, Venezuela, Guyana, French Suriname.* Chicago & London: The University of Chicago Press. 449 pp.

Eslava, J., López & Olaya, G. 1986. Los climas de Colombia (Sistema de C. W. Thornthwaite). *Atmósfera* 6:33-76.

Garcia-C., M. & Chamorro-B., C. H. 1994. Contribución al conocimiento de la dinámica temporal de la edafofauna en unbosque altoandino de la región de Monserrate. In *Estudios ecológicos del páramo y del bosque altoandino Cordillera Oriental de Colombia*, ed. L. E. Mora-Osejo and H. Sturm, 619-630. Santafé de Bogotá, Colombia: Academia Colombiano de Ciencias Exactas, Físicas y Naturales. Colección Jorge Alvarez Lleras. No. 6. Tomo II.

Janzen, D. H. 1970. Altruism by coatis in the face of predation by *Boa constrictor*. *J. Mamm.* 51:387-389.

Kaufmann, J. 1962. Ecology and behavior of the coati *Nasua narica* on Barro Colorado Island, Panama. *Univ. Calif. Publ. Zool.* 60(3):95-222.

Kaufmann, J., Lanning, D. V. & Poole, E. E. 1976. Current status and distribution of the coati in the United States. *J. Mamm.* 57:621-637.

Korschgen, L. J. 1980. Procedimientos para el análisis de los hábitos alimenticios. In *Manual de técnicas de gestión de vida silvestre*, ed. R. T. Rodríguez, 119-134. Estados Unidos: The Wildlife Society. 703 pp.

López-Arévalo, H. F. & Montenegro-Diaz, O. L. 1993. Mamíferos no voladores de Carpanta. In *Carpanta, Selva nublada y P*áramo, ed. G. I. Andrade, 165-184. Fundación Natura Colombia.

Ludwing, J. A. & Reynolds, J. F. 1988. *Statistical ecology. A primer on methods and computing.* A Wiley-Interscience Publication. 335 pp.

Newcomer, M. W. & De Farcy, D. D. 1985. White-faced capucin (*Cebus capucinus*) predation on a nesting coati (*Nasua narica*). *J. Mamm.* 66:185-186.

Putman, R. J. 1984. Facts from faeces. *Mamm. Rev.* 14:79-97.

Rangel, C. O. & Rudas-Ll., A. 1989. Macroclima de Gorgona y de la Región Costera aledaña. In *Biota y ecosistema de* Gorgona, ed. J. Aguirre and C. O. Rangel, 13-41. Bogotá, Colombia: Fondo FEN.

Repizzo, A. A. 1993. Presentación de la Reserva Biológica Carpanta. In *Carpanta, Selva nublada y Páramo*, ed. G. I. Andrade, 17-47. Colombia: Fundación Natura.

Rodríguez-Bolaños, A. 1995. Rango de acción y hábitos alimenticios del coatí de montaña, *Nasuella* oliveceo, en la Reserva Biológica Carpanta. Tesis de Pregrado. Universidad Distrital Francisco José de Caldas.

Russell, J. K. 1981. Exclusion of adult male coatis from social groups: Protection from predation. *J. Mamm.*, 62:206-208.

Russell, J. K. 1982. Timing of reproduction by coatis (*Nasua narica*) in relation to fluctuations in food resources. In *The ecology of a tropical forest: Seasonal rhythms and long-term changes,* ed. E. G. Leigh, Jr., A. S. Rand and D. M Windsor, 413-431.

Salamanca-P. & Chamorro-B., C. H. 1994. La edofauna del páramo de Monserrate, sector Hacienda Santa Bárbara (Cundinamarca-Colombia) In *Estudios ecol*ógicos del páramo del bosque altoandino Cordillera oriental de Colombia, ed. L. E. Mora-Osejo ans H. Sturm, 631-648. Santafé de Bogotá, Colombia: Academia Colombiana de Ciencias Exactas, Físicas y Naturales. Colección Jorge Alvarez Lleras. No. 6. Tomo II.

Smythe, G. B. 1970. The adaptive value of the social organization of the coati. *J. Mamm.*, 51:818-820.

Sturm, H. 1994. Fauna In *Estudios ecol*ógicos del páramo del bosque altoandino Cordillera oriental de Colombia, ed. L. E. Mora-Osejo ans H. Sturm, 71-87. Santafé de Bogotá, Colombia: Academia Colombiana de Ciencias Exactas, Físicas y Naturales. Colección Jorge Alvarez Lleras. No. 6. Tomo II.

Instituto de Ciencias Naturales, Universidad Nacional de Colombia Universidad Distrital Francisco José de Caldas, Santafé de Bogota, Colombia

3rd International Martes Symposium - Martes 2000 "*Martes* in Managed Landscapes" 13 - 16 Augustus 2000 - Corner Brook, Newfoundland, Canada

Travelling the last leg of the journey to Newfoundland on board a small, propeller-driven aeroplane in which everybody gets a seat by the window, I realised that Corner Brook was going to be very different to Edmonton where the last *Martes* symposium was held in 1995. And indeed it was. Corner Brook is a small town on a sheltered inlet on the forested west coast of the island, with a vast pulp and paper plant at its heart clearly demonstrating the dependence of the area on forestry.

In the five years since the Alberta symposium much groundbreaking work on *Martes* has been undertaken, building on earlier studies and trying to apply the knowledge gained to practical management. The theme "*Martes* in a managed landscape" was seen as a natural progression from the work presented at the previous meeting.

Most delegates had assembled by the Sunday evening "Icebreaker Reception" which, in view of the unexpected heat wave which Newfoundland seemed to be experiencing, left delegates in the glass atrium feeling decidedly flushed and not at all icy! The organised opportunities for informal meetings such as this were very much a part of the symposium and were very welcome occasions for the real business of networking.

Monday morning saw the first of seven sessions, "Planning and Managing Landscapes for *Martes*" which introduced us to some of the habitat modelling work which has become possible recently with an increased understanding of the distribution, status and ecology of *Martes*. Bill Adair and Kathy Knox each gave papers on Newfoundland marten habitat modelling and Bill Zielinski and Richard Truex reported on their work in south-west USA on fishers and martens. Landscape planning in New Brunswick was covered by Dan Beaudette and Dan Harrison looked into landscape fragmentation effects.

Monday afternoon gave us the first opportunity to view the large number of poster presentations that covered a wide range of research areas. The poster sessions were all well supported and provided yet more opportunity for informal discussion.

Session two, "Responses of *Martes* to Human Land Uses" gave us the results of studies of the effects on *Martes* of various aspects of commercial forestry operations (Erin O'Doherty, David Payer, Angela Fuller) as well the impact of fur trapping (Brian Hearn).

A very pleasant Monday evening was spent at the Marble Mountain Ski Lodge, where delegates battled with plates brimming over with such delights as whole lobsters, moose hot-dogs and caribou burgers. The beer and the live music were exceptionally good too!

The next day started bright and early with session three "*Martes* in Forest Communities" and the first non-North American paper from Margarida Santos-Reis on Stone martens in cork-oak woodlands in Portugal. There then followed papers on prey by Angela Fuller and also by Kazuki Suda, who examined the relationship between sika deer density and the consumption of mice by Japanese martens, and lastly a paper by Bill Krohn on foot-loading, which indicates that martens have the edge on fishers in soft snow.

Session four "Habitat Ecology of *Martes*" saw papers on marten rest sites (Bill Adair, Richard Weir), habitat evaluation for fishers (Roger Powell), the effects of timber harvesting and trapping on habitat selection (David Peyer) and marten research and management in Newfoundland's own Terra Nova National Park (John Gosse).

After this session an open meeting of the *Martes* Working Group was held to discuss progress and the future. There was general agreement that the Group was fulfilling a useful function and should continue along much the same lines, although ideas such as extending the range of mustelid species covered were considered. The strong North American bias of these symposia and the failure of the group to attract enough interest from elsewhere in the world was recognised: this symposium attracted only eight delegates from overseas, four Europeans and four Japanese. The high cost of travel to North America (Corner Brook being a case in point) was identified as a major factor in deterring would-be delegates and it was decided that more effort should be made to increase attendance from outside the USA and Canada. In view of this, the location of the next symposium is to be Portugal, a commendable but high-risk strategy in view of the large North American membership of the Group, but essential if the Group is to have wider appeal.

Session five, "Population management and research techniques" was a mixed bag of papers including two on marten harvesting (Clément Fortin, Michel Hénault), the use of microsatellite DNA in relatedness in fishers (Keith Aubrey), the status of martens in coastal forests (Bill Zielinski) and the reliability of scat surveys (Johnny Birks).

➤➤➤ see page 25

Some small carnivore records from Nagaland, India

Anwaruddin CHOUDHURY

Introduction

The state of Nagaland in north-eastern India (25°10´-27°01´N, 93°17´- 95°15´E) covers an area of 16,600 km² and is divided into seven districts, viz. Kohima, Mokokchung, Mon, Phek, Tuensang, Wokha and Zunheboto. Physiographically, almost the entire state is hilly and mountainous. The main hill ranges are the Barail in the south and southwest and Patkai in the north. A high range exists along the Indo-Myanmar border with Mt Saramati, 3,842 metres, as its highest point (highest in Nagaland). The hills in the central areas are generally referred to as Naga Hills. The highest peak of the Barail Range is Mt Japfu (Japvo) which stands at 3,043 m. The climate of Nagaland is tropical 'monsoon' type with a hot, wet summer and a cool, dry winter (annual rainfall, 1,000 to more than 6,000 mm; temperature, less than 0°C in winter [average minimum, especially on Mt Saramati] to 35°C in summer [average maximum]).

Tropical wet evergreen forest occurs in patches at lower and middle elevations all over, except in the southwest where tropical moist deciduous and semi-evergreens dominate. Many of the river valleys and gorges are covered with evergreen forest, but tropical semi-evergreen forest also occurs in many of the once evergreen pockets. In the higher hills, subtropical broadleaf (evergreen) forest occurs with small areas of conifers in the eastern areas. Higher up in Saramati, temperate broadleaf forest is found while atop (Mt Saramati), the vegetation type is subalpine. During winter, the peak remains under snow.

Although located in a rich biogeographic unit being part of the Eastern Himalaya Biodiversity "Hotspot" (Myers, 1988, 1991), the documentation of its diverse fauna has yet to be done up to the desired extent and the small carnivores are among the most poorly known. Nagaland has at least nine species of mustelids, seven viverrids and three herpestids. No specific field study has been done solely on these small carnivores, but general information can be found in some broader works (Choudhury 2000, Corbett & Hill 1992, Ellerman & Morrison-Scott 1951, and Prater 1948).

Field work has been carried out in Nagaland in 1991, 1992 and 1996, with brief visits to fringe areas in 1987 and 1988. During the course of these visits, I covered Kohima (including Dimapur), Phek and Zunheboto districts, and the fringe areas of Mon and Mokokchung districts. Data were obtained through direct sighting in wild, records of wild-caught captive animals, the examination of dead specimens (including preserved skins) and reports by experienced hunters, forest officials and other observers.

For direct observation, foot-transects were made along existing and newly cut paths and trails, and vehicle-transects along roads and drivable tracks. There was also a regular sale of wild animals and birds at Kohima market. Besides visiting the market in June 1996, I engaged members of a local NGO to photograph different species for records and future identification. All photos of dead animals referred to in the text were taken in 1997 and 1998 (except when mentioned otherwise).

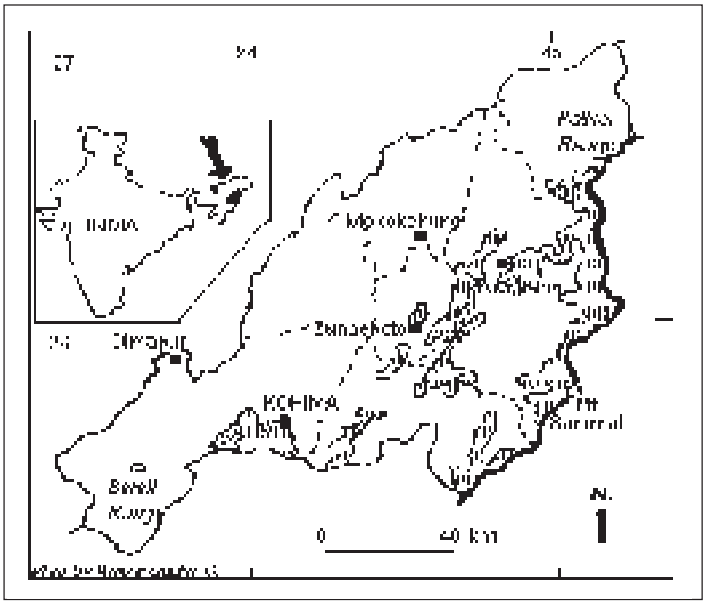


Fig.1. Map of Nagaland showing the places mentioned in the text (land above 1,800 m ▦)

Species notes

MUSTELIDAE

Yellow-bellied weasel, *Mustela kathiah*

Not uncommon but rarer than *Martes flavigula*. This hill-dwelling species is found between 1,000 and 2,000 m ASL. In winter, it may come down a little lower than 1,000 m also. A killed specimen was on sale at Kohima market as food in 1997.

Black-striped weasel, *Mustela strigidorsa*

No specimen record so far, but occurrence in nearby areas of Arunachal Pradesh (Choudhury, 1997) indicates its presence in the Patkai Range of northern Nagaland (occurs at elevations lower than 1,000 m).

Yellow-throated marten, *Martes flavigula*

Common all over, however, its distribution is restricted to the forest areas. Sightings not very frequent. In Intanki Wildlife Sanctuary occurs as low as below 200 m (Corbett & Hill, 1992 state that it occurs between 300 and 3,000m). Usually seen singly, although two animals are also seen occasionally. Occurs from near the edge of hills to the mountains. In the less disturbed forests, it can be seen during the daytime also.

Hog-badger, *Arctonyx collaris*

Widespread in the forests as well as well-wooded countryside, it is perhaps the commonest of all the badgers/ferret-badgers. Most sightings were of lone animals. May occur in the higher hills also - one was recently caught in Arunachal Pradesh at 1,700 m elevation.

Burmese ferret-badger/Large-toothed ferret-badger, *Melogale personata*

Found all over. Exact status unclear. Sighting very difficult due to nocturnal habit. Occurs in both hill forests as well as grassland in the abandoned *jhums* (slash-and-burn shifting cultivation). One killed specimen was on sale at Kohima market in 1997.

Chinese ferret-badger/Small-toothed ferret-badger, *Melogale moschata*

Also found all over, however, exact status unclear. Like *M. personata*, its sighting very difficult. Recently (1997) recorded from Kohima market where two dead (shot) animals were on sale for food.

Common otter/Eurasian otter, *Lutra lutra*

Once common all over, especially in hill streams. It has become extremely rare nowadays (see discussion). Seen singly, twos (often pairs) or small groups.

Smooth Indian otter/Smooth-coated otter, *Lutrogale perspicillata*

Also not uncommon in the recent past. It was a familiar sight in the foothills and adjacent plains bordering Assam. Inhabits rivers, lakes, marshes, pools, ponds and even roadside ditches. Seen singly or in small groups. This species is usually not found in the higher hills.

Clawless otter/ Small-clawed otter, *Aonyx cinerea*

Rare and confined mainly in the foothills and adjacent plains. All the otters are seriously threatened now due to illegal trade (see discussion).

VIVERRIDAE

Large Indian civet, *Viverra zibetha*

Widespread and common all over Nagaland. Found from plains to the higher hills in forest, plantations and scrub jungle, as well as well wooded countryside. Also common in abandoned *jhums.* Usually seen singly. Often sold in Kohima market for food.

Small Indian civet, *Viverricula indica*

Also common all over the state. It prefers the vicinity of human habitation and frequently kills domestic chickens and ducks. Also found in abandoned *jhums.* It is occasionally seen even in busy towns such as Dimapur. Also often sold in Kohima market for food.

Spotted linsang, *Prionodon pardicolor*

The rarest of all small carnivores described in this article. Sighting very difficult and there are virtually no records except that reported here. Perhaps occurs in the forests in the foothills and hills as well as grasslands near forests. The lone authentic record was of a killed specimen on sale for food in Kohima market in 1997.

Common palm civet/Toddy cat, *Paradoxurus hermaphroditus*

Common all over including in forests, well wooded villages and older abandoned *jhums.* A familiar and well known killer of domestic chickens.

Masked palm civet/Himalayan palm civet, *Paguma larvata*

Also common. It is found all over the state especially in the forests and light woodlands of the foothills and hills. The range map in Corbett & Hill (1992) did not include Nagaland. Dead animals are occasionally seen at Kohima market.

Binturong *Arctictis binturong*

Not uncommon in the forests, both edge of the plains and hills all over Nagaland. However, it is becoming rarer as it requires good treecover. Protected areas where the species is found include Intanki Wildlife Sanctuary. There are also reports from Singphan Reserved Forest in the extreme north.

Small-toothed palm civet *Arctogalidia trivirgata*

So far no specimen record, but definitely occurs as it has been recorded from both sides of the state in Arunachal Pradesh (Choudhury, 1997) and Manipur. Its exact status is unclear.

HERPESTIDAE

Small Indian mongoose *Herpestes auropunctatus / javanicus*

Still abundant all over in almost all types of habitats ranging from forests, scrub jungle, and grassland, to the vicinity of human habitation in towns and villages. Dead animals for the pot are occasionally seen at Kohima market.

Indian grey mongoose *Herpestes edwardsii*

Also widespread but less abundant than *Herpestes auropunctatus / javanicus.* Occasionally sold at Kohima market for food.

Crab-eating mongoose *Herpestes urva*

Inhabits wetlands and forest streams including small marshes inside forests. Inhabits both plains and hills, but usually in forested areas. Rarest of the *Herpestes* found in Nagaland. Not observed near human habitations. Recorded near Intanki Wildlife Sanctuary. Sightings are, however, rare. Usually seen in twos or more. The crab-eating mongoose is less agile than the other two species, but vanishes into undergrowth whenever any human being is noticed.

Discussion

Most of the small carnivores are nocturnal, shy and poorly known, and are also low on the agenda of potential researchers. However, there is an urgent need to take up baseline studies on these smaller species. For baseline surveys to ascertain their exact status and distribution (especially of the least known and endangered species), camera trapping should be used.

It appears that the exact status of most of the species is still unclear. Many (eg. *Mustela sibirica, Melogale* spp., and *Prionodon pardicolor*) are known only from one or two dead specimens sold at Kohima market for food.

The main threats faced by the small carnivores are destruction of forest through the felling of trees and *jhum* cultivation, and poaching for food and trade. The closed forest (canopy cover 40% and above) in Nagaland was 42.8% of the total geographical area in 1972-75. In 1980-82, it was reduced to 29.8 % (source: National Remote Sensing Agency). It has further come down to only 21% in 1995 (source: State of Forest Report 1997). Today, it is invariably less than 20%. Considering such large-scale deforestation, forest-dwelling species such as the spotted linsang and binturong, are becoming rarer day by day. Although for species such as the civets and mongooses, degraded forest and abandoned *jhums* also provide excellent habitat, they are not under threat from forest loss. Some species, such as *Viverricula indica, Paradoxurus hermaphroditus,* and *Herpestes auropunctatus*, can adapt well in a diverse range of habitats (including human habitations).

All the mustelids, viverrids, and herpestids are considered edible by the tribal groups inhabiting Nagaland. These are regularly shot with guns and trapped with the help of crude snares for the pot. However, because most small carnivores are cryptic and nocturnal, such hunting has not represented a serious threat until now as the numbers involved always remain low.

Trade in small carnivores was mostly confined to the sale in local markets of their meat as food. Skins were occasionally preserved as decorations or were eaten with meat. But in the early and mid1990s, large numbers of otters were snared by locals and also outsiders (perhaps from Assam) for their skins. These were reportedly smuggled to China through Myanmar for unknown medicinal use. Sightings of all species of otter have become a matter of chance only.

Many species are legally protected under Schedule-I (binturong, hog-badger, clawless otter and spotted linsang) and Schedule-II (part I: ferret-badgers; part II: all civets, martens and otters), of the Wild Life (Protection) Act of India, which prohibits their killing or capture dead or alive. However, enforcement in the field is non-existent, not even in the protected areas. Most people are also unaware of this legal status.

The existing protected area network in Nagaland covers very insignificant habitat (only 1.33% of the geographical area of the state). The protected areas (all wildlife sanctuaries) are, Intanki (202.02 km²), Pulie-Badge (9.23 km²), Fakim (6.42 km²), and Rangapahar (4.70 km²). Except for Intanki, all are tiny and hardly cover any sizeable area of the small carnivore habitat. Moreover, in the sanctuaries, protective measures are very inadequate.

Formation of new and larger protected areas such as Saramati-Fakim (500 km²), and Satoi (100 km²), and adequate protection of existing sanctuaries are recommended. Sale of animals at Kohima market has come down to some extent because of activities of local NGOs such as the People's Group.

Acknowledgements

For help and assistance during field work, I would like to thank the following persons: M.I.Bora (D.C., Zunheboto), Akato Sema (EAC), Y.Lotha, Thomas Kent, and J.Jasokie of People's Group NGO, S.Hukiye (GB of Zunheboto), Hakeem (driver), and Natwar Thakkar of Nagaland Gandhi Ashram. Special thanks are due to Khekiho Sohe, also of People's Group NGO, for photographing some of the small carnivores at my request.

References

Choudhury, A.U. 1997. Small carnivores (ailurid, mustelids, viverrids and herpestids) in Arunachal Pradesh, India. *Small Carnivore Conserv.,* 17: 7-9.

Choudhury, A.U. 2000. Status of mustelids, viverrids and herpestids in north-eastern India. *ENVIS Bull.* 4. Wild Life Institute of India, Dehra Dun.

Corbett, G. & Hill, J. 1992. *The mammals of the Indomalayan region*. Oxford University Press, New York.

Ellerman, J.R. & Morrison-Scott, T.C.S. 1951. *Checklist of Palaearctic and Indian mammals*, *1758 to 1946*. British Museum, London.

Myers, N. 1988. Threatened biotas: "Hotspots" in tropical forests. *Environmentalist* 8(3):1-20.

Myers, N. 1991. The biodiversity challenge: Expanded "hotspots" analysis. *Environmentalist* 10(4):243-256.

Prater, S.H. 1948. *The Book of Indian animals.* Bombay Natural History Society, Bombay (Mumbai).

The Rhino Foundation for nature in NE India,
c/o The Assam Co. Ltd., G.Bordoloi Path,
Bamunimaidam
Guwahati 781 021 (Assam), India
Email: badru@gw1.dot.net.in

Badgers and the cattle TB crisis: An update

Two reports have been published on the worsening bovine tuberculosis situation in cattle: the second report of the Bourne Independent Scientific Group and the Phillips Husbandry Panel's report. These reports are rather disappointing since they contain no solutions to curb the spread of cattle TB.

Indeed it is still questioned wether and to what extent cattle as opposed to badgers are the source of the TB problem. Sadly, this highlights the gap between such academic studies and practical cost-effective sustainable policies in the field, not helped by political obfuscation of this "highly complex and emotive issue".

And yet, classic studies cited in both reports suggest that a century's experience of cattle TB schemes in over a hundred countries worlwide reveal a very simple scientific basis for success. TB in cattle is a progressive infectious lung disease which spreads slowly but inexorably in the individual and then in the population via the respiratory route. It takes about a year for an individual to get to the multi-lesion highly infectious stage. And so eradicating cattle TB simply depends on preventing the spread at two levels. Annual testing of all cattle gradually removes the most infectious cases. But since neither the TB test nor traceability is 100% accurate, the only way to guarantee that "missed" carriers do not spread TB is via a movement ban of all stock into TB-free areas. GB had a textbook cattle TB scheme into the mid-1970s, and TB only occurred in tiny southwest pockets.

If these had been depopulated it would have eradicated TB. Sadly however, a relaxation of the scheme with longer herd test intervals and no movement bans has allowed TB to spread back into former Midlands strongholds, with incidence back to 1960s levels.

Cattle TB is appearing in areas even in the southwest where it has been absent a decade or so i.e. not from badgers. And so sadly the long process of annual tests/movement bans will be needed again…but this requires a U-turn in political outlook.

M. Hancox,
29 St. Peter Street,
Tiverton EX16 6NW, UK

First observation of the Gambian mongoose, *Mungos gambianus*, in Guinea (Conakry)

Marc COLYN[1], Sylvain DUFOUR[1] and Harry VAN ROMPAEY[2]

Introduction

Genus *Mungos* E. Geoffroy Saint-Hilaire & G. Cuvier, 1795 holds two species: *M. mungo* (Gmelin, 1788), the Banded mongoose and *M. gambianus* (Ogilby, 1835), the Gambian mongoose. Both species occur in sub-Saharan open grass-woodlands. *M. mungo* inhabits the greater part of sub-Saharan Africa except for forests, deserts, and semi-deserts. The distribution of the Gambian mongoose, on the other hand, is chiefly limited to the Guinea savannah zone, degraded forests, and savannah-forest edges from The Gambia to the River Niger. Although both species are common to abundant, their distribution pattern is not clearly defined in western Africa and their zone of sympatry is not clearly delimited.

The Gambian mongoose, in spite of its abundance in certain regions (Booth,1960), has not been studied and is scarcely represented in museum collections. A summary of what is known about this species is given by Van Rompaey (1991); its bibliography by Van Rompaey & Colyn (1996).

At present, *M. gambianus* is only known from about 20 museum specimens originating from The Gambia, Senegal, Guinea Bissau, Sierra Leone, Côte d'Ivoire, Ghana, Togo, and Nigeria. Jeannin (1936) stated that they were distributed in the center and even common in the north of Cameroon. Either they have disappeared or, more likely, these records are based on confusion with *M. mungo*; they are not cited for Cameroon by Depierre & Vivien (1992).

This note mentions the first observation of *M. gambianus* in Guinea (Conakry).

The mammalian fauna of Mount Nimba

The Mount Nimba Biosphere Reserve and World Heritage Site is situated between 07°25' – 07°45'N and 08°35' – 08°20'W astride Guinea, Côte d'Ivoire and Liberia. The highest point of the Mt. Nimba range is in Guinea where it rises to an altitude of 1,768 m ASL (Coe, 1975); its ridges are covered with characteristic herbaceous vegetation. An important hydrographic network is

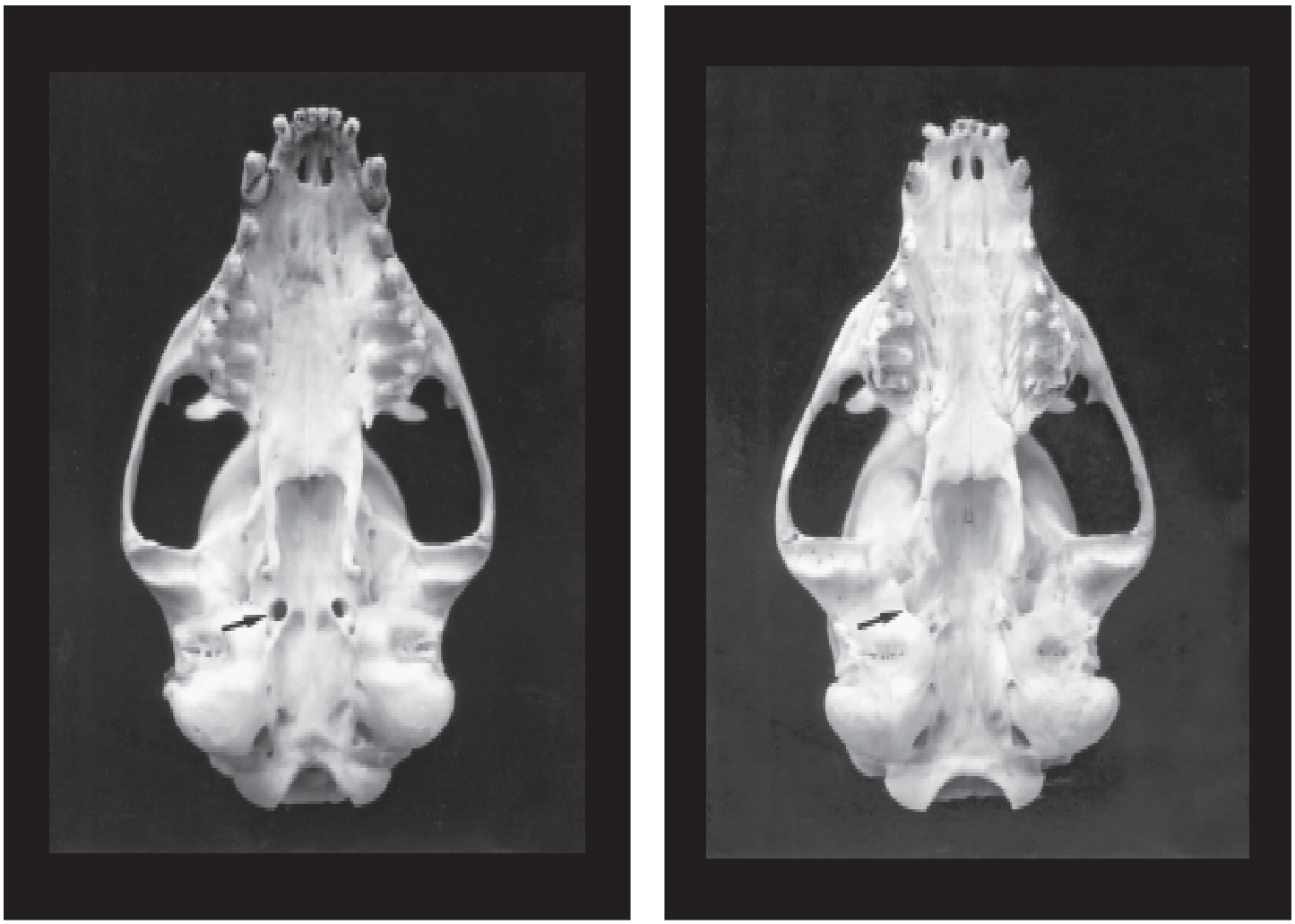


Fig.1. Left: Mungos mungo *(No. RCA 1/1995 from Bangui, Central African Republic, HVR collection); right:* Mungos gambianus *(No. SBP. 2012 from Mt. Nimba, Guinea (Conakry), Paimpont, France). The arrow indicates the carotid foramen.* x 3/2

Character	*Mungos gambianus*					*Mungos mungo*		
	Holotype	N	X	Range	SBP.2012	N	X	Range
GSL	–	8	70.2	66.5 - 72.8	67.1	62	71.9	62.0 - 78.4
CBL	--	7	69.4	66.1 - 72.4	67.1	62	70.2	61.1 - 77.2
ROL	21.3	8	20.8	19.5 - 22.9	20.5	64	21.7	18.3 - 24.3
PAL	34.5	8	34.2	32.8 - 36.1	33.2	59	36.7	32.4 - 41.2
MAX	23.5	8	22.7	21.4 - 24.3	21.5	63	23.8	20.7 - 26.8
TYM	--	8	14.9	14.0 - 17.6	14.2	61	14.9	13.7 - 16.0
CAN	13.3	8	13.3	12.6 - 14.0	12.2	63	14.1	12.2 - 15.8
ROB	17.0	8	15.6	14.7 - 16.7	15.4	62	17.2	14.2 - 19.5
IOB	13.3	8	12.9	11.9 - 14.0	12.4	64	14.0	11.5 - 16.7
PAB	20.5	8	20.7	19.3 - 21.5	19.4	60	22.2	19.5 - 23.9
ZYG	39.7	8	36.9	34.8 - 38.9	37.6	59	38.8	33.8 - 44.2
BRB	–	8	27.4	26.8 - 28.4	26.9	62	27.1	24.5 - 29.5
MAS	--	8	29.2	28.0 - 29.8	28.3	60	30.0	26.9 - 32.2
BRH	–	8	21.7	20.4 - 22.4	20.8	61	22.5	20.2 - 24.7
MAL	49.2	8	47.1	44.6 - 49.4	44.4	63	48.4	41.3 - 53.8
MAN	27.2	8	26.7	25.5 - 28.2	24.8	62	27.5	24.1 - 30.6
CMH	17.6	8	16.3	15.4 - 17.7	15.4	63	18.8	16.1 - 22.0
POC	14.0	8	14.0	13.5 - 15.3	14.5	62	13.6	11.6 - 16.3
upP4L	worn	8	4.3	4.2 - 4.9	3.9	52	4.9	4.2 - 5.8
upP4B	worn	8	4.2	4.0 - 4.7	3.8	52	5.2	4.6 - 6.0
upP4D	worn	8	5.6	5.3 - 6.0	4.9	52	6.5	5.7 - 7.5
upM1L	worn	8	2.9	2.5 - 3.5	3.0	51	3.4	2.8 - 3.9
upM1B	worn	8	4.6	4.3 - 5.2	4.4	51	5.6	4.9 - 6.6
upM2L	worn	7	2.3	2.1 - 2.7	1.9	45	2.5	2.1 - 2.9
upM2B	worn	7	3.7	3.3 - 4.1	3.2	45	3.9	2.8 - 5.4
loM1L	worn	5	4.6	4.3 - 5.2	4.3	50	4.9	4.4 - 5.9
loM1B	worn	5	2.8	2.7 - 2.9	2.8	50	3.2	2.7 - 3.7
loM2L	worn	5	3.7	3.5 - 4.1	3.4	44	4.0	3.2 - 4.8
loM2B	worn	5	2.5	2.4 - 2.7	2.3	44	2.7	2.3 - 3.0

Table 1. Comparison of craniometric data (in mm) of M. gambianus *and* M. mungo *specimens with the new specimen from Mt. Nimba, Guinea (Conakry). Skull characters: see Acronyms. Holotype* M. gambianus*: BMNH-55.12.24.226, female from The Gambia. No.SBP. 2012:* M. gambianus *from Mt. Nimba, Guinea (Conakry).*

present and the numerous valleys are covered with deciduous high forest and related vegetation types. The multiplicity of biotopes is the source of a scientifically recognized biodiversity.

Nevertheless, little research has been done on the mammalian fauna. In 1942, Lamotte made a first inventory of the mammals on the Guinean side, totalling 37 species. Coe (1975) trapped 55 species (of the 88 supposed to be present) on the Liberian side. Other research was done on the rodents, shrews, and bats (Heim de Balzac & Lamotte, 1958; Roche, 1962, 1971; Verschuren, 1976; Misonne & Verschuren, 1976; Gautun *et al.*, 1986; Verschuren, 1986). These mammal inventories are incomplete as shown by works in preparation which will confirm for the first time the presence of the bovids *Sylvicapra grimmia, Cephalophus rufilatus,* and *C. sylvicultor.*

First record of Gambian mongoose from Guinea

Since 1999 one of us (SD) is doing research on hunting and its impact on the mammalian fauna in the region of the Guinean Nimba.

The aims of the study are: 1) to determine the dynamic, cultural, and economic characteristics of this activity and, 2) to evaluate the degree of hunting pressure on animal populations both quantitatively (species, sex, age…) as well as quantitatively. To this end 'table left-overs' of animals consumed in villages around Mt. Nimba are collected as far as possible. This material consists chiefly of incomplete skulls of ungulates (Cephalophinae), primates (Cercopithecidae) and large rodents (cane rats and brush-tailed porcupines). In the mean time carnivores (Herpestidae and Viverridae) as well as pangolins, hyrax, and squirrels have been observed.

In July 2000, while determining the species of animals consumed in the villages, one of us (MC) remarked the presence of a *Mungos* skull (orig. no. 2.09.99M). This adult male mongoose was trapped 2 September 1999 on the northern flank of Mt. Nimba, in secondary forest in the valley of the Zougué River, ca. 600 m ASL. Later the incomplete skull (incisors and nasal bones missing) was studied at the Station Biologique de Paimpont (No. SBP. 2012) in order to identify the species concerned.

The skulls of the two *Mungos* species are very similar and determination of species solely on craniological material is not easy. In general, the skull of *M. gambianus* is smaller than that of *M. mungo* and its dentition is clearly smaller.

Hayman (1935: 926) states: "In *M. mungo* the carotid foramen pierces the basisphenoid by a large, distinct, uncovered opening in the bone, entirely unconnected with, and uncovered by, the antero-internal angle of the bulla. On the other hand, in *M.*

gambianus the carotid foramen in the basisphenoid is small and is almost obscured from view by a peculiar irregularly formed angular projection forward of the antero-internal angle of the bulla" (Fig. 1).

According to Rosevear (1974) the zygomatic breadth averages 53-54 per cent of the condylobasal length in *M. gambianus* and about 56 percent in *M. mungo.* We found 52.8 (51-54; N=7) and 54.2 (51-62; N=57) respectively. As with the other craniometric data there is considerable overlapping. The Nimba specimen shows a ratio of 56.

Rosevear (1974) also found the interorbital breadth to be greater than the postorbital constriction in *M. mungo*, whereas in *M. gambianus* it is almost always less. In eight specimens of *M. gambianus* (N=9) IOB<POC and in one IOB>POC. In 35 specimens of *M. mungo* (N=60) IOB>POC but in 23 IOB<POC and in two IOB=POC. The Nimba specimen has IOB<POC.

The most obvious distinction between the two species lies in the teeth, which are strikingly smaller in *M. gambianus* (Rosevear, 1974). All molars and the upper fourth premolar are on the average smaller in *M. gambianus* but again there is considerable overlapping (Table 1).

When we consider the smallness of the teeth, the small, obscured carotid foramen, and the IOB/POC ratio of the Mt. Nimba specimen it can be identified, without any doubt as *M. gambianus.*

The presence of *M. gambianus*, chiefly occurring in savanah habitat, on the forested flanks of Mt. Nimba is not unexpected considering that the mountain is situated at the transition between the Guinea and Sudan savannah zone and that the forest is largely fragmented on its northern periphery. Consequently, numerous savannah species are to be found on the natural edaphic savannah characteristic of the higher flancs of Mt. Nimba as well as in the nowadays degraded forests. This is case with *Cephalophus rufilatus, Sylvicapra grimmia, Tragelaphus scriptus, Herpestes sanguineus, Tryonomys swinderianus,* and *Hippotragus equinus.*

Acronyms

GSL: greatest skull length, from the anterior edge of the I^1 to the posterior edge of occipital bone; **CBL**: condylobasal length of the skull, from anterior edge of I^1 alveolus to posterior edge of occipital condyle; **ROL**: length of rostrum, from lateral base of hamular process of lacrimal to anterior most edge of premaxillae; **PAL**: length of palate, from posterior edge of alveolus of I^1 to posterior edge of palatine; **MAX**: greatest crown length of maxillary toothrow; **TYM**: greatest length of tympanic bulla, not along longitudinal axis of skull; **CAN**: breadth of canines, distance between labial crown edges of C^1-C^1; **ROB**: breadth of rostrum, distance between lateral base of hamular process of lacrimals; **IOB**: least interorbital breadth; **PAB**: breadth of palate, distance between labial crown edges of M^1-M^1; **ZYG**: greatest zygomatic breadth; **BRB**: greatest breadth of braincase at the right angle to longitudinal axis of skull; **MAS**: mastoid breadth; **BRH**: height of braincase, distance from occipital bone between bullae and parietal,excluding sagittal crest; **MAL**: mandible length from anterior edge of I_1 alveolus to posterior surface of mandibular condyle; **MAN**: greatest crown length of mandibular toothrow; **CMH**: mandible height, perpendicular distance from dorsal edge of coronoid process to line from angular process to ramus; **POC**: postorbital constriction; **upP4L**: length of upper fourth premolar; **B**: breadth; **D**: diagonal length; **loM1L**: length of lower first molar.

Acknowledgments

We are very grateful to Mr. Saramady Touré, Directeur du "Centre d'Etude et de Gestion de l'Environnement des Monts Nimba (C.E.G.E.M.) without whose help this research would not have been possible; Mrs Christine Sagno Kourouma, Chef de la Division Faune à la Direction National des Eaux et Forêts (Ministère de l'Agriculture, des Eaux et Forêts) for her help and encouragement. We also want to thank the two project assistants, Messrs. Bernard Doré and Guila Gbamou as well as all the members and participants of the 'Etude Chase Villageoise' of Guinean Nimba.

References

Booth, A. H. 1960. *Small mammals of West Africa.* London: Longman Group Ltd. 68 pp.

Coe, M. 1975. Mammalian ecological studies on Mount Nimba, Liberia. *Mammalia* 39:523-582.

Depierre, D. & Vivien, J. 1992. *Mammifères sauvages du Cameroun.* Fontainebleau: Office National des Forêts.

Gautun, J. C., Sankhon, I. & Tranier, M. 1986. Nouvelle contribution à la connaissance des rongeurs du massif guinéen des monts Nimba (Afrique occidentale). Systématique et aperçu quantitatif. *Mammalia* 50:205-217.

Hayman, R. W. 1935. On a collection of mammals from the Gold Coast. *Proc. Zool. Soc. London* 1935:916-937.

Heim de Balzac, H. & Lamotte, M. 1958. La réserve naturelle intégrale du mont Nimba. XV. Mammifères rongeurs. *Mémoire IFAN* 53:339-357.

Jeannin, A. 1936. *Les mammifères sauvages du Cameroun.* Paris: Paul Lechevalier.

Lamotte, M. 1942. La faune mammalogique du Mont Nimba (Haute Guinée). *Mammalia* 5-6: 114-116.

Misonne, X. & Verschuren, J. 1976. Les rongeurs du Nimba libérien. *Acta Zool. Pathol. Antv.*, 66:199-220.

Roche, J. 1962. Rongeurs de Guinée forestière. *Science et Nature* 49:24-32.

Roche, J. 1971. Recherches mammalogiques en Guinée forestière. *Bull. Mus. Hist. Nat. Paris* 16:737-781.

Rosevear, D. R. 1974. *The carnivores of West Africa.* London: Trustees of the British Museum (Nat. Hist.).

Van Rompaey, H. 1991. The Gambian mongoose: A forgotten species? *Mustelid & Viverrid Conserv.*, 4:11-13.

Van Rompaey, H. & Colyn, M. 1996. An annotated bibliography of the Herpestidae and Viverridae (Carnivora, Mammalia). *Koninkl. Mus. Midden-Afrika, Ann. Zool. Wetensch.*, 279:1-411.

Verschuren, J. 1976. Les chiroptères du Mont Nimba (Libéria). *Mammalia* 40:615-632.

Verschuren, J. 1986. Notes d'écologie, principalement des mammifères du Mont Nimba (Libéria). *Bull. Inst. Roy. Sci. Nat. Belg.*, 56:27-43.

[1]CNRS – UMR 6552,
Ethologie – Evolution – Ecologie,
Université de Rennes 1,
Station Biologique, 35380 Paimpont, France

[2]Royal Museum for Central Africa,
3080 Tervuren, Belgium

Indecent exposure: Secondary poisoning risks in small carnivores

Robbie A. McDONALD

Several recent studies have highlighted the hazards caused to small carnivores by the widespread use of rodenticides.

Rodenticides are an essential part of pest control in most regions of the world. Although they are designed and deployed for controlling rodents, most often rats and mice, they are also highly toxic to most mammals and birds.

Given the urgent need for rodent control for public health and crop protection, rodenticides appear to have been 'waved through' the pesticide registration process in many countries. Two of the main criteria for pesticide approval are the specificity and humaneness of the chemical. By both these criteria, rodenticides fall short of approval requirements applicable to other pesticides. They are non-specific by virtue of their broad-spectrum toxicity and the general inability to ensure targeted deployment of baits. They are also markedly inhumane for target and non-target species alike since they cause death over several days by promoting internal haemorrhages.

The particular problem for small carnivores arises from the long biological half-life of modern rodenticides and the fact that they are bio-accumulated in secondary consumers. Predators can therefore be exposed by eating sub-lethally exposed prey animals, moribund animals or carrion. Added to these hazards, many rodent populations are becoming resistant to anticoagulants and this has lead to increasing bait usage, increasing concentration of active ingredients in baits and increasing toxicity of active ingredients. The original anticoagulant rodenticide, warfarin, was formulated in the 1950s and is now seen as passé in many countries and has largely been replaced by second-generation compounds such as difenacoum and bromadiolone. These and other anticoagulant rodenticides are now used on approximately 80% of farms and up to 92% of game estates in Britain (De'Ath *et al*., 1999; Garthwaite *et al*., 1999; McDonald & Harris, 2000) and are widely used in other developed and developing nations.

Fig. 1: In a recent survey, 31% of road-killed polecats in western England were positive for rodenticides (photo: J.D.S. Birks).

Fig. 2: Widespread usage of rodenticide baits around farm buildings places non-target species at risk (photo courtesy of ADAS)

The evidence for small carnivores suffering from exposure to rodenticides is slowly gathering force. Although most studies have taken place in Europe where concern about several species has been sufficient to stimulate targeted research, many of the results are doubtless relevant to other regions where rodenticide usage is commonplace. In laboratory trials, rodenticides have been shown to be toxic to weasels *Mustela nivalis* (Anon., 1982; Townsend *et al*., 1984), stoats *M. erminea* (Grolleau *et al*., 1989) and martens *Martes foina* (Lund & Rasmussen, 1986) while field experiments have also confirmed these findings for stoats (Berny *et al*., 1997). Indeed the large scale use of brodifacoum, a particularly toxic second-generation compound, has been trialled specifically as a technique for controlling stoats in New Zealand, where they are an introduced pest species (Murphy *et al*., 1998). A major factor holding back further screening studies is the expense of High Performance Liquid Chromatography (HPLC) analytical techniques. To determine the concentration of several key rodenticides in a single tissue sample using HPLC costs in the region of 150–200 GBP (240–320 USD).

Evidence for exposure is also emerging from conservation studies and from wildlife poisoning investigations. In Britain 31% of wild polecats *Mustela putorius* killed on roads (Shore *et al*., 1996), 23% of stoats and 30% of weasels killed by gamekeepers (McDonald *et al*., 1998) have been found to have been exposed to anticoagulants to some degree. The similar levels of exposure in these three related species as well as in other rodent predators such as barn owls *Tyto alba* (Newton *et al*., 1999) has led some authorities to conclude that exposure is widespread and commonplace in lowland Britain. While the sample sizes for these projects were small, the incidences observed may be underestimates since the first polecat study only tested for four compounds while the second stoat and weasel study only tested for six of the eight anticoagulants that are commonly used on British farms. Furthermore, it is significant that although the concentrations of rodenticides detected in these samples were small, these individuals were killed by cars or gamekeepers before the rodenticides had accumulated to the point where they could have been lethal.

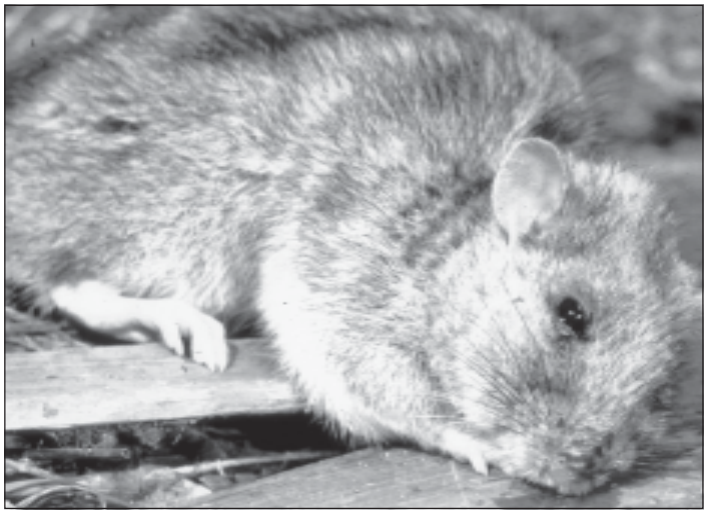


Fig. 3: Small carnivores are secondarily exposed to rodenticides by eating moribund rats and mice (photo courtesy of ADAS)

Fig. 4: Rat control is an essential part of farm hygiene (Photo courtesy of J.D.S. Birks)

The statutory scheme for post-registration monitoring of pesticide poisoning in Britain, the Wildlife Incident Investigation Scheme, has also recorded small but increasing numbers of badger *Meles meles* fatalities caused by anticoagulant poisoning, either deliberate or accidental (Shore & Fletcher, in review). This scheme has also recorded the death of one polecat due to exposure to bromadiolone (Birks, 1998). The trouble with such schemes is that they depend on the public locating and sending in animal carcasses. However, the bodies of small carnivores such as weasels, are rarely if ever located and so these programmes can never expect to report the true extent of poisoning of small carnivores

Unfortunately, there is little alternative to pest control using rodenticides in most situations, such is the ability of most rodents to resist other forms of control. As the toxicity and usage of rodenticides increases, most governments are poorly equipped to monitor the occurrence and importance of secondary non-target exposure of predators. There is certainly some scope for increasing the specificity of bait deployment techniques in many rodent control campaigns and this may hold promise for reducing non-target primary exposure. However, the future for many common predators living on farmland looks bleak. Even though occasional poisoning incidents may not present a threat to the conservation status of some commoner species, rarer species will certainly be vulnerable. Furthermore, the non-humaneness of rodenticide poisoning means that animal welfare concerns will be significant for all predators of farmland rodents.

References

Anon. 1982. Secondary poisoning of weasels by rodenticides. *Agricultural Science Service Pesticide Science 1981*, p. 37. MAFF Reference Book 252 (81). HMSO, London.

Berny, P. J., Buronfosse, T., Buronfosse, F., Lamarque, F. & Lorgue, G. 1997. Field evidence of secondary poisoning of foxes (*Vulpes vulpes*) and buzzards (*Buteo buteo*) by bromadiolone, a 4-year survey. *Chemosphere* 35:1817–1829.

Birks J. D. S. 1998. Secondary rodenticide poisoning risk arising from winter farmyard use by the European polecat *Mustela putorius*. *Biol. Conserv.,* 85: 233–240.

De'Ath, A., Garthwaite, D. G. & Thomas, M. R. 1999. *Pesticide usage survey report 144: Rodenticide usage on farms in Great Britain growing arable crops 1996*. MAFF Publications, London.

Garthwaite, D. G., De'Ath, A. & Thomas, M. R. 1999. *Pesticide usage survey report 154: Rodenticide use on farms in Great Britain growing grassland and fodder crops 1997*. MAFF Publications, London.

Grolleau, G., Lorgue, G. and Nahas, K. 1989. Toxicité secondaire, en laboratoire, d'un rodenticide anticoagulant (bromadiolone) pour des prédateurs de rongeurs champêtres: buse variable (*Buteo buteo*) et hermine (*Mustela erminea*). *EPPO Bull.,* 19:633–648.

Lund, M. & Rasmussen, A. M. 1986. Secondary poisoning hazards to stone martens (*Martes foina*) fed bromadiolone-poisoned mice. *Nordisk Vet. Med.*, 38:241–243.

McDonald, R. A. & Harris, S. 2000. The use of fumigants and anticoagulant rodenticides on game estates in Great Britain. *Mamm. Rev.*, 30:57–64.

McDonald, R. A., Harris, S., Turnbull, G., Brown, P. & Fletcher, M. 1998. Anticoagulant rodenticides in stoats (*Mustela erminea* L.) and weasels (*M. nivalis* L.) in England. *Environm. Pollution* 103:17–23.

Murphy, E. C., Clapperton, B. K., Bradfield, P. M. F. & Speed, H. J. 1998. Effects of rat-poisoning operations on abundance and diet of mustelids in New Zealand forests. *New Zealand J. Zool.*, 25:315–328.

Newton, I., Shore, R. F., Wyllie, I., Birks, J. D. S. & Dale, L. 1999. Empirical evidence of side-effects of rodenticides on some predatory birds and mammals. In: *Advances in vertebrate pest management*, eds. D. P. Cowan and C. J. Feare, 347–367. Fürth: Filander Verlag.

Shore, R. F., Birks, J. D. S., Freestone, P. & Kitchener, A. C. 1996. Second generation rodenticides and polecats (*Mustela putorius*) in Britain. *Environm. Pollution* 91:279–282.

Shore, R. F. & Fletcher, M. R. In review. The impact of agricultural pesticides in mammals in Britain. In *Farming and mammals,* eds. F. Tattersall and W. Manley. London: The Linnean Society.

Townsend, M. G., Bunyan, P. J., Odam, E. M., Stanley, P. I. & Wardall, H. P. 1984. Assessment of secondary poisoning hazard of warfarin to least weasels. *J. Wildlife Manage.*, 48:628–632.

Department of Biological Sciences,
University of Waikato, Hamilton, New Zealand
E-mail: Robbie.McDonald@stoats.com

Mustelids in a molecular world

Angus DAVISON

Introduction

I have been workig on the molecular genetics of two British mustelid species –Polecats (Mustela putorius) and Pine martens (Martes martes) – with a view to assisting the conservation efforts of The Vincent Wildlife Trust. The comparison with similar species in Europe (and elsewhere) is important, so I have made sure to include a range of samples, and also begun a study on the highly endangered European mink (Mustela lutreola). With the exception of pine martens, this work is now published. The aim of this article is to review some of the results.

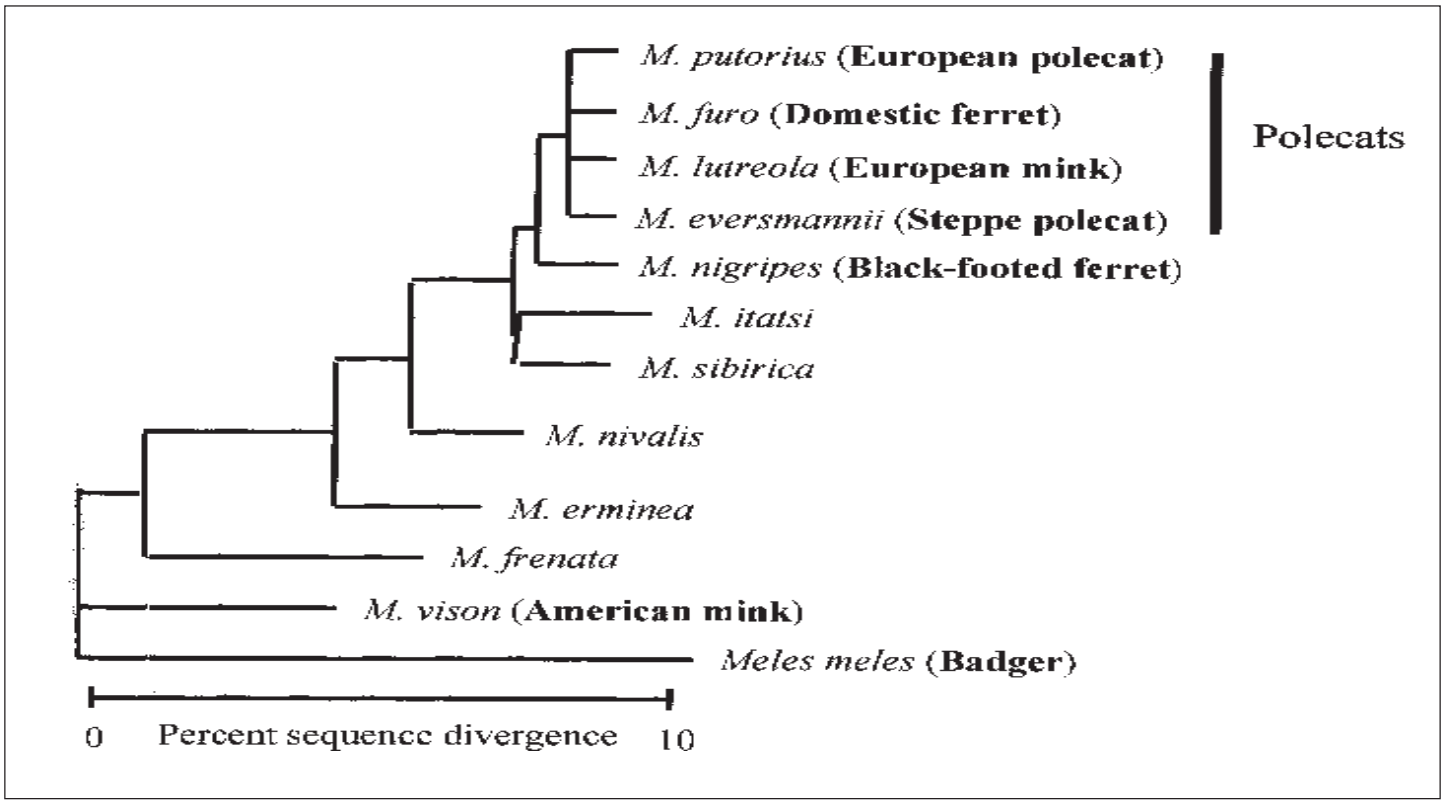
Polecats and ferrets

In Britain, domestic ferrets (*Mustela furo*) were probably introduced for hunting rabbits (*Oryctolagus cuniculus*), possibly by the Normans, or as late as the 14th century. Inevitably, some domestic ferrets escaped and may have hybridised with native polecats which were widespread and common at the time. Polecats began to decline around 1850, becoming extinct throughout much of England and Scotland, and reaching a nadir in the years prior to World War I. Along with a number of other British carnivores which survived in relict populations, the near extinction of the polecat was a direct result of persecution by gamekeepers.

Fortunately, a small population of polecats survived in a core area in Wales and in lower numbers in the English border counties. In the post-war era, sporting estates fell into decline so that polecats were soon reported to be increasing in numbers. The relaxation from persecution, the banning of the gin trap in the 1950s, and the post-myxomatosis increase in rabbit numbers has apparently allowed polecats to expand their range, continuing to the present day where polecats have been recovered as far east as Oxfordshire and Northamptonshire.

However, concern has arisen as to the extent of genomic introgression in Britain, and particularly, whether the eastern edge of the expanding population and re-introduced populations are mainly hybrid or ferret origin. Therefore, we used mitochondrial DNA sequences to question whether any British polecat or ferret populations remain genetically distinct despite hybridisation. Two geographycally distinct lineages were found: one may be ancestral to the British polecat, and the other to the domestic ferret. This pattern may reflect a historical distribution of polecats and domestic ferrets that has persisted even beyond the World War I bottleneck, because polecats have always been more abundant in mid-Wales, and the reverse was true elsewhere after the local extinction of the polecat. A further comparison between the distribution of the polecat phenotype and mitochondrial haplotype implies that the current population expansion may be mediated by dispersing male polecats hybridising with female feral ferrets.

The combined analyses suggest that domestic ferrets in Britain hybridise with polecats, and that introgression may be extensive. The deliberate backcrossing of domestic ferrets to wild polecats has occurred over many years, so that feral and domestic populations of ferrets may be genetically more similar to polecats in their own geographic region than to other ferrets. Our study



Phylogenetic tree showing relationships between Mustela *species based on cytochrome b data (from Davison* et al.*, 2000a)*

suggests that in Britain two parental populations may be present which have hybridised to varying degrees depending upon the local release and survival of feral ferrets. Balharry *et al*. (1994) suggest that polecats and even polecat/domestic ferret hybrids may receive some protection under Schedule 6 of the British Wildlife and Countryside Act (1981). Unfortunately, whilst this may be true, mitochondrial DNA is not sufficiently discriminatory to establish whether an individual animal is a ferret, hybrid or polecat. A more sensitive DNA profiling technique, such as microsatellites, is required. It would also help to understand whether there is any predominant direction to the introgression.

A phylogeny

An important part of the work on polecats was a phylogeny of *Mustela* species (see Fig; Davison *et al.*, 1999, 2000a). As expected, it was found that both polecat species (*M. putorius* and *M. eversmanni*) and ferrets fall together. Surprisingly, however, the same phylogeny placed a single European mink specimen within the polecats. This could have been because the individual chosen was either a hybrid, or else polecats and European mink speciated relatively recently. As European mink are endangered, and part of a captive breeding programme, I felt it was important to try to understand the relationship within and between the species. In particular, I was keen to know whether the mink populations in Spain and Eastern Europe have a separate evolutionary history and thus should be treated separately in the captive breeding programme.

European mink

The European mink is one of Europe's most endangered carnivores since recent population censuses estimate that it now exists in isolated populations covering only one fifth of its former range. The territory of the former Soviet Union was regarded until recently as the remaining stronghold, but surveys have revealed drastic declines and local extinctions. Further vulnerable populations exist in Spain, France, and Romania.

We investigated variation between European mink samples, using the same region of mitochondrial DNA. As before (see Fig.), phylogenetic methods failed to resolve the relationships between the species. One mitochondrial type was even found in both species, and predominated in European mink from Spain and Eastern Europe. Since the known *M. lutreola* fossils are of a very young date, either mink arose recently, or else the situation has been confused by hybridisation and a biased fossil recovery (Davison *et al.*, 2000b).

The failure to resolve the species relationships is strongly suggestive of either a recent origin of one or all of the species, or else a result of introgressive hybridisation. Conceivably, both processes are implicated. It is unlikely that the explanation lies solely in the slow evolution of the mustelid cytochrome *b* gene, because it has proved useful in resolving relationships within other closely related mustelid species groups, such as otters, martens, and weasels (Carr & Hicks, 1997; Koepfli & Wayne, 1998). In contrast to the polecat/European mink situation, in other European mammals distinct lineages *within* species have frequently been found, presumed to have arisen through isolation in glacial refugia. Often, the degree of differentiation, both molecular and non-molecular, is sufficiently great to warrant distinct subspecies or species status.

Instead of resolving the issue of the origins of European mink, the study highlights the problem in defining units for conservation (ESUs) based on a single molecular genetic marker, especially since the one I used may easily introgress between taxa. The use of further markers, such as rapidly evolving microsatellites, on both the polecats/mink would enable identification of ESUs. It could also help understand whether European mink have a recent origin or, alternatively, an ancient origin with partial genomic introgression (including the mitochondria).

More problematic was whether European mink from E. Europe (Belarus, Estonia, Russia) and Spain should be managed separately (Management Units), depending upon whether they meet the defined criteria of differences in haplotype frequencies. We found that a single cytochrome *b* haplotype was shared between most European mink individuals, yet some population specific could only be addressed with further extensive sampling. A priority for future studies must be to investigate mink from the remaining isolated populations in Romania and France, as well as any animals to be used for reintroductions.

Acknowledgements

I am especially grateful to The Vincent Wildlife Trust for funding this work, and to all those people who have donated samples. Thanks also (I think) to Huw Griffiths for getting me into this in the first place. Further mustelid samples are still required. E-mail a.davison@hgmp.mrc.ac.uk for details.

References

Balharry, E. *et al*. 1994. *Hybridisation in British mammals*. JNCC Report No. 154, Joint Nature Conservation Committee, Petersborough, UK.

Carr, S. M. & Hicks, S. A. 1997. Are there two species of marten in North America? Genetic and evolutionary relationships within *Martes.* In Martes: *taxonomy, ecology, techniques, and management*, ed. G. Proulx, H. N. Bryant and P. M. Woddard, 15-28. Edmonton: The Provincial Museum of Alberta.

Davison, A. *et al*. 1999. Hybridization and the phylogenetic relationship between polecats and domestic ferrets in Britain. *Biol. Conserv.*, 87:155-161.

Davison, A. *et al*. 2000a. Conservation implications of hybridisation between polecats, ferrets and European mink (*Mustela* spp.). In *Mustelids in a modern world. Management and conservation aspects of small carnivore: human interactions*, ed. H. I. Griffiths, 153-162. Leiden: Backhuys Publishers.

Davison, A. *et al.* 2000b. Mitochondrial DNA and palaeontological evidence for the origins of endangered European mink, *Mustela lutreola. Anim. Conserv.*, 3:in press.

Koepfli, K. P. & Wayne, R. K. 1998. Phylogenetic relationships of otters (Carnivora: Mustelidae) based on mitochondrial *cytochrome* b sequences. *J. Zool.*, 246:401-416.

Institute of Genetics,
Oueen's Medical Centre,
University of Nottingham,
NG7 2UH Nottingham, UK

The Short-tailed mongoose, *Herpestes brachyurus*

Harry VAN ROMPAEY

Although described in 1836 the, Short-tailed mongoose, *Herpestes brachyurus* Gray, is still a relatively unknown and unstudied species. The following sums up what we know about this widespread but seemingly elusive mongoose.

Local names

In Borneo: **Dumbang** (Dyak or Iban; Hose, 1893); **Toeban** (Dingai, Kalimantan; Jentink, 1898); **Tulok** (Kadazan; Harrison, 1964). In Malaya: **Musang tierou** (Blyth, 1863);**Musang túron** (Cantor, 1846); **Musang babi** (Ridley, 1895); **Bambun** in Perak according to L. Wray (Flower, 1900); and **Bambun ekor pendek** (Harrison, 1964). In Sumatra: **Langga-Langga** or **Rangga-Rangga** (Ogan-Ulu District, Palembeng, Jentink, 1903).

H. brachyurus has also been called Water-mongoose (Flower, 1900; Ridley, 1895; Medway, 1965)

Distribution

BORNEO

Specimens without a specified locality: MCZ-5033, 5037.

BRUNEI

Marabok River (RMNH-3498). This specimen in the Leiden Natural History Museum is the only specimen known from Brunei. It was collected by S. Waterstraat in 1899. The Marabok River was not located.

KALIMANTAN

Balikpapan Bay (USNM-154351, 154352); **Dingai,** on the Upper Long-Bloe River (RMNH-34984, 34985); **Kajan Peleben River,** Timor Province (AMNH-103988, 103747); **Mt. Kenepai,** Ruma Manual on the S foot of (RMNH-34981); **Karangan River** (USNM-198069, 198070); **Lanchut,** on the Kendawangan River (USNM-153851); **Long Mindjau, Segah River** (USNM-196611); **Long Petak** on the Upper S. Telen (Chasen & Kloss, 1928); **Merah River** (USNM-198709); **Pelawan River** (USNM-198071, 198072); **Surok,** on the Kendawangan River (USNM-153850), 1994); Teluk Kaba area, **Kutai National Park,** 85-120 km N of Samarinda (Nozaki et al., 1994); **Tanjong Seglu** (USNM-197251); and 'No specific locality' (USNM-19231).

SABAH

Bettotan, 22 miles W by S of Sandakan (Chasen & Kloss, 1931); Cocoa Research Station, **Quoin Hill, Tawau** (BMNH-71.3079); **Kalabakan,** Mile 12 N of (BMNH-71.3023, 71.3080, 71.3081); **Kalabakang River** (MCZ-36725); **Samawang River,** 25 miles W by N of Sandakan (Chasen & Kloss, 1931); Tibas River Camp, **Kalabakan, Tawau** District (FMNH-85936); and without locality: BMNH-1878.7.4.2 (presented by Governor Ussher) and BMNH-1908.7.17.12 (presented by the British North Borneo Company).

SARAWAK

Specimen without a specified locality: MHNG-641.93.

Baram River (BMNH-88.8.13.3, NMNH-83942); **Buya,** Third Div. (FMNH-88603, 88604); **Mt. Dulit** (BMNH-8.717.13); **Entawa,** Samarahan (BMNH-55.750); **Kuching** (Banks, 1931); **Lundu** (MCZ-57834); **Mt. Poeh** (BMNH-93.3.4.9); **Suai River** (Hose, 1893); Ulu Kabaan, Ulu Tutoh, ca. 10 miles NE of **Bareo,** Kelabit Plateau, Fourth Div. (FMNH-88321); and without locality: BMNH-1850.10.24.12 (presented by Rajah Brooke) and BMNH-1876.9.20.3 (collected by Sir Hugh Low, probably from the Sarawak/Sabah border area)

PENINSULAR MALAYA

Bukit Tanjong, Selangor (BMNH-55.1637); **Bukit Mandol,** Kuala Langat Forest Reserve, Tanjong Duablas, Selangor (USNM-489417, 489418, 489419); **Johor** (ZRCNUS-4.1508, presumed by Wells [1989] to have been collected locally); **Kuala Lompat**, Kerau Game Reserve, Pahang (sighting mentioned by Wells, 1989); **Kuala Lumpur,** Selangor (BMNH-21.10.2.2); **Larut,** Perak (Flower, 1900 according to L. Wray); **Malacca** (now Melaka) (BMNH-79.11.21.561, 60.5.4.60); Sedili Kechil, **Kota Tinggi,** Johor (MHNG-1700.45); **Pasoh Forest Reserve,** Jempol District, Negeri Sembilan (sightings reported by Wells, 1989); **Subang Forest Reserve,** IMR; Wells, 1989); **Tringganu** (now Terengganu) Province (Ridley, 1895).

A sighting "in the swamps near Jenan, Kedah mentioned by Flower (1900) is deemed unlikely to be correct by Wells (1989).

According to Wells (1989) Central Perak and Terengganu States (ca. 4°- 5°N) mark the limit of definitive localisations in Peninsular Malaya but if a specimen from Trang Province (in the AMNH) has been correctly identified the distribution range is carried at least 200 km further north (and into Thailand).

SUMATRA

Aru Bay (USNM-143615, 143616, 143617, 144100); Batang Kwis, Medan Deli (ZSM-1906.3, 1908.142, 1908.3008, 1908.3009, 1909.4008, 1909.4009, 1909.4010, 1909.4011); **Bindjei,** N. Sumatra (ZFMK); **Bohorok** (BZM-21217); Butik Sawa Hills, Tapanuli Bay (now **Sibolga Bay**) (USNM-114463, 114464); **Deli** (BMNH-90.1.20.2; RMNH-2016); Fort De Kock (now **Bukittinggi**), Padang Highlands (BMNH-1937.7.2.14); **Little Siak River** (USNM-144095, 144097, 144098, 144099, 144100, 144101; FMNH-43343); Lubuk Landur, **Mt. Talamau** (now Mt. Talakmau, Mt. Ophir on some maps) (RMNH-34986); **Mandau River** (USNM- 49925, 144102, 144103, 144104); **Oyan-Oeloe District,** Palembang Residence (RMNH-34982); **Siak** (RMNH-34979); **Telok Betong** (BZM-21074).

PHILIPPINES

The Palawan region is part of the Sunda zoogeographic province, not part of the Philippine faunal province (Heany, 1986).

PALAWAN I.

Brooke's Point (Sanborn, 1952); **Iwahig** (AMNH-29744); **Puerto Princesa** (FMNH-62872).

CALAMINE IS.

Probably **Busuanga I.** (Jentink, 1895; Hollister, 1912; Heany, 1986)

Habitat and status

Natural habitat old jungle but it visits clearings and secondary growth (Banks, 1949).

In Peninsular Malaya very rare (Ridley, 1895) to widespread in the hills and the lowlands throughout the mainland, but nowhere common (Medway, 1965, 1969). Accurate localisations of *brachyurus* in Peninsular Malaya have all been from 100 m elevation or less, in primary or regenerating evergreen lowland forest (Wells, 1989).

In Borneo fairly common, being found all through the low country and on the mountains to a height of more than 900 m (Hose, 1893); widespread in the hills and lowlands (Medway, 1965) and up to 1,280 m in the Kelabit uplands (Medway, 1965, 1977).

Not rare in Sumatra (Van Balen, 1914). Heany *et al.* (1987) state it as "widespread, probably moderately common" on Palawan, The Philippines.

Description

The Malayan form is dark brown, finely marked with yellow; head paler and more olive-brown; forelegs and lower half of hind legs dark brown; cheeks and throat rusty yellowish-brown; chest and belly brown. Tail untufted, tapering from the base to the tip, short, about 55% of head and body. More extensive descriptions are given by Anderson (1878) and Hose (1893). Iris red-brown (Jentink, 1897) or ochre-yellow (Jentink, 1898).

Gray (1843) compared the skull with that of *H. ichneumon.* The calcaneum is described by Stains (1983).

The measurements of the length of Head & Body (Table 1) and the condylobasal length (Table 2) show that males are slightly larger than females as is the case in all members of Herpestidae. Weight averages 1,500 g, ranging from 1,000 g (Lyon, 1911) to 2,000 g (Harrison, 1964).

Harrison (1964) stated that the length of the tail is about 55% of the length of head & body. Two tails measured by Jentink (1898) and one by Hose (1893) give a ratio of 46, 48, and 48%. This corresponds with the two ratios of 46 and 49% found by Miller (1903) when only the tail vertebrae are measured. Tails (N=8) measured by Lyon (1911), Chasen & Kloss (1931), and Nozaki *et al.* (1994) give a mean of 54.7% (52-58) which confirms Harrison's ratio.

	Sex	N	Min	Max	Mean
Borneo	M	4	38.5	44.5	41.4
	F	4	38.0	44.5	41.1
Sumatra	M	1			43.0
	F	2	40.6	43.5	42.0
Mal. Pen.	M	1			47.0
	F	1			41.2
Palawan	M	2	35.2	39.5	37.3
	F	1			39.1

Table 1. Measurements of Head & Body (in cm; taken from literature) of short-tailed mongooses from Borneo, Sumatra, Malayan Peninsula, and Palawan. M: male; F: female.

The length of the tails of a male and female from Palawan (measured by Sanborn, 1952) were respectively 70% and 66% of the length of Head & Body.

Habits

According to the natives of Sumatra the short-tailed mongoose would prefer to live in trees and eat fruits (Van Balen, 1914). Ridley (1895; 1906) who calls it the Water mongoose, stated that it is very fond of bathing, never really becomes tame, and is not at all playful. Schneider (1906) also also found that his captive specimens were prone to bite.

No observations in the wild as to the supposed aquatic habits of the short-tailed mongoose have been made, but sightings at Pasoh and in Kuala Lompat were on low-lying ground close to the forest streams (Wells, 1989).

Banks (1949) found it "savage and quite fearless, but easily handled and strangely reluctant to bite. Erects and fluffs out its fur when excited or alarmed. Very swift runner, and progress difficult to follow, in and out of holes, round corners at great speed, tireless and not at all easily exhausted.

It is said to be partially aquatic, partial to banks of streams, and climbs well". Strangely enough he specifies "no characteristic smell" while Hose (1893) found it to have a "very particular smell". Jentink (1903) stated that when a specimen was skinned the smell was unbearable; when theatened the species is said to discharge an oily and bad-smelling substance.

According to Banks (1949) it has a "prolonged, cackling laugh, resembling two jays calling to one another, surprising in volume and character"and when angry it produces "an explosive spit".

A specimen in Sabah was collected on the ground in primary forest, during the day (Davis, 1962).

Food

According to Ridley (1895) it lives exclusively on fish, refusing meat, adding in 1906 that it is also partial to snakes. Jentink (1897) says it is a raider of birds' nests and in 1898 he found the remains of a rat in a disected specimen.

The stomach of a specimen collected in Sabah contained insect fragments including a scarab beetle, some orthopterans, a spider, a small crab and an intact, 20 mm long reptile egg (Davis, 1962), while another specimen's stomach was filled with cockroaches after it was seen running about in and out among the stones on the bank of a stream (Banks, 1949).

According to Banks (1949) a captive specimen ate rats, mouse deer, squirrels, tree-shrews, frogs, fish and snakes, but showed no preference or any special methods of approach.

It seems that the short-tailed mongoose will eat 'anything it can get'.

Nothing is known about reproduction.

	Sex	N	Min	Max	Mean	Sn-1
Borneo	M	14	82.4	94.0	87.2	2.48
	F	10	81.0	87.7	85.1	2.40
Sumatra	M	13	87.6	95.9	91.5	2.46
	F	5	82.3	91.7	88.6	3.72
Mal. Pen.	M	3	90.4	94.2	92.1	1.92
	F	3	86.6	94.7	91.1	4.11

Table 2. Measurements of the condylobasal length (in mm) of short-tailed mongooses from Borneo, Sumatra, and the Malayan Peninsula. M: male; F: female.

Parasites

A flea, *Ctenocephalus felis* Bouché, 1835, was identified from a specimen collected on Mt. Talakmau, Ophir District, Sumatra (Jordan & Rothschild, 1922).

A short-tailed mongoose died in Berlin Zoo following an accident. It had been imported a year earlier. The gallbladder contained 126 trematodes of genus *Concinnum*. An extensive description of the new species *Concinnum dathei* is given by Odening (1960).

Chromosomes

As with all species of the genus *Herpestes* the functional Y chromosome in *H. brachyurus* is translocated on to an autosome and consequently the males have one chromosome less than the females. This type of sex chromosome mechanism might be called "pseudo-X0/XX" and is unique among the Carnivora. The general appearance of the karyotype of *H. brachyurus* is rather similar to that of *H. auropunctatus*; the most interesting difference is the absence of an individually distinguishable Y chromosome in *brachyurus.* Karyotype 2n= 35/36 (Fredga, 1970, 1972).

Taxonomy

Seven subspecies have been described:

Herpestes brachyurus Gray, 1836. *Proc. Zool. Soc. London* 1836, IV:88. "Indian Islands". Short description in Gray, 1837. *Mag. Nat. Hist. n.s. (i)*:578. There has been some confusion on the type locality: It was changed to "India" by Waterhouse (1838). In 1843 Gray changed to "Malacca", accepted by Allen (1910) and Chasen (1940). According to Kloss (1917) "Borneo" may be accepted as the typical locality.

Mungos parvus Jentink, 1895. *Notes Leyden Mus.* 17(9):48. "Calamianes Is."Adult skin and skull. Presented by Schadenberg.

Mungos palawanus J. A. Allen, 1910. *Bull. Amer. Mus. Nat. Hist.* 28:17. Male adult, skin only. "Iwahig, Palawan I., Philippines". Collected by Col. John R. White. AMNH-29744.

Herpestes brachyurus sumatrius Thomas, 1921. *Ann. Mag. Nat. Hist.* (9)8:134. Female skin and skull. "Deli, Sumatra". Collected by Iverson, 3 November 1888. BMNH-90.1.20.2.

Herpestes brachyurus rajah Thomas, 1921. *Ann. Mag. Nat. Hist.* (9)8:135. Adult female skin and skull. "Balinean, in lowlands, Sarawak". Collected by Herbert C. Robinson March 1903. BMNH-5.3.1.8.

Herpestes brachyurus dyacorum Thomas, 1921. *Ann. Mag. Nat. Hist.* (9)8:135. Old male skin and skull. "Mt. Dulit, Sarawak". Collected by Charles Hose 17 December 1896. BMNH-00.12.9.26.

Herpestes brachyurus javanensis Bechtold, 1936. *Z. Säugetierk.* 11:50. Adult male skin and skull. From the Warwick Collection.

In 1921 Thomas described three new subspecies (*H. b. sumatrius, H. b. rajah,* and *H. b. dyacorum*), hence accepting a classification of four subspecies, based mainly on colour differences.

In 1939 Bechtold suggested a classification for *H. brachyurus* with no less than eight subspecies: *H. b. brachyurus*, *H. b. javanensis*, *H. b. sumatrius*, *H. b. hosei*, *H. b. palawanus*, *H. b. parvus*, *H. b. fuscus*, and *H. b. fulvescens*. Under *H. b. hosei* he lumped *H. b. rajah*, *H. b. dyacorum,* and *H. hosei.*

H. fulvescens is a synonym of *H. fuscus* which is a valid species distributed in SW India and Sri Lanka (Corbet & Hill, 1992), and accepted by all authors except by Wozencraft (1993) who still considers it synonymous with *H. brachyurus.*

Jentink (1895) stated that the tail of *H. parvus* was shorter than that of *H. brachyurus* but gave no figures. The tail of the holotype of *H. palawanus* was given as 190 mm. These short tails may only be variations as the tail of the female from Brooke's Point is 260 mm and that of the male from Puerto Princesa 247 mm (Sanborn, 1952). *H. parvus* and *H. palawanus* are synonymous and the form should be known as *H. parvus.*

Chasen (1940) stated that: "There is no reliable evidence for the occurrence of this species in Java, and Bechtold's *H. b. javanensis* is founded on an ex-menagerie specimen in the British Museum of doubtful provenance but labelled "Java".

In 1947 Schwarz proposed a new classification, making *H. semitorquatus* synonymous with *H. brachyurus* and *H. hosei.* He considered only two subspecies:

1. *H. b. brachyurus* Gray including *H. brachyurus* Gray, *H. semitorquatus uniformis* Robinson & Kloss, *H. b. sumatrius* Thomas, and *H. b. javanicus* Bechtold, distributed in the Malay Peninsula and Sumatra. The animals are more uniform in colour, with a dark tail which, in most cases, is shorter than half of the length of head and body.
2. *H. b. semitorquatus* Gray including *H. semitorquatus* Gray, *H. hosei* Jentink, *H. b. rajah* Thomas, and *H. b. dyacorum* Thomas, distributed in Borneo. This subspecies is more finely speckled with a tail lighter than the body and always longer than half the length of the head and body.

Schwarz (1947) considered *H. semitorquatus* as a red colour morph of the dark *H. brachyurus* but did not take into account the yellow neck colouration. *H. semitorquatus* is now generally accepted as a valid species (Payne *et al., 1985*; Wozencraft, 1993), Corbet & Hill (1992) specifying that it is distinguishable by its clear neck-stripe, redder pelage, longer tail and, in the Bornean specimens examined, the contrast between the pelage above (dark) and below (lighter and reddish brown) the neck-stripe.

There is no such agreement on the status of *H. hosei.* It is recognised as a valid species on the basis of a less rounded coronoid process of the mandible by Chasen (1940) and Payne *et al.* (1985), but considered as an aberrant specimen of *H. bracyurus* by Corbet & Hill (1992) and Wozencraft (1993).

Banks (1931) remarked that two specimens from Kuching (lowlands) are dark resembling most of the darker mountain specimens, whilst a very lightly marked one from Mt. Dulit recalled the numerous lowland specimens. This is in accordance with Chasen & Kloss (1928) who had made Thomas' *H. b. rajah* and *H. b. dyacorum* synonymous on the basis of two specimens collected in Long Petak, Sarawak.

This leaves us with four subspecies of the short-tailed mongoose: *H. b. brachyurus* from the Malay Peninsula, *H. b. palawanus* from the Philippines, *H. b. sumatrius* from Sumatra, and *H. b. rajah* from Borneo.

Robinson & Kloss (1919) found that the skin of a Sumatran specimen 'cannot be separated from specimens from the Malay Peninsula' and Chasen & Kloss (1931) found that three specimens from Sabah, Borneo, were "very near to *brachyurus* of the Malay Peninsula and perhaps only separable by their more buffy tails".

J. A. Allen (1910) in his description of *Mungos palawanus* stated that a comparison with Gray's description and figure left little room for doubt that the Palawan form of *H. brachyurus* is a quite different animal from the *H. brachyurus* of the Malayan Peninsula and that it is also different from the Sumatran form, which is a much larger and much darker animal.

Chasen (1940) found that "skins from Borneo divide into two colour groups as Thomas noticed but I cannot yet appreciate that the difference is also geographical, i.e. subspecific".

It seems skins vary greatly in colour and this variation may be linked with altitude, humidity, or both together, so that those from about coastal localities are blackest and those from the more open uplands lighter.

From Table 1 and 2 it seems that Malayan Peninsular specimens are larger than Sumatran which are larger than Bornean specimens. Although there are only two head & body measurements and no condylobasal measurements available for Palawan specimens, these seem considerably smaller.

Acknowledgements

I am grateful to the curators of the **AMNH**, New York; **BMNH**, London; **BZM**, Berlin; **FMNH**, Chicago; **MCZ**, Cambridge, MA; **MHNG**, Genève; **RMNH**, Leiden; **USNM**, Washington, D.C.; **ZFMK**, Bonn; **ZRCNUS**, Singapore; and **ZSM**, München, for information about their collections, and especially to Daphne Hills (London), Craig Ludwig (Washington), and Maria E. Rutzmoser (Cambridge, MA) for looking up obscure localities.

Gazetteer

Abbreviations: BRU: Brunei, Borneo; KAL: Kalimantan, Borneo, Indonesia; MAL: Peninsular Malaya, Malaysia; PAL: Palawan, Philippines; SAB: Sabah, Borneo, Malaysia: SAR: Sarawak, Borneo, Malaysia; SUM: Sumatra, Indonesia.

Balikpapan Bay, KAL: 01°15'S, 116°50'E; **Bareo**, KAL: 03°35'N, 115°22'E **Bettotan**, ca. 22 miles W by S of Sandakan, SAB; **Bukittinggi** (former Fort de Kock), SUM: 00°18'S, 100°20'E; **Kalabakan**, SAB: 04°22'N, 117°29'E; **Mt. Kenepai**, KAL: 00°42'N, 111°44'E; **Kota Tinggi**, MAL: 01°45'N, 103°53'E; **Kuala Lumpur**, MAL: 03°08'N, 101°42'E; **Long Petak**, KAL: ca. 01°40'N, 116°20'E; **Lundu**, SAR: 01°40'N, 109°52'E; **Malacca** (now Melaka), MAL: 02°14'N, 102°14'E; **Merah River**, KAL: 00°50'N, 116°49'E; **Padang**, SUM: 01°00'N, 100°21'E; **Puerto Princesa**, PAL: 09°46'N, 118°45'E; **Samawang River**, ca. 25 miles W by N of Sandakan, SAB; **Sandakan**, SAB: 05°45'N, 118°00'E; **Segah River**, mouth of, KAL: ca. 02°10'N, 11°73'E; **Sungai River**, mouth of, KAL: 01°06'N, 117°54'E; **Mt. Talakmau**, SUM: 00°10'N, 100°00'E; **Tanjong Duablas**, Kuala Langat Forest Reserve, MAL: 02°554N, 101°34'E; **Tawau**, SAB: 04°16'N, 117°54'E.

Museum abbreviations

AMNH: American Museum of Natural History, New York, NY, USA; **BMNH**: The Natural History Museum, London, UK; **BZM**: Museum für Naturkunde der Humboldt-Universität, Berlin, Germany; **FMNH**: Field Museum of Natural History, Chicago, IL, USA; **IMR**: Institute for Medical Research, Kuala Lumpur, Malasia; **MCZ**: Museum of Comparative Zoology, Cambridge, MA, US; **MHNG**: Muséum d'Histoire naturelle, Genève, Switzerland; **RMNH**: Nationaal Natuurhistorisch Museum, Leiden, Netherlands; **USNM**: National Museum of Natural History, Washington, D.C.; **ZFMK**: Zoologisches Forschungsinstitut & Museum A. Koenig, Bonn, Germany; **ZRCNUS**: National University of Singapore, Singapore; **ZSM**: Zoologische Staatssammlung, München, Germany.

References

Allen, J. A. 1910. Mammals from Palawan Island, Philippine Islands. *Bull. Amer. Mus. Nat. Hist.*, 28:13-17.

Anderson, J. 1878. *Anatomical and zoological researches.* London: Bernard Quaritch.

Banks, E. 1931. A popular account of the mammals of Borneo. *J. Malay Br. Roy. Asiat. Soc.*, 9(2):1-139.

Banks, E. 1949. *Bornean mammals.* Kuching: The Kuching Press.

Bechtold, G. 1936. Enige neue Unterarten asiatischer Herpestiden. Z. Säugetierk., 11:149-153

Bechtold, G. 1939. Die asiatischen Formen der Gattung *Herpestes*, ihre Systematik, Öklogie, Verbreitung und ihre Zusammenhänge mit den afrikanischen Arten. *Z. Säugetierk.*, 14:113-219.

Blyth, E. 1863. *Catalogue of the Mammalia in the Museum Asiatic Society*. Calcutta: Savielle & Cranenburgh, Bengal Printing Company.

Cantor, T. 1846. Catalogue of Mammalia inhabiting the Malayan peninsula and islands. *J. Asiat. Soc.*, 15(87):171-203, (88):241-277.

Chasen, F. N. 1940. A handlist of Malaysian mammals. A systematic list of the mammals of the Malay Peninsula, Sumatra, Borneo, and java, including the adjacent small islands. *Bull. Raffles Mus.*, 15:1-209.

Chasen, F. N. & Kloss, C. B. 1928. On some Carnivora, Rodentia and Insectivora principally from eastern Borneo. *Malay Br. Roy. Asiat.Soc.*, 6:38-49.

Chasen, F. N. & Kloss, C. B. 1931. On a collection of mammals from the lowlands and islands of North Borneo. *Bull. Raffles Mus.*, 6:1-82.

Corbet, G. B. & Hill, J. E. 1992. *The mammals of the Indomalayan region: A systematic review.* Oxford: Oxford University Press.

Davis, D. D. 1962. Mammals of the lowland rain-forest of North Borneo. *Bull. Natl. Mus. Singapore* 31:1-129.

Flower, S. S. 1900. On the mammals of Siam and the Malay Peninsula. *Proc. Zool. Soc. London* 1900:306-379.

Fredga, K. 1970. Unusual sex chromosome inheritance in mammals. *Philos. Trans.Roy. Soc. London* B259:15-36.

Fredga, K. 1972. Comparative chromosome studied in mongooses (Carnivora, Viverridae). I. Idiograms of 12 species and karyotype evolution in Herpestinae. *Hereditas* 71:1-74.

Gray, J. E. 1836. [No title; October 11, 1836]. *Proc. Zool. Soc. London* 1836(IV):88.

Gray, J. E. 1837. Description of some new or little known Mammalia, principally in the British Museum collection. *Mag. Nat. Hist.* New Series 1: 577-587.

Gray, J. E. 1843. *List of the specimens of Mammalia in the collection of the British Museum.* London: British Museum (Nat. Hist.) Publications.

Harrison, J. L. 1964. Guide to the mammals of the Malay Peninsula. University of Singapore. Mimeo. 36 pp.

Heany, L. R. 1986. Biogeography of mammals in SE Asia: Estimates of rates of colonization, extinction and speciation. *Biol. J. Linn. Soc.*, 28:127-165.

Heany, L. R., Gonzales, P. C. & Alcala, A. C. 1987. An annotated checklist of the taxonomic and conservation status of land mammals in the Philippines. *Silliman J.*, 34(1/4):32-66.

Hollister, N. 1912. A list of the mammals of the Philippine Islands, exclusive of the Cetacea. *Philip. J. Sci.*, 7:1-64.

Hose, C. 1893. *A descriptive account of the mammals of Borneo.* London: Abbott.

Jentink, F. A. 1895. On two mammals from the Calamianes-Islands. *Notes Leyden Mus.*, 17:41-48.

Jentink, F. A. 1897. Zoological results of the Dutch scientific expedition to central Borneo. The mammals. *Notes Leyden Mus.*, 19:26-66.

Jentink, F. A. 1898. Zoological results of the Dutch scientific expedition to central Borneo. The mammals. *Notes Leyden Mus.*, 20:113-125.

Jentink, F. A. 1903. A new Bornean *Herpestes*. *Notes Leyden Mus.*, 23:223-228.

Jordan, K. & Rothschild, N. C. 1922. The Siphonaptera collected by Mr. E. Jacobson on Sumatra. In *Ectoparasites*, ed. K. Jordan and N. C. Rothschild, 223-230. London: Hazell, Watson & Viney, Ltd.

Kloss, C. B. 1917. On the mongooses of the Malay peninsula. *J. Fed. Stat. Mus.*, 7:123-125.

Lyon, W. M. Jr. 1911. Mammals collected by Dr. W. L. Abbott on Borneo and some of the small adjacent islands. *Proc. U. S. Natl. Mus.*, 40:53-146.

Medway, Lord. 1965. Mammals of Borneo. Field keys and an annotated checklist. *J. Malay. Br. Roy. Asiat. Soc.*, 36(3):1-193.

Medway, Lord. 1969. *The wild mammals of Malaya and offshore islands including Singapore.* Kuala Lumpur-Singapore: Oxford University Press.

Medway, Lord. 1977. Mammals of Borneo. Field keys and an annotated checklist. *Monogr. Malay. Br. Roy. Asiat. Soc.*, 7:1-172.

Miller, G. S. 1903. Mammals collected by Dr. W. L. Abbott on the coast and islands of northwest Sumatra. *Proc. U.S. Natl. Mus.*, 26(1317):437-484.

Nozaki, E., Azuma, S., Sasaki, H. & Torii, H. 1994. Home range of the Malay civet (*Viverra tangalunga*) in Teluk Kaba area, Kutai National Park, East Kalimantan, Indonesia. *Kyoto Univ. Overseas Res. Rep. Stud. Asian Non-human Primates.* Spec. Numb.:85-94.

Odening, K. 1960. Eine neue *Concinnum*-Art (Trematoda: Dicrocoeliidae) aus *Herpestes brachyurus* (Carnivora: Viverridae). *Biol. Zentralbl.*, 79:513-519.

Payne, J., Francis, C. M. & Phillipps, K. 1985. *A field guide to the mammals of Borneo.* Kota Kinabalu: The Sabah Society with WWF Malaysia.

Ridley, H. N. 1895. The mammals of the Malay Peninsula. *Nat. Sci.* (Skodsborg) 6:89- ?

Ridley, H. N. 1906. The menagerie at the Botanic Gardens. *J. Straits Br. Roy. Asiat. Soc.*, 45:133-194.

Robinson, H. C. & Kloss, C. B. 1919. On mammals, chiefly from the Ophir District, west Sumatra. *J. Fed. Malay Stat. Mus.*, 7:299-325.

Sanborn, C. C. 1952. Philippine zoological expedition 1946-1947. Mammals. *Fieldiana Zool.*, 33:89-158.

Schneider, G. 1906. Ergebnisse zoologischer Forschungsreisen in Sumatra. I. Säugetiere (Mammalia). *Zool. Jahrb.*, 23:1-172.

Schwarz, E. 1947. Colour mutants of the Malay short-tailed mongoose, *Herpestes brachyurus* Gray. *Proc. Zool. Soc. London* 117:79-80.

Stains, H. 1983. Calcanea of members of the Viverridae. *Bull. S. Calif. Acad. Sci.*, 82:17-38.

Thomas, O. 1921. The geographical races of *Herpestes brachyurus*, Gray. *Ann. Mag. Nat. Hist.*, (9)8:134-136.

Van Balen, H. H. 1914. *De dierenwereld van Insulinde.* Zutphen: W. J. Thieme & Co.

Waterhouse, G. R. 1838. *Catalogue of the Mammalia preserved in the Zoological Society of London*. London: R. & J. Taylor.

Wells, D. R. 1989. Notes on the distribution and taxonomy of Peninsular Malaysian mongooses (*Herpestes*). *Nat. Hist. Bull. Siam Soc.*, 37:87-97.

Wozencraft, W. C. 1993. Order Carnivora. In *Mammal species of the world. A taxonomic and geographic reference. Second ed.*, ed. D. E. Wilson and D. M. Reeder, 279-348. Washington and London: Smithsonian Institution Press.

Jan Verbertlei, 15,
2650 Edegem, Belgium
Harry.VanRompaey@ping.be
Harry.VanRompaey@tijd.com

Chrotogale owstoni Conservation Breeding Project Update Cuc Phuong National Park, Vietnam

This year the project housed two breeding pairs of Owston's civets from the end of January through February. Based on previous year's matings, this was the suspected breeding period. Only one pair was observed mating and this occurred in early February; after an estimated gestation period of 82 days, a litter of 0.2 was born on May 1. The mother had successfully birthed two cubs in 1997 but this time required veterinary assistance to deliver her young. Subsequently, both mother and cubs remained in very good health and development was normal. In mid-September, however, both young (approximately 4.5 months of age) were found dead in the cage over a two-day period. Autopsy revealed blood in their stomach and intestines. At this time, the cause of death is suspected to be toxic earthworms that were mistakenly fed to the animals. Earthworms are a daily part of the animals' diet and are usually collected from non-agricultural areas within the park, however post-death it was learned that the worms had been collected from a new site in an agricultural (rice paddy) area. It is suspected that this site may have been laden with pesticide or pesticide residue, as local farmers apply such chemicals to their paddies and an amount toxic to the young animals may have accumulated in the earthworms.

In August, two of the 1997 captive-bred animals (1.1) were fitted with radio collars and released within the national park in a monitored release exercise coordinated by Barney Long and Le Trong Dat. The release conformed as closely as possible to IUCN guidelines. The animals initially appeared to be foraging successfully and behaving normally as they adapted to their new forest environment, but unfortunately, both animals died within a short period of each other. Both animals were recovered immediately and preliminary autopsy results suggest that both died as a result of predation, one directly and one indirectly. The results of this release will be reported in more detail at a later date.

Despite these very unfortunate losses, the project has continued to maintain the remainder of its 16 animals in excellent health. The newest of these is a young adult male that was brought to the project in July after being confiscated by local authorities from the wildlife trade. Currently the project is attempting to develop an international breeding loan programme, and continue with behavioural and biological research activities. It will continue to receive and care for Owston's civet confiscated from the wildlife trade, and look into the feasibility of releasing these animals back to the wild post-quarantine. In addition, the project is trying to raise much-needed funds as the core funding that has allowed the project to operate for the last few years will cease at the end of 2000.

**Shelagh Heard Rosenthal, P.O.Box 156,
Honeymoon Bay, Vancouver Is., BC,
Canada VOR 1YO**

Are badgers in Somerset a pest?

Wildlife conservation issues tend to produce polarised views of a very black or white nature, with selective "scientific" arguments as support for either faction, e.g. "scientific" whaling, limited elephant culls, or hunting cruelty or traditional pest control. Over the last decade or so a retired civil engineer has had many articles in country and farming publications making out a case for culling of badger "pests" near his home at Kite's Croft, Westbury sub Mendip, Wells BA5 1HU in Somerset. Dr. W. Stanton produces good evidence of a big increase in badgers locally, paralleling the national increase between 1988-1997 of 77% in Britain (Wilson census). He also documents increasing damage to gardens such as those open to the public under the Natl. Gardens Scheme, to farms including risk to stock of broken limbs, destabilised barns, crop damage, etc., and the decimation of other wildlife, in particular hedgehogs, slow worms, toads, and grass snakes which control garden pests. He finds 24 reasons under these headings of garden, farm, general public and wildlife nuisance factors for a cull of badgers to keep populations within bounds, arguing that such culls were in place before the 1973 & 1992 Badger Acts.

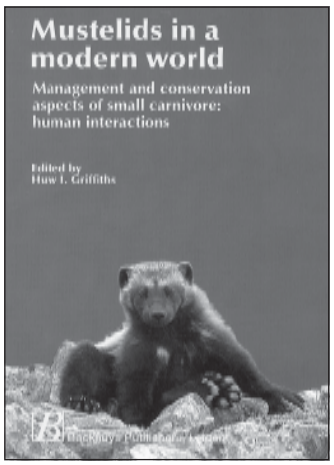
Many badger groups have attempted to suggest to Dr. Stanton that badgers and any other species find an ecological balance in relation to food supply. But such reasoning has fallen on deaf ears, and the Somerset Wildlife Trust advised members to ignore further debate. Dr. Stanton's article in fact points out some of these things. Hedgehogs were seemingly absent from the Wytham Hill area, even back in the 1970s before the present several-fold badger population "explosion". A selective view does seem "convincing" but what of the "natural predation" of 50,000 badgers/year by cars? And badger cubs are probably a major predator of slugs and snails but unrecorded since they don't use territorial latrines sampled by scientists!

Mention is made of TB, and sadly the Bourne triplet cull will include Exmoor/Somerset. This is because starting in 1993 with 14 TB farms on Exmoor this rose to 27 in 1997 & 1998, and 44 last year in Somerset. But, from 1972-1993 MAFF had only found 11 TB badgers out of 1,204 sampled for the whole of Somerset. Clearly not a badger "source"; and finding up to 85% of badgers with TB on epicentre farms since then merely shows with "overwhelming scientific" evidence that they merely catch it from cattle, as have red deer on Exmoor. It seems rather a pity that the Krebs/Bourne team find it necessary to pursue their "scientific" badger cull under these circumstances, merely in order to prove what the 1986 Dunnet Review had already discovered: badger culls are a waste of money because they don't work. It is perhaps ironic that Dr. Stanton quotes Ernest Neal who pioneered badger studies in Somerset: "If an animal causes harm there is a logical reason for destroying it, but when it is well proved that the good it does far outweighs the occasional harm, why do we go on persecuting it"?

Reference: Stanton, W. L. 1999. Problems caused by badger activity in Westbury sub Mendip and elsewhere in Somerset: The case for a return to badger culling. *Proc. Bristol Nat. Soc.* 57:77-97.

**M. Hancox,
29 St. Peter Street, Tiverton EX16 6NW, UK**

Mustelids in a modern world



Mustelids in a modern world. Management and conservation aspects of small carnivore: Human interactions. 2000. Edited by Huw I. Griffiths. Leiden: Backhuys Publishers. 342 pp. US$ 84 at Backhuys Publishers, Postbus 321, 2300 AH Leiden, The Netherlands.
E-mail: backhuys@backhuys.com

"Mustelids in a modern world" is a collection of 21 chapters by 48 authors (reads like a 'Who's who' in the mustelid world!) giving us an idea of the conservation status of a great number of mustelids worldwide ranging from the still common species like badger, polecat, stoat, weasel, American marten, and pine marten over the lesser-known ones such as the spotted skunk and marbled polecat to the rare and threatened wolverine and black-footed ferret. The book takes us through the nearby Great Britain, Italy, Scandinavia, the Balkans, and eastern Europe but also the United States, Canada, New Zealand, and Taiwan.

While the stress is on subjects such as distribution, status, management, threats, and conservation there are also more 'off the beaten track' subjects such as "Prehistoric exploitation of the wolverine, badger, and pine marten", "Hybridization between polecats, ferrets, and European mink", "Application of GIS to mustelid research", and " A retrospective evaluation of badger removal operations in connection to bovine tuberculosis".

Each chapter is followed by a list of references: I counted 1,253 of them, and even taking into account some overlapping, still a sizeable source of information. The book contains numerous maps, tables and figures and moreover, not customary but very useful, a list of the author's addresses with e-mail address when available. It is very professionally edited and it seems amazing that such a small and handy format can contains such an enormous amount of information. Every 'Mustelid aficionado' will surely want to possess a copy.

The 17 papers are mentioned in the 'Recent literature' section of this number. To facilitate looking them up they are printed in bold. There are also four 'Otter' chapters, not mentioned (not because we do not like otters, but they belong to a Specialist Group of their own!).

Wildlife in Laos

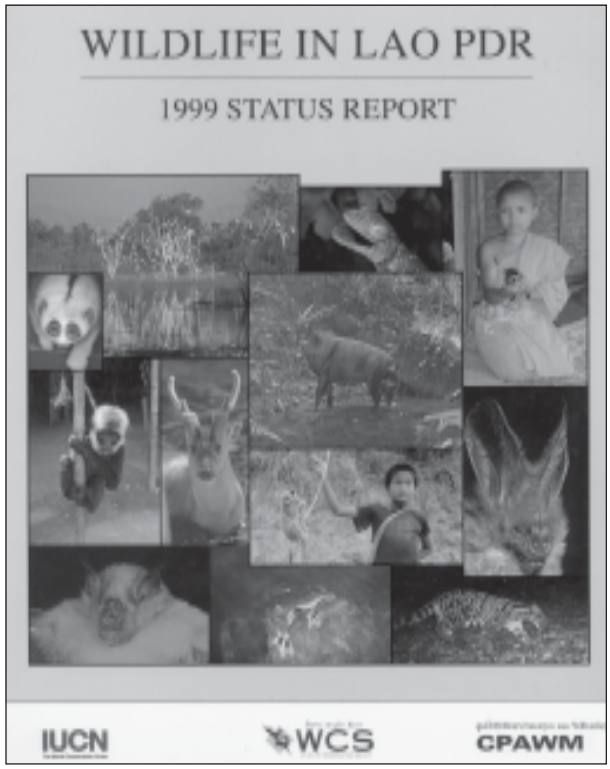
Duckworth, J. W., Salter, R. E. & Khounboline, K., compilers. 1999. *Wildlife in Lao PDR: 1999 Status Report.* Vientiane: IUCN-The World Conservation Union/ Wildlife Conservation Society/Centre for Protected Areas and Watershed Management. 275 pp. 144 colour photos. This publication can be obtained from: IUCN Publications Services Unit, 219c Huntingdon Road, Cambridge CB3 ODL, UK. Price ca. US$ 30.

The 1999 Status Report is a revised edition of Salter's "Wildlife in Lao PDR 1993 Status report", providing a more comprehensive assessment of historical data as well as adding new species and expanding the knowledge of species distribution, factors influencing range, population, and conservation status of many species within the country.

Lao PDR's wildlife, although relatively abundant, is declining through loss of habitat but chiefly through hunting pressure. Human population and development pressures are rising especially since about 1990. The report goes deep into these threats and causes and the counter measures currently made. The potential management measures for wildlife conservation can be grouped as hunting reduction, habitat conservation and the protected area system, and captive breeding.

Besides an introduction (32 pp.), treating chiefly the geography and biogeography of Lao PDR, human use of wildlife, and wildlife conservation in Lao PDR, there are chapters on amphibians and reptiles (19 pp.), birds (83 pp.), large mammals (50 pp.), Insectivora (13 pp.), and Rodentia (3pp.). In the large mammal section every species occurring in Lao PDR of each of the families of special interest to us is treated: Least weasel (*Mustela nivalis*), Yellow-bellied weasel (*M. katiah*), Siberian weasel (*M. sibirica*), Back-striped weasel (*M. strigidorsa*), Yellow-throated marten (*Martes flavigula*), Hog badger (*Arctonyx collaris*), Large-toothed ferret badger (*Melogale personata*), Small-toothed ferret badger (*M. moschata*), Large Indian civet (*Viverra zibetha*), Taynguyen civet (*V. tainguensis*), Large-spotted civet (*V. megaspila*), Small Indian civet (*Viverricula indica*), Spotted linsang (*Prionodon linsang*), Common palm civet (*Paradoxurus hermaphroditus*), Masked palm civet (*Paguma larvata*), Binturong (*Arctictis binturong*), Small-toothed palm civet (*Arctogalidia trivirgata*), Owston's civet (*Chrotogale owstoni*), Lowe's otter civet (*Cynogale lowei*), Small Asian mongoose (*Herpestes javanicus*), and Crab-eating mongoose (*H. urva*). Thusfar there is no evidence of Red panda and Eurasian badger occurring in Lao PDR. All four otter species distributed in Lao PDR are At Risk.

Books and papers on former 'Indochina' wildlife have been relatively scarce. Many of them were not very comprehensive and are now out of date. Besides its 144 colour photos *Wildlife in Lao PDR* has numerous maps and tables and its 486 references are an important source of information. Anyone working on or even interested in southeast Asian fauna should have a copy.



Recent literature

Mustelidae

Abramov, A. V. 2000. The taxonomic status of the Japanese weasel *Mustela itatsi* (Carnivora: Mustelidae). *Zool. Zh.*, 79:80-88. (In Russian, English abstract)

Abramov, A. V. 2000. A taxonomic review of the genus *Mustela* (Mammalia, Carnivora). *Zoosystemica Rossica* 8:357-364. (In Russian)

Abramov, A. V. & Baryshnikov, G. F. 2000. Geographic variation and intraspecific taxonomy of the weasel *Mustela nivalis* (Carnivora, Mustelidae). *Zoosystematica Rossica* 8:365-402. (In Russian)

Birks, J. D. 2000. The recovery of the polecat, *Mustela putorius*, in Britain. In *Mustelids in a modern world. Management and conservation aspects of small carnivore: Human interactions*, ed. H. I. Griffiths, 141-152. Leiden: Backhuys Publishers.

Balharry, E. A. & Macdonald, D. W. 2000. Cost-effective electric fencing for protecting gamebirds against Pine marten *Martes martes* predation. *Mamm. Rev*., 29:67-72.

Blackman, S. 2000. Minks troubled by otter waters. *BBC Wildlife* 18(7):59. (*Mustela vison*)

Bonesi, L., Dunstone, N. & O'Connell, M. 2000. Winter selection of habitats within intertidal foraging areas by mink (*Mustela vison*). *J. Zool.*, 250:419-424.

Buskirk, S. W. 2000. The conservation status of New World mustelids, 41-52. **See Birks, J. D.**

Charles, R. 2000. Prehistoric mustelid exploitation: An overview, 127-140. **See Birks, J. D.**

Davison, A., Birks, J. D., Maran, T., Macdonald, D. W., Sidorovich, V. E. & Griffiths, H. I. 2000. Conservation implications of hybridisation between polecats, ferrets and European mink (*Mustela* spp.), 153-162. **See Birks, J. D.**

Delahay, R. J. *et al.* 2000. The use of marked bait studies of the territorial organization of the European badger (*Meles meles*). *Mamm. Rev.*, 30:73-87.

Drees, M. 2000. Steenmarters en vleermuizen in huis: Wie helpt? *Zoogdier*11(2):9-11. (*Martes foina*)

Fornasari, L., Bani, L., Bonfanti, I., de Carli, E. & Massa, R. 2000. A spatial analysis of mustelid distributions in northern Italy, 201-215. **See Birks, J. D.**

Goszczyñski, J., Jêdrzejewska, B. & Jêdrzejewska, W. 2000. Diet composition of badger (*Meles meles*) in a pristine forest and rural habitats of Poland compared to other European populations. *J. Zool.*, 250:495-505.

Gough, M. C. & Rushton, S. P. 2000. The application of geographic information systems and computer modelling to mustelid research, 185-199. **See Birks, J. D.**

Hancox, M. 2000. Cattle TB schemes: Control or eradication, a personal perspective. *Letts. Apl. Microbiol.*, 31:87-93.

Kryštufek, B. 2000. Mustelids in the Balkans –small carnivores in the European biodiversity hotspot, 281-294. **See Birks, J. D.**

Landa, A., Linnell, J. D., Lindén, M., Swenson, J. E., Røskaft & Moksnes, A. 2000. Conservation of Scandinavian wolverines in ecological and political landscapes, 1-20. **See Birks, J. D.**

Lin Liang-Kong. 2000. The status and conservation of Taiwan's mustelids, 331-335. **See Birds, J. D.**

McDonald, R. A. & Murphy, E. C. 2000. A comparison of the management of stoats and weasels in Great Britain and New Zealand, 21-40. **See Birks, J. D.**

Messenger, J. E. & Birks, J. D. 2000. Monitoring the very rare: Pine marten populations in England and Wales, 217-230. **See Birks, J. D.**

Milenković, M., Paunovic,́ M., Abel, H. E. & Griffiths, H. I. 2000. The marbled polecat, *Vormela peregusna* (Güldenstaedt, 1770), in FR Yugoslavia and elsewhere, 321-329. **See Birks, J. D.**

Proulx, G. 2000. The impact of human activities on North American mustelids, 53-75. **See Birks, J. D.**

Ray, J. C. 2000. Mesocarnivores of Northeastern North America: Status and conservation issues. *WCS Working Paper* No. 15. 82 pp.

Robitaille, J.-F. 2000. Management and conservation of mustelids in Ontario and eastern Canada, 77-96. **See Birks, J. D.**

Sidorovich, V. E. 2000. Seasonal variation in the feeding habits of riparian mustelids in the river valleys of NE Belarus. *Acta Theriol.*, 45:233-242. (*Mustela lutreola, M. putorius, M. vison*)

Sidorovich, V. E. 2000. The on-going decline of riparian mustelids (European mink, *Mustela lutreola*, polecat, *Mustela putorius*, and stoat, *Mustela erminea*) in eastern Europe: A review of the results to date and an hypothesis, 295-319. **See Birks, J. D.**

Tuyttens, F. A., Barron, L., Rogers, L. M., Mallinson, P. J. & Macdonald, D. W. 2000. Wildlife management and scientific research: A retrospective evaluation of two badger removal operations for the control of bovine tuberculosis, 247-265. **See Birks, J. D.**

Van der Linden, P. & Vink, H. 2000. Waar lopen de Gooise dassen heen? *Zoogdier* 11(1):3-6. (*Meles meles*)

Vargas, A., Gober, P., Lockhart, M. & Marinari, P. 2000. Black-footed ferrets: Recovering an endangered species in an endagered habitat, 97-105. **See Birks, J.** D.

Wilkinson, D. *et al.* 2000. The effects of bovine tuberculosis (*Mycobacterium bovis*) on mortality in a badger population in England. *J. Zool.*, 250:389-395.

Won, C. & Smith, K. 1999. The mammals of the Korean peninsula. *Mamm. Rev.*, 29:3-33.

References in bold: Contents of *Mustelids in a modern world.* See 'Recent Publications'.

Viverridae

Angelici, F. M. 2000. Food habits and resource partitioning of carnivores (Herpestidae, Viverridae) in the rainforests of southeastern Nigeria: Preliminary results. *Rev. Ecol. (Terre Vie)* 55:67-76.

Angelici, F. M., Grimod, I., & Politano, E. 1999. Mammals of the Eastern Niger Delta (Rivers and Bayelsa States, Nigeria): An environment affected by a gas-pipeline. *Folia Zool.*, 48:249-264. (*Atilax paludinosus, Civettictis civetta, Crossarchus obscurus, , Genetta maculata, Herpestes ichneumon, H. (Xenogale) naso, Nandinia binotata*)

Angelici, F. M., Luiselli, L., Politano, E. & Akani, G. C. 1999. Bushmen and mammal-fauna: A survey of mammals traded in bush-meat markets of local people in the rainforests of southeastern Nigeria. *Anthropozoologica* 30:51-58. (*Atilax paludinosus, Civettictis civetta, Crossarchus obscurus, Galerella sanguinea, Genetta maculata, G. cristata, Herpestes ichneumon, H. naso*)

Taylor, M. E. & Matheson, J. 1999. A craniometric comparison of the African and Asian mongooses in the genus *Herpestes* (Carnivora: Herpestidae). *Mammalia* 63:449-464.

Mustelidae and Viverridae

Acharjyo, L. N. 1999. Status of mustelids, viverrids and herpestids of Orissa. In *ENVIS Bulletin: Wildlife and protected areas. Mustelds, viverrids and herpestids of India*, ed. S. A. Hussain, 2(2):62-64.

Amori, G., Angelici, F. M. & Boitani, L. 1999. Mammals of Italy: A revised checklist of species and subspecies (Mammalia). *Senckenberg. Biol.*, 79:271-286. (*Genetta genetta, Herpestes edwardsii, Martes martes, Mustela erminea, M. nivalis, M. putorius*)

Choudhury, A. 1999. Mustelids, viverrids and herpestids of northeastern India. In *ENVIS Bulletin: Wildlife and protected areas. Mustelids, viverrids and herpestids of India*, ed. S. A. Hussain, 2(2):43-47.

Duckworth, J. W. 1997. Mammals in Similajau National Park, Sarawak, in 1995. *Sarawak Mus. J.*, 51:171-192. (*Martes flavigula, Arctogalidia trivirgata, Hemigalus derbyanus, Paradoxurus hermaphroditus, Viverra tangalunga*)

Gupta, A. K. 1999. Mustelids, viverrids and herpestids of Tripura. In *ENVIS Bulletin: Wildlife and protected areas. Mustelids, viverrids and herpestids of India,* ed. S. A. Hussain, 2(2):54-58.

Hanfee, F. & Ahmed, A. 1999. Some observations on India's illegal trade in mustelids, viverrids and herpestids. In *ENVIS Bulletin: Wildlife and protected areas. Mustelids, viverrids and herpestids of India,* ed. S. A. Hussain, 2(2):113-115.

Hussain, S. A. 1999. Mustelids, viverrids and herpestids of India: Species profile and conservation status. In *ENVIS Bulletin: Wildlife and protected areas. Mustelids, viverrids and herpestids of India*, ed. S. A. Hussain, 2(2):1-38.

Kumar, A. & Yoganand, K. 1999. Distribution and abundance of small carnivores in Nilgiri Biosphere Reserve, India. In *ENVIS Bulletin: Wildlife and protected areas. Mustelids, viverrids and herpestids of India*, ed. S. A. Hussain, 2(2):74-86.

Kumar, A. & Umapathy, G. 1999. Home range and habitat use by Indian grey mongoose and Small Indian civets in Nilgiri Biosphere Reserve, India. In *ENVIS Bulletin: Wildlife and protected areas. Mustelids, viverrids and herpestids of India*, ed. S. A. Hussain, 2(2):87-91.

Kumar, A., Rai, N. D. & Ashraf, N. V. K. 1999. A plea for Malabar civet. In *ENVIS Bulletin: Wildlife and protected areas. Mustelids, viverrids and herpestids of India*, ed. S. A. Hussain, 2(2):98-102.

Kumar, R. S. 1999. Locality records of mustelids, viverrids and herpestids from Arunachal Pradesh. In *ENVIS Bulletin: Wildlife and protected areas. Mustelids, viverrids and herpestids of India*, ed. S. A. Hussain, 2(2):48-53.

Mudappa, D. 1999. Lesser known carnivores of the western Ghats. In *ENVIS Bulletin: Wildlife and protected areas. Mustelids, viverrids and herpestids of India*, ed. S. A. Hussain, 2(2):65-70.

Sanyal, P. 1999. Common mustelids, viverrids and herpestids of West Bengal. In ENVIS Bulletin: Wildlife and protected areas. Mustelids, viverrids and herpestids of *India*, ed. S. A. Hussain, 2(2):59-61.

Sathyakumar, S. 1999. Mustelids and viverrids of the northwestern and western Himalayas. In *ENVIS Bulletin: Wildlife and protected areas. Mustelids, viverrids and herpestids of India,* ed. S. A. Hussain, 2(2): 39-42.

Walker, S. & Molur, S. 1999. Conservation breeding of Indian species of mutelids, viverrids and herpestids: A perspective. In *ENVIS Bulletin: Wildlife and protected* areas. Mustelids, viverrids and herpestids of India, ed. S. A. Hussain, 2(2): 103-112.

➤➤➤ from page 6

3rd International Martes Symposium - Martes 2000

Tuesday evening was the social and banquet at the Glynmill Inn in Corner Brook. We were treated to a huge spread of traditional Newfoundland cuisine (including, as one might expect, fresh fish and sea food) and some more of the excellent local beers. The evening was rounded off with a gift exchange, which was great fun and provided much more entertainment than the usual speeches!

Wednesday dawned less bright (for some) with an even earlier start planned. Session six, "Biology & Life History of *Martes*", another broad range of papers, was efficiently but ruthlessly chaired by Roger Powell. We were treated to papers on mustelid life histories (Steve Ferguson), development of fishers (Bert Frost), fisher reintroduction (Jean-François Robitaille), the effects of timber harvesting and trapping on territoriality and home ranges (David Payer), a review of marten diet in Europe (Andrzej Zalewski) and microsatellite DNA analysis of marten (Chris Kyle).

Following this, there was panel discussion on "What is suitable habitat for North American Marten" which, despite its title, had some interest for those of us from "over the pond". The afternoon was given over to two concurrent sessions, one a workshop on habitat modelling in Newfoundland and the other a forum on the status of Martes and their habitats from a global perspective. This meeting was informal but very illuminating and resulted in the Group appointing Gilbert Proulx, with the help of the various area representatives, to coordinate a global review of the status of *Martes*, a much needed baseline study.

Whilst some delegates had to depart immediately after the symposium closed, others were able to stay on for the symposium excursion to Gros Morne National Park further north along the west coast of Newfoundland. The Park is a UNESCO World Heritage Site of outstanding geological interest. The high point of the day was a boat trip along Western Brook Pond (vast lakes in this part of Canada are called ponds!), which is a land-locked fjord with spectacular cliff scenery. At one point, two members of the party claimed to have seen a black bear romping on the open hillside, but the other 76 people on the boat who had suffered less from the effects of the sun were unable to confirm this.

Overall the conference was an overwhelming success and there was little I would like to have seen changed, with the possible exception of the sheer quantity of papers presented. Some sessions seemed a little overloaded and some presenters clearly could have made use of a little more time. The opportunities to meet and discuss informally were well planned and I left Newfoundland with a lot more knowledge and many new friends. My thanks go to the programme committee and the local committee who worked so hard to make this symposium a great success. See you in Portugal in 2005!

John Messenger,
The Vincent Wildlife Trust, 3&4 Bronsil Courtyard, Eastnor, Ledbury, Herefordshire HR8 1EP, UK

Sponsors

We are grateful to the following for sponsoring the publication of our newsletter:

Zoologischer Garten, Köln, Germany
Colchester Zoo, Stanway, Essex, UK
Woodland Park Zoological Gardens, Seattle, WA, USA
St. Louis Zoological Park, Saint Louis, MO, USA
The Royal Melbourne Zoological Gardens, Parkville Victoria, Australia
Toledo Zoological Society, Toledo, OH, USA
Edinburgh Zoo, Edinburgh, Scotland, UK
Helsinki Zoo, Helsinki, Finland
Riverside Zoo, Scottsbluff, NE, USA
Copenhagen Zoo, Frederiksberg, Denmark
Mr. Emmanuel Fardoulis, Randwick, NSW, Australia

Female mountain coati *(Nasuella olivacea)* - Photo: A. Rodríguez-Bolaños

Subscriptions

Subscription for 2001 (two numbers planned) is 600 Belgian francs.
All subscribers please send cash: 600 Belgian francs (or 20 US$, or 12£, or 100FF, or 30DM),
or a Eurocheque for 600 Belgian francs (no banking costs deducted!).
On other cheques, please add 50% to cover currency converting and banking costs and send to:

Harry Van Rompaey • Jan Verbertlei, 15 • 2650 Edegem • Belgium

The aim of the Newsletter is to promote communication between all interested in mustelid, viverrid and procyonid conservation and to stimulate conservation related activities for the species involved.

In order to do so we should be financially independent.
Any assistance in the form of donations, sponsorship, and subscriptions is most welcome.