SMALL CARNIVORE CONSERVATION

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

IUCN The World Conservation Union

Number 20 April 1999

SPECIES SURVIVAL COMMISSION

Fanaloue *(Eupleres goudotii)* - Photo: Roland Wirth

The production and distribution of this issue has been sponsored by
"Blijdorp Zoo", Rotterdam, Holland,
"Columbus Zoo", Powell, Ohio, USA
"Copenhagen Zoo", Fredericksberg, Denmark
"Marwell Preservation Trust Ltd", Colden Common, UK
"Royal Zoological Society of Antwerp", Antwerp, Belgium and
the "Carnivore Conservation & Research Trust", Knoxville, TN, USA

SMALL CARNIVORE CONSERVATION

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

•

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

•

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

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

Printed on recycled paper

ISSN 1019-5041

Owston's Palm Civet Conservation Breeding Project Cuc Phuong National Park, Vietnam

Shelagh HEARD ROSENTHAL

Introduction

Chrotogale owstoni Thomas, 1912 is a highly range-restricted species believed confined to northern Laos, central to northern Vietnam, and a small area of China bordering Laos and Vietnam. It is listed as "vulnerable" in the IUCN (1996) Red List of globally threatened species, and included as a protected species in Vietnam's own Red Book (1995). At least in Vietnam, the little information available points to a patchy distribution. Nowhere does the species appear abundant (especially as compared to several other civet species such as *Paguma larvata, Paradoxurus hermaphroditus, Viverricula indica*, and *Viverra zibetha*). Due to its restricted distribution and low abundance it is of high conservation concern. While apparently not targeted by hunting and Vietnam's rampant wildlife trade, it does succumb to both uncontrolled pressures.

The Owston's Palm Civet Conservation Breeding Project was initiated in 1995, and grew out of a field research project on civets at Cuc Phuong National Park, Vietnam. The park is located in northern Vietnam, approximately 120 kilometers southwest of Hanoi. The original aim of the field study was to investigate the ecology and behaviour of the park's several sympatric civet species, which include *Chrotogale owstoni*. Cuc Phuong was Vietnam's only protected area where *Chrotogale* was known to occur when the IUCN Mustelid & Viverrid Action Plan was compiled in 1989, a key reason for siting the project at Cuc Phuong.

Over a three-year period, the field study failed to sight or trap *Chrotogale owstoni* at the park. The Action Plan stated that villagers reported that the species may still be common in the park, and that it would approach houses in search of kitchen waste – this is now assumed to be erroneous. Village interviews confirmed that the species is uncommon in the park and that it has become rarer in recent years. In early 1995, however, two fresh skins were viewed in a village shop at the north end of the park; the animals were reported to have been hunted in the park. Also in May 1995, two infant female *Chrotogale* were confiscated by park rangers from a local hunter who had hand caught them inside the park. The park authorities subsequently requested the author to care for and raise them. Approximately two weeks later, three (1.2) infants were confiscated from a logger in Kim Boa District (approximately 30 kilometers northeast of the park) and also sent to the park for care. These animals thus formed the basis of the Owston's Palm Civet Conservation Breeding Project.

The initial reason for raising the *Chrotogale* was to collect information on their growth, behaviour; and basic biology, with an intention to undertake a monitored release once they reached adulthood. Over time, however, the decision was made to maintain the animals captive due to both hunting pressure at the park and the need for firm evidence that *Chrotogale owstoni* could be bred successfully in captivity, something that had never been achieved. Although Hanoi Zoo had held several animals for more than four years, their attempts to breed and successfully raise this species had failed, and animals kept at Frankfurt Zoo for the period 1993-1996 also failed to reproduce. Hence, there seemed to be some concern that this species might be difficult to breed in captivity. This continues to be the case as Saigon Zoo has attempted to breed *Chrotogale* without success over the last few years, and a private facility in Laos reported births last year but no survivors (N. Schonwalter, pers.com.). As the Cuc Phuong animals were housed in very good conditions and in excellent health, for conservation concerns this seemed like a valuable opportunity to gather further information on the species' behaviour and reproduction. In addition, given the limited knowledge of most civet species biology and reproduction, it was hoped that the experience and information obtained might be relevant to the care and captive breeding of other more threatened civet species.

DATE	SEX	SOURCE	LOCALE	AGE	BREEDER
May 1995	F	Confiscate	Ninh Binh	A	Y
"	F	Confiscate	Ninh Binh	A	Y
May 1995	F	Confiscate	Hoa Binh	A	Y
"	F	Confiscate	Hoa Binh	A	Y
"	M	Confiscate	Hoa Binh	Died 10'98	Y
Nov 1996	M	Confiscate	Unknown	Died 05'98	Y
April 1997	M	Captive birth		YA	
"	F	Captive birth		YA	
"	M	Captive birth		YA	
"	M	Captive birth		Dispersed '97	
"	M	Captive birth		Dispersed '97	
"	M	Captive birth			
"	M	Captive birth		Died newborn[1]	
"	F	Captive birth		YA	
Nov 1997	F	Confiscate	Unknown	A	Y
April 1998	M	Captive birth		J	
"	F	Captive birth		Died infant[2]	
May 1998	M	Confiscate	Unknown	OA	

J = juvenile; YA = young adult; A = adult; OA = old adult

[1] Neonate was rejected by mother who did not nurse it, died after 36 hours

[2] Infant squeezed through wire into adjoining cage where it was killed by adult civet(s)

Table 1. *Chrotogale owstoni* maintained at Cuc Phuong NP

Notes on husbandry

HOUSING

The fact that Owston's palm civets are placid, relatively approachable and unaggressive (both towards conspecifics and humans) animals facilitates ease in keeping them. The species is suspected to be largely solitary in the wild, however the project has managed to house several animals together without incident. For the first eighteen months of their lives, all five original animals were housed together and appeared to be a very content social group: although two nest boxes were available in the cage, the animals always slept in one box together. It appears that up to about one year of age, young animals can live together very easily, during which social interactions are characterised by allo-grooming, some forms of play, purring, resting together rather than separate, etc. After this time, mildly aggressive interactions begin to appear (chasing, snapping, avoidance, etc.). With adults, it has been easy to keep one pair together (either male/female or female/female), although there is great variation in relationships between individual animals and this is an important factor in deciding which to house together.

Housing conditions have expanded and improved with the growth of the project and breeding success. At the end of 1996, the animals were split into two groups housed in a 6x6x4 meter cage and a 6x8x4 meter cage. Enclosures now number ten, with the latest additions being four 6x4x3 breeding cages. These are constructed of wire mesh sides and top, with concrete footings for the mesh, and earthen floors. There are two clusters of cages, each centered on a large catch cage area. In general, animals are housed in pairs or singly, although as mentioned groups of up to five juveniles have been kept together for extended periods.

Mother and young (about 12 weeks) – mother in typical nursing position.

The enclosure floors are covered bi-weekly in fresh forest leaf litter. As the Owston's are very light-footed animals, the ground area successfully supports live ground cover, grasses, shrubs and small trees, and seasonally this vegetation becomes quite dense, offering a habitat which varies over time. The vegetation attracts insects and other invertebrates that serve as forage, and occasionally rodents and birds will also enter the enclosures. Rocks and logs are placed on the ground for climbing, and numerous branches of varying width and size give access to all areas of the cages. Sleeping boxes have been placed at a height of approximately 1 - 2 meters, with access to the ground and upper reaches via branches. When given a choice, all animals prefer the higher sleeping boxes to those placed on or near the ground, and they prefer to sleep socially rather than in individual boxes (bar one temporary pairing). Cages are re-furbished with branches at least once a year, with minor adjustments periodically. Shade is provided by trees and bamboo planted around the perimeter, and bamboo mats have been secured on the roof for additional protection against wind, rain and sun. A plastic roof mat over the area of the sleeping boxes provides additional rain protection. A large shallow plastic bowl is placed in a corner of each enclosure; with the addition of a few centimeters of water (which seems to both attract the animals and facilitate cleaning), the animals use this as a permanent toilet site.

DIET

Testing for dietary preferences has confirmed that Owston's palm civet has a predilection for earthworms. Working from the suspicion that lack of keeping success elsewhere may be due partly to a dietary problem, every effort has been made to include a high proportion of wild-type foods in the daily diet. Thus, freshly dug earthworms are a regular feature on the evening menu. At feeding time the worms are scattered around the cage so that the animals must search for them; the leaf litter provides cover for some worms so that foraging time is prolonged. Another feeding technique has been to throw the worms on top of the wire-topped cage so that they fall through gradually, stimulating prolonged foraging in the civets. Foraging time has been increased and resting and walking time reduced by employing such feeding methods.

The remainder of the diet has been worked out within the constraints of cost, preparation time demands, and seasonal availability of fruits and vegetables. In addition to worms, the other daily staple is a mix of raw beef, cooked potato and carrot, sweet potato, banana, beetroot when available, and frequently egg. As *Chrotogale* has a very fine dentition and the jaws do not appear particularly robust, it seems the species may be more adapted to consuming soft-bodied foods (invertebrates, soft fruits, etc.). With this in mind, most hard or tough ingredients in their diet are reduced to a fairly fine consistency in a food processor to facilitate mastication. Grapes are also given every night as a staple fruit item. Other items, which are offered depending on their seasonal availability, are orthopterans, snails, geckos, tadpoles, forest fruits, apples, pears, and other cultivated fruits. Some of the animals will also take small frogs, and certain species of small freshwater fish. While dead rodents have been rejected and no interest shown in captive domestic mice, one civet did catch and consume – with great effort – a small wild rat which entered the cage. The civets also take small, soft-shelled snails, orthopterans and other insects that enter the cage. In addition, they occasionally eat the grass and the leaf tips of wild ginger plants in the enclosures; presumably these are consumed as an intestinal scourer.

Young Owston's palm civets (about 10 weeks)

Several scats were collected from captive civets which temporarily free-ranged (see *Development*, below) in botanical gardens and degraded secondary forest habitat. Initial analysis of a few of these scats revealed that the majority of food items taken were invertebrate, and they also contained large amounts of undigested plant matter and small amounts of fruit. Much of the plant matter was composed of fruit calyx bracts from *Rubus* sp., seeds of which were also found in the scat indicating fruit ingestion. Remnants of six other plant species were also found, but no vertebrate remains were present. Invertebrate remains were primarily orthopterans and giant centipedes (Myriapoda) – which can inflict a painful bite. Other items found in small amounts were Mollusca (snails), Coleoptera, Hymenoptera, and Mantodea (praying mantises). The scats have not yet been analysed for earthworm remains, but judging from the earthy, compacted nature of the scats, they are likely to be present.

HEALTH ISSUES

To date, the civets have remained very healthy with only minor problems. Occasionally a few animals have experienced ear mites that were treated with oral or injectable Ivomec. A few new arrivals have carried intestinal parasites which were also treated with Ivomec. Minor wounds such as cuts, abrasions, and punctures have been left to heal naturally, or a topical ointment or powder applied (Negasunt, etc.). Two deaths through illness have occurred: one adult male (died May 1998) developed a malignant tumour on his neck, which surgery revealed had become invasive and could not be successfully removed. Autopsy revealed additional small tumours in other major organs. A second adult male (died October 1998) died of unknown causes after a three-day illness; poisoning or a viral infection is suspected, however no other civets became ill.

Three animals have required surgery that was performed by skilled veterinarians: one partial tail amputation, two leg amputations, and one paw operation. Both the leg and paw injuries were on new arrivals confiscated from the wildlife trade, and were most likely sustained from hunter's traps or from an injury during transportation. For surgery and handling requiring anaesthesia, animals have been anaesthetised with Zoletil 100 (teletamine & zolazepam) at a dosage of 7 mg/kg (or 0.07ml/kg). Ketamine, or a combination of Ketamine and Rompun (0.1ml/kg or 2.0 mg/kg of each drug) also works well. The effects of anaesthesia with these two drugs is marked, with Zoletil effecting an increased heart rate and lower temperature than the Rompun/Ketamine combination. With *Chrotogale*, the Rompun/Ketamine combination is preferable to Zoletil. While Zoletil was seen to be very well tolerated in species-specific doses with wild caught *Paradoxurus hermaphroditus*, *Paguma larvata*, and *Viverra zibetha* (3.5, 3.0 and 4.0 mg/kg respectively) during the field survey, it was more problematic with *Chrotogale*. Although the drug took effect quickly and uneventfully with all species and induced a deep anaesthesia, *Chrotogale* demonstrated a long recovery, often accompanied by salivation, panting, foot peddling, occasional vomiting, and a long period (up to one hour) of disorientation. Recovery in the other civet species was not marked by these events. With all drug types used, there is also striking individual variation in down times with equal doses, which is in part likely caused by the varying levels of stress individuals experience with handling prior to injection.

Breeding

MATING

Owston's palm civet appears to take two years to reach full adult size, with sexual maturity obtained at approximately 18 months of age and a first breeding season at about 21 months after their birth. From observations made in 1997 and 1999, oestrus appears to occur within the period end January to early February. Breeding occurs only once a year, based on the fact that pairs kept together throughout the year have not bred at any other time. At the end of January 1997, three females were presumed to be in oestrus based on their slight swelling of the vulva and increased interest in the male housed adjacent. This interest was demonstrated in both sexes by uncharacteristic pacing and flank rubbing along their separating fence, increased scent marking on the adjacent ground, and increased vocalisation. Given these cues, the animals were paired and mating occurred immediately, and in the second week of February a fourth female mated. Mating and breeding success was 100 percent.

The situation in 1999 involved five females and four males, and success was mixed. Two females were alternated with a male starting the third week of January, but nothing occurred initially. It is presumed that the females had not yet entered oestrus and were thus unreceptive. During the non-receptive stage leading up to oestrus, the females were more inactive than normal and displayed little or no interest in the male. Mating occurred on January 30th and 31st in one of these pairs, while the second female was not seen to mate. A third pair mated as soon as they were put together on February 5th and 6th. Apart from these two confirmed matings, it is possible - but unlikely - that the other three females did mate but were not observed to do so. One of these females was tried with two males at different times, one of whom she was very aggressive towards; mating definitely did not occur with one male.

Mating behaviour observed was similar to that reported by Dang (1997). Successful copulations could not always be seen and/or distinguished from mere mountings (due to the dense cage vegetation), however as observed in 1997, mountings were numerous with 8 to 15 bouts per night observed and possibly many more occurring. Copulation bouts usually lasted two to three minutes but occasionally four, during which the female lowered herself flat and would often purr, and both male and female would often growl and snap immediately before and after copulation.

In all four of the 1997 pairings and one from 1999, there was very little aggression between the animals which would sleep together in one nest box, allo-groom frequently and at times purr. With four pairs in 1999, cohabitation was characterised by more growling, chasing and snapping than usual. In two other pairings, the aggression and avoidance was much more marked, in one case to the point where the male and female slept in different nest boxes – the only case of two civets not preferring to sleep together. In the rare case where the male aggressively pursued the female for mating, the result was often increased aggression from the female. Outside the breeding season, it appears that such uncharacteristic aggression diminishes between male and female pairs.

PARTURITION AND BIRTH

With the 1997 births, three females were separated from their mates in late March, and one female was left with her mate. Pregnancies progressed without any complications, weight gain was noticeable in the latter part of the pregnancy in three animals but not in the fourth (which had only one offspring). Throughout pregnancy an emphasis was placed on minimising all forms of stress for the animals, thus no weight measurements were taken and no data were collected via invasive techniques. There were no obvious behavioural changes prior to parturition, although data for this period are yet to be analysed. In the two to three days immediately preceding delivery, females "bagged up", with the teats mildly elongated and the surrounding area swollen. Contrary to information reported by Dang (1997) no nest building ensued, even though grasses, leaves, and other plant materials were available. Straw placed in nest boxes was pushed aside. Gestation periods ranged between 77 and 87 days (see Table 2). Of the five litters born so far, three have occurred during the night, with one mid-day and one early evening birth.

The latter birth of a sole young was observed: from the time contractions were noticed and the vulva seen to be protruding, the delivery took approximately one hour. The contractions appeared to be infrequent but very strong, lasting approximately 30-45 seconds. During this time the female's body was strongly arched, with her head tucked down, and her vagina would protrude extensively. After each contraction she would lick her vagina and then walk slowly around the cage. She continued to eat her evening meal intermittently. Once the head of the baby appeared at the vagina, it quickly progressed to about halfway out, then remained at this station for about two minutes after which time it was expelled from a standing position. The mother immediately began to lick it and eat all the afterbirth, finishing with chewing down to the umbilical cord. She subsequently spent several minutes repeatedly picking up the baby in her mouth and dropping it, then about 30 minutes walking around the cage during which she carried it firmly. The baby was dry by the time she finally entered her nest box to settle. Another female carried her two babies alternately in and out of her nest box for almost 1.5 hours shortly after their birth; it appeared she was searching for a new place to hide them. Despite subsequent birthing mothers being offered a second nest box, did not choose to move their babies from their original boxes.

Facial markings; note elongated face suited to ground foraging and catching earthworms

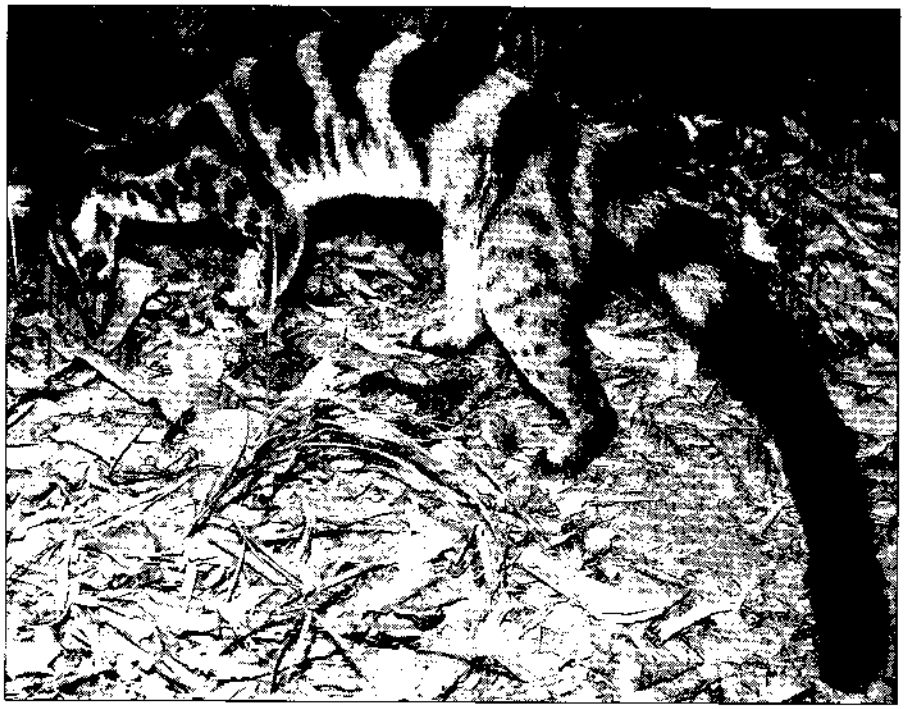
As mentioned, three females were separated from their mates well prior to delivery. This was done as a precaution based on information provided by Hanoi Zoo, whereby they feared that an adult male would harm the young. In the 1997 breedings, however, one pair was left together for the duration of pregnancy, parturition and raising of young, without incident. This same male was mated and housed with a different female in 1998, and again, successfully lived with the female and young. Although in both cases there were two nest boxes in the cage, the pair always slept together. In 1997 the male moved to a second nest box the night before the female delivered, and back into the female's box three days after the young were born. In 1998 he also moved the day before delivery, but back to the female and young after only two days. In both cases, his interaction and behaviour with the young was very similar to the female's, in that he groomed them, slept, played and eventually foraged with them.

DEVELOPMENT

The young from two litters of longest gestation periods were much more developed at birth (thicker fur, with genitals, feet, and noses much less pink, and more robust behaviour) and opened their eyes much earlier. It appears clear from the recorded gestation period range (75-87 days) and ensuing development that a gestation of 80 days is advantageous. Still births recorded at Hanoi Zoo occurred after gestation periods of 60-70 days, indicating premature delivery of fetuses.

The young civets opened their eyes between four and fifteen days, the marked difference being a reflection of the range of litter gestation length. In general, the young were capable of very wobbly walking at 10-14 days. At four to six weeks of age they began to emerge from the nest box. Further exploration of the cage began a few days later, closely following the mother who would oftentimes carry them back to the box. Mothers carried their babies in their mouths by grasping them around the middle. Independent cage exploration occurred at about seven weeks of age. Beginning at this age the young showed only mild interest in the adult's food, but did not poke or actively smell it. At 8 to 10 weeks of age the first solid food was taken, which were grapes. Within days, the longest gestation period litters began to play and poke at worms and other forms of wild food, but did not eat them until 9 weeks, with the other young eating worms at 11 weeks of age. On no occasion was any female seen to call her young to feed, or to take food to them. After about 12 to 13 weeks they began to catch grasshoppers on their own, and at approximately 16 weeks began to eat the daily beef mixture.

The offspring weaned at approximately 12, 15 and 18 weeks, and it appeared that the sole young of one female continued to suckle occasionally until 21 weeks. *Chrotogale* have four mammae, and all young have preferred to suckle from the lower two teats, which are embedded in a more fleshy, soft area of the



Owston's palm civet's pelage is characterised by the same number of distinct dorsal bands (4), however there is great individual difference in pattern details.

belly. The most common nursing position was with the mother reclined on her back against a wall of her nest box, with the young laying on the stomach whilst suckling. With two being the maximum number of surviving offspring from any female, there was little competition for teats or nursing position.

The young civets demonstrate an impressive array of vocalisations. From birth they are able to purr, mew, growl and "chuff", a call used to draw the mother, which was also used to communicate with siblings and other civets in adjoining cages. Adults also use this vocalisation to call to the young and occasionally other civets. Up until seven weeks of age, when presented with a frightening or threatening situation, the young would not spit or attempt to bite, but only press themselves flat or try to retreat from the threat, and growl.

The young animals are also very social. With the 1997 offspring, at 8 to 9 weeks of age the civets discovered that they could squeeze through their cage wire and enter the main catch cage to which all the cages adjoined. They were most likely attracted initially by the food preparation carried out there. Within a matter of days, it became a regular appearance for all the young civets to congregate and play (run, chase, play bite, chase their tails, jump on others) in the catch cage at dusk, during feeding time. Shortly thereafter they began to follow each other into different cages; all adults tolerated this and there were only a few minor incidences of mild aggression (growl and snap) directed towards strange young. Interestingly, the young civets

Litter birth date	Gestation (days)	Number of young	Eyes open (days old)
17/04/97	77	1.0	15
23/04/97	84	1.1	4
27/04/97	87	2.0	6
28/04/97	approx.75	2.1	13
25/04/98	unknown	1.1	10

Table 2. Birth date, gestation and litter size of some captive born *Chrotogale owstoni*

even began to visit the lone adult male's cage, again without incidence. This lead to the young sleeping in nest boxes other than their own, so that some nights a mother would have up to five young in her box, while others would have none. Several of the young would also sleep with the lone adult male in his box. In 1998, however, an offspring of the one litter produced (one female only was bred) was found dead in an adjoining cage, presumed killed by one or both of the male and female adult civets there after entering the cage. This was indeed in contrast to the behaviour of 1997. It is speculated that had these adults been caring for their own young and been in "parental mode", they might have been more tolerant.

At about 10 weeks of age the civets also began to venture out of the catch cage at dusk and into the surrounding grounds, returning after 10 to 20 minutes initially, then longer periods thereafter. At approximately twenty weeks some of the young started staying out overnight, initially for one night, then for several nights before returning to the cage. At about six months old they seemed to be ready to leave their mothers, as they were leaving the cage for up to a week at a time. At this point, the cages were re-covered with smaller gauge wire to prevent them dispersing permanently.

Conclusion and Future Plans

To date the project has been very fortunate with its breeding success, in so far as all matings have resulted in live births. Just as importantly, the young have been successfully raised, bar one neonatal death and one accidental infant death. However, breeding attempts in 1999 were mixed; although five pairings were attempted (four females), it is certain that mating occurred in only two pairs. One female - who bred successfully in 1998 - was tried with two different males over a two week period. She was paired first with an older adult male, and while they got along well no mating occurred (this male subsequently mated with another female). She was next paired with one of the 1997 captive born males, which resulted in the only case of extreme aggression witnessed between the civets to date. One suspicion for the difficulties encountered this year is that there were too many paired animals in too close quarters, which may have affected behaviour. The experience this year has highlighted the fact that while successful breeding of Owston's palm civet can be achieved, the animals are very individual and the relationships between them are not all equal. It is thus extremely important to know the traits of each animal, and the breeding process requires very close monitoring and management to ensure that animals are appropriately paired.

Another possible reason for the difficulties encountered this year is that as the oestrus period is not known accurately, the animals may have been paired too early or too late. It is not known what triggers the oestrus, but if it is at all weather related, this may have been a factor. In 1997 and 1998, the winters included typical spells of cold weather through January, whereas winter this year was marked by unseasonal warmth. In an effort to better understand the reproductive cycle in Owston's palm civet, the project is collecting fecal samples from several females (from this breeding season to the next) in hope of undertaking hormonal analysis.

The project will continue to operate on a small scale, with limited captive breeding and ongoing research and data collection. Under consideration is a plan to undertake a closely monitored, limited release of some of the captive born animals (of local gene stock) in order to collect much-needed ecological data on the species. The project will also continue to serve as a rescue centre for the very few Owston's palm civets confiscated from the wildlife trade. Another small study to be undertaken is an examination of the genetic variability within the species, hopefully including samples from Laos animals in addition to the Vietnamese stock. Depending partly on the results of this study, it may be permissible to release within the park (after a suitable quarantine and veterinary inspection) some of the civets rescued by the project in future.

Maintaining the civets in captivity and captive breeding are the least desirable tools of conservation, but to date this has provided some valuable insights into the species behaviour, biology and reproduction. In addition, the project has also provided reassurance that this species can be captive bred successfully, important knowledge should its status become more precarious. There is no doubt that like all mammals in the Indochina region, Owston's palm civet is under threat from habitat destruction, subsistence hunting and the seemingly insatiable demands of the wildlife trade. While to date there is virtually no effective protection for national parks and protected areas in Vietnam, since the *Action Plan* was written, Owston's palm civet has at least been confirmed in some other protected areas which retain good habitat. Three of these areas —Vu Quang, Pu Mat and Phong Nha Nature Reserves, which all lay along the Vietnam-Laos border — are large and contain some relatively undisturbed areas, and could support good populations of this small carnivore. In addition, conservation initiatives to improve reserve management are underway at the first two sites. Pu Mat in particular has been revealed as good habitat for the species: approximately half a dozen individuals were photo-trapped as part of Fauna & Flora International's 1998 baseline biodiversity survey for the "Social Forestry and Nature Conservation Project" (funded by the European Economic Community). The Phong Nha Owston's palm civet sightings were of two animals being carried out of the forest by hunters (R. Timmins, pers.com), but on the positive side this may be an important site for the species given its close proximity to Pu Mat, and the reserve is also beginning to receive attention from international conservation organisations.

Note the leaf ground cover that provides an ideal cage substrate for captive Owston's palm civets.

Acknowledgements

I am particularly indebted to Roland Wirth, Harry Van Rompaey, and Paul Robinson for their considerable encouragement, advice, and support for the project over the past four years. Others who have been instrumental in the project's establishment include: the Cuc Phuong National Park authorities, the Ninh Binh Forest Protection Department, the Forest Protection Department of the Ministry of Agriculture and Rural Development, particularly Dr. Ngyuen Ba Thu, and Tilo Nadler. I remain grateful to staff of the Cuc Phuong Conservation Project, particularly Douglas B. Hendrie, Le Trong Dat and Kate Blazeby, for their ongoing involvement with *Chrotogale* care and study. Dr. Mike Hill undertook the scat analysis, and along with Claire Beastall made painstaking efforts to ensure the animals' health and welfare. I am especially grateful to the reliable work of the civets' main keeper, Mr. Nguyen Van Huong, and thank Dr. Ulrike Streicher for veterinary assistance. The project would not have progressed without the advice, encouragement and commitment of Shane Rosenthal.

Funds in support of this project have come from the British Petroleum & Statoil Alliance through the Cuc Phuong Conservation Project, administered by Fauna and Flora International; Pittsburgh Zoo's Conservation Fund; and Thrigby Hall Wildlife Gardens. In addition, a grant from the IUCN/SSC for the field study at Cuc Phuong helped facilitate the author's opportunity and ability to establish the captive research and breeding programme.

References

IUCN. 1996. *The IUCN 1996 Red List of threatened animals.* IUCN, Gland & Cambridge.

Ministry of Science, Technology and Environment. 1995. *Red Book Vietnam. Vol.1 . Animals.* Science and Technology Publishing House.

Nguyen Xuan Dang & Pham Trong Anh. 1997. New information on the reproduction of Owston's palm civet, *Chrotogale owstoni*, Thomas 1912. *Small Carnivore Conserv.*, 16:28-29.

Nguyen Xuan Dang, Pham Trong Anh, Ngo Bich Nhu & Le Chan. 1991. Owston's palm civet, *Chrotogale owstoni*, in captivity. *Mustelid & Viverrid Conserv.*,4:7.

Schreiber, A., Wirth, R., Riffel, M., Van Rompaey, H. 1989. *Weasels, civets, mongooses, and their relatives. An action plan for the conservation of mustelids and viverrids.* IUCN/SSC Mustelid and Viverrid Specialist Group, Gland.

P.O. Box 156, Honeymoon Bay, Vancouver Island, BC, Canada VOR 1YO

Preliminary report on the status, activity cycle, and ranging of *Cryptoprocta ferox* in the Malagasy rainforest, with implications for conservation.

Luke DOLLAR

Abstract

A preliminary study of Fossa (*Cryptoprocta ferox*) in a southeastern rainforest of Madagascar examined their morphometrics and activity patterns from May-August 1996. Two fossa, a juvenile male and an adult male were captured and followed using radiotelemetry. *C. ferox* in Ranomafana National Park (RNP) maintained a cathemeral or non-period-specific activity pattern. This observation of fossa activity pattern is contrary to previously published accounts. This is the first study of the behavior of *C. ferox* in the rainforest of Madagascar.

Introduction

In the absence of additional endemic carnivoran competitors, the eight viverrid and herpestid carnivore genera found on Madagascar must fill a particularly broad range of niches (Wright *et al.*, 1997). Despite their unique ecological roles and evolutionary histories, the Malagasy carnivores (Table 1) have been the subject of few in-depth field studies and there is an unfortunate paucity of data on their current distributions, abundances, and behavioral ecologies. The largest of the extant Malagasy carnivores, *Cryptoprocta ferox*, commonly known as the fossa (Fig. 1), displays an enigmatic conglomeration of morphological characteristics that have facilitated some questioning of its taxonomic assignment between either the Viverridae or the Felidae. It is generally agreed that the fossa may resemble modern representative evidence of a primitive connecting link between these two families (Wozencraft, 1989). The fossa is currently more commonly allied with the viverrids (Wozencraft, 1989).

C. ferox is equipped with carnassial teeth and sharp, semiretractable claws (Fig. 2), making it a formidable hunter. The fossa is the only Malagasy predator capable of successfully preying upon adults of all extant lemur species in Madagascar. Rainforest territory size for this solitary predator has not yet been conclusively studied and reported, but a 12-month project recently completed in RNP (Dollar, in prep) will help eliminate this deficit. A series of lemur kills in RNP in 1994 indicated that hunting area is likely to exceed four square kilometers (Wright *et al.*, 1997).

Order Carnivora, Bowdich 1821

Family Viverridae, Gray 1821

SUBFAMILY CRYPTOPROCTINAE, GRAY 1864

Cryptoprocta ferox, Bennett 1833; Fossa

SUBFAMILY EUPLERINAE, CHENU 1852

Eupleres goudotii, Doyère 1835; Fanaloue

Fossa fossana, (Müller 1776); Fanaloka or Malagasy civet

SUBFAMILY VIVERRINAE, GRAY 1821

Viverricula indica, (Desmarest 1804); Small Indian civet

Not endemic to Madagascar.

Family Herpestidae, Bonaparte 1845

SUBFAMILY GALIDIINAE, GRAY 1864

Galidia elegans, I. Geoffroy St.Hilaire 1837; Ring-tailed mongoose

Galidictis fasciata, (Gmelin 1788); Broad-striped mongoose

Includes *G. ornata* & *G. striata* listed separately by Ewer (1973).

Galidictis grandidieri, Wozencraft 1986; Giant striped mongoose

Mungotictis decemlineata (A. Grandidier 1867); Narrow-striped mongoose

Includes *M. substriata* listed separately by Ewer (1973).

Salanoia concolor, (I. Geoffroy St.Hilaire 1837); Malagasy brown mongoose

Includes *S. olivacea* listed separately by Ewer (1973).

Table 1. Classification of the Malagasy carnivores, with scientific and common names (derived from Wozencraft, 1989).

Fig. 1. Subadult *Cryptoprocta ferox* with radiocollar in Ranomafana National Park, Madagascar.

In addition to primate prey, the diet of the fossa includes other mammals, birds, and reptiles (Albignac, 1973), even other viverrids (Louvel, 1954). In a recent analysis of *C. ferox* feces found in the dry, deciduous forest in western Madagascar, Rasoloarison, *et. al.* (1995) note that 57% of the biomass of prey items in these scats was lemur matter, with a significant representation of large lemurs such as *Propithecus verrauxi*. All fossa feces found in RNP before 1996 contained matter from lemurs (Wright *et. al.*, 1997).

From May through early August 1996, a preliminary study was conducted in the southeastern rainforest of RNP, Madagascar to assess the density, ranging, and activity patterns of *C. ferox*. Data were collected on fossa morphometrics, activity, and ranging to obtain a more detailed account of rainforest *C. ferox* populations and to afford a more balanced view of Malagasy rainforest ecosystem dynamics. This report represents the first examination of fossa activity patterns in the Malagasy rainforest. This report focuses on the morphological and activity data collected in this preliminary study.

Study area and methods

The study was conducted from the Vatoharanana site (altitude 1,000 m; Fig. 3) in RNP, which consists of 41, 000 ha of submontane rainforest ranging in altitude from 500-1,500 m. This site was selectively cut in the early 1980s and contains some introduced plant species, but is relatively undisturbed. Average rainfall is approximately 2,500mm. (Overdorff, 1988).

Fig. 2. Semi-retractable claws of *C. ferox*.

Seven traps were placed along a seven km transect spanning between Vatoharanana and two additional sites (Talatakely and Valohoika). Live adult chickens, canned corned beef, and raw pork were used as bait. Traps were checked at least twice daily. Trapped fossa were tranquilized while still in the trap, using Telazol and the Pneu-dart blowpipe system. Once adequately tranquilized, fossa were removed from the trap for collection of anatomical measurements and attachment of a specially designed Telonics MOD-365 radiocollar equipped with an activity sensor. After anatomical measurements and collar attachment were complete, the fossa were returned to their traps and locations of capture, monitored until free from drug effects, and released.

Anatomical measurements included body length, tail length, hindlimb length, hindfoot length, hindlimb circumference, forelimb length, forefoot length, forelimb circumference, chest circumference, neck circumference, canine lengths, and genital measurements. Body length was measured from the tip of the nose to the base of the tail. Tail length was measured from the base of the tail to the tip of the most distal bony tail segment. Hindlimb and forelimb length was measured from the medial fold of the limb to the tip of the longest portion of the footpad. Hindfoot and forefoot length was measured from the most proximal to the most distal portion of the footpad. Forelimb circumference was measured around the widest portion of the brachium. Hindlimb circumference was measured aroung the widest portion of the thigh region. Chest circumference was measured just inferior to the forelimbs. Neck circumference was measured at its most caudal point. Canine lengths were measured from the gumline to the tips of the teeth.

Activity and movement patterns were monitored at five-minute intervals using close- to medium-range (25-500 m) single-receiver radiotracking. Activity state was determined with the aid of the collars' activity sensors and movement patterns.

Results

Two fossa, an adult male and a subadult male, weighing 8.1 kg and 6.5 kg, were captured during this study. The anatomical measurements taken on these two animals are presented in Table 2. Daily path lengths ranged from 2-≥5 km/day. Home ranges overlapped by approximately thirty percent. *C. ferox* travel paths extrapolated from radiotracking indicate heavy use of man-made trail systems when travelling for extended periods of time.

The overall activity cycle for both fossa is presented in Fig. 4. Both individuals maintained a cathemeral activity pattern, with activity levels highest through the late night hours but always complemented by several hours of daytime activity.

The subadult male in this study was killed by local villagers in late July 1996.

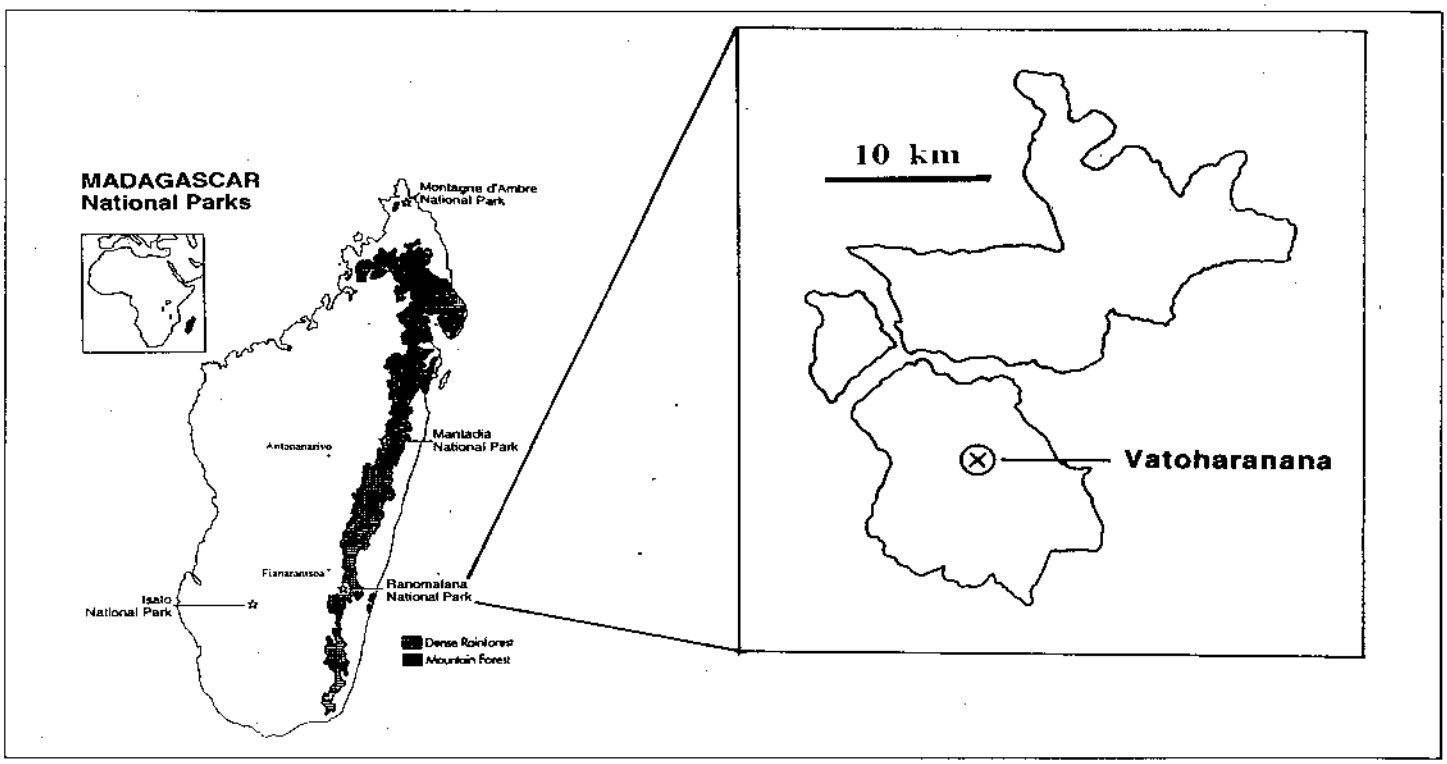


Fig. 3. Map of Madagascar noting the locations of several National Parks, with Ranomafana National Park enlarged. The study site for this project was Vatoharanana, in the southern parcel of the Park.

Discussion

Body size of *C. ferox* males is reported to range from 7 kg (Köhncke & Leonhardt, 1986) to ≥ 12 kg (Albignac, 1973). The adult male in this study weighs in the lighter portion of this range. Additional animals captured during a 1997 project in RNP (Dollar, in prep) also fall in this smaller size range. There are several reasons why fossa inhabiting the dense Malagasy rainforest may be small relative to other reports of sizes. It has been argued that carnivores inhabiting open spaces may be larger for predator defense reasons (Gittleman, 1985). As *C. ferox* is the top predator in the Malagasy food chain (Wright *et al.*, 1997), this is probably not a reason why rainforest fossa might be smaller than their counterparts elsewhere in Madagascar.

Other reasons for smaller body size might be a need for easy movement through dense rainforest foliage or for pursuit of arboreal prey in terminal branches (Clutton-Brock & Harvey, 1977). If the fossa is, in fact, a primate specialist (Wright, 1995), reduced body size would certainly be beneficial in pursuit of primate prey, as all species of lemur in RNP are arboreal. Other work, however, indicates that fossa may be a more generalist predator. Goodman *et. al.* (1997) discovered a wide range of vertebrate prey in *C. ferox* feces collected from the summital zone of the Andringitra Massif. In addition, preliminary analysis of *Cryptoprocta* fecal contents from Ankarafantsika National Park in Western Madagascar indicates a wide range of prey across many tropic levels may be taken by fossa in this area (Dollar & Goodman, in prep.). Gittleman (1985) notes that "larger carnivores must maintain flexible dietetic preferences so as to increase the absolute number of potential foods available to them." Similarly, Goodman *et. al* (1997) suggest that the discrepancy of prey selectivity between fossa at various sites probably follows differences in prey community structure.

Another important, unique observation on the behavior of *C. ferox* in RNP, is their conformation to a cathermeral or non-period-specific activity pattern, characterized by a fluctuating combination of both nocturnal and diurnal activity. This notion is contrary to previously published accounts, in which fossa activity patterns have been described as either nocturnal of crepuscular (Albignac, 1973). Given conclusions by Goodman *et. al* (1997) mentioned above, it seems reasonable that Ranomafana fossa may be lemur specialists. No other park in Madgascar boasts a greater lemur species richness than RNP (Mittermeier *et al.*, 1994), and all fossa feces from this area analyzed to date (n=8) have contained matter from the larger diurnal or cathemeral lemur species (Wright *et al.*, 1997). Ongoing analysis of additional feces from *C. ferox* in RNP (Dollar & Goodman, in prep.) appear to support this trend. Fully half of the lemur species in RNP are diurnal or cathemeral. These lemurs are also notably larger than their nocturnal counterparts. It is possible that fossa's non-uniform activity patterns in Ranomafana may be optimized to cope with the wide range of the varied activity patterns in its large preferred prey taxa.

Implications for conservation

C. ferox is the top carnivore within the Madagascar food chain (Wright, 1995). Large predators, however, are often the first species to succumb to human encroachment on their habitat (Terborgh & Wright, 1994). Owing to its low densities and large home ranges (Dollar *et al.*, 1997), the fossa is particularly sensitive to any perturbations in RNP environment.

	Adult male	Subadult male
Weight	8.1 Kg	6.5 Kg
Tail-crown length	64.8 cm	53.6 cm
Tail length	67.7 cm	63.1 cm
Hindlimb length	33.4 cm	31.5 cm
Hindlimb circumference	25.8 cm	19.8 cm
Hindfoot length	13.3 cm	12.2 cm
Forelimb length	24.6 cm	23.3 cm
Forelimb Circ.	17.3 cm	15.0 cm
Forefoot length	9.0 cm	7.8 cm
Chest circumference	35.6 cm	28.5 cm
Neck circumference	24.5 cm	20.2 cm
RUpper Canine length	16.81 mm	14.97 mm
RLower Canine length	16.34 mm	14.17 mm

Table 2. Anatomical measurements of two C. ferox *males captured in this pilot project.*

Displacement of the fossa from the food chain would have significant short- and long-term effects on lemurs and their ecosystem. Large predators play a keystone role in their balanced ecosystems by keeping prey populations with a reproductive or competitive advantage in check. In the short-term, loss of this top carnivore would result in significant increases in population density of their common prey, including lemurs. Long-term repercussions stemming from loss of this top carnivore and subsequent increase in densities of their more competitively successful seed-predating or seed-dispersing ex-prey may include diminished and/or increased rates of various seedling and sapling replenishment. Long-term ramifications most certainly include an unnatural restructuring of the entire forest ecosystem. This may be detrimental to those populations dependent on present botanical species densities and distributions.

The actual density of fossa within most of Madagascar's forests is not known. If densities of *C. ferox* are naturally low, as has been suggested (MacDonald, 1984; Dollar *et al.*, 1997), even minimal amounts of human interference within fossa populations may have unfortunate effects upon the ecosystem as a whole. Low densities of *C. ferox* can likely be attributed to past human encroachment on their habitat and home range. Such encroachment manifests itself in the form of human/fossa encounters in which the fossa has been killed out of revenge for raided livestock or fear brought about by erroneous folklore regarding the legendary ferocity of *C. ferox*.

The fossa, listed as "vulnerable" by the IUCN, is thought to be reasonably widespread throughout Madagascar, except in the central high plateau region, but this species is targeted for persecution by indigenous human populations and continues to decline (pers. obs.; Baillie & Groombridge, 1996). *C. ferox* populations have been identified in more than twenty protected areas throughout Madagascar (Albignac, 1973; Köhncke and Leonhardt, 1986), but most of these populations have not been monitored for almost thirty years. Recent and current detailed investigations of fossa populations in Madagascar are limited to less than five sites. An island-wide survey is currently underway to more accurately assess the current distribution, abundance, behavioral ecology, and genetic variability of carnivore populations throughout Madagascar.

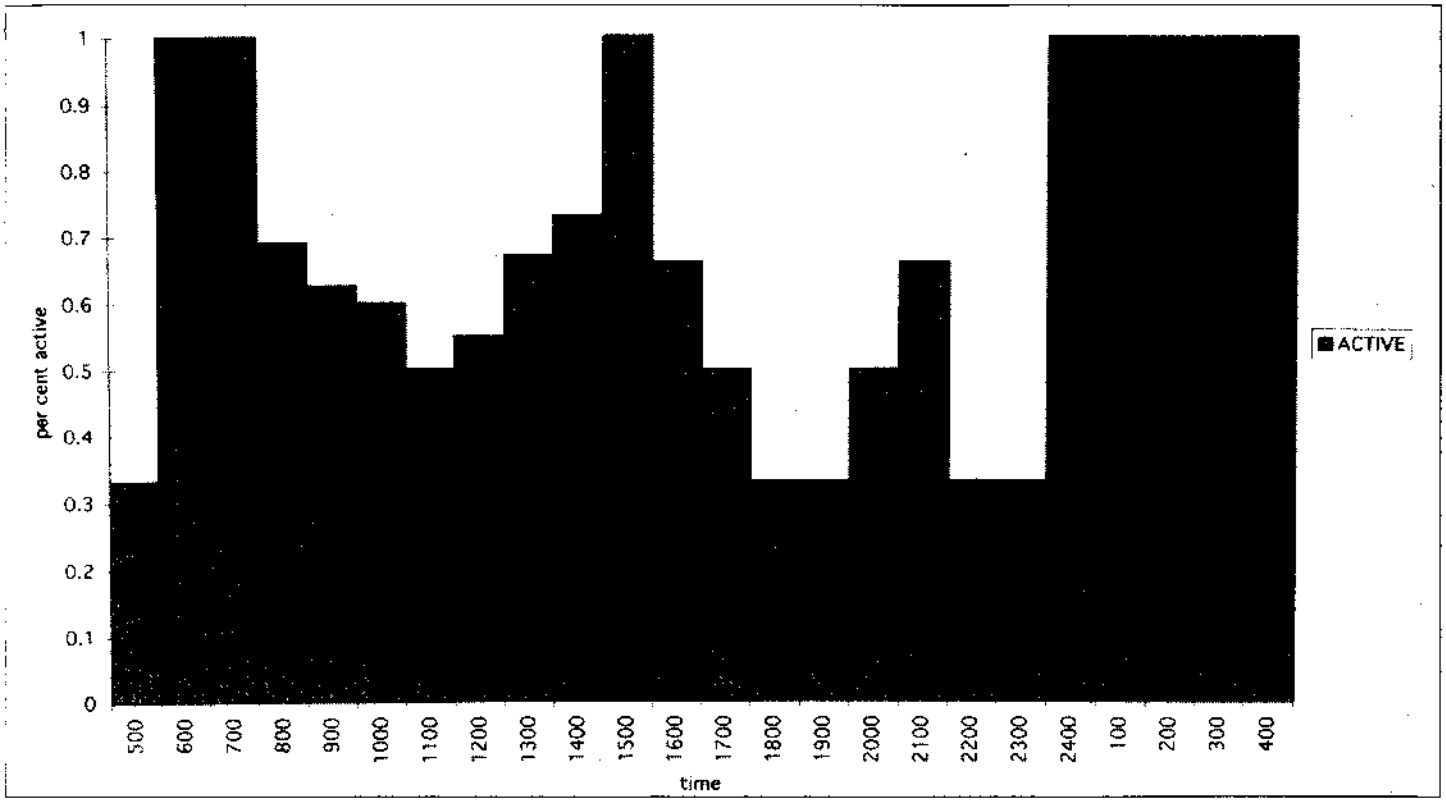


Fig. 4. Overall activity pattern of *C. ferox* in Ranomafana National Park, May-August 1996.

Acknowledgements

E. Rahita, Z. Forward, B. Andriamihaja, A. Dunham, C. Hawkins, F. Kerridge, J. Gittleman, D. Simberloff, S. Pimm, and P. Wright provided valuable advice, information, logistical assistance, or comments in the course of this project and the production of this report. Permits to carry out this ongoing research have been graciously granted by the Madagascar ANGAP and 'Eau et Forêt' Agencies and Departments. Funding was provided by the Douroucouli Foundation of Los Angeles and the Carnivore Conservation and Research Trust. DUPC publication #681.

References

Albignac, R. 1973. *Faune de Madagascar. Vol. 36. Mammifères carnivores*. ORSTOM-CNRS, Paris et Antananarivo.

Baillie, J. & Groombridge, B., eds. 1996. *IUCN Red list of threatened animals*. Gland & Cambridge: IUCN.

Beaumont, G. 1964. Remarques sur la classification des Felidae. *Ecologae Geol. Helvet.*, 57: 837-845.

Clutton-Brock, T. H. & Harvey, P. H. 1977. Primate ecology and social organization. *J. Zool. (Lond.)*, 183:1-39.

Clutton-Brock, T. H. & Harvey, P. H. 1983. The functional significance of variation in body size among mammals. In *Advances in the Study of Mammalian Behavior. Special Publication no. 7.* ed. J. F. Eisenberg and D. G. Kleiman, 632-658. Lawrence, Kansas: American Society of Mammalogists.

Dollar, L. J., in prep. Long-term study of *Cryptoprocta ferox* activity and ranging patterns in Ranomafana National Park, Madagascar.

Dollar, L. J. & Dunham, A.E., in prep. Systematic mark-recapture survey of carnivore populations in Ranomafana National Park, Madagascar.

Dollar, L. J. & Goodman, S. M., in prep. Food habits of *Cryptoprocta ferox* from different protected areas and forest types throughout Madagascar.

Dollar, L. J., Forward, Z. A. & Wright, P. C. 1997. First study of *Cryptoprocta ferox* in the rainforests of Madagascar. *Am. J. Phys. Anthropol.*, Suppl. 24:103-104.

Gittleman, J. L., 1985. Carnivore body size: Ecological and taxonomic correlates. *Oecologica* 67: 540-554.

Goodman, S. M., Langrand, O. & Rasolonandrasana, B. P. N. 1997. The food habits of *Cryptoprocta ferox* in the high mountain zone of the Andringitra Massif, Madagascar (Carnivora, Viverridae). *Mammalia*, 61:185-192.

Hemmer, H. 1978. The evolutionary systematics of the living Felidae : present status and current problems. *Carnivore*, 1:71-79.

Köhncke, M. & Leonhardt, K. 1986. Cryptoprocta ferox. *Mamm. Species*, 254:1-5.

Louvel, M., 1954. Quelques observations sur le "Fossa." *Bull. Acad. Malgache, N. S.*,31:45-46.

MacDonald, D., 1984. Civets and Genets. In *The Encyclopedia of Mammals*, 136-145. Equinox, Oxford.

Mittermeyer, R.A. *et al.* 1994. *Lemurs of Madagascar.* Washington, DC: Conservation Intern. Press.

Overdorff, D. J. 1988. Preliminary report on the activity cycle and diet of the red-bellied lemur *(Lemur rubriventer)* in Madagascar. *Amer. J. Primatol.*, 16:143-153.

Rasoloarison, R. M., Rosolonandrasana, B. P. N., Ganzhorn, J. U. & Goodman, S. M. 1995. Predation on vertebrates in the Kirindy Forest, western Madagascar. *Ecotropica* 1:59-65.

Terborgh, J. & Wright, S. J. 1994. Effects of mammalian herbivores on plant recruitment in two neotropical forests. *Ecology* 75:1829-1833.

Veron, G. 1995. La position systématique de *Cryptoprocta ferox* (Carnivora). Analyse cladistique des caractères morphologiques des carnivores Aeluroidea actuels et fossiles. *Mammalia*, 59:551-582.

Wozencraft, W. C. 1989. The phylogeny of the recent carnivora. In *Carnivore behavior, ecology, and evolution*, ed. J. L. Gittleman, 279-349. Chapman & Hall, London.

Wright, P. C. 1995. Demography and life history of free-ranging *Propithecus diadema edwardsi* in Ranomafana National Park, Madagascar. *Int. J. Primatol.*, 16:835-854.

Wright, P. C., Hecksher, K. & Dunham, A. E. 1997. Predation on Milne-Edward's Sifaka (*Propithecus diadema edwardsi*) by the fossa (*Cryptoprocta ferox*) in the rain forest of southeastern Madagascar. *Folia Primatol.*, 68:34-43.

Duke University Primate Center, 2705 Old Erwin Road, Durham, North Carolina 27705, USA.
E-mail: lukedollar@yahoo.com

& Department of Ecology and Evolutionary Biology, University of Tennessee at Knoxville, Knoxville, TN 37996, USA

A note on the Tainguen civet - a new species of viverrid from Vietnam (*Viverra tainguensis* Sokolov, Rozhnov & Pham Trong Anh, 1997)

Viatcheslav V. ROZHNOV and PHAM TRONG ANH

Introduction

Until recently four species of genus *Viverra* Linnaeus, 1758 (Carnivora, Viverridae) were known: *V. zibetha* Linnaeus, 1758, the Large Indian civet, *V. megaspila* Blyth, 1862, the Large-spotted civet, *V. tangalunga* Gray, 1832, the Malayan civet and *V. civettina* Blyth, 1862, the Malabar civet. Two of them, *V. zibetha* and *V. megaspila*, are distributed only on the mainland and are sympatric (Tate, 1947; Wenzel & Haltenorth, 1972; Corbet & Hill, 1992; Wozencraft, 1993). Now another mainland species of the genus *Viverra* has been described - *V. tainguensis* Sokolov, Rozhnov & Pham Trong Anh, 1997, the Tainguen civet. This species was originally described from the north of Tainguen Plateau (Vietnam) and named after this geographical location.

V. tainguensis is known from Vietnam (Sokolov et al., 1997, 1999), where *V. zibetha* and *V. megaspila* are distributed too (Pham Trong Anh, 1992; Dang Huy Huynh et al., 1994). All three species are quite similar and are characterised as follows: The fur of all these species is short but fluffy; their general coat pattern is dark-gray or gray with white and black spots or stripes. A black bristly crest runs over the back, rising when the animal is agitated. The tail has distinct light and dark rings. There are no spots on the snout. There are three light (different tints of white) and dark (black or black-brown) transversal stripes on the throat and the flanks of the neck.

Fig. 1. Colouration of *V. tainguensis* (a - specimen from IHEH; b - specimen S-144515, ZMMU, holotype).

Differences between these mainland species are numerous and significant. It should be noted that all species of genus *Viverra* have been described on the basis of external morphological traits, mainly colouration. Some of these, in the cases of *V. zibetha* and *V. megaspila*, are noted by Pocock (1939), Lekagul & McNeely (1977) and Corbet & Hill (1992). *V. megaspila* has a significantly shorter tail than *V. zibetha*: no more than a half of the body length (30-50% versus 55-60%). *V. megaspila* differs in the arrangement of the rings on the tail and by their reduced number: 3-4 rings closer to the tailbase versus 5-6 rings over the entire tail. *V. megaspila* has larger spots arranged in five rows on each flank, whereas *V. zibetha* has smaller, less distinct spots sparsely over the entire body. The claws on the 3rd and 4th fingers are covered with sheaths in *V. megaspila* but not in *V. zibetha*. There is weak development of the postorbital processes in *V. megaspila* and their strong development in *V. zibetha* is the most important craniometric feature.

Material and method

We have examined 7 specimens of *V. tainguensis* from Vietnam (list see below) and for comparison 46 specimens of *V. zibetha* from different regions of Vietnam (12 from Tonkin, 12 from North Annam, 11 from Central Annam, 7 from South Annam; for 4 specimens of unknown provenance) and 4 specimens from China, 2 specimens of *V. megaspila* from Vietnam (South Annam), and 8 specimens of *V. tangalunga* - 1 from Sumatra, 1 from Java, 3 from Borneo, 2 from Moluccas (Ternate Island) and 1 from Philippines (Luzon Island). All specimens are stored in Russian and Vietnamese Museums (list see bellow).

Examined specimens of *V. tainguensis* from Vietnam: **Tonkin**: 1. male ad., 2.IX 1964, Langson Province, Huulung, Yenbinh (21°29' N, 106°20' E) (ZMUV: M373, skull, skin); 2. female ad., 18.III 1968, Habak Province, Shondong (21°20' N, 106°51' E) (ZMIEBR: 28, stuffed) (paratype); **North Annam**: 3. sex?, ad., 27.XI 1961, Nghean Province (ZMUV: M371, skin); 4. sex?, ad., 27.XI 1961, Nghean Province (ZMUV: M372, skin); **Central Annam**: 5. male subad., 17.X 1986, Gialai Province, 75 km N of Ankhe City (14°34' N, 108°35' E), 700-800 m ASL (ZMMU: S-144515, skull, skin) (holotype), collected by V.V. Rozhnov & G.V. Kuznetsov; **South Annam**: 6. sex?, ad., 1996, Daclac Province (IHEH: without number, stuffed); 7. sex?, ad., 1958, place of capture unknown (ZMUV: M550, skin).

The following abbreviations for the collections (where the materials are stored) are used: Zoological Museum of Moscow State University - **ZMMU**; Zoological Museum of National University of Vietnam (Hanoi) - **ZMUV**; Zoological Museum of the Institute of Ecology and Biological Resources of the National Centre for Natural Sciences and Technologies of Vietnam (Hanoi) - **ZMIEBR**; Institute of Hygiene and Epidemiology of the High-Plateaux (Buonmathuot) - **IHEH.**

The external measurements used are standard: **L** - body length (from the tip of the snout to the anus), **C** - tail length (from the root of the tail to the tip, not including any terminal pencil of

hairs), **PL** - hind foot (from the extremity of the heel behind the os calcis to the extremity of the longest digit, not including the claws), **Au** - ear - (from the lower border of the external auditory meatus to the tip of the pinna).

The following measurements were taken from examined skulls. **CBL** - condylobasal length (from the exoccipital condyle to the anterior extremity of the premaxilla); **BAL** - basic length (from the anterior margin of the occipital foramen to the anterior extremity of the premaxilla); **GTL** - greatest length (the greatest antero-posterior diameter of the skull, taken from the most projecting point at each extremity); **LFC** - length of facial case (from the line, going through the postorbital processes to the anterior extremity of the premaxilla); **LBC** - length of braincase (from the exoccipital condyle to the line, going through the postorbital processes); **PL** - palatal length (from the tip of palatine to the posterior alveolar margin of the first upper incisive); **ZB** - zygomatic breadth (the greatest width of the skull across the zygomatic arches, regardless of where this point is situated along the length of the arches); **MBFUM** - maxilla breadth in first upper molars (the width of the maxilla across the external alveolar margins of the first upper molars - for S-144515 in D^4, for M373 in M^1); **IC** - interorbital constriction (the narrowest width across the interorbital region); **PC** - postorbital constriction (the narrowest width of the constriction behind the postorbital process); **BPP** - breadth in postorbital processes (greatest width across the postorbital processes); **MAXT** - maxillary toothrow (from the front of the upper canine to the back of the crown of the last upper molar - for S-144515 dC-D^4, for M373 C-M^2); **MANL** - mandible length (from the condyl of the mandible to its most anterior projecting point); **HMCP** - height of mandible in coronoid process (greatest height of the mandible in coronoid process).

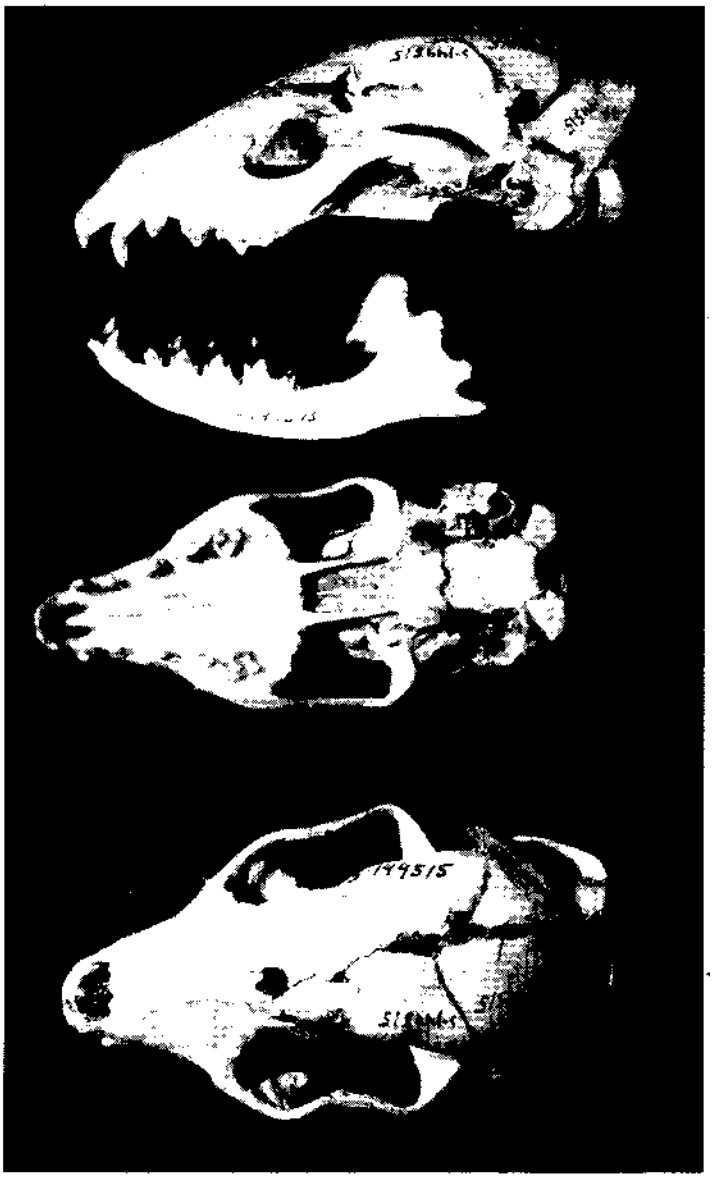


Fig. 2. Skull of *V. tainguensis* (specimen S-144515, ZMMU, holotype).

Skull measurements	S-144515 (ZMMU) *male s-ad*	M373 (ZMUV) *male ad*
CBL	103.5	132.5
BAL	96.7	127.4
GTL	108.5	138.2
LFC	54.2	68.6
LBC	61.1	80.8
PL	49.6	66.7
ZB	46.5	62.0
MBFUM	29.7	44.7
IC	17.7	22.1
PC	19.3	18.7
BPP	21.0	25.4
MAXT	33.4	53.9
MANL	73.7	93.4
HMCP	22.6	32.5

Table 1. Skull measurements (in mm) of examined specimens of *Viverra tainguensis* from Vietnam

Description

All specimens of *V. tainguensis* examined have the characteristic colouration of the pelts (Fig. 1). General background colouration is light brown, almost sandy, and gray in the nape area. Well-developed, semilunar, dark spots opening caudally are dispersed over the light brown background of the body. A light brown stripe with light brown edging starts from the rib area behind the shoulders, rising to the back, then sharply bends caudally and runs parallel to the bristly crest. This stripe may be interrupted somewhere in similar-coloured edged spots, which are more or less elongated. This stripe, or chain, finishes with a clear spot in lateral part of the tailbase. This stripe, or chain, is separated from the black bristly crest by a narrow, light gray field starting from the nape and running between the stripe chain and the bristly crest, and joining the light ring at the tailbase. The second, similar but less contrasting stripe runs below and caudally from the stripe chain. Breast and belly are light gray. Forelegs (area of the forearm and below) and hind feet (below the region of basipodium) are brownish gray; a narrow, light gray stripe with clear, dark, almost black spots or stripes runs over their frontal part almost to the digits.

We have noted (Sokolov et al., 1997) that the quite stable characters of colouration are typical for *V. zibetha*. The same can be noted for *V. tainguensis*. Weak variation in external morphology is typical for all species of genus *Viverra* (Corbet & Hill, 1992).

Claws on the 3rd and 4th front digits (important specific characters, see Corbet & Hill, 1992) of *V. tainguensis* are covered with sheaths as in *V. megaspila*, but not as in *V. zibetha*.

The body sizes of *V. tainguensis* follow Sokolov *et al.* (1999): specimen S-144515 (ZMMU); L=600 mm, C=312 mm,

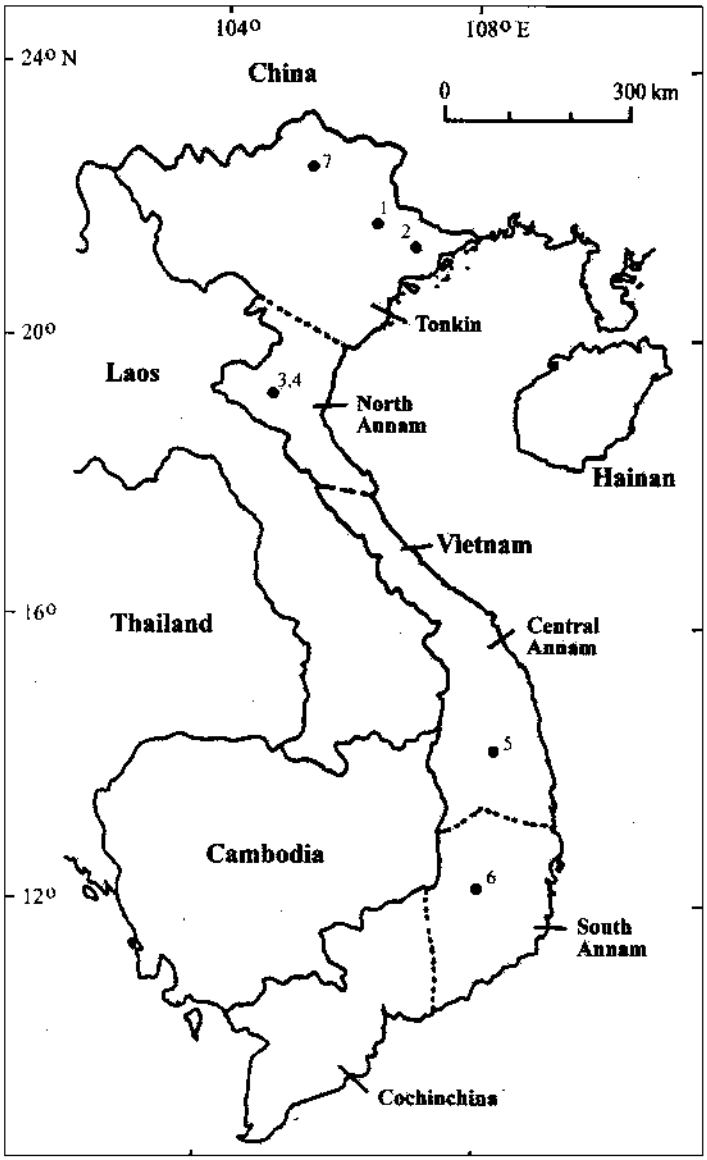


Fig. 3. Localities where *V. tainguensis* has been collected in Vietnam (the digits correspond to these from the list of examined specimens: 1 - Langshon, 2 - Habak, 3-4 - Ngean, 5 - Zialai, 6 - Daclak; the locality 7 - Tuyenquang, Nahang Nature Reserve after photo by Dr. Ramesh Boonratana).

Pl=100 mm, Au=45 mm, body weight 3,000 g; specimen M373 (ZMUV); L=780 mm, C=440 mm, Pl=130 mm, Au=55 mm, body weight 7,500 g; specimen from IHEH - L=790 mm, C=420 mm (the measurements were taken from the stuffed specimen).

In the skull of *V. tainguensis* the postorbital processes are weakly developed (Fig. 2). They are located frontally from the middle of the total skull length. Nasal bones broader than in *V. zibetha*. Upper deciduous premolar D^4 differs significantly in its shape from that in *V. zibetha* of similar age: its inner blade is much broader and more rounded. The skull measurements of examined specimens of *V. tainguensis* are presented in the Table 1.

So, *V. tainguensis* differs from another species of the genus *Viverra* by the following: *V. tainguensis* is smaller in body size than *V. zibetha*; it has a relatively short tail (52-56% versus 55-60% in *V. zibetha*), a contrasting colour pattern (presence of well-expressed semilunar spots), the colouration on the front legs (area of the forearm and below) and hind feet (below the region of basipodium), and presence of sheaths covering the claws of the 3rd and 4st front digits. From *V. megaspila* and *V. civettina* it differs in its smaller body, smaller size of spots, their arrangement on the body (the spots do not form regular rows) and in the presence of 6 rings over the tail (*V. megaspila* and *V. civettina* have only 3-4 rings positioned closer to the tailbase). *V. tainguensis* has a smaller number of rings around the tail as does *V. tangalunga* (10 and more in *V. tangalunga*) and a semilunar spot shape on the body (they are rounded in *V. tangalunga*).

Distribution

Distribution of *V. tainguensis* is shown on Fig. 3. Previously this species was known from two localities (Sokolov et al., 1997), i.e. Gialai Province, 75 km N of Ankhe City (14°34' N, 108°35' E) and Habak Province, Shondong (21°20' N, 106°51' E). The data on the collection spots for the examined specimens permits characterisation of this species' area in more detail. *V. tainguensis* is known from the provinces of Langson, Bacgiang (former Habak), Nghean, Gialai and Daclac. So, this species' area is expanded in Vietnam from Tonkin in the north to South Annam in the south.

Without the data on the collection spots I have received from Dr. Ramesh Boonratana and Fauna & Flora International (FFI) - Indochina Programme a photo of *Viverra* sp. taken 4th October 1998 in Nahang Nature Reserve, Tuyenquang Province, approximately 22°21' N, 105°22' E, 900 m ASL (Fig. 4). All colour characteristics of the phototrapped animal are expressed very well and testify that it is *V. tainguensis*. This is a new record of this species in Vietnam.

Habitat and habits

As in *V. zibetha*, *V. tainguensis* is a terrestrial, nocturnal species. It was collected from the moist primary tropical forest in the valley of small brook at 04.20 h (Sokolov et al., 1977). These data are confirmed by phototrapping by Dr. Ramesh Boonratana.

Fig. 4. *V. tainguensis* in the wild in Nahang Nature Reserve, Tuyenquang Province. Photo by Dr. Ramesh Boonratana and Fauna & Flora International (FFI) - Indochina Programme.

Acknowledgements

I am very thankful to Dr. Ramesh Boonratana and Fauna & Flora International (FFI) - Indochina Programme for two photos of *Viverra* sp., taken in the wild (Nahang Nature Reserve, Vietnam and Nakai Plateau, Laos), and to Will Duckworth who kindly sent me these photos.

References

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

Dang Huy Huynh (ed.), Dao Van Tien, Cao Van Sung, Pham Trong Anh & Hoang Minh Khien. 1994. *Checklist of Mammals in Vietnam.* Ha Noi: Publ. House "Science and Technics". (In Vietnamese)

Lekagul, B. & McNeely, J.A. 1977. *Mammals of Thailand.* Bangkok: Assoc. Conserv. Wildlife.

Pham Trong Anh. 1992. Carnivorous mammals of North Vietnam. In *Zoological investigations in Vietnam.* Moscow: Nauka Publ. Pp. 81-132. (In Russian)

Pocock, R.I. 1939. *The fauna of British India, including Ceylon and Burma. Mammalia, Vol. 1. Primates and Carnivora (Felidae and Viverridae).* London: Taylor & Francis, Ltd.

Sokolov, V.E., Rozhnov, V.V. & Pham Trong Anh. 1997. New species of viverrids of the genus *Viverra* (Mammalia, Carnivora) from Vietnam. *Russian J. Zool.*, 1(2): 204-207. Translated from *Zoologicheskii Zhurnal.* 1997, 76(5): 585-589.

Sokolov, V.E., Rozhnov, V.V. & Pham Trong Anh. 1999. New data on the *Viverra tainguensis* Sokolov, Rozhnov et Pham Trong Anh, 1997 (Mammalia, Carnivora) from Vietnam. *Zool. Zh.*, 78 (in press).

Tate, G.H.H. 1947. *Mammals of Eastern Asia.* New-York: The Macmillan Company.

Wenzel, E. & Haltenorth, M. 1972. System der Schleichkatzen (Viverridae). *Säugetierk. Mitt.*, 20:110-127.

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.

A.N. Severtsov Institute of Ecology and Evolution, Russian Academy of Sciences, Leninsky Prosp., 33, Moscow 117071 Russia

Observations on two sympatric, diurnal herpestids in the Betampona NR, eastern Madagascar

Two diurnal herpestid species occur sympatrically in the 2,228 ha Betampona Natural Reserve (17°15' - 17°55' S; 49°12' - 49°15' E): *Galidia elegans* and *Salanoia concolor* (subfamily Galidiinae). Both are frequently sighted by personnel of Project Betampona and are known locally as "Vontsira" and "Vontsira boko". Despite being of similar body size and pelage colour, they are easily distinguishable as *Galidia* tails have dark bands and are slightly longer.

No quantitative studies of population sizes have been conducted, but both species appear to be fairly common and are reproducing successfully. It is estimated that family groups occupy territories of around 20 ha. Approximately 50 % of the reserve is relatively undisturbed primary rainforest (i.e., 1,114 ha). Thus it is possible that 50 family groups of each species could occur at Betampona, although this is most likely an overestimate.

Both species exhibit a preference for primary rainforest, although *Galidia* have been occasionally observed in secondary forest areas. Altitude at Betampona ranges from 275 - 590 m, and the reserve is characterised by steep slopes descending from ridges and peaks. *Galidia* have been observed at all altitudes from valley bottoms to ridge tops (they are often sighted along streams), while *Salanoia* have been observed only along ridge tops.

Galidia have been observed to consume freshwater crustaceans, frogs and on one occasion an eastern woolly lemur (*Avahi laniger*). It is unclear whether the *Galidia* had captured the *Avahi* or whether they stole it from a Henst's Goshawk (*Accipiter henstii*). Three *Galidia* were originally sighted, one carrying the *Avahi* (weight ca. 2kg), but later a goshawk was observed feeding on the corpse. Goshawks have been previously observed feeding on *Avahi* at Betampona. *Salanoia* have been observed breaking up rotten wood to feed on beetle larvae.

Both species have been observed singly, in adult pairs and in presumed family groups (2 adults and 1 infant or juvenile). Infants are observed accompanying their parents in November/ December.

Galidia are extremely curious and bold, uttering a range of whistling calls when foraging. When alarmed they emit a low-pitched growl or a high-pitched squeal. *Salanoia* seem more nervous and typically react to humans by erecting the hair on the tail, producing low-pitched growls and fleeing rapidly. Both species have been observed to stand upright on their hind legs. Local people claim that *Salanoia* uses this posture to assess an animal as potential prey: if the *Salanoia* is taller, when standing upright, than an animal it encounters, it will attack!?!

More detailed studies of these two sympatric species are required to determine differences in their behavioural ecology that enable them to co-exist in lowland primary rainforest. Anyone interested in carrying out such work at Betampona should contact the author by e-mail at <ivoloina.bow.dts.mg>.

Footnote: The other herpestid and viverrid recorded at Betampona are both nocturnal. *Cryptoprocta ferox* (which admittedly does exhibit some diurnal activity) has been observed feeding on *Eulemur fulvus albifrons*, and is presumed to be responsible for the death of one captive-bred *Varecia variegata variegata* released as part of the Betampona Re-stocking Programme. *Galidictis fasciata* also occurs both within and around the reserve. Further survey work is required to determine the presence of *Fossa fossana* and *Eupleres goudotii*.

Adam Britt, Madagascar Fauna Group Research Co-ordinator, Project Betampona, B.P. 442, Tamatave 501, Madagascar

Conservation of small carnivores (mustelids, viverrids, herpestids, and one ailurid) in north Bengal, India.

Anwaruddin CHOUDHURY

The three northern districts of West Bengal in eastern India are popularly known as 'north Bengal'. These districts are Darjeeling, Jalpaiguri, and Koch Bihar. During field trips to north Bengal in June-July, October-November 1995, and August-September, December 1996, data on the current distributions and status of small carnivores (ailurid, mustelids, viverrids, and herpestids) were collected. The data include direct sightings in the wild, and records of wild-caught animals held as captives. The examinations of dead specimens included preserved skins and reports from experienced hunters, forest officials and other observers. Unfortunately, as these families of small carnivores are often overlooked during field surveys (which are aimed primarily at larger mammals and birds) so many of the observations were not documented in detail. There is little published information on the status and abundance of these animals (Inglis *et al.*, 1919), although status reports on the small carnivores of Assam and Arunachal Pradesh have been published recently (Choudhury, 1997a, 1997c). Accounts of the small carnivores of Assam can also be found in Choudhury (1994, 1997b). No specific field study solely concerned with these small carnivores has been undertaken in the area so far, but general information on these groups can be found in some synoptic works, notably those of Prater (1948), Ellerman & Morrison-Scott (1951), Corbett & Hill (1992) and ZSI (1992).

The three districts of north Bengal (25°55'-27°15'N, 88°00'-89°55'E) cover an area of 12,500 km^2 and form part of a rich biogeographic unit that represents one of the world's biodiversity 'Hotspots' (Myers, 1988, 1991). The district of Darjeeling is mostly hilly and mountainous being part of the eastern Himalayas. Northern areas of Jalpaiguri district are also hilly and are part of the Himalayan foothills. The bulk of Jalpaiguri and all of Koch Bihar are flat plains. The highest areas, especially in the the Shingalila and Neora Valley experience heavy snowfall in winter.

North Bengal has one species of ailurid, 11 species of mustelid, 7 viverrids, and 3 herpestids (Choudhury, unpubl.). In this paper I present the information at present available on the different species.

Species notes

AILURIDAE

Red panda, *Ailurus fulgens*

Found only in the higher areas of Darjeeling district. Known populations are confined to Shingalila and Neora Valley National Parks only. It has already vanished from the forests near Darjeeling including Senchal Sanctuary. Although rare it is still not uncommon in suitable localities inside these two national parks. It occurs above 2000 m ASL in subtropical and moist temperate forests with bamboos, and also in subalpine forest.

MUSTELIDAE

Yellow-bellied weasel, *Mustela kathiah*

Both common and widespread in the hills of Darjeeling district, and it might also occur in the hilly Buxa Fort and Chunabhati areas of Buxa Tiger Reserve of Jalpaiguri district. This hill-dwelling species could be seen during the day time also. It usually occurs above 1,000 m ASL although in winter it may come down a little lower. Part of its population is protected in the Neora Valley NP, Shingalila NP, and Senchal Sanctuary.

Siberian weasel, *Mustela sibirica*

A high elevation species occurring only in the mountains of Darjeeling district. It is rarer than *Mustela kathiah*. Since it occurs mostly above 2,400 m ASL, its distributional range is very limited. Protected areas having this species are the Neora Valley NP, Shingalila NP, and Senchal Sanctuary.

Back-striped weasel, *Mustela strigidorsa*

Found in the higher hills (usually above 1,000 m and below 2,000 m ASL), especially in the middle ranges of the eastern Himalayas (Darjeeling district). This species is also rarer than *Mustela kathiah* but its possible occurrence in the hilly areas of Buxa Tiger Reserve of Jalpaiguri district is not ruled out. Its occurrence in north Bengal is mentioned by ZSI (1992).

Beech marten, *Martes foina*

Found in Darjeeling district, only occurring in the middle and higher ranges of the eastern Himalayas (usually above 1,500 m ASL). Protected areas having this species are Neora Valley NP (Ghose, 1985), Shingalila NP, and Senchal Sanctuary. This species is rare.

Yellow-throated marten, *Martes flavigula*

Common all over Darjeeling and the northern areas of Jalpaiguri district, however, its distribution is restricted to forested areas (both tropical and subtropical) and hence its continued presence in Koch Bihar district is doubtful and in all probability it is extinct here. It is very rare in the southern areas of Jalpaiguri district. Usually seen singly although two animals are also encountered. Occurs from near the edge of the hills to the higher mountains. In the less disturbed forests, such as Neora Valley and Mahananda, it can be seen during the daytime also.

Honey badger or **ratel, *Mellivora capensis***

Very rare. Found in the southern areas of Darjeeling district and in Jalpaiguri district. Its present status in Koch Bihar is not known, but considering the lack of habitat in the area, it might be either extinct or perhaps only stray animals are left. Usually an animal of drier environments and not known to occur in north-eastern India (Prater, 1948; Corbett & Hill, 1992) the ZSI (1992) has recorded it in Jalpaiguri district. Protected areas having potential habitat include Buxa Tiger Reserve, Jaldapara Sanctuary, Gorumara NP, and Mahananda Sanctuary.

Hog-badger, *Arctonyx collaris*

Not uncommon, this species is widely distributed in the forests as well as in well-wooded parts of the countryside in Darjeeling, Jalpaiguri and Koch Bihar districts. Most records were of lone animals.

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

Occurs in the foothills and grasslands of Darjeeling and

Jalpaiguri districts. Observation is very difficult due to its nocturnal habits. There are specific records from Jaldapara Sanctuary and from Hasimara (ZSI, 1992). Potential habitat is in Gorumara NP, Mahananda Sanctuary, Chapramari Sanctuary, and Buxa Tiger Reserve.

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

Occurs but exact status is unclear. Not recorded by ZSI (1992), however, a dead specimen (road-kill) was found near the road side in Buxa Tiger Reserve in 1995. As in *Melogale personata*, observation is very difficult.

Common otter or **Eurasian otter,** ***Lutra lutra***

Not uncommon, especially in the hill streams including the larger rivers such as the Teesta, Mahananda, Jaldhaka, Neora, Raidak, and Torsa. Occurs in the mountains also (above 2,500 m ASL). Also recorded from wetlands of the plains of Jalpaiguri and Koch Bihar. Seen singly, in twos (often pairs) or small groups.

Smooth-coated otter, ***Lutra perspicillata***

Common and familiar, this species is also well distributed in the hills and plains affecting rivers, lakes, marshes, pools, ponds, and even road-side ditches, in all three districts. Seen singly or in small groups. This species is usually not found in the higher hills and mountains.

Short-clawed otter, ***Aonyx cinerea***

Not uncommon in wetlands including rivers, but less numerous than *Lutra perspicillata*. Found mainly in the plains and foothills including Jaldapara Sanctuary and Gorumara NP.

VIVERRIDAE

Large Indian civet, ***Viverra zibetha***

Common and widespread all over north Bengal. Found in the plains as well as the hill forests, plantations, scrub jungle, as well as in the vicinity of villages. Usually seen singly.

Small Indian civet, ***Viverricula indica***

Very common all over north Bengal except for the high mountains. It prefers the vicinity of human habitations and regularly takes domestic chickens and ducks. It is common even in busy towns such as Siliguri and Jalpaiguri.

Spotted linsang, ***Prionodon pardicolor***

The rarest of all the small carnivores covered by this paper. Observation is very difficult and there are no records of specimens from north Bengal, although their occurrence in Assam and Nepal suggests their presence in the area, (unconfirmed reports have been received from Mahananda Sanctuary and Buxa Tiger Reserve). It is likely to occur in some other protected areas such as Neora Valley and Shingalila NPs, and the Jaldapara and Senchal Sanctuaries, but in very small numbers. This species is rare all over its range.

Common palm civet or **toddy cat,** ***Paradoxurus hermaphroditus***

Very common all over, including within forests and well-wooded villages and towns. It is a familiar and well-known killer of domestic poultry.

Masked palm civet, ***Paguma larvata***

Also common, but less abundant than the toddy cat. It occurs all over Darjeeling district and in the hilly areas of northern Jalpaiguri district, especially in the forests and light woodlands of the foothills and hills. This species is also found in many of the protected areas such as Mahananda and Senchal Sanctuaries, Jaldapara Sanctuary (northern areas near Totopara), Neora Valley NP, and Buxa Tiger Reserve.

Binturong or **bear-cat,** ***Arctictis binturong***

No record from north Bengal exists so far (ZSI, 1992). However, its records from adjacent areas of Sikkim and Bhutan suggest that small numbers do occur in the Neora Valley NP and also perhaps in the Buxa Tiger Reserve. It is an animal of the foothills and hills with good tree-cover.

Small-toothed palm civet, ***Arctogalidia trivirgata***

Its presence in the area needs further investigation. Its known distribution in north-eastern India is in the south bank of the Brahmaputra River which suggests that it is unlikely to occur in north Bengal. However, Sclater (1891) mentions the species from Darjeeling district. There are no other specimen records thus far (ZSI, 1992).

HERPESTIDAE

Small Indian mongoose, ***Herpestes auropunctatus***

Very common all over north Bengal inhabiting almost all types of habitats ranging from forests, scrub jungle, and grassland to the vicinity of human habitations (towns and villages).

Indian grey mongoose, ***Herpestes edwardsii***

Also very common all over north Bengal, inhabiting almost all types of habitats ranging from forests, scrub jungle and grassland to the vicinity of human habitations (towns and villages).

Crab-eating mongoose, ***Herpestes urva***

Not uncommon in forested areas, both plains and hills of Darjeeling and Jalpaiguri districts. This species inhabits wetlands and forest streams. Not observed near human habitations. However, sightings are rare. The species is less agile than the other two species and vanishes amongst undergrowth whenever allerted by the presence of any human being. Usually seen in groups of twos or more. There are also past records from Darjeeling and Jalpaiguri districts (Wroughton, 1916).

Discussion

There is an urgent need to undertake 'base-line' studies on the small carnivores in biodiversity-rich areas like north Bengal. As in the case of Assam and Arunachal Pradesh (Choudhury, 1997a, 1997c), potential researchers tend not to show much interest in these animals. Nocturnal, shy, and little known, the small carnivores are yet to generate curiosity (to a great extent!) among the students and scientists.

The exact status of many species is still unclear (e.g. *Mustela strigidorsa, Melogale* spp., and *Prionodon pardicolor*). Moreover the occurrence of *Arctictis binturong* is yet to be confirmed but its presence cannot be ruled out in the extreme northern areas because of records from the adjacent areas of Sikkim and Bhutan. Considering the large-scale deforestation here, forest-dwelling species such as the red panda and the spotted linsang are perhaps becoming rarer day by day. The main reasons of deforestation are felling and encroachment. Unlike other parts of north-eastern India, *jhum* or slash-and-burn shifting cultivation is not there. But there are problems from the orange cultivators in Buxa Tiger Reserve (Chunabhati and Fort areas) who have

destroyed good tropical forest. Large forest areas were also converted into tea and cinchona plantations in the past.

Most of the mustelids, viverrids, and herpestids are considered edible by some of the tribal groups including the tea garden labourers inhabiting the different parts of north Bengal. They are often trapped with the help of crude snares or shot with guns for the pot. Because most species are cryptically coloured and nocturnal, such hunting does not represent a serious threat as the numbers involved always remain very low. Species such as *Viverricula indica, Paradoxurus hermaphroditus, Herpestes auropunctatus*, and *H. edwardsii* appear to be in no danger from any corner, and their survival is assured because of their adaptability within a diverse range of habitats (including human habitations). The protected area network present in north Bengal also helps conservation of some of these animals (Fig. 1.), Buxa Tiger reserve (759 km^2), Neora Valley NP (86.9 km^2), Gorumara NP (78 km^2), Shingalila NP (78.6 km^2), Jaldapara Sanctuary (115.6 km^2), Chapramari Sanctuary (9.6 km^2), Senchal Sanctuary (38.6 km^2), and Mahananda Sanctuary (129 km^2) are all protecting significant habitats of the small carnivores. Protection measures are adequate in Jaldapara, Gorumara, parts of the core area of Buxa, and also to a great extent in Mahananda; however, it is inadequate in Senchal.

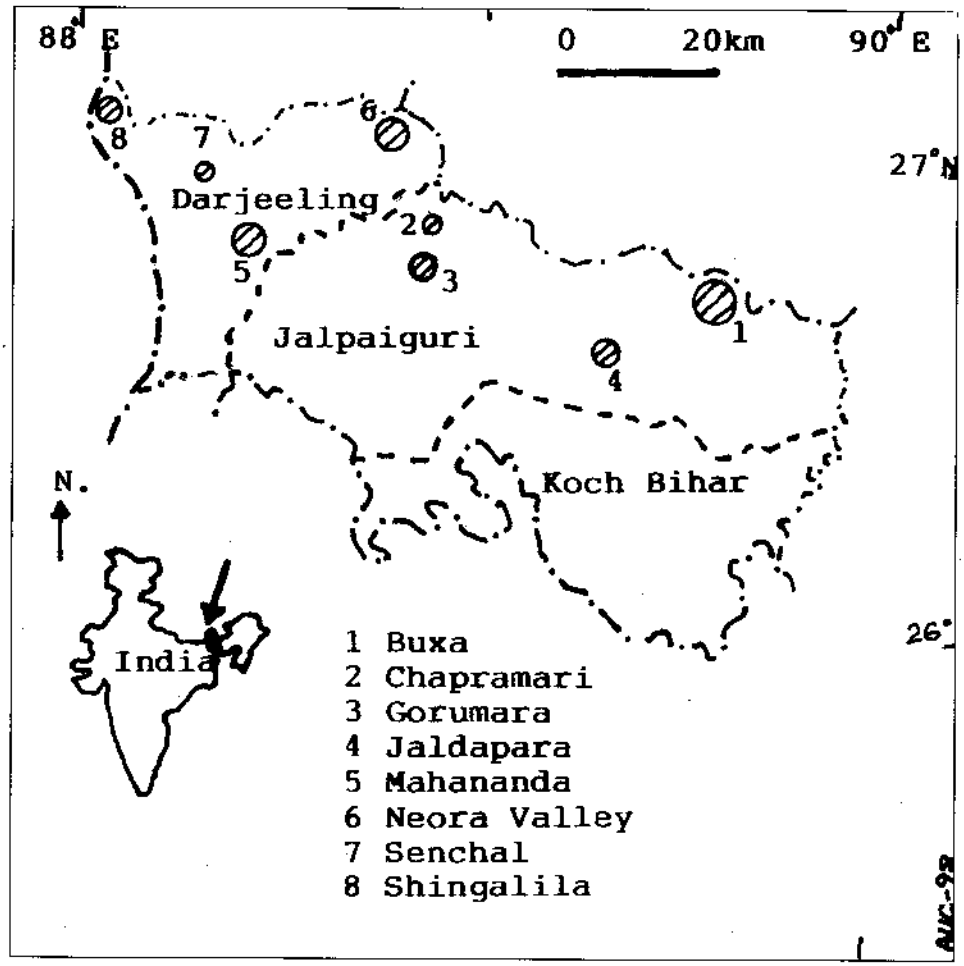


Fig. 1. Map of north Bengal showing districts - ▨ = protected areas

Acknowledgements

For help and assistance during field work as well as for providing valuable information, I would like to thank the following persons: S. S. Bist (Field Director of Buxa), Mr. Bahuguna (Director of Darjeeling Zoo), Ujjal Bhattacharjee and Mr. Chaki (Range Officers, Bamonpokhri), the staff based at Mahananda, Lava, Kalimpong, Gulma, 10th Mile, 14th Mile, Latpanchor, Jaldapara, Gorumara, Chapramari, Mirik, Panighatta, Laltong, Jaldhaka-Jhalong, Raja Bhatkhawa, Alipur Duar, Jainty, and Bhutanghat.

Saumyadeep Datta, P. Bhatta of NESPON, Hakeem Choudhury, Bondhon (both drivers) also extended help and I thank them all. Lt. Col. Shakti Banerjee, Dr. Silanjan Bhattacharjee, Ms Abhoya Bose, Gour Gopal Biswas and Hirak Nandy accompanied me to different forest areas (as part of a WWF-Forest Department Project on the Gaur) and I thank them.

References

Choudhury, A. U. 1994. *Checklist of the mammals of Assam.* Gibbon Books, Guwahati.

Choudhury, A. U. 1997a. The distribution and status of small carnivores (mustelids, viverrids, and herpestids) in Assam, India. *Small Carnivore Conserv.*, 16:25-26.

Choudhury, A. U. 1997b. *Checklist of the mammals of Assam.* Revised 2nd ed. Gibbon Books with ASTEC, Guwahati.

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

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

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

Ghose, R. K. 1985. Ecological observation on the Neora Valley, Darjeeling district, West Bengal. *J. Bengal Nat. Hist. Soc.* (N.S.), 3(2):84-98.

Inglis, C. M., Travers, W. L., O'Donel, H. V. & Shebbeare, E. O. 1919. A tentative list of the vertebrates of the Jalpaiguri district, Bengal. *J. Bombay Nat. Hist. Soc.*, 26:819-825.

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).

Sclater, P.L. 1891. *Catalogue of Mammalia in the Indian Museum, Calcutta. Part 2.* Calcutta: Trusties of the Indian Museum.

Wroughton, R. C. 1916. Bombay Natural History Society's mammal survey of India, Burma and Ceylon. Report No. 23. Sikkim and Bengal terai. *J. Bombay Nat. Hist. Soc.*, 24:468-493.

Wroughton, R. C. 1917. Bombay Natural History Society's mammal survey of India, Burma and Ceylon. Report No. 27. Bhutan Duars. *J. Bombay Nat. Hist. Soc.*, 25:63-71.

ZSI (Zoological Survey of India). 1992. *Fauna of West Bengal. Part 1.* Zool. Survey of India, Calcutta.

The Rhino Foundation for Nature in NE India, c/o The Assam Co. Ltd., G. Bordoloi Path, Bamunimaidam, Guwahati 781 021, India

Fidelity and core area in the space and resource use system of the Pine marten, *Martes martes*

E. PULLIAINEN, A. KARUSALMI, P. OLLINMÄKI AND P. TUNKKARI

Introduction

The space and resource use system of the Pine marten, *Martes martes*, has been studied continuously for successive 22 winters in Finnish Forest Lapland by organizing tracking of individually recognizable animals for ca. 18,600 km (Pulliainen, 1981a, 1981b, 1982, 1984, Pulliainen & Ollinmäki, 1996). The data obtained so far allow us to analyse aspects such as long-term changes in the composition of the diet of this opportunistic predator (Pulliainen 1981a; Pulliainen & Ollinmäki 1996), the general characteristics of its space and resource use system (Pulliainen, 1981b, 1984), and the behaviour of individuals within their home ranges (Pulliainen, 1982).

Our studies (Pulliainen, 1981b, 1984) as well as those of Mech & Rogers (1977), for example, show that although the pine marten is not a territorial species, spatio-temporal separation of home ranges occurs. Pulliainen (1981b) called this space and resource use system of certain solitarily moving predators *martelism*.

One interesting detail in our project has been to study the fidelity ("Ortstreue") of martelistic pine martens and the nature of the possible core area in their home ranges. An answer to these questions was obtained by radio-tracking one male individual (called "Panu") for three successive winters. The purpose of the present paper is to provide records of these studies.

Material and methods

The area concerned, amounting to approximately 80 km^2, lies in Eastern Finnish Forest Lapland, west of the Värriö Subarctic Research Station (67°45'N, 29°37'E). The area is mainly in a virgin state and is dominated by mature spruce and mixed taiga forests with a large number of standing and fallen dead trunks. Some of the forests have been felled. The area is also characterized by stony hills, open bogs, some solitary fells and small rivers and brooks.

Resting site	**1993-94**	**1994-95**	**1995-96**
Under the snow	93.6	90.1	91.8
Under a fallen tree	57.9	78.7	76.6
Under the roots of a tree	9.3	0.0	1.3
Among rocks	26.4	11.4	13.9
Squirrel's nest	0.0	2.3	1.9
Hollow tree/hole in a tree	5.0	3.8	6.3
Others	1.4	3.8	0.0
Total number of resting sites,	**140**	**132**	**158**
which of different ≥	75	97	96

Table 1. *Resting sites of "Panu" expressed as percentages during three successive winters, 1993/94, 1994/95 and 1995/96. The number of resting sites means sites situated on different 100 x 100 metre grids.*

We will consider here the data arising from intensive tracking of the pine marten during three successive winters: 1993/94-1995/96. The lengths of the trackings for these three winters were 676.1, 564.9, and 1312.7 kilometres, respectively.

Panu was trapped for the first time in a hollow, dead spruce on 12 November 1993 and was weighed, radiocollared and released into the same hollow spruce. The radio collar was replaced with a new one on 20 November 1994, and again on 3 December 1995 and 4 December 1996. Panu's physical condition was determined by weighing in connection with each change of the radio collar. The tracking finished in November 1997, when Panu died in an accident.

The coordinates of all the resting sites were determined and the core area (the smallest area that contained 60% of the resting sites) and home range (95% of the resting sites, excluding occasional exploratory excursions) were estimated using the RangesV program. A fixed kernel estimator with a 0.5 h_{cv} smoothing parameter value was used (cf. Worton 1995). The rest site selection from year-to-year was tested using the G^2 test (Sokal & Rolf 1981).

Results

Physical condition. When captured for the first time in November 1993, Panu was one of the heaviest Pine martens ever weighed in our long-term study, with a body mass of 1,610 g. Thereafter the body mass decreased gradually year by year, being only 1,340 g in November 1997. It is worth mentioning that there was quite a low population density of small mammals in the area during these years (Pulliainen *et al.*, unpubl.).

Use of the home range. The daily rhythm of a pine marten was clear: the animal was active by night and spent the daylight (and twilight) times at resting sites which mainly were below the surface of the winter snow. Only in 6.4 % of cases did it rest above the surface of the snow (Table 1). When Panu succeeded in catching a large prey item, e. g. a Mountain hare or Willow grouse, it sometimes spent several successive days in the same resting site without leaving it. The year-to-year changes in its rest site selection were not significant (G^2 test, ns).

Panu appeared to be a good conservative in terms of behaviour showing remarkable fidelity by occupying the same area from one winter to another, and even the size of the home range varied within narrow limits (between 62 and 69 km^2; Fig. 1). Being a large male, it had a wide home range.

Structure of the home range. As mentioned above, the decision to go to a particular resting site is a purposeful one, and at least repeated use of the same resting site is evidence of residence. Both the core area (60 %) and home range (95 %) within Panu's living area are depicted in Fig. 1. The size of the core area varied between 1,893 and 1,970 ha, and that of the 95 % area between 6,168 and 6,938 ha. There were 5-6 fragments of core area pieces within the 95 % area.

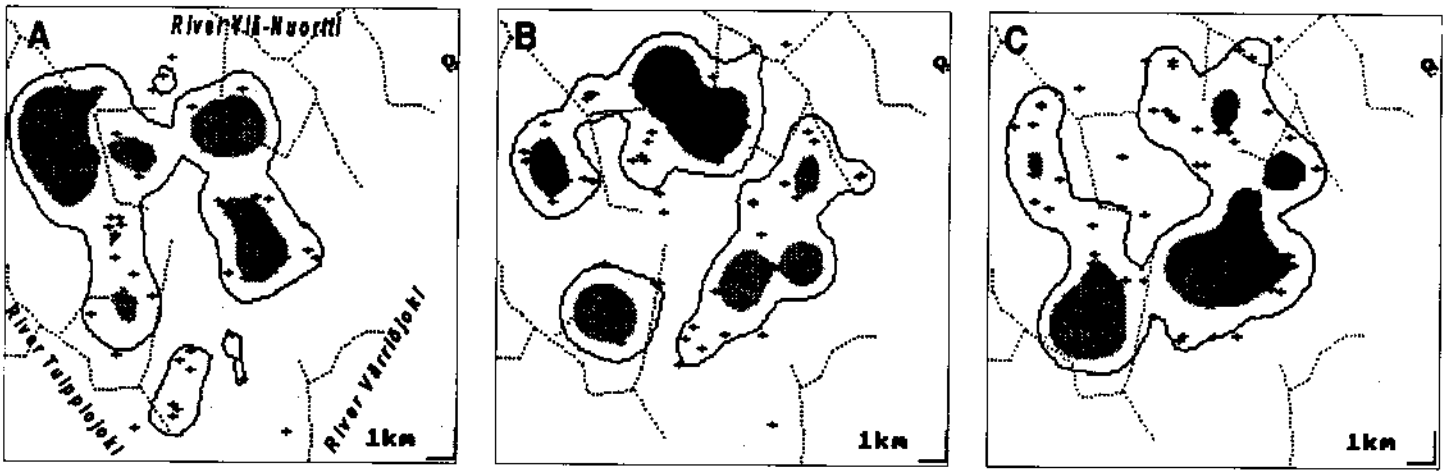


Fig. 1. *Home ranges of "Panu" during three successive winters, 1993/94 (A), 1994/95 (B) and 1995/96 (C). The map shows both the core areas (60 %, shaded) and the home range proper (95 %, solid line).* ● = *Värriö Subarctic Research Station,* ◆ = *centre of home range,* ✚ = *resting site.*

Discussion

Although it would be very easy for an opportunistic predator with a diet that may comprise both animals and easily digestible berries and mushrooms (Pulliainen, 1981a; Pulliainen & Ollinmäki, 1996) to move fairly freely from one place to another within a vast partly protected forest area, the pine marten instead preferred to show remarkable fidelity ("Ortstreue"). This conservative pattern must entail certain benefits relative to a free-moving pattern.

The pine marten is very purposeful in its orientation. Although it moves in the darkness of the night it knows its exact coordinates within its home range. It is able to use the scent marks left by itself to find its way to the resting site it intends to use during the next day, using a route that avoids areas with no overhead cover to avoid "victimization" (Pulliainen, 1981b, 1984).

Since Panu did not leave his home range, that area must have offered enough food for it from winter to winter, although it was evident that the abundance of the populations of small rodents varied to some extent. We must remember, however, that Panu's home range was always large and that there may be some home ranges of pine martens which are less than one tenth of this (Pulliainen, 1984). It is of the same magnitude as the largest one recorded so far (82 km^2 Pulliainen, 1984), in the measuring of which more edges were taken into account. Thus it is worth continuing these studies in order to ascertain what the site tenacity rate is when the home range covers only a few square kilometres (see Pulliainen, 1984), and how far the Pine marten wanders if it leaves its home range.

It is easy to imagine the benefits to be obtained from a familiar area, as governs the seasonal return migratory system of many animals (see Pulliainen, 1974; Baker, 1978). In the case of the pine marten, an individual may even prefer particular resting sites, to which it repeatedly returns directly, even in complete darkness. However, why do occasional trips out of this core area occur? They may simply be exploratory in nature, but usually pine martens are just tracking prey or they are looking for food after detecting promising scents.

The benefits of the division of a territory as practised by a wolf pack are apparent: unnecessary (fatal) confrontations with neighbouring packs are minimized and prey survive in the buffer zone. The general appearance of the structure of Panu's home range was very similar to that of a wolf pack, with a buffer zone at the edges and a core area in the middle (Mech, 1994). There is one fundamental difference, however: the home ranges of martelistic pine martens can partly or totally overlap (Pulliainen, 1981b, 1984) and thus the prey at the edge zones of the home ranges may be exploited in a similar manner to that in the core areas.

Acknowledgements

We would like to express our gratitude to the staff of the Värriö Subarctic Research Station for their help in the field. This paper constitutes Report No. 364 of Värriö Subarctic Research Station, University of Helsinki.

References

Baker, R. R. 1978. *The evolutionary ecology of animal migration.* Hodder and Stoughton, London.

Mech, L. D. 1994. Buffer zones of territories of grey wolves as regions of intraspecific strife. *J. Mamm.*, 75:199-202.

Mech, L.D. & Rogers, L. L. 1977. Status, distribution, and movements of martens in northeastern Minnesota. *USDA For. Ser. Res. Pap.* Nc-143:1-7.

Pulliainen, E. 1974: Seasonal movements of moose in Europe. *Natur. Can.*, 101:379-392.

Pulliainen, E. 1981a. Food and feeding habits of the pine marten in Finnish Forest Lapland in winter. Worldwide Furbearer Conference Proceedings August 3-11, 1980. Frostburg, Maryland USA. Vol. I:580-598.

Pulliainen, E. 1981b. Winter habitat selection, home range, and movements of the pine marten in Finnish Forest Lapland. Worldwide Furbearer Conference Proceedings August 3-11, 1980. Frostburg, Maryland USA. Vol. II:1068-1087.

Pulliainen, E. 1982. Scent marking in the pine marten (*Martes martes*) in Finnish Forest Lapland in winter. *Z. Säugetierk.*, 47:91-99.

Pulliainen, E. 1984: Use of home range by pine martens (*Martes martes*). *Acta Zool. Fenn.*,171:271-274.

Pulliainen, E. & Ollinmäki, P. 1996. A Long-term study of the pine marten (*Martes martes* Linné) in Finnish Forest Lapland. *Acta Theriol.*, 41:337-352.

Sokal, R. R. & Rolf, F. J. 1981. *Biometry.* Freeman, San Fransisco.

Worton, P. J. 1995. Using Monte Carlo simulation to evaluate kernel-based home range estimators. *J. Wildl. Manage.*, 59:794-800.

Värriö Subarctic Research Station, Linnanmaa, FIN-90570 Oulu, Finland

On the status of *Martes foina bunites* Bate, 1905

Arnd SCHREIBER

The Appendix 3 of the IUCN Conservation Action Plan for mustelids and viverrids (Schreiber *et al.*, 1989) provides a list of a large number of species and subspecies, some of which of questionable taxonomic validity, which are endemic to small distributional ranges, e.g. one or a few islands only. Although status information was absent or insufficient for assigning a definite category of threat to these taxa, small insular ranges might imply rarity and a high risk of extinction. Narrowly endemic taxa are clearly candidates for a closer look into their conservation status.

Among these taxa, the Aegaean or Cretan beech marten, *Martes foina bunites*, has been recommended to the attention of conservationists because it is endemic to islands in the Aegaean Sea, Greece. Apart from the 8,729 km^2-sized island of Crete (Barrett-Hamilton, 1899; Bate, 1905; Zimmermann, 1952; Niethammer & Niethammer, 1967), it has been reported from the much smaller islands of Skopelos, Naxos, Erimomilos, Karphathos, Samothrake, Seriphos, and Kythnos (Koller, 1928; de Beaux, 1929; Wettstein, 1942; Ondrias, 1965). Rhodes is said to be inhabited by a different subspecies, *Martes foina milleri* (Festa, 1914), whose separation from the Aegaean marten has never been validated (Ondrias, 1965).

The most conspicuous distinguishing character of *M. f. bunites* is the variability of the largely reduced white throat patch, which hardly ever reaches the extent observed in the nominate beech marten, *Martes foina foina*, from continental Europe (including mainland Greece, the Peloponnesus Peninsula, and at least Korfu off the Ionian islands). In some Cretan specimens, the throat patch is reduced to two white lateral stripes or small spot marks (Niethammer & Niethammer, 1967; Kumerloeve, 1970). Throat patch variability, and a trend to the reduction of this mark, is also typical of beech martens from the Turkish mainland (Kumerloeve, 1970), as well as of populations, *Martes foina intermedia*, living in Iran, Afghanistan, Kashmir, Tienshan, Mongolia and Chinese Turkestan (Heptner & Naumov, 1974). Niethammer & Niethammer (1967) concluded that the populations on the Aegaean Islands represented a marginally distributed relict stock with Asian affinities. They should have persisted as insular isolates from a period in earth history when at least the southern Aegaean island arc was a mountainous landbridge connected with Asia Minor (and with mainland Greece). The evolution on Crete of not less than eight subspecies and one true species of endemic mammals confirm the long-standing isolation of this island; geological data agree to suggest the interruption of a land connection with Asia already in pre-Pleistocene times (Sfikas, 1998). However, the geological evidence dates the most recent connection of the ancient southern Aegaean landmass with Asia minor at some 5 million years before present (Jahn & Schönfelder, 1995). Such an early date of insular isolation is difficult to reconcile with the divergence of the isolated marten stock merely at the subspecies level.

A modern revision of the geographic variation of *Martes foina* is unavailable (Heptner & Naumov, 1974; Stubbe, 1993). Kumerloeve (1970) doubted if the Aegaean, Turkish and southwest Asian populations were subspecifically distinct at all.

Neither is there any explanation for the scattered occurrence of the Aegaean marten on some, but not on all islands of the Cyklades and Sporades Archipelagos (Douma-Petridou, 1984). This irregular mosaic of inhabited islands, and islands for which there is no record of *M. foina*, although they seemingly do not differ in their habitat spectrum, could be explained either by an inadequate knowledge of the marten's range, or reflect the human-aided and therefore stochastic colonization of some, but not all sites in the Aegaean archipelagos. It is even unknown if the Aegaean marten lives a synanthropic* life, as is typical of *M. foina foina* in Central Europe. Within Crete, the published records of *M. f. bunites* giving exact origins refer to the western and central part of the island, including only Chania (Barrett-Hamilton, 1899; Bate, 1905), the White Mountains and the Ida range (Zimmermann, 1952), and the Katharo high plateau (Bate, 1905). Thus the literature suggests the occurrence in the more humid portions of Crete, and a preference for higher altitudes. Niethammer & Niethammer (1967) further obtained furs from a trader in Sitia.

Schreiber *et al.* (1989) recommended the collection of status data on the Aegaean beech marten, not the least because all Cretan wildlife is subject to heavy persecution, and several vertebrate species have been lost from this island during the last decades (Sfikas, 1998). Formerly densely forested, Crete nowadays retains a mere 2-10% forest cover, which became replaced by vast tracts of overbrowsed and eroded phrygana scrub and garigue (Jahn & Schönfelder, 1995). The fate of the Ibiza beech marten, a presumably distinct although taxonomically undescribed Mediterranean island population, which was reported to the Action Planning Committee as having been exterminated recently (Schreiber *et al.*, 1989), serves as an additional warning.

During a journey in the eastern third of Crete from 31st August-14th September 1998, five road-killed Cretan beech martens were found in the coastal plain and in low hills of the more arid eastern part of the island, incuding ecologically rather degraded, and even suburban, habitats. It is concluded that the Cretan beech marten is able to cope successfully with habitats created by human economic activities. Martens of this population do not avoid the proximity of human settlements, and may even prove synanthropic. In any case, *M. f. bunites* ranges through the most widespread and extensive habitat type of Crete, i.e. overbrowsed phrygana. With less certainty, but still with some plausibility, one could conclude that this subspecies is common.

One marten carcass was found on the road from Jerápetra to Goúrnia in the foothills of the Oris Thriptis range, in a relatively well-watered area used by traditional Mediterranean agriculture (olive tree groves, orchards, and small fields surrounded by dry walls piled up from loose stones). The area was traversed by a summer-dry watercourse fringed with giant reeds, and was dotted with single farm houses. The second marten had been killed on the highway-like national road N 90 from Ágios Nikolaos to Heraklion,

* synanthropic: living in or near human habitations, together with man

at some 1 km SE of Neapoli town. This specimen, like the third road-killed marten observed on the same road at some three kilometers further northwards to Mália, had ranged through hills covered with phrygana vegetation, consisting of thorny dwarf shrubs and scattered prostate *Quercus coccifera* bushes. The area was strewn with rocks and stones. At the kill site of the third marten, the national road traversed a gorge-like valley devoid of human settlements, with a dried-out watercourse. This specimen was flattened and badly destroyed by traffic, but was the only carcass which could be examined: Its dorsal fur was greyish-brown to buff-coloured, the legs were blackish-brown, and those portions of the front part not completely destroyed displayed no trace of a white throat patch. The fourth marten lay in the immediate vicinity of Chersónisou town, where the new perimeter road around the city passes through a barren hill slope with short dry grasses, therophytes and many spots of bare soil. Trees, rocks, or other shelters were not available at this site, but the edge of the town followed at a distance of only 500 m. The fifth marten carcass was observed on the Heraklion-Rethimnon road, at some 3-4 km west of Heraklion, the capital of Crete, in an area used by relatively intense agriculture, which included patches of suburban wasteland.

These carcasses were seen while driving some 800 km through the eastern third of Crete, i.e. the region roughly between Heraklion, Jerápetra, and Sitia. However, at least 50% of this distance was travelled on winding and rather narrow and sometimes bumpy mountain roads, some of them without asphalt cover, where the low maximum driving speed is believed to make collisions with crossing martens unlikely. Not unexpectedly, all carcasses of Cretan martens (and of domestic cats too) were observed exclusively on the modernized national road N 90 in the northern coastal plain and the adjacent low hills, or on its major branch to the south coast city of Jerápetra.

Considering the state of decomposition in the Cretan summer heat, none of the five martens is believed to have been killed more than a few days, at most, before these observations, and the best-preserved, presumably freshly-killed specimen had been collected by passers-by within a few hours of detection by the author. One might conclude that five dead Cretan martens represent the minimum traffic mortality on the N 90 within a few days only. On this road, beech martens were killed as commonly as were domestic cats.

Note: In his booklet *Birds and mammals of Crete*, G. Sfikas (1998) presents a colour photo showing the dorsal fur of a Cretan marten. The blackish-brown legs of this otherwise buff-coloured subspecies are clearly evident. Sfikas (1998) does not provide detailed status information except reporting an «extreme increase» of the local marten population in the protected Samaria Gorge Nature Reserve. In another chapter, the Cretan marten is enumerated among other mammals said to have been decimated by the active persecution of most wildlife species on Crete. By contrast, the endemic Cretan badger, *Meles meles arcalus*, of which a mounted specimen is depicted by a good colour photograph, is said to be «rather common». The equally endemic subspecies of weasel, *Mustela nivalis galinthias*, is reported to be «common throughout the island». The favourable conservation status suggested by the present observations and by Sfikas (1998) for the Cretan mustelids is a difference to the precarious situation of the endemic Cretan wild cat *Felis silvestris agrius*, which is reported as nearing extinction (Sfikas, 1998).

References

Barrett-Hamilton, G. 1899. Note on the Beech marten and Badger of Crete. *Ann. Mag. Nat. Hist.*, 7:383-384.

Bate, D. 1905. On the mammals of Crete. *Proc. Zool. Soc. London* 1905:315-323.

Beaux, O. de. 1929. Ricerche faunistice nelle isolate italiane dell Egeo, mammiferi. *Arch. Zool. Ital. (Napoli)* 13:1-3, 5-24.

Douma-Petridou, E. 1984. Contribution to the knowledge of *Martes foina* Erxl. (Mammalia, Carnivora) from Achaia, northern Peleponnessus, Greece and rest southern Balkan Peninsula. *Mammalia* 48:565-572.

Heptner, V. G. & Naumov, N. P. , eds. 1974. *Die Säugetiere der Sowjetunion. Band II: Seekühe und Raubtiere.* Gustav Fisher, Jena.

Jahn, R. & Schönfelder, P. 1995. *Exkursionsflora für Kreta.* Eugen Ulmer, Stuttgart.

Koller, O. 1928. Zur Verbreitung von *Martes bunites. Zool. Anz.*, 75:114.

Kumerloeve, H. 1970. Zur Kehlfleck-Variabilität bei türkischen Steinmardern, *Martes foina* (Erxleben, 1777). *Säugetierk. Mitt.*, 18:278-279.

Niethammer, G. & Niethammer, J. 1967. Zur Variabilität der Kehlzeichnung beim Steinmarder, *Martes foina* (Erxleben, 1777). *Z. Säugetierk.*, 32:185-197.

Ondrias, J. C. 1965. Die Säugetiere Griechenlands. *Säugetierk. Mitt.*, 13:109-127.

Schreiber, A., Wirth, R., Riffel, M., & Van Rompaey, H. 1989. *Weasels, civets, mongooses, and their relatives. An action plan for the conservation of mustelids and viverrids.* IUCN, Gland.

Sfikas, G. 1998. *Birds and mammals of Crete.* Efstathiadis Group, Athens.

Stubbe, M. 1993. *Martes foina* Haus-, Steinmarder. Pp. 427-479 *in* M. Stubbe and F. Krapp, eds. *Handbuch der Säugetiere Europas, Band 5. Teil 1.* Aula-Verlag, Wiesbaden.

Wettstein, O. von. 1942. Die Säugetierwelt der Ägäis, nebst einer Revision des Rassenkreises von *Erinaceus europaeus. Ann. Naturhist. Mus. Wien* 52:245-278.

Zimmermann, K. 1952. Die Carnivora von Kreta. *Z. Säugetierk.*, 17:58-65.

Zoologisches Institut I, Universität Heidelberg,
Im Neuenheimer Feld, 230,
D-69120 Heidelberg, Germany
E-mail: r05@ix.urz.uni-heidelberg.de

2nd International Wildlife Management Congress

The 2nd International Wildlife Management Congress: «Wildlife, Land, and People: Priorities for the 21st Century», will be organized in Gödöllő, Hungary, at the University of Agricultural Sciences (29 km east of Budapest) from 28 June to 2 July 1999.

For information contact:
The Wildlife Society,
5410 Grosvenor Lane, Bethesda, Maryland 20814, USA
E-mail: tws@wildlife.org Http://www.wildlife.org

How to identify mustelid tracks

Vadim E. SIDOROVICH

Skill in identifying the signs of mustelid activities is very important for research on these species. It is especially important to know the distinguishing features of the mustelid tracks to use these skills in snowtracking, for winter census and during any other fieldwork on mustelids.

In this brief paper, descriptions of the distinguishing features of the most complicated situations to differentiate mustelid tracks such as those of European mink, American mink and polecat or weasel and stoat are given taking into account that the simple situations in identifying the mustelid tracks, e.g. tracks of otter and badger, badger and pine marten etc. are well known. Moreover, such previous knowledge is easily got from the many field guides and literature on mustelid ecology. Nevertheless, typical pictures of the tracks of all mustelid species occurring in the forest zone of Europe are presented (Figs. 1-8).

Otter tracks (Fig. 1) are fairly specific, and it is easy to differentiate them from the tracks of any other mustelid species. They are 6.5-13.5 cm long by 5.5-7 cm wide for the hind footprint and 5.5-9 by 6 cm for the fore footprint (adults).

Badger tracks are also specific (Fig. 2) and usually about 6 cm long by 5 cm wide for the hind footprint and about 6 by 5.5 cm for the fore footprint (adults). There are very long and solid claws, especially on the forepaws. The tracks are broad in relation to their length and the fore footprint is larger than the hind footprint.

In Figs 3-5, the martens' tracks are shown. In winter the Pine marten's footprints are larger than in the warm season: usually 4.5-6 cm long by 3.5-4 cm wide versus 4-5 by 3-3.5 cm. The size of adult Stone marten footprints does not change during the year, and it is similar to the size of the pine marten's footprints in summer. In the warm season, it is fairly difficult to distinguish the tracks of pine marten (Fig. 3) and the stone marten (Fig. 5), whereas usually there is no problem to differentiate between them in winter. In the cold season, all the pads of the pine marten are overgrown by hair. Therefore, instead of the normal pad prints there are the larger hair prints with unclear edges (Fig. 4). Fairly often it is impossible to find any such prints on the winter footprints of pine martens. In the cold season, the tracks of stone martens look like the ones in summer (Fig. 5). The relatively slow bounding gait of martens gives trails in twos, 30-60 cm apart. A high-speed bound creates a trail that consists of footprints in groups of either two or four with a stride of 50-90 cm. If a marten walks, the trail consists of separate footprints located on the line of movement with a stride of 5-10 cm. Stone martens walk more often than pine martens. Also, the type of habitat can indicate the marten species whose tracks are observed there. Normally, in the temperate forest zone, pine martens inhabit forest whereas stone martens only live in open landscapes, especially in and around villages. Nevertheless, in mainly open river valleys, fragmented woods and parks, the tracks of both marten species may be observed.

Footprints of adult mink (Fig. 6b & c) have less size than marten footprints: usually 3-4.4 cm long by 2-2.6 cm wide. Although the European mink is characterized by a smaller size than the American mink, both mink species have nearly equal footprint sizes which are only slightly different in males and females. Polecat footprints (Fig. 6a) are rounder: usually 2.5-3.8 cm long by 2-3.6 wide. There are several important features of the footprints that allow identification. When examining the pads in the feet of both mink species and the polecat, it easily can be noticed that the European mink and polecate have relatively large pads, while the American mink has considerably smaller ones. The differences are particularly convincing when individuals with approximately equal dimensions and weights are examined. Due to the specific character of the foot's construction, their tracks on soft ground or fine-aired snow turn out differently. So, in polecat (Fig. 6a) and European mink (Fig. 6b), the area of a footprint (filled by the prints of digital and interdigital pads) turns out to be considerably larger than in the American mink (Fig. 6c). Also, claw prints in polecat tracks are more crooked, while claw prints in mink tracks (Fig. 6) are shorter and mainly straight. Another important feature in the tracks of mink and polecat is the way in which footprints are grouped in their succession (Fig. 7). Footprints of the European mink usually lie in pairs (Fig. 7a). Within the pairs footprints are mainly located at an incline. The American mink's trail consists of footprint groups of either two or four, but a particular track pattern is maintained for a rather long distance. Over a distance of 300 m it should be more than 80% of the particular pattern of footprint grouping, whereas the proportion of twos and fours in polecat tracks varies between 40 and 60% (Fig. 7c). Footprints in the groups of the trail of the American mink are located at an incline as in the tracks of the European mink. The front footprints in their groups on a polecat's trail are mainly located on a line which is perpendicular to the direction of movement. Such a pattern of footprint grouping should be recorded in more than in 80% cases or a 300 m trail. In trails of mink and polecat stride usually varies between 20-70 (average ca. 40 cm). Also, an important feature to separate the tracks of mink and polecat is that polecats normally do not catch aquatic prey if the air temperature is below 0°C.

Footprints of adult individuals of the small mustelids (Fig. 8) are smaller than the footprints of mink and polecat. Stoat tracks are 2-3.5 cm long by 1.4-1.8 wide for the hind footprint and 1.8-2 by about 1.5 cm for the fore footprint in adults. Relatively slow-speed moving, stoats give trails in twos, 14-30 cm apart. A high-speed bound creates a trail consisting of footprints in groups of four with a stride of 30-70 cm (average ca. 50 cm). Weasel tracks are 1-1.7 cm long by about 1 cm wide. Stoat footprints are more oval, especially the hind ones, while footprints of weasels are nearly round (Fig. 8a & b). Weasel trails consist of footprints in groups of two, usually with 12-40 cm between each group.

The front footprints of the stoat's trail are mainly located at an incline, whereas footprints in pairs of weasel tracks are mainly located on a line which is perpendicular to the direction of movement. Sometimes, a tail mark is recorded in trails of the small mustelids, which looks very different in the tracks of stoats and weasels (Figs. 8c & d) - the tail of the stoat is longer and wider than a weasel's. It could be also an important feature to separate the tracks of the small mustelids.

Some difficulties may arise in distinguishing tracks of female mink and both sexes of stoat, as well as female polecat and both sexes of stoat. The appearance of the pad prints (Figs. 6 & 8) and the footprint form (footprints of mink and stoat have an oval form, while polecat tracks are rounder) can be useful for this. In winter the use of aquatic environments to catch prey is a good enough feature to identify the tracks of mink.

Acknowledgements

I am grateful to Dr. W. Jedrzejewski for his useful comments about recognition of small mustelid tracks and to Sergei Saluk who also helped to draw Figs. 1-8 of mustelid tracks and trails.

Institute of Zoology,
National Academy of Sciences of Belarus,
The Vertebrate Predation Unit,
Academicheskaya Street, 27, Minsk -220072, Belarus
E-mail: mustbel@mustbel.belpak.minsk.by

Fig. 1. *Otter footprints (right=right hindpaw, left= right forepaw)*

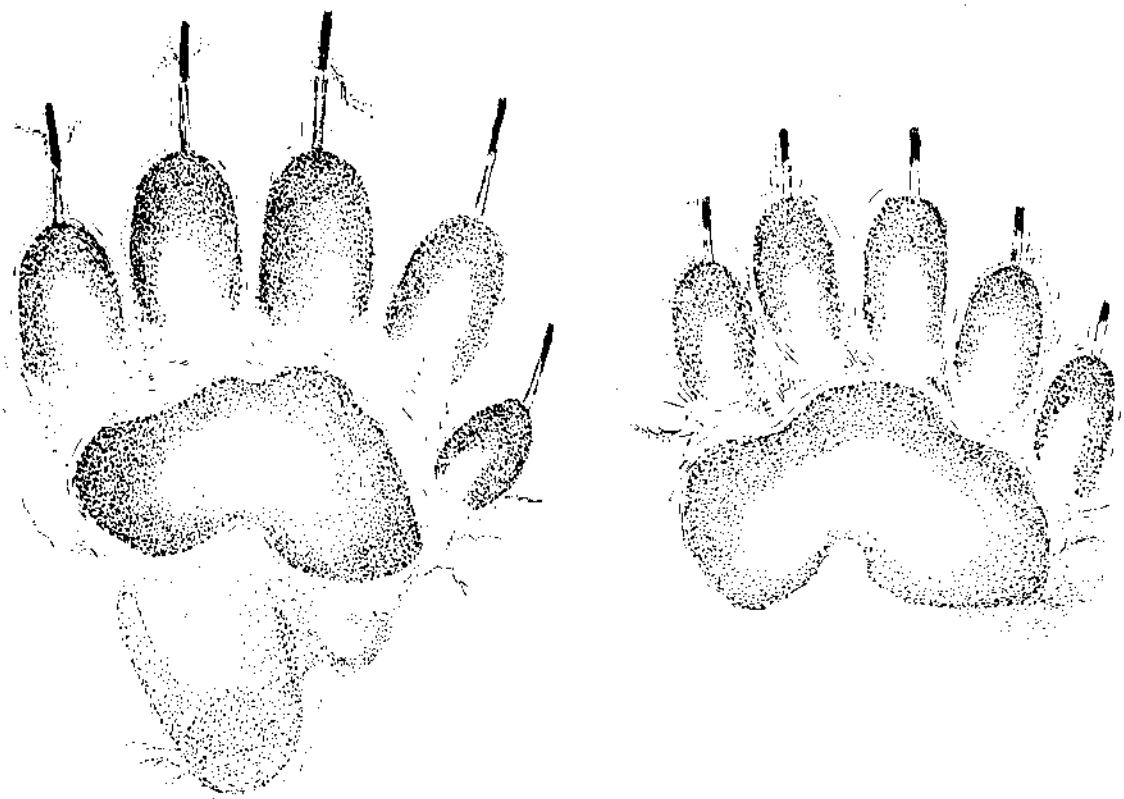


Fig. 2. *Badger footprints (right=right hindpaw, left=right forepaw)*

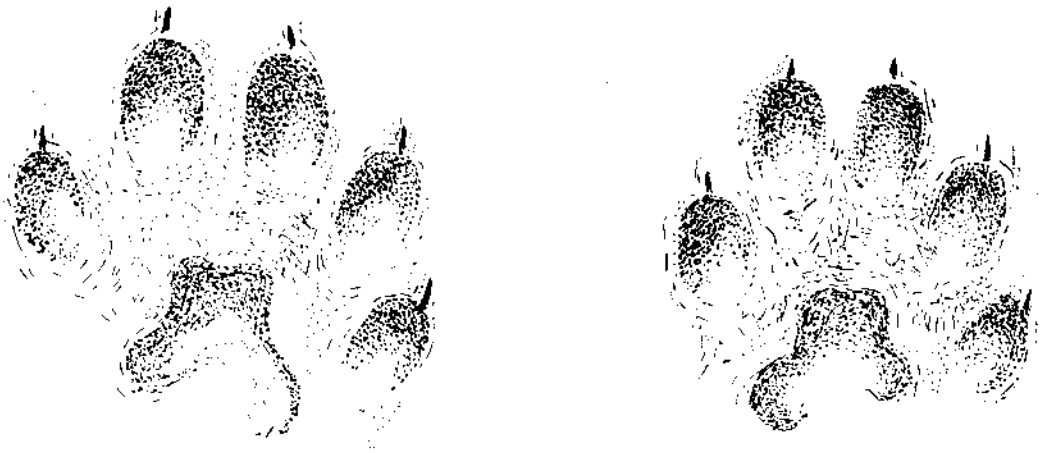


Fig. 3. *Footprints of pine marten in the warm season (right=right hindpaw, left= right fore paw)*

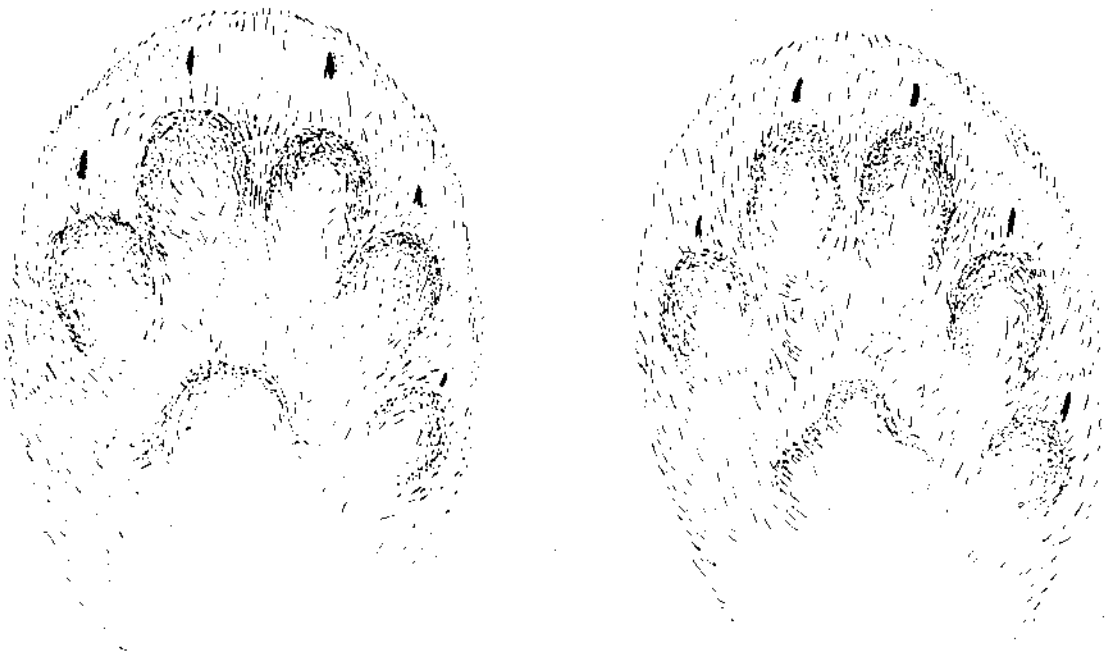


Fig. 4. *Footprints of pine marten in winter (right= right hindpaw, left= right forepaw)*

Fig. 5. *Footprints of stone marten (right= right hindpaw, left= right forepaw)*

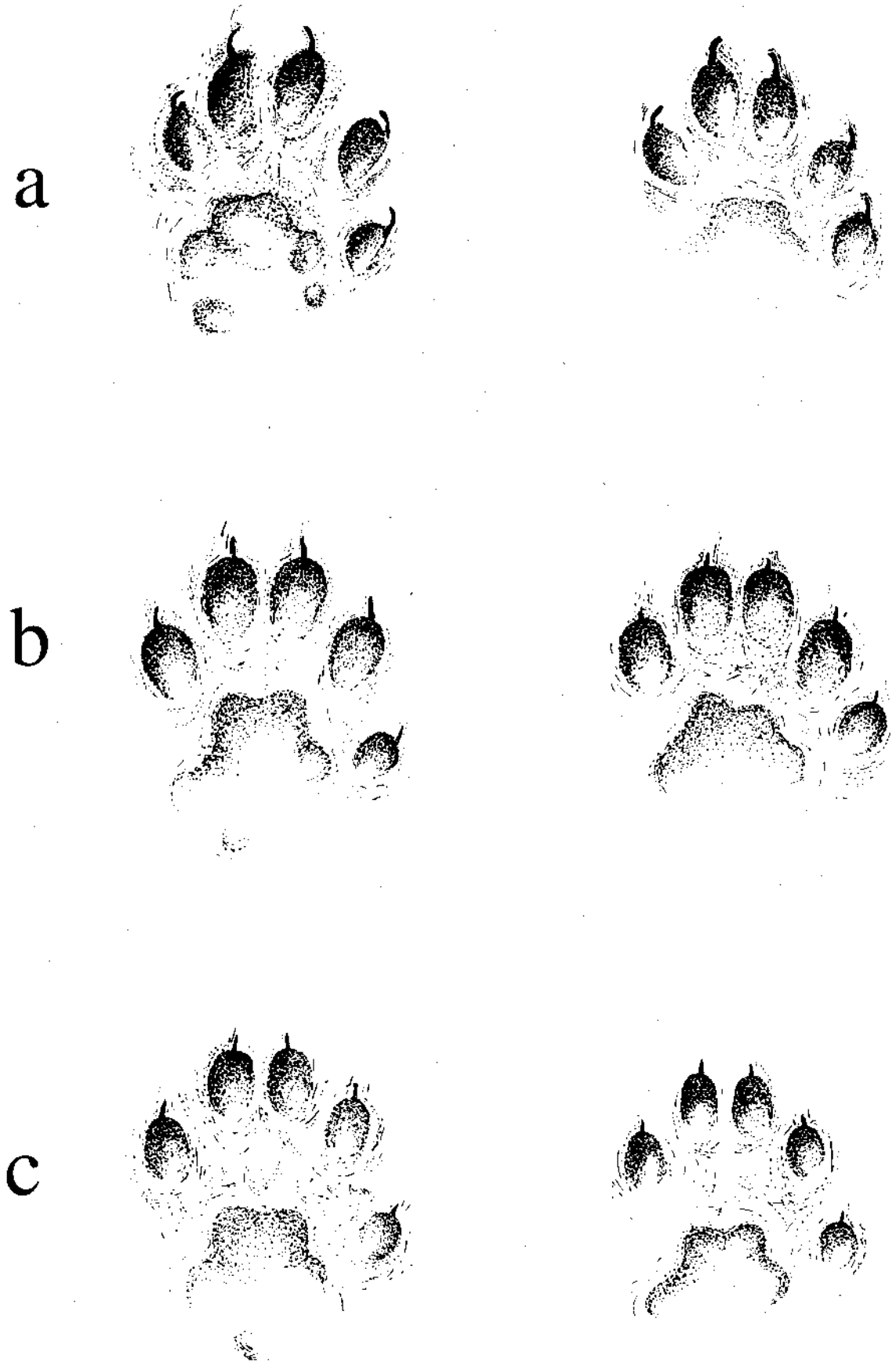


Fig. 6 *(a) Footprints of polecat, (b) European mink, (c) American mink (right=right hindpaw, left=right forepaw)*

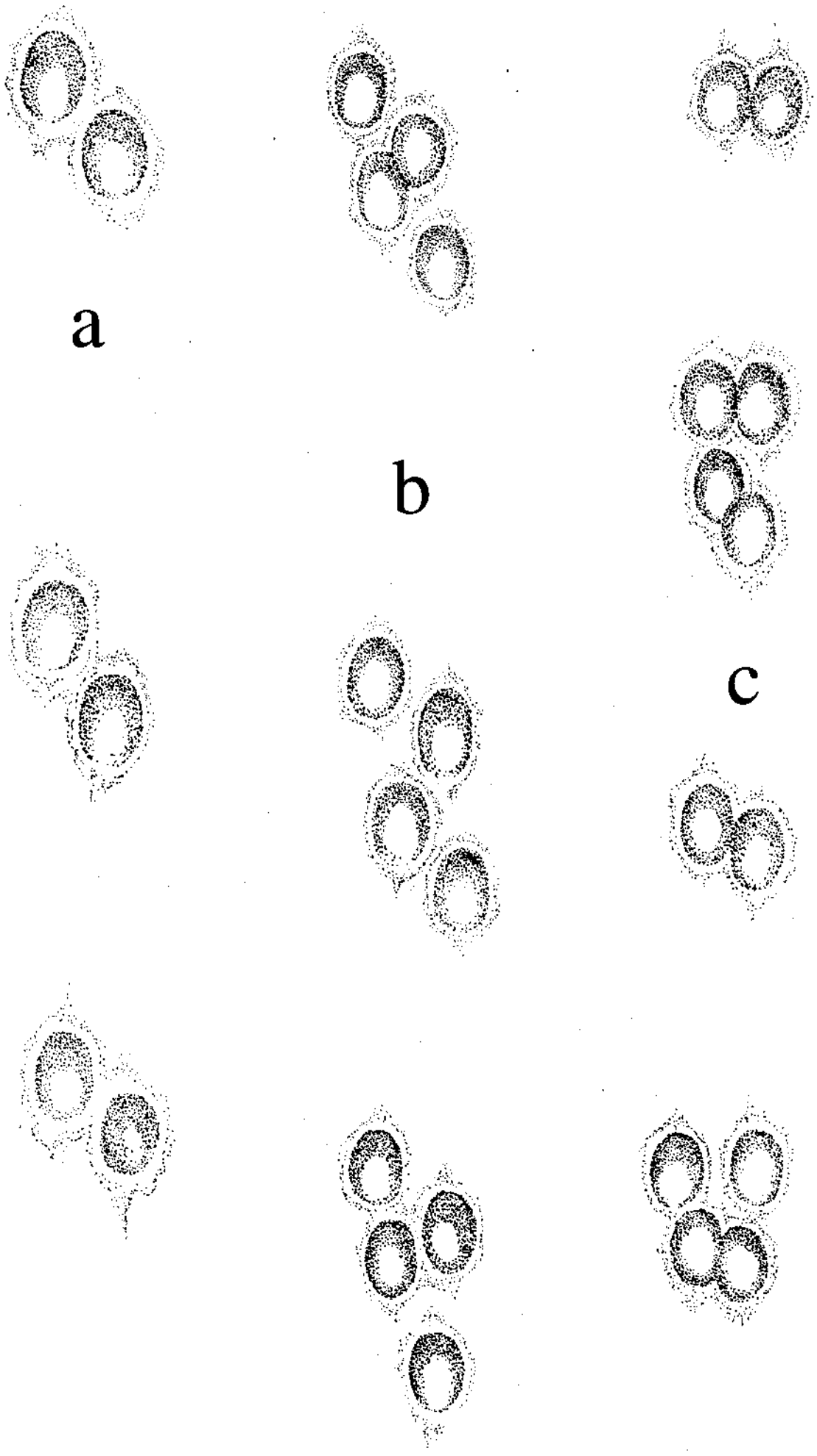


Fig. 7. *Typical trails of (a) European mink, (b) American mink, (c) polecat*

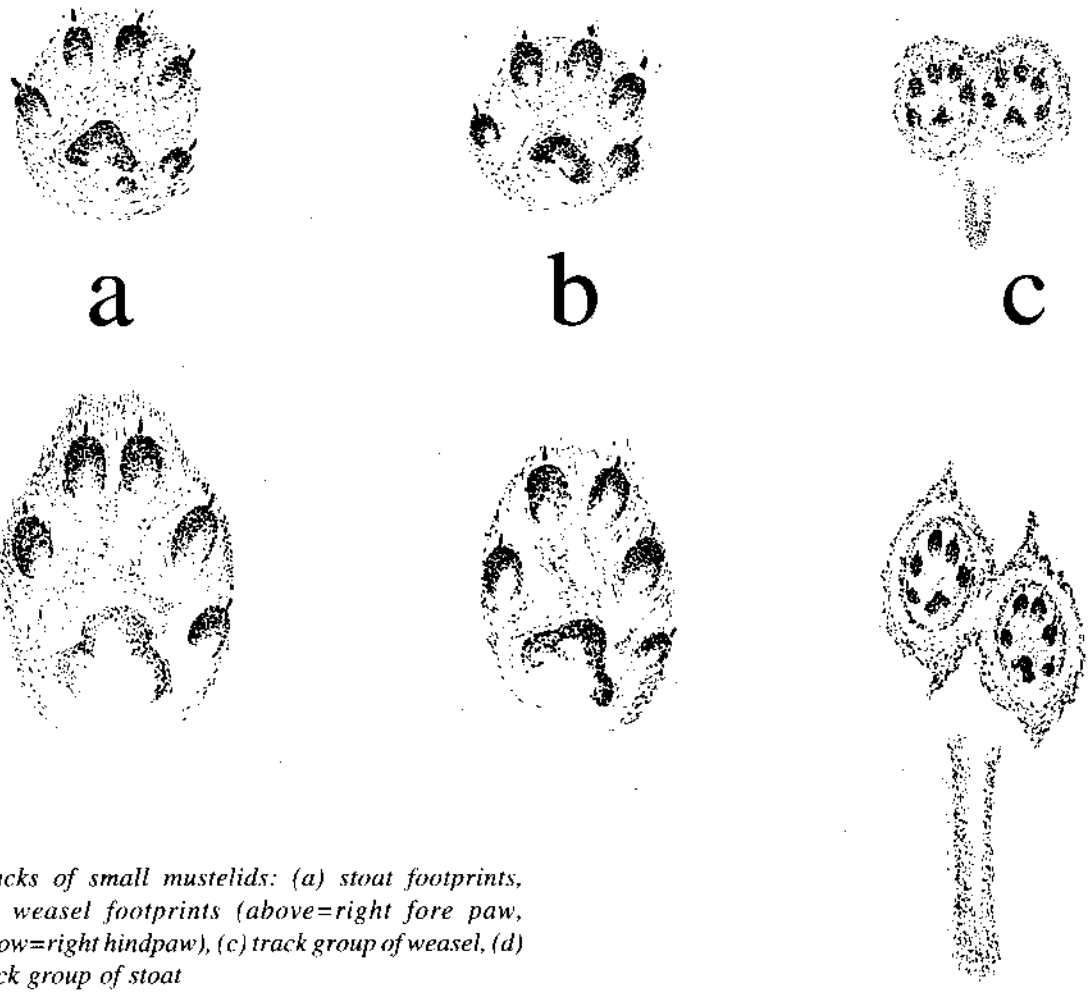


Fig. 8. *Tracks of small mustelids: (a) stoat footprints, (b) weasel footprints (above=right fore paw, below=right hindpaw), (c) track group of weasel, (d) track group of stoat*

18th Mustelid Colloquium, 16-19 September 1999, Schloss Zeillern, Austria

This year the Austrians are organizing the mustelid collo-
.m. The 1999 program will present contributions from the
le field of investigations on mustelids (morphology, genetics,
.iology, ethology, ecology, hunting and trapping...). Oral
.entations should deal with planned projects or "work in
.ress", posters should present already finished studies.

In round tables and a planned panel discussion there will
.mphasis on the topic "do our results have any influence on
.lation or the practice of conservation and hunting".

As an excursion a hike across rolling meadows with
.sands of old apple trees in the adjacent "cider country" (a
.liar and rare type of landscape!) is planned.

Dates

Sept 16: Welcome reception
Sept 17: Scientific program
Sept 18: Scientific program, excursion and farewell meeting
Sept 19: Conclusions, departure.

Location

Convention center "Schoss Zeillern"

Languages

German and English (translation not provided)

Accommodation

In the convention center or a nearby guesthouse. Single, double or three-bed rooms (all with shower and WC). Full board (with a choice from three menus).

Expected costs

"All inclusive" (conference fee, 3 nights accommodation including full board, welcome and farewell party, excursions) approx. ATS 2,100 / DM 300 or EUR 155.
Conference fee only = ATS 500, DM 70, EUR 40.

Pre-registration

Before 15 March.

For further information contact

Dr. Johanna Sieber, KLIVV Savoyenstrasse 1a, A-1160 Wien, Austria • Tel: +431 486 21 21• Fax: +431 486 21 21 28
E-mail: J.SIEBER@KLIVV.OEAW.AC.AT

The colonisation by badgers (*Meles meles*) of Coney Island, Co Sligo, Ireland

Paddy SLEEMAN, David O'LEARY[1], and Robert CUSSEN

Introduction

Colonisation is a key element in understanding wild mammal populations. The process of colonisation by mammals of these islands (Britain & Ireland), in general, and Ireland in particular, has been the subject of much debate (e.g., Yalden 1982, Sleeman *et al.*, 1986). One of the problems is that it is not possible to re-create the past. However observations can be made on colonisation as it occurs today. An example is the colonisation of Coney Island, Co. Sligo, by badgers, which has been observed by residents and hunters on the island. The process of colonisation, or recolonisation, in this species is of central importance to strategic planning of tuberculosis control (Cheeseman *et al.*, 1993) both in Ireland and Britain. It may also be relevant to attempts to re-introduce badgers and other carnivores.

The island

Coney Island lies in Sligo Bay in North West Ireland (Fig. 1). It is connected to the mainland by a 2.5 km causeway which is exposed at low tide. There are 14 stone pillars that mark the causeway. The island is 1.6 km^2 (397 acres), there is a village at the northern end with only one resident family, most of the islanders having left in the 1950's. The rest of the northern half of the island is pasture and the southern half is sand dune, known locally as the 'banks' where rabbits are regularly hunted. The island's badgers have been noted for many years by both residents and hunters, and some who are both.

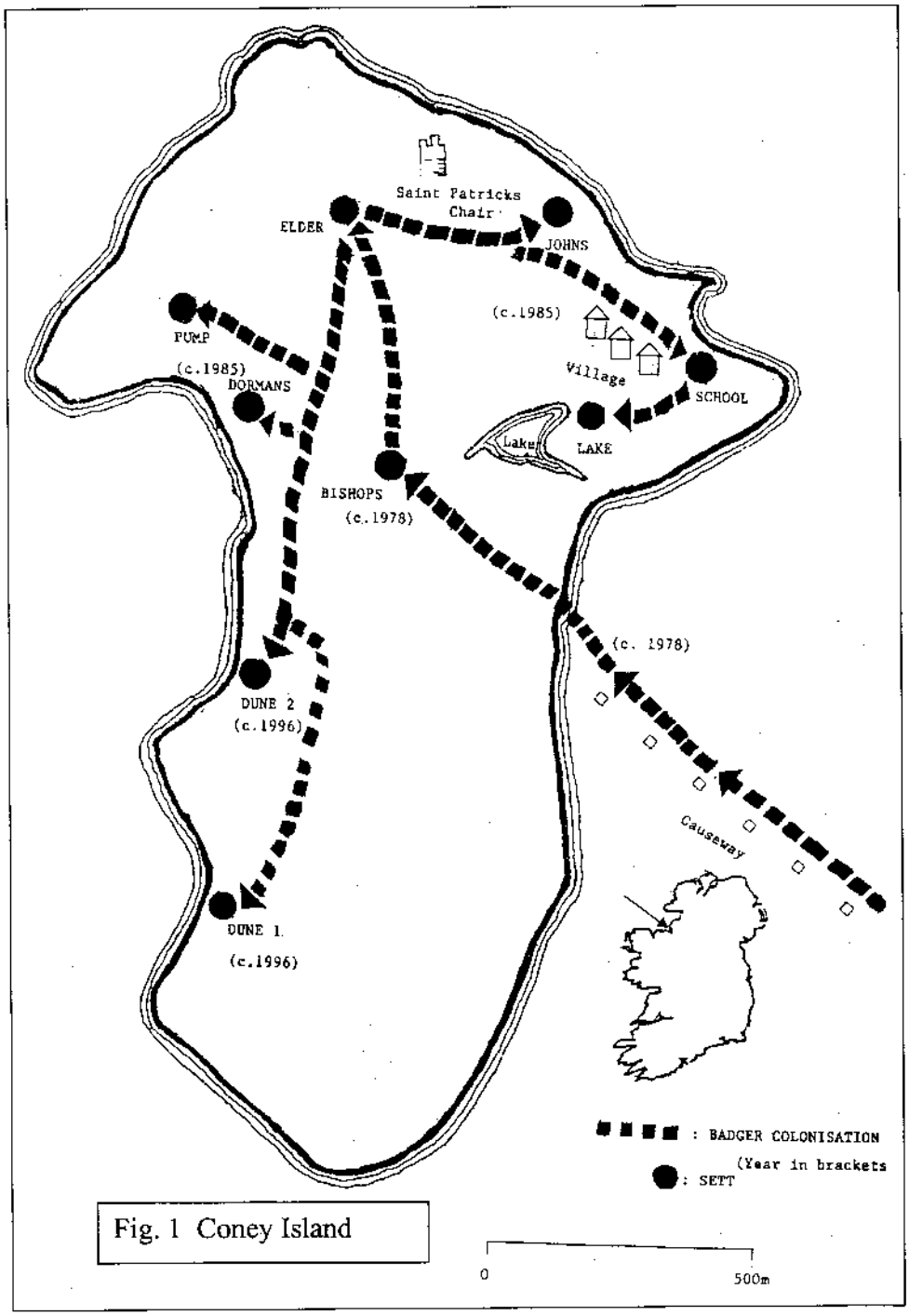


Fig. 1 Coney Island

We began to study the population in 1997. We have established territories by feeding plastic pellets and peanuts, and population density by capture-recapture and direct enumeration. The badgers on the island are smaller, both in length and weight, than badgers found on the mainland, and all, except one, have white noses (Fig. 2).

Colonisation

Two badgers were seen by Mr. Frank Carter on a moon-lit night crossing the causeway in or around 1978. After this a badger sett was noted near the Lake, this today know as Bishop's sett (Fig. 1). Cubs were noted playing at this sett in the 1980's by local residents. The next sett to be occupied was near St Patrick's Chair, an unusual rock formation found on the island, today known as Elder sett. It is of interest that these two setts, which were the first noted to be occupied are the only two permanently occupied main setts on the island today, and the only two at which breeding occurs at regularly. Setts to the east: Johns and School, were occupied in or around 1985, as were setts to the west ; Dormans and Pump (Fig. 1). Finally it is only in the last three years (circa 1996) that badger activity been noted on the 'banks', the sand dune area at the southern end of the island. The total adult badger population of the Island today is estimated at twenty individuals. Most of these (17) occur in the northern half of the island, only 3 adults are resident in the dunes. If the density of the northern half is taken alone, it is approximately 17 adults per km^2.

Discussion

It would appear likely that badgers were present on the Sligo coast in sufficient numbers in the late 1970's to cause this colonisation. This, and the low human population density on the island, must have prompted the colonisation. Badgers are not previously recorded on any Irish islands or in areas of sand dune (Ní Lamhna, 1979; Feore, 1994; Smal, 1995). Such island populations hold considerable promise for studies of this species, especially in attempts to vaccinate badgers against bovine tuberculosis. It also shows that it takes a long time to colonise an area, in particular poor habitat such as sand dune, which it took approximately 18 years for the badgers to occupy (Fig. 1).

Our knowledge of how badgers react to various landscapes is largely speculative (Harris & Wollard 1990). However there is much published material which gives opinions, on for example how rapidly badgers colonise, or how they are assumed to have been introduced by man to Ireland, due to for example 'religion' (Lynch & Hayden 1993; Lynch 1994, Lynch pers.comm.). It is clear from this example that badgers can cross tidal stretches of more to colonise islands and this makes it more likely that they are a 'natural' native member of the Irish fauna.

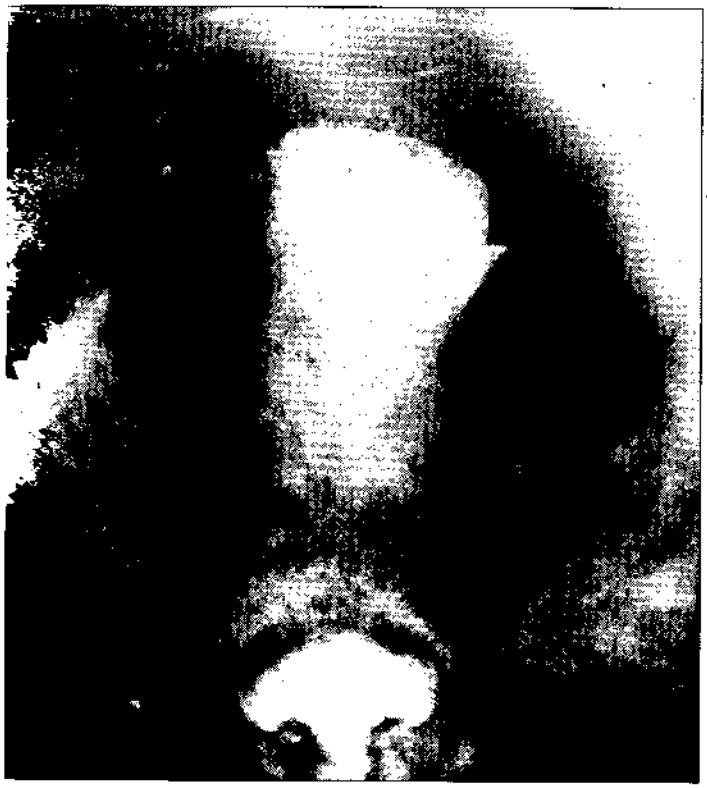


Fig. 2. *White-nosed badger found dead on pasture*

Acknowledgements

We wish to thank Professor Maire F. Mulcahy for encouragement and staff of the Irish Department of Agriculture in particular Michael Sheridan and Iain O'Boyle for all sorts of assistance. Also Sandrine Lesellier, Angela Southey and several members of Sligo District Veterinary office, in particular Jim Foley for sterling support and cheerful assistance. Also John, Margaret McGowen and family for much support while we are on the island, and Don Cotton for guidance.

References

Cheeseman, C.L., Mallinson, P. J., Ryan, J. & Wilesmith, J.W. 1993. Recolonisation by badgers in Gloucestershire. In *The Badger*, ed. T.J. Hayden. Dublin: Royal Irish Academy.

Feore, S.M. 1994. *The distribution and abundance of the badger Meles meles L. in Northern Ireland.* Ph.D thesis, Queens University, Belfast.

Harris, S. & Wollard, T. 1990. The dispersal of mammals in agricultural habitats in Britain. In *Species dispersal in agricultural habitats*, eds. R. G. H. Bunce and D. C. Howard. London: Belhaven.

Lynch, J. M. 1994. Morphometric variation in the badger (*Meles meles*): Clinal variation in cranial size and shape across Eurasia. *Small Carnivore Conserv.*, 10: 6-7.

Lynch, J.M. & Hayden, T. J. 1993. Multivariate morphometrics and the biogeography of Irish mustelids. In *Biogeography of Ireland; past present and future* No 2: 25-34, eds M. J. Costello and K. S. Kelly.

Ní Lamhna, E. 1979. *Provisional distribution atlas of Amphibians, Reptiles and Mammals in Ireland.* Dublin: An Foras Forbartha.

Sleeman, D. P., Devoy, R. J., & Woodman, P.C., eds. 1986. The Postglacial colonisation conference. *Occasional Publ. Irish Biogeograph. Soc.* Numb. 1.

Smal, C. M. 1995. *The badger and habitat survey.* Dublin: Government Publications.

Yalden, D.W. 1982. When did the mammal fauna of the British Isles arrive? *Mamm. Rev.*, 12:1-57

Department of Zoology and Animal Ecology, University College, Cork, Ireland

[1]Department of Biochemistry, University College, Cork, Ireland.

Rooker's badger blunder

...son, T. 1999. Rooker's badger blunder. *BBC Wildlife* 17(2):31.

Agriculture minister (UK) Jeff Rooker did not know the ...dger was a protected species in Europe when he approved a ...ientific cull» of up to 20,000 of them last year. Just a month ...r. Britain alone abstained from supporting a motion at the Bern ...nvention's annual standing committee meeting, calling on the ...tish Government to suspend the cull immediately.

The killing had begun in Devon that very day, with dozens of badgers being trapped in cages and shot through the head. But Rooker promptly decided to carry on culling because the convention is not legally binding.

High-level sources report that Ministry of Agriculture (MAFF) officials regard the wildlife convention as «a joke», even though its principles underlie all European and British wildlife legislation...

Notice of *Eupleres goudotii* in the rainforest of southeastern Madagascar.

Luke DOLLAR

Fig. 1. Phototrap image of *Eupleres goudotii* near the Vatoharanana satellite camp area of Ranomafana National Park, June 1997

The carnivores of Madagascar display a particularly high degree of endemism among modern taxa as seven of its eight carnivoran genera have no extant representatives anywhere else in the world. Despite their unique ecologies and enigmatic evolutionary histories, Madagascar's carnivores have been the subject of relatively few field studies and there is a paucity of data on their current distributions, abundances, and behavioral ecologies.

The Fanalouc, *Eupleres goudotii*, has been ranked a top conservation priority among the Malagasy carnivores and is listed as "endangered" by the IUCN (1996). Although distributed widely in Madagascar, there is no locality where the fanalouc is believed to be abundant (Albignac, 1973). In addition to being actively hunted for its meat by humans (Albignac, 1984), other reasons for the fanalouc's rarity may include predation by dogs and competition with the non-endemic Small Indian civet, *Viverricula indica* (Albignac, 1973).

Gregory & Hellman (1939) suggested placing the fanalouc in its own family, Eupleridae, based on dental and skeletal autapomorphies, but it is now generally allied with the viverrids owing to similar auditory characteristics (Wozencraft, 1989). Within the Viverridae, *Eupleres* had previously been assigned to the subfamily Hemigalinae (Anderson *et al.*, 1984) based on dental characters (Ewer, 1973), but it is now assigned its own subfamily, *Euplerinae*, by Wozencraft (1989) and others (e.g., MacDonald, 1984). Two distinct populations, possibly subspecies, have been noted within the genus *Eupleres*. These are *Eupleres goudotii goudotii* inhabiting eastern coastal regions, rainforests and marshes, and *Eupleres goudotii major* inhabiting undisturbed forests and wetlands in northwestern Madagascar (Albignac, 1973).

A single *Eupleres* specimen was photographed by a camera trap (Fig. 1) during a 1997 carnivore trapping survey conducted to determine the density, diversity, and abundance of the carnivore populations within Ranomafana National Park (RNP). Two other sightings have been reported in the Park (Fig. 2), when a visitor briefly videotaped a fanalouc near the Talatakely Research Station in December, 1991 (Chapple, pers. obs.) and when a primate researcher encountered one individual running along a trail south of the Vatoharanana research site in June 1998 (E. Erhart, pers. comm.).

RNP consists of 41, 000 hectares of submontane rainforest ranging in altitude from 500-1500m (Wright *et al.*, 1997). Only one event involving *Eupleres* occurred during a multiple-site carnivore trapping project in RNP (Dollar *et al.*, in prep). A fanalouc passed through a Trailmaster TM1500 active-beam trail monitor equipped with a TM-35 camera assembly at 23.28 hours on July 23, 1997. This event occurred on a trail within the northern portion of RNP's Vatoharanana region (Fig. 2). Elevation of the site is 1,043 m and annual rainfall is approximately 2,500 mm (Overdorff, 1988). This report provides the first published evidence of *Eupleres* in Ranomafana National Park, a new confirmed location for the species.

Here I address three questions regarding the behavioral ecology of *Eupleres* directly relating to fanalouc social behavior and seasonal activity patterns. First, the fanalouc has been said to live either alone (Macdonald, 1984) or in family groups (Nowak *et al.*, 1983). This photocapture involving just one individual may indicate that a solitary lifestyle could be more likely in *Eupleres*. This idea is supported by a recent sighting recorded by Goodman (1996) in the relatively nearby Réserve Naturelle Intégrale d'Andringitra and by both sightings of *Eupleres* in RNP.

Second, *Eupleres* has been said to adhere to a nocturnal activity cycle (Albignac, 1974). However, the 1991 viedorecording and the 1998 sighting of active fanaloucs occurred after 10.30 and 12.00 hours respectively, well after dawn. This may indicate that the activity cycle of the fanalouc might be more cathemeral or non-period-specific in nature; like that of other Malagasy carnivores (e.g., *Cryptoprocta ferox*; Dollar, in review) previously thought to adhere to crepuscular or nocturnal activity cycles.

Third, although the fanalouc has been known to store up to 800 g of fat in its tail during the cold winter months from July-August, it may not use these reserves to hibernate during this period (Albignac, 1973). Rather, it seems that this fat helps them survive a period in which their primary food source, earthworms, is scarce (Albignac, 1984). The July 1997 photo-capture event and June 1998 sighting lend support to the non-hibernation hypothesis of fanalouc activity patterns.

Acknowledgements

Invaluable logistical help and field assistance was facilitated by the Institute for the Conservation of Tropical Environments (United States and Madagascar). A. Dunham, E. Erhart, and D. Simberloff commented on earlier drafts of this report. Funding was provided by the Douroucouli Foundation and the Carnivore Conservation and Research Trust. DUPC publication number 681.

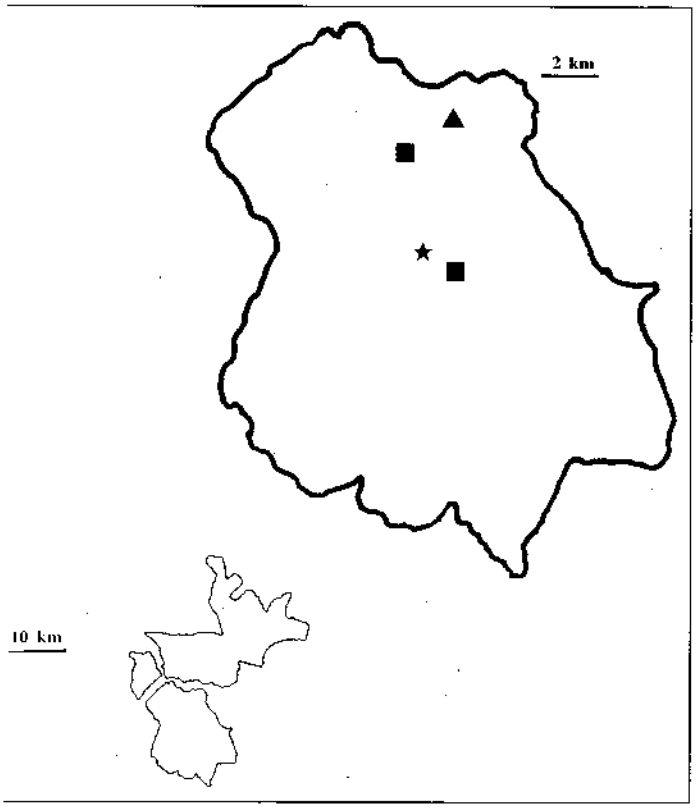


Fig. 2. Map of Ranomafana National Park with the southern parcel enlarged to show *Eupleres* sighting locations (★ Talatakely Research Station; ▲ Vatoharanana Satellite Camp; ■ *Eupleres* Sighting Locations)

References

Anderson, S. & Jones, J. K.1984. *Orders and families of recent mammals of the world.* John Wiley and Sons, Toronto.

Albignac, R. 1973. *Faune de Madagascar. Vol. 36. Mammifères carnivores.* ORSTOM-CNRS, Paris et Antananarivo.

Albignac, R. 1974. Observations éco-éthologiques sur le genre *Eupleres*, viverridé de Madagascar. *Terre Vie* 28:321-351.

Albignac, R. 1984. The Carnivores. In *Key Environments Madagascar*, ed. A. Jolly, P. Oberle, and R. Albignac. IUCN & Pergamon Press, Oxford.

Dollar, L. J. 1999. Preliminary report on the status, activity cycle, and ranging of *Cryptoprocta ferox* in the Malagasy rainforest; with implications for conservation. *Small Carnivore Conserv.*, 20:7-10.

Dollar, L. J. & Dunham, A. E. In prep. Systematic mark-recapture survey of carnivore populations in Ranomafana National Park, Madagascar.

Ewer, R. 1973. *The Carnivores.* Cornell Univ. Press, Ithaca, NY.

Goodman, S. M. 1996. A floral and faunal inventory of the eastern slopes of the Réserve Naturelle Intégrale d'Andringitra, Madagascar: with reference to elevational variation. *Fieldiana Zool.*, 85:298-292.

Gregory, W. K. & Hellman, M. 1939. On the evolution and major classification of the civets (Viverridae) and allied fossil and recent Carnivora: Phylogenetic study of the skull and dentition. *Proc. Amer. Philos. Soc.*, 81:309-392.

MacDonald, D. 1984. Civets and Genets. In *The Encyclopedia of Mammals*, 136-145. Equinox, Oxford.

Nowak R. M. & Paradiso, J. L. 1983. *Walker's mammals of the world, 4th edition.* The John Hopkins University Press, Baltimore and London.

Overdorff, D. J. 1988. Preliminary report on the activity cycle and diet of the red-bellied lemur *(Lemur rubriventer)* in Madagascar. *Amer. J. Primatol.*, 16:143-153.

Wozencraft, W. C. 1989. The phylogeny of the recent Carnivora. In *Carnivore behavior, ecology, and evolution*, ed. J. L. Gittleman, 279-349. Chapman & Hall, London.

Wright, P. C., Hecksher, K. & Dunham, A. E. 1997. Predation on Milne-Edward's Sifaka (*Propithecus diadema edwardsi*) by the fossa (*Cryptoprocta ferox*) in the rain forest of southeastern Madagascar. *Folia Primatol.*, 68:34-43.

Duke University Primate Center,
2705 Old Erwin Road, Durham, NC 27705, USA

8th International African Small Mammal Symposium

The next International Symposium on African Small Mammals will be organized in Paris, at the auditorium of the *Grande Galerie de l'Evolution* of the Musée national d'histoire naturelle, between the 4th and 9th of July, 1999.

The deadline for receipt of registration, communication proposals and registration *was* the 1st of March 1999.

An internet site is available at:
http://www.mnhn.fr/meo/asm/ and all information requests can be made via E-mail at: asm@mnhn.fr

Fax or regular mail to: Christiane Denys or Laurent Granjon, Laboratoire mammifères & oiseaux, MNHN, 55, rue Buffon, 75005 Paris, France. Fax: +33(0) 1 40 79 30 63

4th International Conference on Environmental Enrichment

The 4th International Conference on Environmental Enrichment will be held in Edinburgh, Scotland from 29 August - 3 September 1999. The Royal Zoological Society of Scotland will host the conference, which will take place at the University of Edinburgh.

The main aim of this conference is to provide a forum for discussion between the theory-based scientist and the practical application of the zookeeper. There will be oral presentations, workshops, posters, and discussions. Everyone involved in enriching the lives of captive animals, through their theoretical and/or practical work, is welcome to attend.

Further information:
Conference Ltd., 10B Broughton Street Lane, Edinburgh EH1 3LY, Scotland. Tel. 44 (0) 131 556 9245. Fax. 44 (0) 131 556 9638. E-mail: inconference@cableinet.co.uk

Black-footed ferret reproduction and reintroduction in 1998

The black-footed ferret (*Mustela nigripes*) of the Great Plains of North America, was thought to be extinct in the 1970's. A small population was discovered near Meteetsee, Wyoming in 1981. Four years later, this population succumbed to canine distemper and sylvatic plague. In an effort to save the species, 18 surviving wild black-footed ferrets (ferrets) were captured to initiate a captive breeding program. Propagation efforts have been successful and, to date, more than 2600 kits have been born in captivity. Presently, there are seven facilities involved in an SSP program. The ferret SSP reached its genetic and demographic goals in 1996, and it now manages 240 (90.150 = 90 male and 150 female) breeders. Ferrets in excess of SSP needs are available for reintroduction into suitable habitats.

1998 Recovery update

In 1998, the production of black-footed ferrets from Species Survival Plan (SSP) captive breeding facilities (six zoos and one government breeding center) far surpassed all previous years with a total of 425 born and 321 ferret kits surviving at the time of final allocation for field and captive breeding efforts. The largest contribution of ferrets came from the U.S. Fish and Wildlife Service's, National Black-footed Ferret Conservation Center where 249 kits were born and 191 have survived. Remarkable production was also experienced at the Phoenix Zoo and the Toronto Zoo. Higher birth rates resulted, in large part, from the discovery by the Conservation Research Center of the National Zoo of a principal cause of false pregnancy in ferrets; a problem that has long affected captive breeding efforts (Howard *et al.*, 1998; Wolf *et al.*, 1998). In 1998, the detection of aspermic males via electroejaculation decreased the number of pseudopregnant females at FCC by 20%. This technique will be implemented as a program-wide management tool at SSP facilities starting in 1999.

A total of 217 kits were allocated for reintroduction and field breeding programs in 1998. Ninety-four (59.35) ferret kits were provided to the Conata Basin/Badlands National Park reintroduction area in South Dakota. Seventy-seven ferret kits were allocated to two separate release sites on a Montana experimental reintroduction area; 55 kits (35.20) to the Ft. Belknap Indian Reservation and 22 kits (11.11) to the Charles M. Russell National Wildlife Refuge. Finally, 29 kits (18.11) were sent to Arizona, some of which have been released while some have been retained for on-site breeding efforts in 1999. Ferrets are also being provided to two new field breeding projects. Seven kits (4.3) will be transferred to a New Mexico breeding facility constructed by the Turner Endangered Species Fund; and 10 kits (5.5) will be sent to a breeding project on an experimental reintroduction area in the Colorado-Utah border.

As was the case last year, all ferret kits destined for release in the wild in 1998 have received adequate "preconditioning"; extended exposure to outdoor pens that have naturalistic prairie dog burrows, and in which developing kits are exposed to prairie dog prey (Vargas *et al.*, 1996). Preconditioning significantly enhances the survival of ferrets released to the wild (Biggins *et al.*, 1998). With construction of 24 on-site preconditioning pens by the Forest Service in South Dakota in 1997, the national program now has sufficient capacity to precondition all ferrets targeted for release.

News regarding ferret production in the wild in 1998 are also highly encouraging. Of 56 adult ferrets (25.26, 5 sex undetermined) found during spring surveys in South Dakota, more than 60 kits have been observed. Of 25 adults (5.20) located last spring in Montana, at least 35 different kits have been detected. So far, it appears that litter sizes are also larger than past years. Between both South Dakota and Montana over 30 litters and more than 100 wild born young may have been produced in 1998.

Significant progress in the area of on-site breeding was also achieved this past spring in Arizona. In addition to the breeding success experienced at SSP facilities, the Arizona Game and Fish Department produced 26 kits (of which 18 survived) in 1998. This marks the first time that ferrets were produced in on-site pens at an existing reintroduction area. A portion of the kits will be released from their pens directly to the wild while others will be retained for future breeding efforts.

Although field surveys and reintroduction efforts are still ongoing at the time of this report, 1998 can be considered to be the most successful year in the history of the ferret recovery program. Considering all the black-footed ferrets reintroduced in 1998, there are presently more ferrets in the wild that there are in the SSP captive breeding program. Captive breeding and reintroduction capabilities continue to steadily improve. However, little progress has been accomplished to ensure the protection of prairie dog habitat, the ecosystem upon which black-footed ferrets depend. A recent evaluation by the Service indicated that only ten sites exist in all of North America that have prairie dog complexes of sufficient size and density to support viable ferret populations. The most formidable challenge now facing ferret recovery is whether suitable prairie dog habitat can be secured to achieve the objectives of establishing multiple, self-sustaining ferret populations in the wild.

References

Biggins, D., Godbey, J., Hanebury, L., Marinari, P., Matchett R., & Vargas, A. 1998. Survival of Black-footed Ferrets. *J. Wildl. Manage.*, 62:643-653.

Howard, J. G., Wolf, K. N., Marinari, P. E., Kreeger, J. S., Anderson, T. R., Vargas, A. & Wildt, D. E. 1998. Delayed onset of sperm production in 1-year old male black-footed ferrets. *Proc. Soc. Study Reprod., Suppl.*, 58: 124.

Vargas, A., Lockhart, M., Marinari, P. & Gober, P. 1996. The Reintroduction Process: Black-footed Ferrets as a Case Study. Pp. 829-834 *in* Proceedings: American Zoo and Aquarium Association Western Regional Conference, May 15-19, 1996, Denver, Colorado.

Wolf, K. N., Wildt, D. E., Vargas, A., Marinari, P., Williamson, L., Ottinger, M. A. & Howard, J. G. 1998. Compromised reproductive efficiency in male Black-footed ferrets. *J. Andrology* 1998 Suppl.: 44.

Astrid Vargas, Mike Lockhart, Paul Marinari and Pete Gober

National Black-footed Ferret Conservation Center

410 Grand Ave., ste 315, Laramie WY 82070, USA

Age dynamics in body weight and physiological indices in some mustelid species (Mustelidae)

I.L. TUMANOV and E.A. SORINA

The study of adaptive reactions, which show different ...vels of intensity in different systems of organs, gives the ...ssibility to reveal the combined, compensatory character of ...se reactions, and also provides general directions for the ...velopment of measures for providing a stable number of ...nomically valuable animals when environmental conditions ...ange. Definition of the confidence limits of ecological-physio-...gical parameters in these allows us to use the data obtained as ...dices of the animals' normal state, and this needs to be conside-...d in the "industrial" breeding of fur animals - especially mustelids.

Thermometrical data, research on heart and respiration ...tes, have an important place in the assessment of the functional ...ndition of young animals. They do not only define compensa-...ry possibilities, but can also indicate energetic metabolism ...hnson & Gessaman, 1973; Pauls, 1980; Sokolov *et al.*, 1984; ...kolov, 1990). Information on age-based changes in the main ...ysiological parameters in representatives of natural populations ...small mustelid species is highly fragmentary, however (Slonim, ...52; Iversen, 1972; Tumanov & Levin, 1974; Segal, 1975; ...sey & Casey, 1979; Tumanov *et al.*, 1982). This fact can be ...plained by the species' natural rarity, and the difficulties ...volved in the capture, maintenance and captive breeding of ...ese animals.

In this paper data on age dynamics in body weight and ecological-physiological indices are generalised based on observations made on cubs of various mustelid species during the summer seasons of 1975-1986. Most of the research was undertaken at the experimental station of the Biological Institute of the Siberian Department of the Academy of Sciences of the USSR in the years 1975, 1976, and 1979, with the direct participation of D. V. Ternovsky and Yu. G. Ternovskaya -scientists specialising in the captive breeding of small mustelids; the authors express their sincere thanks to these scientists. Besides, this paper contains data obtained at the vivarium of the West Department of VNII of Hunting Economy and Fur Farm.

Totally 113 cubs of different sex and age were considered. These included young European mink, *Mustela lutreola* (L., 1761) (20 males, 14 females), European polecats, *M. putorius* L., 1758 (11 males, 11 females) and Steppe polecats, *M. eversmanni* Lesson, 1827 (11 males, 14 females). For comparison we used original data on development of some physiological functions in cubs of Ferrets, *M. putorius furo* L., 1758 (14 males, 10 females), Pine marten, *Martes martes* L., 1758 (4 males, 2 females, and Sable, *M. zibellina* L., 1758 (1 male, 1 female). The total number of adult animals from which certain physiological parameters have been taken, are presented in the corresponding tables.

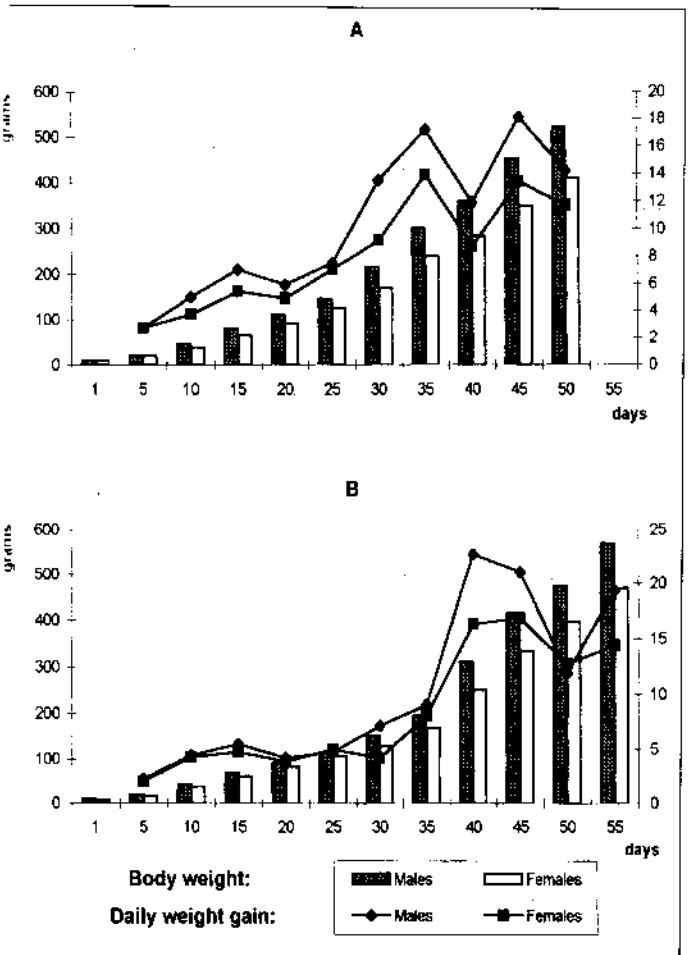


Fig. 1. Age changes in body weight and daily weight gain A - in European and B - in steppe polecats

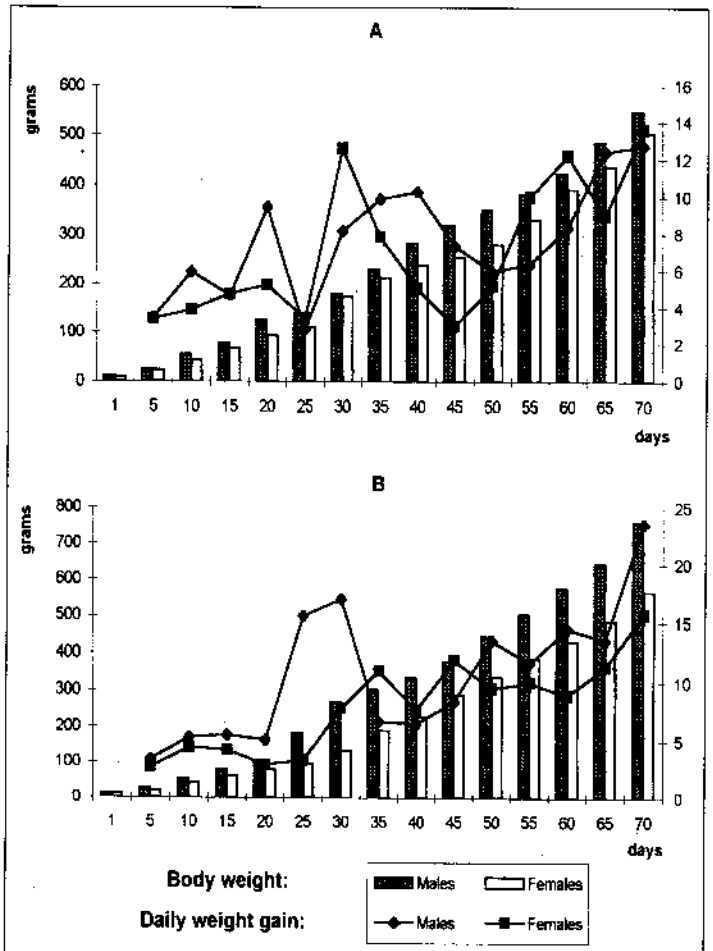


Fig. 2. Age changes in body weight and daily weight gain A - in European mink and B - in furo

The cubs born in captivity were weighed at an interval of five days, and their body temperature was measured, and pulse, respiration and electrocardiogram (ECG) were registered. At first they were weighed on pharmaceutical scales, then on technical scales. In order to obtain comparative data, all measurements were conducted in the morning hours and during the same period - in May-July.

Body temperature was measured rectally by medical electrothermometer (TEMP-60), environment temperature was 22-26°C. For ECG records and heart rate registration a one-channel ink-writing electrocardiograph (ELKAR-6) with "cuff"-type lamellar electrodes was used. ECG measurements were conducted in standard excursions from the extremities at a tape mechanism velocity of 50 mm/sec and an apparatus working regime of 1 mV=10 mm. While deciphering ECG (in the 2nd excursion) we followed the scientific work of N. G. Nikulin (1956) and G. L. Lempert (1963). Sometimes we used a two-channel electrocardiograph that besides the ECG recorded at the same time registered the respiratory rate of carnivores under consideration. In this case we used an electronic scheme which included an electrothermometer (TEMP-60) and microresistance from measuring bridge, allowing us to catch the temperature overfalls during the inhalation and expiration of the animals (Galantsev & Korotetskova, 1980). It should be noted also that the measurement of all physiological parameters in young and adult individuals was conducted without the use of narcosis, and in natural condition of their body (Ternovsky et al., 1981).

Body weight

The general growth of a mammal can be characterised by the dynamics of the weight changes that indicate its ontogenetic development. Such indicators as daily weight gain give the most obvious idea about this process. During a study of the age dynamics of body weight in polecats and European mink, daily weight gain was calculated by the formula: A=(v2-v1)/t, where A is daily weight gain in grams, v2-v1 is the difference in body weight in grams during a certain time interval, and t is the duration of the period of time in days.

One-day old cubs of Steppe and European polecats weigh on average 8.0-9.5 g, European mink and ferret weigh 9.0-11.8 g, and sable and marten weigh 2.7-2.9 g. By the end of the second week the body weight of the European mink and European and Steppe polecats was more than 7.3-8.6 times the body weight of one-day old cubs, and in the ferret, marten, and sable it was 6.3-6.7 times.

In the smallest representatives of Mustelidae one day-old male and female cubs of the Least weasel, Stoat, and Alpine weasel cannot be differentiated by body weight (Tumanov *et al.*, 1982). In contrast, male polecats and mink of this age are noticeably bigger than females, although this difference is not always essential. The reliable differences from this test can be traced very early - at 10-12 days of age, whilst in small mustelids it is at the end of the first month of age (when their eyes open).

On the whole, for cubs of the carnivore species under consideration, an equal and sufficient increase in daily weight gain in the period from birth to the opening of the eyes is typical (Figs 1 & 2). During and after the complete opening of the eyes (at 28-35 days of age) daily weight gain essentially increases. This is apparently connected with more frequent excursions from the nest by the cubs (research reactions), increases in moving activity and consumption of supplementary food. If before this period daily the weight gain of cubs of different sexes is approximately equal, after the opening of the eyes it increases more in males, although the general growth rate of females in the first month of their life is noticeably higher. Thus, the body weight of females by the age of two months (with respect to definitive level) was equal to 67.8% in the Steppe polecat, 51.2% in the European mink and European polecat, and 46.4% in the ferret. At the same time in males this index corresponded to 41.2%, 36.1%, and 37.5%.

A similar picture of changes in body weight growth rate can also be traced in young sables and martens. According to our observations in the first month of their life the daily weight gain fluctuated in the limits of 8.2-10.6 g. Later, after the opening of the eyes, in cubs of 2-3 months of age it increased and was equal to 10.8-22.7 g in a day.

Table 1

Age dynamics of the body temperature of polecats and European mink, °C (M±m)

Age, days	European polecat		Steppe polecat		Furo		European mink
	Males	Females	Males	Females	Males	Females	Males
1	(6) 28,0±0,9	(4) 26,8±1,9	(6) 26,3±0,1	(2) 26,0	(5) 29,2±0,6	(2) 29,5	(2) 28,3
5	(3) 32,8±0,3	(5) 31,8±0,6	(3) 31,3±0,4	(3) 32,0±0,3	(10) 32,5±0,4	(9) 32,0±0,7	(2) 32,7
10	(3) 33,4±0,3	(5) 32,7±0,5	(10) 33,1±0,3	(12) 32,7±0,5	(10) 33,2±0,2	(9) 33,5±0,3	(2) 32,2
15	(3) 34,1±0,3	(4) 34,0±0,3	(10) 34,2±0,3	(13) 34,4±0,2	(10) 33,9±0,5	(9) 32,7±0,3	(2) 32,1
20	(3) 34,5±0,3	(4) 34,4±0,2	(10) 34,6±0,2	(13) 34,3±0,3	(7) 34,9±0,3	(7) 35,1±0,2	(2) 34,4
25	(3) 34,5±0,2	(4) 34,6±0,4	(10) 34,8±0,2	(13) 35,0±0,2	(2) 34,5	(3) 35,2±0,3	(2) 34,7
30	(3) 35,3±0,04	(4) 35,4±0,2	(4) 35,4±0,4	(6) 35,5±0,5	(2) 35,4	(3) 35,5±0,2	(2) 35,5
35	(4) 36,3±1,1	(4) 36,5±0,7	(3) 35,0±0,3	(5) 35,1±0,3	(2) 35,0	(3) 35,2±0,4	(2) 35,2
40	(3) 35,5±0,3	(2) 36,3	(2) 35,4	(1) 35,2	–	–	–
45	(3) 36,2±0,7	(2) 36,7	(2) 35,7	(1) 35,4	–	–	–
50	–	–	(3) 36,0±0,4	(2) 36,3	–	–	–
55	–	(2) 37,0	(3) 36,1±0,8	(2) 35,8	–	–	(3) 36,1±0,2
60	–	–	(2) 36,4	(2) 36,5	(3) 36,2±0,3	(2) 36,2	(3) 36,3±0,3
65	–	–	–	–		–	(3) 36,5±0,4
70	–	–	–	–	(3) 36,4±0,4	(2) 36,8	(6) 36,5±0,4
75	–	–	–	–	(3) 36,6±0,2	–	(3) 36,8±0,3
Adults	(5) 37,8±0,3	(4) 37,6±0,6	(8) 36,9±0,5	(6) 37,0±0,7	(8) 36,9±0,4	(5) 36,7±0,5	(8) 37,0±0,2

Note: In tables 1-3 the number of animals under research is shown in brackets

The value of relative growth gain is the highest in the first ;o weeks of the postnatal ontogeny of mustelids, and then the ;vel of this index starts to decrease. In the first three months of ;eir life an intensive growth of young animals is observed, then slows down. In this age the lengths of the cubs are equal to 90% : the parents' length although their body weight reaches the level ' their parents only by 6-7 months of age.

Body temperature

Small carnivores are attributed to immature parturiated ;imals, the body temperature of which, in the first days of life in ;any cases is defined by environmental temperatures. In that ;riod they had rectal temperatures close to ambient when they ;ere taken from the nest. In one-day old cubs of the European ;nk, Steppe polecat, and European polecat it was practically ;qual: 26.0-28.3°C (Table 1). In larger cubs of ferrets of the same ;e the body temperature was, on average, C more. In the first week representatives : all small carnivores grow quickly and ;eir temperature increase is very clear. By ;e age of five days rectal temperature is ;qual to 31.3-32.8°C. In connection with ;nstant growth of body weight and size, ;velopment of hair and inclusion of chemi- ;l thermoregulation mechanisms, further ;owth of this index can be traced. It reached ;5.0-36.7°C in polecats and mink by the age ; 1-1.5 months. It is interesting that in the ;me age young sable and pine marten had a ;ctal temperature equal to 36.1-37.8°C, which ;parently can be explained by their high ;dices of body weight (hence, smaller heat ;radiation) and the heat exchange level. A ;milar difference is clearly traceable in adult ;imals of these species. Thus, if at 2-3 years ; age males of polecats and European mink ;dy temperatures were equal to 36.9-37.8°C, ;ose in Sable and martens average 39.3°C.

On the whole, in the first months of ;stnatal ontogenesis the body temperatures : the cubs of small carnivores increase ;mparatively fluently. A noticeable jump, ;hich is expressed as temperature increas- ;g on average by 0.7-0.8°C, is traceable ;ly during the opening of the eyes, i.e. in ;e period of 28-35 days of age. In this ;riod, which is accompanied in cubs by ;nforcement of locomotion functions and ; an increase of energy expenses for ;xidative metabolism, the level of oxygen ;nsumption and also the body tempera- ;res of the animals change distinctly ;umanov, 1993).

At the age of 2-2.5 months young ;lecats and mink and, at 3-4 months of age ;artens and sables, have a body temperature ;milar to that of the adults. It should also be ;ted that there were no essential sex differ- ;ces in the indices of rectal temperature, ;spiration and heart rates in small carni- ;res in the first 3-4 months of their life.

Respiration rate

Registration of external respiration of the polecats under consideration demonstrates a inverse dependence of its rate from the body weight and age of animal (Table 2). In the first days the cubs' respiration is very frequent and shallow, because the plane of disposition of the ribs and a relatively big liver restrict a phrenic component of the act of respiration. With age, it is noted that respiratory movements became noticeably less often and deeper, which increases lung ventilation.

Thus, in comparison with the fifth day of age, by the end of the first month of age the frequency of respiration decreases in the European polecat by 28-29%, and in the Steppe polecat by 30-32%. They reached a definitive level in this test at 2.5-3.5 months of age. Slow respiration rate in adult Steppe polecats when compared with European polecats also attracts our attention.

Table 2

Age changes of respiration rate (in 1 min) in polecats and European mink, (M±m)

Age, days	European polecat	Steppe polecat	European mink
5	(2) 84	(2) 72	(2) 66
10	(5) 64±3,9	(5) 70±12,4	(3) 77±12,6
15	(6) 63±8,5	(8) 50±5,3	(3) 90±6,3
20	(6) 60±4,3	(8) 57±6,4	(3) 90±8,3
25	(6) 71±8,1	(8) 61±6,4	(2) 92
30	(6) 60±5,0	(7) 49±4,8	(3) 90±7,6
35	(6) 63±6,4	–	(2) 105
40	(2) 72	–	(2) 86
45	(5) 64±7,7	(3) 51±8,7	–
Adults	(16) 55±3,8	(8) 32±6,7	(18) 48±2,8

Table 3

Age dynamics of heart rate (heartbeats/min) in European mink and polecats

Age, days	European mink	Furo	Steppe polecat
1	(5) 260±8,3	(7) 251±4,5	(4) 240±16,9
5	(5) 300±25,7	(17) 279±6,3	(15) 306±7,8
10	(4) 420±3,5	(17) 299±4,2	(15) 331±6,2
15	(7) 372±18,2	(19) 322±3,8	(15) 364±8,3
20	(3) 350±17,8	(14) 365±9,8	(15) 393±4,6
25	(3) 420±7,6	(2) 450	(15) 404±6,9
30	(2) 453	(3) 465±8,6	(8) 425±6,2
35	(2) 413	(2) 440	(2) 375
40	(2) 450	(2) 440	(3) 363±12,6
45	(2) 450	(3) 430±12,7	(2) 358
50	(3) 443±8,6	(3) 422±7,6	(3) 349±9,7
55	(3) 440±15,8	(3) 390±8,6	(3) 345±8,6
60	(3) 355±25,2	(3) 376±13,1	(2) 340
65	(3) 420±7,5	(2) 330	–
70	(8) 409±19,9	(3) 375±9,3	–
75	(8) 386±12,5	(2) 345	–
80	(3) 353±63,0	(2) 330	–
Adults	(13) 222±12,6	(11) 282±25,6	(9) 257±10,1

which agrees with the bigger absolute and relative lung weight of Steppe polecats (Ternovsky, 1977). This probably can be explained by intensive fossorial activity and by permanent stay of Steppe polecats in conditions of difficult respiration - i.e. in deep burrows, which they penetrate in search of rodents.

In contrast to the polecats, in European mink in the early stages of postnatal ontogenesis reinforcement of respiration takes place, and this continues until 1.5-2 months of age. Then, at the period of energetic development connected with changes in feeding regime, behaviour forms, and foraging activity which, in semiaquatic animals, is accompanied by increases in lung weight (and hence volume) the respiration of young mink becomes less often and deep.

During the first month of age the respiration rate of cubs increased by 36-59%, then further, for the period of 1-1.5 months of age to one year, it decreased by 45-54% (Table 2). Apparently noted age changes in the respiratory rate of the young mink, which have begun to live actively and independently due to their aquatic mode of life, can have a trend to reinforce ventilation of their respiratory organs.

Heart rate

Indices of heart activity have an important place in assessment of functional state of an organism; in many respects they define its compensatory possibilities. In the process of individual development of small carnivores, dependence of heartbeat rate on their body weight and age is noted. For cubs of the species under consideration a sufficiently frequent pulse is characteristic, relatively constant for each age heart rate. Dynamics of these transformations are shown very clearly and in general are similar to those of other animals. (Arshavsky, 1967; Galantsev & Tattar, 1971; Roschevsky, 1972, 1978; Pauls, 1980; Sokolov, 1990).

One-day old cubs have a relatively sparse heart rate, which is close (in frequency) to adult individuals (Table 3). From the first days after birth the heart rate constantly increases. Thus, if in one-day old polecats and minks it was equal to 223-268 heartbeats/min, then by the fifth day of age heart rate increased to 273-326 heartbeats/min, and by the 20th day of age to 332-398 heartbeats/min.

In the most part for the cubs under research the eye opening period (28-35 days of age) was accompanied by an increase of the level of physiological parameters: body temperature, heart and respiration rates, which are also characteristic for other small carnivores (Melkina, 1966; Segal, 1975; Tumanov et al., 1982).

During eye opening the heart rate in polecats and mink was, on average, 130-220 heartbeats/min higher than those of newborns or adults. The increase of their heart rate finishes by the age of 1.5-2 months, after that it decreases, and on both the EKG and respiration records arrhythmia appears, which is characteristic for adult animals.

Similar dynamics of the heart rate are also traceable in young martens and sables. For example, in 10 day-age sable males it was equal to 260-270 heartbeats/min. By the age of one month heart rate reached, on average, 375 heartbeats/min, by 45 days of age 405. Then heartbeat rate decreases, and at an age of 4-5 months the heart rate of cubs (330-350 heartbeats/min) was approximately equal to the heart rates of adult males.

The character of age changes in the main elements of ECG is practically similar. Cardiac cycle duration (R-R) is inversely dependent from the heart rate. Its deceleration was accompanied by an increase in the cardiac cycle size. These changes took place mainly through variation in the phase of heart rest or its diastole (interval T-P), and in a lesser degree by the active ventricular systole (QRST complex); the duration of the auricle-ventricular conductance (interval P-Q) did not change essentially.

To assess the functional state of cardiac muscle such indicators as the percentage ratio of ventricular systole to cardiac cycle, or systolic index [(Q-T)/(R-R) x 100%] , and ratio of all systole size to diastole, or tenseness index [(P-T)/(T-P) x 100%] are used. Their level determines the intensity of cardiac muscle work (Nikulin, 1956; Fogelson, 1957). An analysis of quantities under consideration showed an essential difference between young and adult animals on this test. The intensity of cardiac activity in young individuals was reliably higher than in adult ones. For example, in 1 to 6 month-old cubs of the European mink, Steppe polecat and European polecat the systolic index, on average, was equal to 52-63%, and the tenseness index was equal to 250-460%. In adult individuals these indices had a lesser value: 41-49% and 170-290%, respectively.

Research showed that in the process of postnatal ontogenesis the voltage of basic dents of the ECG in mustelids changes negligibly, except for the positive dents R and T of the ventricular complex QRST. In the period of intensive cub growth and increase in body weight the voltage of dent R increased essentially noticeably. It characterises spreading of a wave of excitations on the cardiac muscle and serves as an indicator of age changes of cardiac muscle and the functional state of an organism in the whole (Meyerson, 1986).

According to our data, in males of polecat, mink, sable and marten, for the period from five days to one month of age, the voltage of dent R increased, on average, from 5.5 mm to 8.7 mm. In 1.5 months-old cubs this index was equal to 11-13 mm, and at puberty it fluctuated in the limits of 16-20 mm.

At the age of 3-4 months young mustelids (especially females) are similar to adults in the indices of heart rate, duration of intervals and the voltages of the basic dents of the ECG. But the final coincidence of the ECG elements of young and adult individuals in different species occurs in a later time.

Conclusion

Noted age chances of thermoregulation, heart and respiration rates in the process of postnatal ontogenesis demonstrate a clear interrelation between physiological functions and the morphological features of weight growth in the animals. The character of age changes of the ECG is traced very clearly and it has a direction on the economical guaranteeing of homeostasis in adult animals. A quickened pulse with a lesser phase of heart rest, a high level of tenseness index of heart work and systolic index, all indicate more intensity in bioelectric processes in the cardiac muscle of young individuals in comparison with their parents. Hence, for young animals a lesser economic regime of work of cardiac muscle and more energy expenditure of an organism are more characteristic than in adult animals. Apparently, in unfavourable conditions, this can be an important factor that determines a high degree of natural elimination of young mustelids from the natural environment.

References

...avsky, I. A. 1967. *Essays on age physiology*. Moscow. 475 pp. (In Russian)

...y, T. M. & Casey, K. K. 1979. Thermoregulation of Arctic weasels. *Physiol. Zool.* 52:153-164.

...elson, L. I. 1957. *Clinical electrocardiography*. Moscow. 158 pp. (In Russian)

...antsev, V. P. & Korotetskova, L. V. 1980. About dynamics of heart and respiration rates in postnatal ontogenesis of hazel dormouse (*Muscardinus avellanarius*). *Zool. J.* 59:1530-1535. (In Russian)

...antsev, V. P. & Tattar, A. V. 1971. Interrelation between body weight and heart activity in musk beaver in postnatal ontogenesis. *Zapiski LSKhI* 156:131-138. (In Russian)

...sen, J. A. 1972: Basal energy metabolism of mustelids. *J. Comp. Physiol.* 81:341-344.

...ison, S. F. & Gessaman, J. A. 1973. An evaluation of heart as an indirect monitor of free-living energy metabolism. Pp. 44-54 in P. Logan, *Ecological energetics of homeotherm.*

...ppert, G. L. 1963. *The principles of electrocardiography*. Moscow. 327 pp. (In Russian)

...person, F. Z. 1986. The basic regularities of individual adaptation. Pp. 10-69 in *Physiology of adaptational processes*. Moscow.

...kina, A. N. 1966. The regularities of growth and energetic metabolism in postnatal ontogenesis of American mink. Autoref. Kand. Diss. Petrozavodsk. 25 pp. (In Russian)

...sulin, N. G. 1956. *The principles and technique of electrocardiography*. Moscow. 204 pp. (In Russian)

...ls, R. W. 1980. Heart rate as an index of energy expenditure in red squirrels (*Tamiasciurus hudsonicus*). *Comp. Biochem. Physiol.* 67:525-548.

...schevsky, M. P. 1972. *Evolutionary electrocardiology*. Leningrad. 250 pp. (In Russian)

...schevsky, M. P. 1978. *Electrocardiology of ungulate animals*. Leningrad. 167 pp. (In Russian)

Segal, A. N. 1975. Growth, metabolism and thermoregulation in postnatal ontogenesis of stoat. *Ecologia* 1:38-44. (In Russian)

Slonim, A. D. 1952 . *Animal heat and its regulation in the organism of animals*. Acad. Sci. USSSR, Moscow-Leningrad. 327 pp. (In Russian)

Sokolov, A. Ya. 1990. Heart rate of Reindeer *Rangifer tarandus* in the conditions of free behaviour. *J. Evol. Biochem. Physiol.* 26:182-184. (In Russian)

Sokolov, A. Ya., Zadalsky, S. V., Zhdan, O. Ya. & Grechkina, L. I. 1984. Energetical cost of different forms of behaviour in Reindeer in the summer and winter. Pp. 32-34 in *Bioenergetics and thermodynamics of living systems*. Novosibirsk. (In Russian)

Ternovsky, D. V. 1977. *Biology of mustelids*. Publ. 'Nauka', Novosibirsk. 280 pp. (In Russian)

Ternovsky, D. V. Tumanov, I. L., Ternovskaya, Yu. G. 1981. Ecological conditionality of heart activity in Mustelidae. *Vestnik Zool.* 1:62-69. (In Russian)

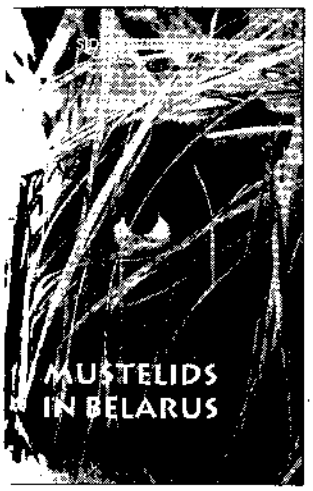
Tumanov, I. L. 1993. Ecological determination of the level of energy metabolism in some mustelids. *Lutreola* 1:17-21.

Tumanov, I. L. & Levin, V. G. 1974. Age and seasonal changes in some physiological indices of *Mustela nivalis* L. and *Mustela erminea* L.. *Vestnik Zool.* 2:25-30. (In Russian)

Tumanov, I. L., Ternovsky, D. V. & Ternovskaya, Yu. G. 1982. Postnatal changes of body weight, body temperature, and heart rate in small carnivores. Pp. 162-173 in *Physiological state of fur animals and ways of its regulation*. (In Russian)

Research Institute for Nature Conservation of the Arctic and the North, Naberezhnaya Chornoy Rechki, 8, Ap. 40, St. Petersburg 197183, Russia

Recent publication



Mustelids in Belarus

Sidorovich, V. E. 1997. *Mustelids in Belarus. Evolutionary ecology, demography and interspecific relationships.* Minsk: Zolotoy uley publisher. 263 pp. 33 photographs in colour.

Although the book is chiefly in Russian, all the chapters contain more or less extensive English summaries.

Chapter 1 describes methods and sample sizes for the study of spatial structure of mustelid populations, diets and interspecific relationships, as well as methods to study ...ustelid carcasses. Drawings of mustelid helminths from Europe are ...companied by identification keys, unfortunately only in Russian.

Chapter 2 gives an analysis of intrapopulation variation and ...terpopulation metric and non-metric differences in otters.

Chapter 3 deals with mustelid habitat diversity and density in ...elarus, the distribution of mustelids as a function of environment, and ...e factors of habitat carrying capacity.

Chapter 4 deals extensively with the diet of otters and American ...nk, with a short note on the diet of European mink. Other subjects ...eated in greater detail are: diet overlap and resource competition in the ...parian mustelid guild; comparative analyses of feeding habits of pine ...arten and polecat; habitat separation of the generalist mustelids in ...rests; the high dietary similarity and habitat separation of stoat and ...easel; ecological separation in the mustelid guild preying on small mammals; the feeding similarity of stone marten and polecat in villages; and the feeding habits of the badger in mixed forests of Belarus.

Chapter 5 gives the current state of studies of the trophic structure of the vertebrate predator community and status of mustelids in the predator relationships. It contains tables with data of vertebrate prey and diet similarity tree diagrams for carnivores and birds of prey.

Chapter 6: Demography of the semiaquatic mustelids: Reproductive regulation and decline, structure of overexploited population, extinction. This part gives an analysis of the non-cyclic breeding of otters in relation to prey abundance and availability, the demography of overexploited populations of otters, the plasticity and decline of reproduction in the American mink, the variation in structure of exploited American mink populations, and a dicussion of hypotheses and original ideas on the disappearance of the European mink.

Chapter 7 deals with the helminth diversity in populations of otter, European mink, American mink, polecat, and pine marten.

Chapter 8 gives analyses of mustelid populations in relation to habitat pollution, treats the Chernobyl fallout, heavy metals, organochlorine pesticides, and polluant concentrations in the European mink and rivers with implications for the decline of its population in Belarus.

Chapter 9 gives tables with comparative analyses of trace element concentrations in mustelids.

The book is a «must» for Russian-speaking zoologists concerned with mustelids but, due to extensive summaries, equally of interest to their English-speaking colleagues.

Recent literature

Mustelidae

Alterio, N. 1998. Spring home range, spatial organisation and activity of stoats *Mustela erminea* in a South Island *Nothofagus* forest, New Zealand. *Ecography* 21:18-24.

Alterio, N., Moller, H. & Ratz, H. 1998. Movements and habitat use of feral house cats *Felis catus*, stoats *Mustela erminea* and ferrets *Mustela furo*, in grassland surrounding Yellow-eyed penguin *Megadyptes antipodes* breeding areas in spring. *Biol. Conserv.*, 83:187-194.

Andelt, W. F. & Beck, T. D. 1998. Effect of Black-footed ferret odors on behavior and reproduction of prairie dogs. *Southwestern Nat.*, 43:344-351.

Baryshnikov, G. F. & Abramov, K. V. 1998. Structure of baculum (os penis) in Mustelidae (Mammalia, Carnivora) - Communication 2. *Zool. Zh.*, 77:231-236. (In Russian)

Ben-David, M. 1998. Delayed implantation in the Marbled polecat, *Vormela peregusna syriaca* (Carnivora, Mustelidae): Evidence from mating, parturition, and post-natal growth. *Mammalia* 62:269-283.

Biancardi, C. M. & Rinetti, L. 1995. Un simpatico mammifero dei nostri boschi: Il tasso. *Il Rondò* 8:78-85.

Biancardi, C. M. & Rinetti, L. 1998. Distribuzione dei sistemu di tana di Tasso (*Meles meles* L., 1758) nell'Alto Luinese (Provincia di Varese, Lombardia, Italia)(Mammalia, Mustelidae). *Atti Soc. Ital. Sci. Nat. Mus. Storia Nat. Milano* 139:57-64.

Black, D. W., Reading, J. E. & Savage, H. G. 1998. Archeological records of the extinct Sea Mink, *Mustela macrodon* (Carnivora, Mustelidae), from Canada. *Can. Field-Nat.*, 112:45-49.

Blackman, S. 1999. Polecat's progress. *BBC Wildlife* 17(2):28.

Bowman, J. C. & Robitaille, J.-F. 1997. Winter habitat use of American marten *Martes americana* within second-growth forest in Ontario, Canada. *Wildl. Biol.*, 3:97-105.

Brochier, B. *et al.* 1996. Epidémiosurveillance de la rage en Belgique: Bilan 1995. *Ann. Méd. Vét.*, 140:347-354. (*Meles meles*)

Broekhuizen, S. & Müskens, G. 1998. Nieuwe kansen voor de Boommarter? *Zoogdier* 9(1):18-20. (*Martes martes*)

Brown, K. P., Alterio, N. & Moller, H. 1998. Secondary poisoning of stoats (*Mustela erminea*) at low mouse (*Mus musculus*) abundance in a New Zealand *Nothophagus* forest. *Wildl. Res.*, 25:419-426.

Chapin, T. G., Harrison, D. J. & Katnik, D. D. 1998. Influence of landscape pattern on habitat use by American marten in an industrial forest. *Conserv. Biol.*, 12:1327-1337.

Charles, R. 1997. The exploitation of carnivores and other fur-bearing mammals during the north-western European Late Upper Palaeolithic and Mesolithic. *Oxford J. Archaeol.*, 16:253-278. (*Martes, Gulo, Meles*)

Clarke, G. P., White, P. C. & Harris, S. 1998. Effects of roads on badger *Meles meles* populations in south-west England. *Biol. Conserv.*, 86:117-124.

Clout, M. 1997. Predator management in New Zealand: An overview. In *Predator workshop 1997. Proc. Workshop 21-24 April, 1997, St. Arnaud, nelson Lakes*, ed. J. Sim and A. Saunders, 3-5. Wellington: Dept. of Conservation.

Clout, M., Denyer, K., James, R. & McFadden, I. 1995. Breeding success of New Zealand pigeons (*Hemiphaga novaeseelandiae*) in relation to control of introduced mammals. *New Zealand J. Ecol.*, 19:209-212. (*Mustela* sp.)

Dayan, T. & Simberloff, D. 1998. Size patterns among competitors: Ecological character displacement and character release in mammals, with special reference to island populations. *Mam. Rev.*, 28:99-124.

Dobson, M. 1998. Mammal distributions in the western Mediterranean: The role of human intervention. *Mam. Rev.*, 28:77-88.

Dowding, J. E. & Murphy, E. C. 1996. Predation of Northern New Zealand dotterels (*Charadrius obscurus aquilonius*) by stoats. *Notornis* 43:144-146.

Duffy, A. J. *et al.* 1998. Four polymorphic microsatellites in wolverine, *Gulo gulo*. *Anim. Genetics* 29:63.

Dunstone, N., ed. 1999. *Behaviour and ecology of riparian mammals*. Cambridge U.K. (mink)

Dyczkowski, J. & Yalden, D. W. 1998. An estimate of the impact of predators on the British Field vole *Microtus agrestis* population. *Mam. Rev.*, 28:165-184.

Fedriani, J. M., Ferreras, P. & Delibes, M. 1998. Dietary response of the Eurasian badger, *Meles meles*, to a decline of its main prey in the Doñana National Park. *J. Zool.*, 245:214-218.

Foresman, K. R. & Pearson, D. E. 1998. Comparison of proposed survey procedures for detection of forest carnivores. *J. Wildl. Manage.*, 62:1217-1226. (*Martes americana, M. pennanti, Gulo gulo*)

Gallagher, J., Monies, R., Gavier-Widen, M. & Rule, R. 1998. Role of infected, non-diseased badgers in the pathogenesis of tuberculosis in the badger. *Vet. Rec.*, 142:710-714.

Gonzalez, C. A. *et al.* 1998. Field immobilization of Pygmy spotted skunks from Mexico. *J. Wildl. Dis.*, 34:186-189.

Goodrich, J. M. & Buskirk, S. W. 1998. Spacing and ecology of North American badgers (*Taxidea taxus*) in a prairie-dog (*Cynomys leucurus*) complex. *J. Mamm.*, 79:171-179.

Greene, T. C. & Fraser, J. R. 1998. Sex ration of North Island kaka (*Nestor meridionalis septentrionalis*), Waihaha Ecological Area, Pureora Forest Park. *New Zealand J. Ecol.*, 22:11-16. (*Mustela erminea*)

Greenwood, R. J., Pietruszewski, D. G. & Crawford, R. D. 1998. Effects of food supplementation on depredation of ducknests in upland habitat. *Wildl. Soc. Bull.*, 26:219-226.

Griffiths, H. I. & Thomas, D. H. 1998. *La conservation et la gestion du blaireau d'Europe* (Meles meles). *Sauvegard de la Nature* No. 90. Strasbourg: Council of Europe Press.

Hancox, M. 1998. Cattle TB crisis? Human implications. *Resp. Med.*, 92:990-991. (*Meles meles*)

Hancox, M. 1998. Cattle TB crisis? Human implications. *Lett. Appl. Microbiol.*, 26:463-464. (*Meles meles*)

Hancox, M. 1998. Of Bourne, badgers, and a bovine TB alert. *Resp. Med.*, 93:72-73. (*Meles meles*)

Hancox, M. 1998. Of Bourne, badgers and bovine TB. *Lett. Appl. Microbiol.*, 27:383. (*Meles meles*)

Hidaka, S. *et al.* 1998. Morphology and morphometry of skulls of raccoon dogs, *Nyctereutes procyonoides*, and badgers, *Meles meles*. *J. Vet. Med. Sci.*, 60:161-167.

Ilyina, T. N. *et al.* 1994. Values of thiamine exchange in mink in different physiological periods. In *Problems of ecological physiology fur animals, 129-136*. Karelian Research Center of Russian Academy of Science Publ., Petrozavodsk. (In Russian)

Jedrjewska, I. B. & Jedrjewski, W. 1998. *Predation in vertebrate communities - the Bialowiezca Primeval Forest as a case study*. Berlin: Springer Verlag.

Junior, B. K. & Masuko, T. S. 1998. Ultrastructure of the parotid and submandibular glands of the Old World marten (Carnivora, Mustelidae). *Ann. Anat.-Anat. Anz.*, 180:31-36.

Kashtanov, S. N. & Kazakova, T. I. 1995. Genetic variability in the sable (*Martes zibellina* L.) with respect to genes encoding blood proteins. *Genetica* 31(2):234-238.

Kauhala, K., Laukkanen, P. & von Rege, I. 1998. Summer food composition and food niche overlap of the Raccoon dog, Red fox, and Badger in Finland. *Ecography* 21:457-463.

Kelly, T. S. 1998. New Miocene mammalian faunas from west central Nevada. *J. Palaeontol.*, 72:137-149.

Kilburn, A. 1999. Slaughter at the sett. *BBC Wildlife* 17(1):42-43. (*Meles meles*)

King, C. M., Flux, M., Innes, J. G. & Fitzgerald, B. M. 1996. Population biology of small mammals in Pureora Forest Park. 1. Carnivores (*Mustela erminea, M. furo, M. nivalis, and Felis catus*). *New Zealand J. Ecol.*, 20:241-251.

Korpimaki, E. & Norrdahl, K. 1998. Experimental reduction of predators reverses the crash phase of small-rodent cycles. *Ecology* 79:2448-2455. (*Mustela nivalis, M. erminea*)

Landa, A. 1997. The relevance of life history theory to harvest and conservation. *Fauna Norvegica* Ser.A. 18:4355.

Landa, A. 1997. *Wolverines in Scandinavia: Ecology, sheep depredation and conservation*. DSc. Thesis. Trondheim: Norges teknisknaturvitenskapelige universitet.

Landa, A. & Skogland, T. 1995. The relation between population density and body size of wolverines *Gulo gulo* in Scandinavia. *Wildl. Biol.*, 1:165-175.

Landa, A. & Tømmerås, B. A. 1996. Do volatile repellents reduce wolverine *Gulo gulo* predation on sheep? *Wildl. Biol.*, 2:119-126.

Landa, A. & Tømmerås, B. A. 1997. A test of aversive agents on wolverines. *J. Wildl. Manage.*, 61:510-516.

Landa, A., Krogstad, S., Tømmerås, B. A. & Tufto, J. 1998. Do volatile repellents reduce wolverine *Gulo gulo* predation on sheep? Results of a large-scale experiment. *Wildl. Biol.*, 4:111-118.

...da, A., Strand, O., Swenson, J. E. & Skogland, T. 1997. Wolverines and their prey in southern Norway. *Can. J. Zool.*, 75:1292-1299.

...rière, S. & Messier, F. 1998. Denning ecology of the Striped skunk in the Canadian prairies: Implications for waterfowl nest predation. *J. Appl. Ecol.*, 35:207-213.

...rière, S. & Messier, F. 1998. Spatial organization of a prairie skunk population during the waterfowl nesting season. *J. Wildl. Manage.*, 62:199-204.

...son, T. 1998. Unconventional cull. *BBC Wildlife* 16(11):31. (*Meles meles*)

...son, T. 1999. Mass cull too cruel? *BBC Wildlife* 17(1):31. (*Meles meles*)

...mards, P. E. *et al.* 1998. Studies of bioaccumulation and biotransformation of PCBs in mustelids based on concentration and congener patterns in predators and preys. *Arch. Environm. Contam. Toxicol.*, 35:654-665.

...cdonald, D. W., Mace, G. & Rushton, S. 1998. *Proposals for future monitoring of British mammals.* London: Dept. Environment, Transport, and the Regions.

...goun, A. J. & Copeland, J. P. 1998. Characteristics of wolverine reproduction den sites. *J. Wildl. Manage.*, 62:1313-1320.

...ppes, T., Koskela, E. & Ylonen, H. 1998. Breeding suppression in voles under predation risk of small mustelids: Laboratory or methodological artifact? *Oikos* 82:365-369.

...wood, E. 1998. Outcry as 'scientific' badger cull is launched to target TB. *Nature* 394:821.

...xwell, J., Torr, S., Leary, H., Coates, G.& Forbes, V. 1997. Predator research in Fiordland trialing stoat control tunnels. In *Predator workshop 1997. Proc. Workshop 21-24 April 1997 St. Arnaud, Nelson Lakes*, eds. J. Sim and A. Saunders. 69-72. Wellington: Dept. of Conservation.

...Donald, R. 1998. Predator. *Natl. Gamekeepers' Organ. Mag.*, 1:12-13.

...Donald, R. & Harris, S. 1998. *Stoats and weasels.* London: The Mammal Society.

...Donald, R. A. 1998. *The effects of wildlife management on stoats* Mustela erminea *and weasels* Mustela nivalis *in Great Britain.* Ph.D. Thesis. Bristol: University of Bristol.

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

...ryushina, I. E. 1996. The wolverine (*Gulo gulo* L.) on Vrangel Island. *Lutreola* 7:1-5.

...skelly, C. M. 1997. Whitaker's skink *Cyclodina whitakeri* eaten by a weasel *Mustela nivalis*. *Conserv. Advis. Sci. Notes* 146. Wellington:Dept. of Conservation.

...ller, H., Ratz, H. & Alterio, N. 1995. *Protection of Yellow-eyed penguins from predators. WWF-NZ final report.* Wildl. Manage. Rep. 65. Otago: University of Otago.

...rphy, E. C., Clapperton, B. K., Bradfield, P. M. & Speed, H. J. 1998. Brodifacoum residues in target and non-target animals following large-scale poisoning operations in New Zealand podocarp-hardwood forests. *New Zealand J. Zool.*, 25:307-314. (*Mustela* spp.)

...rphy, E. C., Clapperton, B. K., Bradfield, P. M. & 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.

...ths, E. 1998. An observation on catching prey by a Long-tailed weasel (*Mustela frenata*). *Southwestern Naturalist* 43:106.

...nhuis, H. 1998. Do polecat, stoat and weasel have an effect on the population of wild rabbits? *Alg. Forst Jagdz.*, 169(6/7):104-109. (In German)

...nik, V. M. & Svetshkina, E. B. 1994. Change in enzymatic spectrum of digestive tract in growing mink. In *Problems of ecological physiology fur animals*, 81-99. Karelian Research Center of Russian Academy of Science Publ., Petrozavodsk. (In Russian)

Mairtin, D., Williams, D. H., Dolan, L., Eves, J. A. & Collins, J. D. 1998. The influence of selected herd factors and a badger-intervention tuberculosis-control programme on the risk of a herd-level trade restriction to a bovine population in Ireland. *Prev. Vet. Med.*, 35:79-90.

Mairtin, D., Williams, D. H., Griffin, J. M., Dolan, L. A. & Eves, J. A. 1998. The effect of a badger removal programme on the incidence of tuberculosis in an irish cattle population. *Prev. Vet. Med.*, 34:47-56.

Malley, P. 1998. Broad badger trial. *New Scientist* 157:55.

...ller, J. R. 1994. *Sett use and sett function in the European badger.* Unpubl. PhD. Thesis. Brighton: University of Sussex.

...ller, J. R. & Roper, T. J. 1998. Changes in size, status, and distribution of badger *Meles meles* L. setts during a 20-year period. *Z. Säugetierk.*, 63:200-209.

...g, V. F. *et al.* 1998. Biliary cystadenoma in a Striped skunk (*Mephitis mephitis*). *J. Vet. Diagn. Invest.*, 10:357-360.

... Kurtis & Ying Wang 1996. Observation on the reproduction of the Taiwan ferret badger (*Melogale moschata subaurantiaca*). In *Proc. IUGB XXII Congress, September 1995, Sofia*, ed. N. Botev, 228. Sofia: Pennsoft Publishers. (Abstract)

Popowics, T. E. 1998. Ontogeny of postcanine tooth form in the ferret, *Mustela putorius* (Carnivora, Mammalia), and the evolution of dental diversity within the Mustelidae. *J. Morphol.*, 237:69-90.

Proulx, G. & Cole, P. J. 1998. Identification of Northern pocket gopher, *Thomomys talpoides*, remains in Long-tailed weasel, *Mustela frenata longicauda*, scats. *Can. Field-Nat.*, 112:345-346.

Reig, S. 1998. 3D digitizing precision and sources of error in the geometric analysis of weasel skulls. *Acta Zool. Acad. Sci. Hungar.*, 44:61-72.

Rifai, L. B., Al-Shafee, D. M., Al-Mehlim, W. N. & Amr, Z. S. 1999. Status of the Marbled polecat, *Vormela peregusna* (Güldenstaedt, 1770), in Jordan. *Zool. Middle East* 17:5-8.

Riley, T. Z., Clark, W. R., Ewing, D. E. & Vohs, P. A. 1998. Survival of Ring-necked pheasant chicks during brood rearing. *J. Wildl. Manage.*, 62:36-44. (*Mustela erminea, M. vison*)

Rogers, L. M. *et al.* 1998. Movement of badgers (*Meles meles*) in a high-density population: Individual, population and disease effects. *Proc. Roy. Soc. London* Ser. B, 265:1269-1276.

Rozhnov, V. V. 1998. The repertoire of the social and communicative behaviour of the European polecat (*Mustela putorius* L.). In *Behaviour, communication and ecology of mammals*, ed. V. E. Sokolov, V. V. Rozhnov, and M. A. Serbenyuk. 119-131. IEE RAS, Moscow. (In Russian)

Rozhnov, V. V. & Naidenko, Sv. V. 1998. Dynamics of interactions between European polecats in the pair encounter tests on neutral territory during the year. In *Behaviour, communication and ecology of mammals*, ed. V. E. Sokolov, V. V. Rozhnov, and M. A. Serbenyuk. 132-154. IEE RAS, Moscow. (In Russian)

Rozhnov, V. V., Petrin, A. A. 1998. Materials on the interspecific interactions between European mink (*Mustela lutreola* L.) and closely related species during non-breeding season. In *Behaviour, communication and ecology of mammals*, ed. V. E. Sokolov, V. V. Rozhnov, and M. A. Serbenyuk, 67-105. IEE RAS, Moscow. (In Russian)

Rozhnov, V. V. & Petrina, T. N. 1998. About some anomalies in the axial skeleton of the Sable (*Martes zibellina* L.). In *Behaviour, communication and ecology of mammals*, ed. V. E. Sokolov, V. V. Rozhnov, and M. A. Serbenyuk, 247-250. (In Russian)

Saint Girons, M.-C. & Moutou, F. 1999. *La belette.* Eveil Nature, Saint Yrieix.

Schley, L., Krier, A., Baghli, A. & Roper, T. J. 1998. Hunting records of game species in Luxembourg during the period 1946-1995. *Bull. Soc. Nat. Lux.*, 99:69-75.

Schubert, C. A., Rosatte, R. C., MacInnes, C. D. & Nudds, T. D. 1998. Rabies control: An adaptive management approach. *J. Wildl. Manage.*, 62:622-629.

Seebass, C. 1998. Der Verein zur Erhaltung des Europäischen Nerzes - EuroNerz e.V. - Ziele und Konzept. *Mitt. Zool. Gesells. Art. Populations.*, 14(2):9-10. (*Mustela lutreola*)

Sivokha, I. N. & Sokolsky, S. 1996. Catalogue of mustelid skulls collection (Carnivora: Mustelidae) of natural History Museum of Pechoro-Ilychsky Biosphere Reserve. Part 2. *Martes zibellina* (L., 1758) and hybrids *M. martes* x *M. zibellina*. *Lutreola* 27-33.

Smith, G. C., Cheeseman, C. L. & Clifton-Hadley, R. S. 1997. Modelling the control of bovine tuberculosis in badgers in England: Culling and the release of lactating females. *J. Appl. Ecol.*, 34:1375-1386.

Sokolov, V. E., Chernova, O. F. & Rozhnov, V. V. 1998. A finding of plantar glandular organs in a Marbled polecat *Vormela peregusna* (Mustelidae, Mammalia). *Doklady Akad. Nauk* 354:846-849. (In Russian)

Sokolov, V. E., Chernova, O. F. & Rozhnov, V. V. 1998. On plantar glandular organs in mustelids (Mustelidae, Mammalia). *Zool. Zh.*, 77:369-375. (In Russian)

Sokolov, V. E., Rozhnov, V. V. & Pham trong Anh. 1997. New species of viverrids of the genus *Viverra* (Mammalia, Carnivora) from Vietnam. *Zool. Zh.*, 5:585-589. (In Russian; English translation by Hayka/ Interperiodica Publishing)

Sokolov, V. E., Meshcherskii, I. G., Rozhnov, V. V. & Naidenko, S. V. 1995. Specific features of water balance and resistance to dehydratation in some mustelids (Carnivora). *Izvestiya RAN ser. Biol.*, 2:163-171. (*Mustela eversmanni, M. lutreola, M. vison, M. putorius*)(In Russian)

Song, J. H., Sirois, J. Houde, A. & Murphy, B. D. 1998. Cloning, developmental expression, and immunohistochemistry of cyclo-oxygenase 2 in the endometrium during embryo implantation and gestation in the mink (*Mustela vison*). *Endocrinology* 139:3629-3636.

Spurr, E. B. 1997. Assessment of the effectiveness of Transonic™ESP and Yard Guard™ ultrasonic devices for repelling stoats (*Mustela erminea*). *Conserv. Advis. Sci. Notes* 151. Wellington: Dept. of Conservation.

Trebukhina, R. V. *et al.* 1994. Adaptation of mink in radioecological situation, medico-biological disturbances and possibilities of post-radiation protection. In *Problems of ecological physiology fur animals*, 100-107. Karelian Research center of Russian Academy of Science Publ., Petrozavodsk. (In Russian)

Uzenbayeva, L. B. & Tiutiunnik, N. N. 1994. Impact of synthetic analogues of prostaglandins on cytoenzymological properties of mink blood. In *Problems of ecological physiology fur animals*, 107-112. Karelian Research Center of Russian Academy of Science Publ., Petrozavodsk. (In Russian)

Van den Brink, N. W. & Ma, W. C. 1998. Spatial and temporal trends in levels of trace metals and PCBs in the European badger *Meles meles* (L., 1758) in The Netherlands: Implications for reproduction. *Sci. Total Environm.*, 222:107-118.

Weckerly, F. W. 1998. Sexual-size dimorphism: Influence of mass and mating systems in the most dimorphic mammals. *J. Mamm.*, 79:33-52.

Wheeler, J. W., Nyalley, L., Davis, D. M. & Weldon, P. J. 1997. Additional sulfur compounds from the anal glands of the Striped polecat, *Ictonyx striatus* (Mustelidae, Mammalia). *Z. Naturforsch.*, 52(C):283-285.

Wijsman, H. & Kleef, H. 1999. Boommarters belaagd door bosuilen en bijen. *Zoogdier* 9(2):16-19. (*Martes martes*)

Williams, E. S. & Thorne, E. T. 1996. Infectious and parasitic diseases of captive carnivores, with special emphasis on the Black-footed ferret (*Mustela nigripes*). *Rev. Sci. Techn. Office Int. Epizoot.*, 15:91-114.

Wilson, P. R., Karl, B. J., Beggs, J. R. & Taylor, R. H. 1998. The role of introduced predators and competitors in the decline of kaka (*Nestor meridionalis*) populations in New Zealand. *Biol. Conserv.*, 83:175-185. (*Mustela* spp.)

Zorawski, C. & Lipiec, M. 1998. Bovine tuberculosis and its control. *Medycyna Weterynaryjna* 54:520-522. (In Polish)

Viverridae

Anon. 1998. Otter civets at Kaeng Krachan National Park. *Bird Conserv. Soc. Thailand Bull.*, 16(5):16.

Baker, C. M. 1998. Communication in Marsh mongooses (*Atilax paludinosus*): Anal gland secretion and scat discrimination in adults, and individual variation in vocalisations of juveniles. *S. Afr. J. Zool.*, 33:49-51.

Burwash, M. D., Tobin, M. E., Woolhouse, A. D. & Sullivan, T. P. 1998. Laboratory evaluation of predator odors for eliciting an avoidance responce in roof rats (*Rattus rattus*). *J. Chem. Ecol.*, 24:49-66. (*Herpestes auropunctatus*)

Clutton-Brock, T. H. *et al.* 1998. Costs of cooperative behaviour in suricates (*Suricata suricatta*). *Proc. Roy. Soc. London* 265(B):185-190.

Corn, J. L. & Conroy, M. J. 1998. Estimation of density of mongooses with capture-recapture and distance sampling. *J. Mamm.*, 79:1009-1015.

De, J. K., Chakraborty, S. & Chakraborty, R. 1998. Identification of dorsal guard hairs of five Indian species of mongoose, *Herpestes* Illiger (Mammalia, Carnivora). *Mammalia* 62:285-295.

Fuchs, S. *et al.* 1997. The nicotinic acetylcholine receptor of the mongoose. Tricks of evolution. *Neuroscience Letters* S48, S17 (Abstract)

Hedges, S. 1997. Mongoose's secret is to copy its prey. *New Scientist* 153(2064):16.

Ray, J. C. 1997. Comparative ecology of two African forest mongooses, *Herpestes naso* and *Atilax paludinosus*. *Afr. J. Ecol.*, 35:237-253.

Rozhnov, V. V. & Rutovskaya, M. V. 1996. Vocalizations of the Common palm civet (*Paradoxurus hermaphroditus*) during mating. *Lutreola* 6:6-9.

Schreiber, A., Eulenberger, K. & Bauer, K. 1998. Immunogenetic evidence for the phylogenetic sister group relationship of dogs and bears (Mammalia, Carnivora: Canidae and Ursidae) - A comparative determinant analysis of carnivoran albumin, C3 complement and immunoglobulin mu-chain. *Experim. Clin. Immunogen.*, 15:154-170.

Streicher, U. 1998. Vietnams Tierhandel. Gibt es einen Ausweg? *Mitt. Zool. Gesells. Art. Populations.*, 14(2):4-8. (*Chrotogale owstoni, Herpestes javanicus, Paguma larvata, Paradoxurus hermaphroditus, Viverricula indica*)

Van Vuren, B. J. & Robinson, T. J. 1997. Genetic population structure in the Yellow mongoose, *Cynictis penicillata*. *Mol. Ecol.*, 6:1147-1153.

Vilella, F. J. 1998. Biology of the mongoose (*Herpestes javanicus*) in a rain forest of Puerto Rico. *Biotropica* 30:120-125.

Vingada, J. V., Keating, A. L., Sousa, J. P. & Ferriera, A. F. 1996. Absence of dietary response to prey's fluctuations *Genetta genetta*: A case study. In *Proc. IUGB XXII Congr. September 1995. Sofia*, ed. N. Botev, 164. Sofia: Pennsoft Publishers. (Abstract)

Wheeler, J. W., Lay, D. M., Blum, M. S. & Weldon, P. J. 1998. Ketones in the anal sac secretions of the Masked palm civet, *Paguma larvata* (Viverridae, Mammalia). *Biochem. Syst. Ecol.*, 26:457-458.

Wolsan, M. & Morlo, M. 1997. The status of «*Plesictis*» *croizeti*, «*Plesictis*» *gracilis* and «*Lutra*» *minor*: Synonyms of the early Miocene viverrid *Herpestides antiquus* (Mammalia, carnivora). *Bull. Brit. Mus. Nat. Hist. London (Geol.)*, 17(3-suppl.):86A.

Mustelidae and Viverridae

Hainard, R. 1997. *Mammifères sauvages d'Europe*. Delachaux et Niestlé.

Kuznetsov, G. V. & Rozhnov, V. V. 1998. Mammals of the mountain region of Sa pa and Fan Si Pan: Biodiversity and problems of their conservation. In *Materials of zoological and botanical studies in Fan Si Pan summit area (North Vietnam)*, eds. L. P. Korzun and M. V. Kalyakin, 129-158. Russian Academy of Science and Joint Russian-Vietnamese Science and Technilogical Tropical Centre, Moscow-Hanoi. (In Russian)

Kolonin, G. V. 1998. Ixodid ticks on small mammals from Fan Si Pan summit area. In *Materials of zoological and botanical studies in Fan Si Pan summit area (North Vietnam)*, eds. L. P. Korzun and M. V. Kalyakin, 252-254. Russian Academy of Science and Joint Russian-Vietnamese Science and Technilogical Tropical Centre, Moscow-Hanoi. (In Russian)

Procyonidae

Fournier, P., Fournier-Chambrillon, C. & Vié, J. C. 1998. Immobilization of wild Kinkajous (*Potos flavus*) with medetomidine-ketamine and reversal by atipamezole. *J. Zoo Wildl. Med.*, 29:190-194.

Gehrt, S. D. & Fritzell, E. K. 1998. Resource distribution, female home range dispersion and male spatial interactions: Group structure in a solitary carnivore. *Ani. Behav.*, 55:1211-1227.

Hanlon, C. A. *et al.* 1998. First North American field release of a vaccinia-rabies glycoprotein recombinant virus. *J. Wildl. Dis.*, 34:228-239.

Hanlon, C. A. *et al.*1998. Concurrent rabies and canine distemper encephalitis in a raccoon (*Procyon lotor*). *J. Vet. Diag. Invest.*, 10:194-196.

Jacques, J. P. & Moutou, F. 1997. Raton laveur et conteneur. *Bipas* 17:43. (*Procyon lotor*)

Krebs, J. W., Smith, J. S., Rupprecht, C. E. & Childs, J. E. 1998. Rabies surveillance in the United States during 1997. *J. Amer. Vet. Med. Ass.*, 213:1713-1728.

Kreindel, S. M., McGuill, M., Meltzer, M., Rupprecht, C. & DeMaria, A. 1998. The cost of rabies postexposure prophylaxis: One state's experience. *Publ. Health Rep.*, 113:247-251.

Meltzer, M. I. & Rupprecht, C. E. 1998. A review of the economics of the prevention and control of rabies. Part 2. Rabies in dogs, livestock and wildlife. *Pharmacoeconomics* 14:481-498.

Page, L. K., Swihart, R. K. & Kazacos, K. R. 1998. Raccoon latrine structure and its potential role in transmission of *Baylisascaris procyonis* to vertebrates. *Amer. Midland Nat.*, 140:180-185.

Pietrzak, S. M. & Pung, O. J. 1998. Trypanosomiasis in raccoons from Georgia. *J. Wildl. Dis.*, 34:132-136.

Riley, S. P., Hadidian, J. & Manski, D. A. 1998. Population density, survival, and rabies in raccoons in an urban national park. *Can. J. Zool.*, 76:1153-1164.

Robbins, A. H. *et al.* 1998. Prevention of the spread of rabies to wildlife by oral vaccination of raccoons in Massachusetts. *J. Amer. Vet. Med. Ass.*, 213:1407-1412.

Rosatte, R. C., Lawson, K. F. & MacInnes, C. D. 1998. Development of baits to deliver oral rabies vaccine to raccoons in Ontario. *J. Wildl. Dis.*, 34:647-652.

Roscoe, D. E. *et al.*, 1998. Efficacy of an oral vaccinia-rabies glycoprotein recombinant vaccine in controlling epidemic raccoon rabies in New Jersey. *J. Wildl. Dis.*, 34:752-763.

Schubert, C. A., Barker, I. K., Rosatte, R. C., MacInnes, C. D. & Nudds, T. D. 1998. Effect of canine distemper on an urban raccoon population: An experiment. *Ecol. Applications* 8:379-387.

White, S. E., Kennedy, P. K., & Kennedy, M. . 1998. Temporal genetic variation in the raccoon, *Procyon lotor*. *J. Mamm.*, 79:747-754.

Wolsan, M. 1997. Oldest procyonids from the earliest Late Oligocene of Europe and the primitive procyonid morphology. *J. Vert. Paleontol.*, 17(3-suppl.):86A.

Zagers, J. J. & Boersma, J. H. 1998. Infections with *Baylisascaris procyonis* by humans and raccoons. *Tijdschrift Diergeneeskunde* 123:471-473. (In Dutch)

General

Cabard, P. & Chauvet, P. 1999. *L'étymologie des noms des mammifères*. Saint Yrieix: Eveil Nature.

Index: Mustelid & Viverrid Conservation 1-5 & Small Carnivore Conservation 6-20

AUTHORS

SPECIES AND SUBJECTS

IUCN/SSC MV&PSG membership

Chairman	***Main interest and/ or main conservation project***
Mr. Roland Wirth Franz-Senn-Strasse, 14 81377 München, Germany e-mail: 106317.3335@compuserve.com	*Conservation and recovery of threatened species, particularly in the Philippines and Vietnam*
Chair, Procyonid Sub-group	
Dr. Angela Glatston Blijdorp Zoo Van Aerssenlaan, 49 3039 KE Rotterdam, Netherlands e-mail: a.r.glatston@inter.nl.net	*Conservation of the Lesser panda* *Studbook keeper for Lesser panda*
Vice-Chairman for Europe & North America	
Mr. Tiit Maran Curator, Tallina Loomaaed Paldiski mnt., 145 200035 Tallinn, Estonia e-mail: tmaran@saturn.zzz.ee	*Conservation, captive breeding, and recovery of the European mink*
Vice-Chairman for Asia & Information Officer	
Mr. Paul Robinson 41 Moss Lane Hesketh Bank Nr. Preston PR4 6AA, UK e-mail: paulrobinson@btinternet.com	*Conservation program for the European marbled polecat*
Vice-Chairman for Madagascar	
Dr. Achim Winkler Duisburg Zoo Muhlheimer Strasse, 273 47058 Duisburg, Germany	*EEP coordinator for the Fossa* *Conservation of Malagassy carnivores*
Vice-Chairman for Africa & Editor-in-chief Newsletter	
Dr. Harry Van Rompaey Jan Verbertlei, 15 2650 Edegem, Belgium e-mail: Harry.VanRompaey@ping.be	*Herpestids & viverrids of Central Africa* *Carnivores of the Niger Delta, Nigeria*
Associate Editor Newsletter	
Dr. H. I. Griffiths Res. Inst. Environm. Sci. & Manage. School Geography & Earth Resources University of Hull Cottingham Road Kingston-upon-Hull HU6 7RX, UK e-mail: H.I.Griffiths@geo.hull.ac.uk	*Conservation biology of Palaearctic mustelids*
Wildlife Trade Monitoring Officer	
Ms. Shelagh Heard Rosenthal P.O.Box 156 Vancouver Is., BC Canada V0R 1Y0	*Study, breeding, and conservation of Owston's civet & other viverrids in Vietnam.* *Conservation education in Vietnam.*
Members	
Mr. Jörg Adler Director Allwetterzoo Sentruperstrasse, 315 D-4400 Münster, Germany	*Conservation in Vietnam*
Dr. Francesco M. Angelici Via Cleonia 30 00152 Roma, Italy	*Mustelids & Viverrids of Italy*
Dr. M. Artois CNEVA, Domaine de Pixérécourt Boîte Post. 9 54220 Malzéville, France	*Conservation of the European mink in France*
Ms Marie-des-Neiges de Bellefroid Muséum d'Histoire Naturelle La Rochelle 28, Rue Albert-1er 1700 La Rochelle, France	
Dr. Merav Ben-David Institute of Arctic Biology 311 Irving Bldg. University of Alaska Fairbanks Fairbanks, AK 99775, USA e-mail: fnmb@&auroraalaska:edu	
Dr. Leif Blomqvist Helsinki Zoo Korkeasaari 00570 Helsinki, Finland	*EEP Coordinator for the Scandinavian wolverine*
Mr. Dan Brooks Neotrop. Faun. Studies Foundation 1645 West main #1 Houston, TX 77006, USA	
Dr. Alberto Cadena Instituto de Ciencas Naturales Apartado Aero 7495 Santafé de Bogota, Colombia	
Mr. John Carnio Curator Mammals, Metro Toronto Zoo P. O. Box 280 West Hill, Ontario M1E 4R5, Canada	*Chairman of the AZA Small Carnivore Taxon Advisory Group*
Dr. Paolo Cavallini Dipart. Biol. Anim. Gen. "Leo Pardi" Univ. degli Studi di Firenze Via Romana, 17/19 50125 Firenze, Italy e-mail: CAVALLINI@www.specola.unifi.it	
Dr. T. W. Clark Northern Rockies Conservation Coop. Box 2705 Jackson, WY 83001, USA	*Conservation of the Black-footed ferret*
Dr. M. Colyn Station Biologique de Paimpont 35380 Paimpont, France e-mail: marc.colyn@univ-rennes1.fr	*Herpestids & viverrids of Central Africa*
Dr. João Crawford M. Cabral Centro de Zoologia do IICT Rua da Junqueira, 14 1300 Lisboa, Portugal e-mail: czool@www.iict.pt	*Taxonomy of African viverrids & herpestids*
Mr. Alfredo Cuaron University of Cambridge Tennis Court Road Cambridge CB2 1QS, UK	
Mr. Luke Dollar Ecology & Evol. Biology University of Tennessee 569 Dabney Hall Knoxville, TN 37996, USA e-mail: lukedollar@yahoo.com	*Behavioral ecology, conservation biology, and population genetics of* Cryptoprocta ferox *& other viverrids throughout Madagascar*
Mr. William Duckworth East Redham Farm Pilning, Bristol BS12 3JG, UK e-mail: wcslao@loxinfo.co.th	*Conservation of carnivores in south-east Asia*
Mr. Dave Fawcett 1 Wootton Way Cambridge, CB3 9LX, UK	*Conservation of the Columbian weasel*
Dr. J. Gittleman Dept. of Zoology University of Tennessee Tennessee, IN37916, USA e-mail: Gittleman@UTKVX.Bitnet	

[illegible] Gompper
[illegible]ronm. & Resource Sci.
[illegible]ty of Nevada
[illegible] 256
[illegible]y Road
Nevada 89512-0013, USA

[illegible] Groves — *Taxonomy of carnivores*
[illegible]rist. & Anthropol. Austr. Ntl. Univ.
Box 4
[illegible], ACT 2601, Australia
[illegible]olin.Groves@anu.edu.au

[illegible] Hawkins — *Field study of the Fossa in western Madagascar*
Zoology
[illegible]ty of Aberdeen
[illegible]e Avenue
[illegible]: AB9 2TN Scotland, UK

[illegible]olm Hunter
Wildlife
[illegible]ty of Maine
Maine 04469, USA

[illegible]. C. Karanth — *Carnivores of southern India*
Conserv. Soc. (India Progr.)
[illegible]cho Apartments
[illegible]a Abbas Ali Road
[illegible]ore 560042, India

[illegible] Kaufmann
Zoology
[illegible]sity of Florida
[illegible]sville, FL 32611, USA

[illegible]is Krystufek
[illegible]e Museum of Nat. History
Box 290
Ljubljana, Slovenia

[illegible]th Kumar — *Conservation of South Indian carnivores*
[illegible] Centre
[illegible]nithology & Nat. History
[illegible]more 641 010, India

[illegible] C. Kurup
Surv. India, West. Ghat Region St.
[illegible] Eranhipalam
[illegible] 673 006, Kerala, India

[illegible]erald E. Moore III
[illegible]niversity of New York
Environm. & Forest Biology
[illegible]estry Drive
[illegible]se, New York 13210, USA

[illegible] Palomares — *Ichneumon and genet in Spain*
[illegible]n Biologica de Doñana
[illegible] Apdo. 1056
[illegible] Sevilla, Spain
FEPALOMA@CICA.ES

[illegible] Poglayen-Neuwall — *Procyonids*
[illegible] N. Indigo Dr.
[illegible]n, AZ 85745, USA

[illegible]. Ramakantha, I.F.S.
[illegible]y Conservator Forests
[illegible] 585 401
[illegible]taka, India

[illegible]R. Ratajszczak
[illegible]ator Wielkopolski Park Zoologiczny
[illegible]Browarna, 25
[illegible]63 Poznan, Poland

Dr. Justina C. Ray — *Monitoring of African forest carnivores*
Faculty of Forestry,
University of Toronto
33 Willcocks Street
Toronto, Ontario, Canada M5S 3B3
e-mail: justina.ray@utoronto.ca

Dr. Michael Riffel
Wiesenweg, 3
69198 Schriesheim, Germany

Mr. René Rosoux
Muséum d'Histoire Naturelle La Rochelle
28 Rue Albert 1er
17000 La Rochelle, France

Dr. Viatcheslav V. Rozhnov
A.N. Severtzov Institute
Russian Academy of Sciences
33, Leninsky Prospect
Moscow V-71, Russia
e-mail: sevin@glas.apc.org

Dr. Hiroshi Sasaki — *Mustelids & viverrids of Japan*
Lab. Ecol., Dept. Biol., Kyushu Univ.
6-10-1 Hakozaki
Higashi-ku, Fukuoka 812, Japan

Dr. Arnd Schreiber
Zool. Inst., Heidelberg University
Im Neuenheimer Feld, 230
6900 Heidelberg, Germany
e-mail: r05@ix.urz.uni-heidelberg.de

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

Dr. Vadim E. Sidorovich — *Field studies of the European mink*
Institute of Zoology
F. Skoriny Street, 27
Minsk 220072, Belarus
e-mail: mustbel@mustbel.belpak.minsk.by

Dr. Chris Stuart
African Arbian Wildlife
Research Centre — *Mustelids, herpestids & viverrids of Africa & Arabia*
P.O. Box 6
Loxton 6985, Republic of South Africa
e-mail: 1336180@beltel.co.za

Dr. M. E. Taylor
Geomatics International
3370 South Service Road
Burlington, Ontario, Canada L7N 3M6
e-mail: mtaylor@beak.com

Dr. Astrid Vargas
Fish & Wildlife Service
Wyoming Coop. Fish & Wildl. Res. Unit
Bio. Sci. Bldg. #419
Box 3166, Univ. Station
Laramie, WY 82071, USA
e-mail: astrid_vargas@hotmail.com

Prof. Wei Fuwen
Institute of Zoology
Zhongguancun Road
Haidan
100080 Beijing, China
e-mail: weifw@panda.ioz.ac.cn

Dr. Pralad Yonzon
GPO Box 2448
Kathmandu, Nepal

Subscriptions

Subscription for 1999 (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.**