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European mink (*Mustela lutreola*) - Photo: Vadim E. Sidorovich

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Findings on the ecology of hybrids between the European mink *Mustela lutreola* and polecat *M. putorius* at the Lovat upper reaches, NE Belarus

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Introduction

Hybridization between the European mink and polecat has been suspected by many zoologists (Ognev, 1931; Novikov, 1939; Heptner *et al*., 1967; Tumanov & Zverev, 1986). In eastern Europe within the European mink's range, mammalogists and numerous trappers have on repeated occasions, captured medium-sized mustelid individuals that looked like something between the European mink and polecat. Based on morphological features they assumed that these strange looking mustelids were polecat-European mink hybrids.

During my long-term study of the mustelids of the upper reaches of the Lovat River in north-eastern Belarus, I handled such mustelid individuals which seemed to be polecat-European mink hybrids on six occasions (five males and one female). Diagnostic characters for the European mink and polecat are the pelage (brown and dense in European mink), mask (a white-yellow pronounced mask in polecats, no mask in European mink), body underhair (brown-grey coloured in European mink, mostly white-yellow in polecats), body overhair (longer and mainly black in polecats, brown in European mink) and the ears (bigger and with white-yellow in polecats, brown coloured in European mink). The suspected hybrids captured had only a poor remainder of the mask and were rather big with some yellow on the ears (Fig. 1), the body underhair was grey-yellow, and the overhair was quite long and dark brown. They were fairly big, the males were as high as the highest size of a male polecat and the female was much bigger than a normal female polecat. As all these features were completely attributed to the captive born polecat-European mink hybrids described by Ternovsky & Ternovskaja (1994), I summarized that the strange mustelid individuals captured were indeed polecat-European mink hybrids.

In the published literature there are no studies aimed at investigating the ecological features of polecat-European mink hybrids, and we found only poor information related to how often such hybrids are present in riparian habitats in eastern Europe (Ognev, 1931; Novikov, 1939; Heptner *et al*., 1967; Tumanov & Zverev, 1986). In respect to the above questions, the goal of this study was to investigate the presence of polecat-European mink hybrids in relation to the dynamics of European mink population density, and to reveal their main ecological features such as habitat selection, home range, activity pattern and feeding habits in the fairly natural environmental conditions of north-eastern Belarus .

Fig.1. Difference in heads of the polecat (left), the European mink (right) and polecat-European mink hybrid (centre)

Study area

The main study took place on the upper reaches of the Lovat River, Gorodok district, Vitebsk region, NE Belarus (32°N, 56°E). The area comprises various types of aquatic ecosystems. There are two main types of small rivers: (1) small, fast flowing rivers between 5 and 8 m wide and 0.5-1.5 m deep with high, steep wooded banksides and small floodplains, and (2) small, slowly flowing rivers between 7 and 25 m wide and 1-2.5 m deep with wide (200-1,000 m) floodplains consisting of black alder swamps and various open marshes (reed, sedge, and often a high diversity of grasses). Also in the area, there are many brooks and five glacial lakes, as well as various wetlands of different types and sizes, located outside the river valleys –e.g. open grassy marshes, black alder *Alnus glutinosa* swamps and pine *Pinus sylvestris* bogs. There are several types of stream banks and glacial lake shores such as (1) open grassy marsh, (2) black alder swamp, and (3) non-swamped wood (mainly either with old spruce *Picea abies* and black alder or with medium-aged grey alder *Alnus incana* and birches *Betula pendula, B. pubescens*). In total, wetlands comprise about 23% of the territory.

The main part (58%) of the study area is forested. Spruce and pine *Pinus sylvestris* are the dominant species among coniferous trees. Black and grey alders, birches, and aspen *Populus tremula* are the most common deciduous trees, whereas there are few masting deciduous trees such as oak and lime.

In the study area, the cold season, when the average air temperature drops below 0°C, is normally from late October or early November until early April. Usually, several periods of strong frost are observed every winter in the study area. During this harshest period, all the streams and lakes are ice bound, water temperatures are 0.5-1°C, and air temperature is -20 to -30°C. Strong frost may continue for 1-3 weeks. A flood is observed each spring and sometimes in summer and autumn. Normally,

turbid water floods all the river valleys. The spring flood continues for at least three weeks. A summer drought is recorded once per 4-6 years. During this unfavourable period all the brooks and fast flowing small rivers dry up.

Material and methods

The main study on ecological features of polecat-European mink hybrids was carried out between 1998 and 2000 on the Lovat upper reaches (Gorodok district, Vitebsk region, NE Belarus), but monitoring in relation to their presence in riparian habitats in that area has continued since 1986. In total, six hybrids (five males and one female) were handled during the study. Two of them (both adult males) were live captured in wooden box traps during mink and polecat live trapping. These hybrids were immobilized by injection of Vetalar, then radio-tagged and released at the place of capturing. Radio-tracking receivers were provided by Telonics Inc. (Mesa, Arizona), and neck-collars with transmitters were made by Biotrack Ltd. (Wareham, UK). The square and border of home ranges of the two polecat-European mink hybrids were estimated based on the radiotracking data by means of the concave polygon method (White & Garrott, 1990). The numbers of radiolocations taken were 1,012 and 499. To outline the main territory which was mostly inhabited by a hybrid, we used 95% of radiolocations done, excluding rare and brief visits to other places. The calculations were carried out with the RANGES-V package.

Scats of the radiotracked hybrids were regularly collected from latrines located close to frequently used shelters throughout the year. A total of 444 hybrid scats were collected. To compare the hybrid diet and the diets of the European mink and polecat, scats of these mustelids simultaneously inhabiting the same area as the hybrids (about 15 km^2) were also collected (497 and 276 scats, respectively). In the laboratory, the scats were washed in detergent and the remains of prey consumed were identified microscopically according to published keys (mammalian hair: Day, 1966; Debrot *et al*., 1982; Teerink, 1991; teeth: Pucek, 1981; Görner & Hackethal, 1988; fish scales, teeth, and vertebrates: Galkin, 1953, Zhukov, 1965, 1988; März, 1987; amphibian bones: Bohme, 1977, März, 1987; reptile bones and skins: März, 1987; the feathers and bones of birds: Day, 1966, März, 1987). Beetles and crayfish were distinguished by their exoskeletal remains, molluscs by the remnants of their shell.

The procedure to calculate the diets was as follows. The number of different prey individuals from which remains were found in all analysed scats was taken to be 100% in calculations of percentages of prey occurrence in the diet. The diets, expressed as percentage occurrences of various prey categories, were transformed into a ratio of prey biomass consumed by means of average weights of each prey species or category. So, the main measure of diets was percentage of food biomass consumed, because this more accurately expresses the proportion of each prey item in the total biomass of food consumed by a predator. To compare the overall dietary diversity (food niche breadth), the B index (Levins, 1968) was calculated for 13 food categories (insects, molluscs, crayfish, fish, frogs, toads, reptiles, birds, birds' eggs, small rodents, small insectivores, hedgehogs, carrion from wild ungulate carcasses). The B index varies from 1 (the narrowest niche) to 9, i.e. the maximum number of food categories used for calculations (the broadest niche possible).

In order to evaluate the overlap in food niche between polecat-European mink hybrids and polecats, as well as for European mink in the study area, Pianka's index (Pianka, 1973) and the least biased Morisita's index (Morisita, 1959; Krebs, 1998) were calculated, which vary from 0 (exclusive niches) to 1 (complete overlap). Both food niche breadth and dietary overlap were calculated according to the diets expressed as a percentage of food biomass consumed.

Results

Findings. In the study area in the Lovat upper reaches and still populated by the European mink, searches for a polecat-

Parameter	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Number of European mink found in local hunting bags during a year	11	42	37	30	22	20	13	6	2	1	7	4	1	2	2
Number of American mink found in local hunting bags during a year	0	0	1	4	21	29	74	114	92	54	137	102	109	78	62
Number of polecats found in local hunting bags during a year (polecats captured in valleys of rivers and glacial lakes were merely counted)	19	45	23	20	18	16	18	22	10	6	8	4	6	12	17
Number of polecat-European mink hybrids found in local hunting bags during a year	-	-	-	-	-	-	-	1	1	2	-	-	1	1	-
European mink per 100 American mink	-	-	3700	750	105	69	18	5.3	2.2	1.9	5.1	3.9	0.9	2.6	3.2
Hybrids per 100 mink (both species)	-	-	-	-	-	-	-	0.8	1.1	1.9	-	-	0.9	1.3	-
Hybrids per one European mink	-	-	-	-	-	-	-	0.2	0.5	2	-	-	1	0.5	-

Table 1. Frequency of occurrence of polecat-European mink hybrids compared to occurrences of both mink species and polecat in the local hunting bags (from both leg-hold trapping and live capturing by box-traps) on the R. Lovat's upper reaches, Gorodok district, NE Belarus, 1986-2000

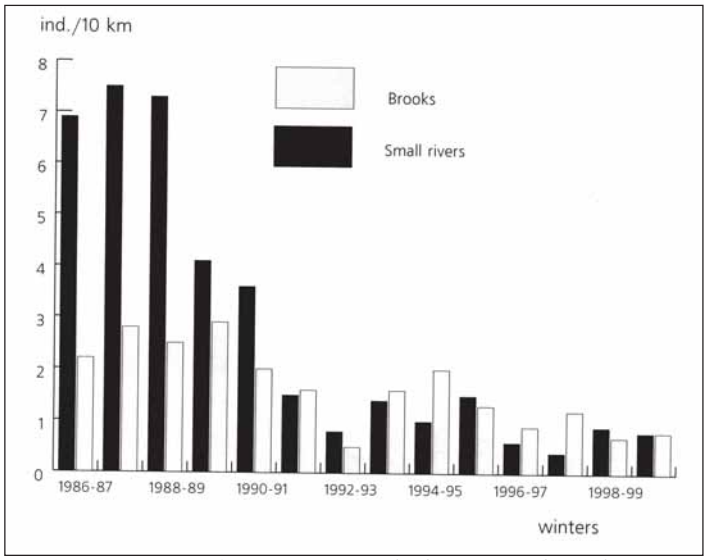

Fig.2. Dynamics of European mink density (ind./10 km water course) in the Lovat river head (winters 1986-2000)

European mink hybrid in local hunting bags were conducted over a fairly long period (1986-2000). This study took in different stages of the European mink population dynamics (dense and stable in 1986-1989, declining in 1990-1992, low density close to extinction in 1993-2000) connected with the American mink population expansion (Sidorovich 1997, 2000). Fig. 2 demonstrates the decline. In showing this, it should be remarked, that the low density maintained by the European mink population in the Lovat's upper reaches seems too long. There may have been a complete disappearance of the native mink 2-4 years before, but in 1993 and continuously since 1998 we undertook a partial eradication of American mink to help maintain the European mink population (Sidorovich & Polozov, unpubl. results).

The information obtained in relation to the presence of polecat-European mink hybrids in local hunting bags on the Lovat upper reaches, NE Belarus, are summarized in Table 1. Based on the sample size and the plausible number of mustelids like mink and polecats populating riparian habitats there, I assume that approximately 30-50% (in 1986-1992, 1994, 1995) and 60-80% (in 1993, 1996-2000) of arrivals were checked by either hunting or live box-trapping. The data show the following features. When the European mink was a common species there (1986-1992), polecat-European mink hybrids were not found. Probably in that time hybridization between the species was very rare. Since the European mink population attained a stable low density (mainly less than one individual per 1 km of stream stretch), polecat-European mink hybrids appeared and their number in the local hunting bags was similar to the number of European mink caught - up to 2 hybrids per one European mink taken, i.e. 0.53 on average (Table 1).

The hybrids were fairly big. The male hybrids (n=5) weighted from 1,120 to 1,746 g, and their body lengths ranged between 41 and 47 cm. The body mass of the single female hybrid examined was 742 g, and its body length was 37 cm.

Habitat use. Both radiotracked hybrids occupied the whole variety of habitats available (Table 2). In the warm season, hybrid habitat selection was very similar to polecat use of habitats on the Lovat upper reaches (Sidorovich *et al*., in press). They inhabited aquatic habitats such as brooks, small rivers and glacial lakes (47% radiolocations) as semiaquatic predators do, as well as swamped biotopes (39%) and dry land habitats (14%) as terrestrial predators do. In comparison with the European mink (Sidorovich, 2000; Sidorovich *et al*., in press) who mostly inhabits water edges (stream bank and glacial lake shore), the hybrids quite frequently (53%) stayed in habitats remote from aquatic ecosystems.

In the cold season, similar to European mink, hybrids tended to stay at streams (82% radiolocations) -basically small ones up to 10 km long (60%). Nevertheless, they quite frequently (18%) visited other habitats (forest, marsh, meadow) remote from aquatic ecosystems, which is not typical of European mink (Sidorovich, 2000; Sidorovich *et al*., in press).

Home range. Both radiotracked male hybrids were residents. Their home ranges comprised 5.1 and 4.3 km^2 in the warm season and 1.8 and 2.1 km^2 in the cold season, respectively. The hybrid territories were frequently visited by mink of both species and by polecats. I did not observe any aggressive attitudes between them. Nevertheless, some avoidance by these mustelids of the big male hybrids (their body mass 1.250 and 1.746 g) is very plausible and some data obtained do suggest this.

Feeding habits and dietary overlap. The diets of polecat-European mink hybrids compared to the diets of European mink and polecats simultaneously inhabiting the same area (about 15 km^2) in the warm and cold seasons is given in Table 3.

In the warm season, the hybrid diet was very similar to the European mink's diet and dominated by frogs. Hybrids mostly fed on common frogs *Rana temporaria* (which constituted 50.6%BC). The difference was merely that European mink consumed crayfish in substantial quantities, whilst hybrids ate crayfish very rarely ($G=11.6$, $P<0.01$). Therefore, the dietary structure of European mink and hybrids heavily overlapped (both Pianka and Morisita's index=0.98). Their dietary similarity with the polecat was markedly lower (Table 3a). The polecat diet was very different and nearly equally composed of four prey items -frogs (15.8%BC), toads (20.1%BC), small rodents (19.3%), and birds (23.0%BC), whereas hybrids more often consumed frogs ($G=30.8$, $P<0.01$) and less frequently preyed on toads, small rodents or birds ($G \geq 4.3$, $P \leq 0.04$). Also fish were more important food for hybrids ($G=7.2$, $P<0.01$), while polecats more frequently ate hedgehogs ($G=4.4$, $P=0.04$). The food niches of the European mink and polecat-European mink were narrow (Levin's index=1.96 and 2.28, respectively). Polecats had a more diversified diet and its food niche breadth was much higher - 6.0.

In the cold season, the dietary overlap of hybrids with European mink and polecats was high (Table 3b). Nevertheless,

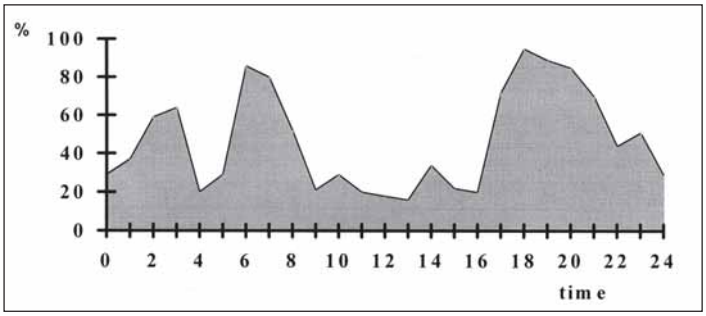

Fig.3. Twenty-four hour activity of polecat-European mink hybrids, 1998-2000, in the Lovat upper reaches, Gorodok district, NE Belarus. The warm season (April - October), 45 % of fixes on average, n=2 individuals/847 radiolocations

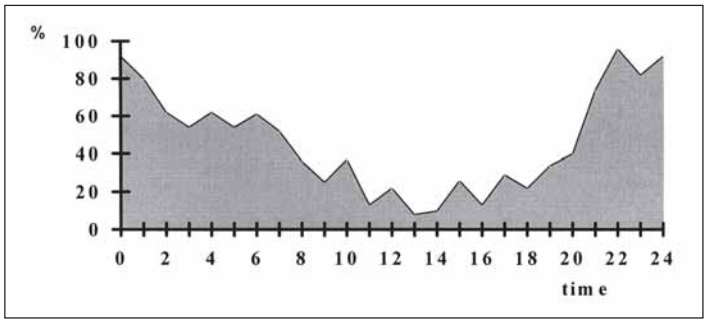

Fig.4. Twenty-four hour activity of polecat-European mink hybrids, 1998-2000, in the Lovat upper reaches, Gorodok district, NE Belarus. The cold season (November - March), 47% of active fixes, n=2 individuals/664 radiolocations. Denotation: % activity in radiolocations is given.

hybrids were closer to polecats in feeding habits. In the cold season, hybrids and polecats established a diversified diet dominated by frogs and small rodents; their food niche breadths comprised 3.4 and 4.6 respectively. The main differences between the diets of hybrids and polecats in the cold season were as follows. Polecats relied on carrion from wild ungulate carcasses a lot (16.2%BC), whereas hybrids consumed carrion fairly rarely (3.8%BC, G=8.3, P<0.01). Also, hybrids relied more on frogs (G=7.3, P<0.01). As in the warm season, in the cold season the European mink specialized more (Levin's index=2.1) as a frog eater (66.9%BC). The portion of frogs in the European mink's diet was nearly twice as high as that in the hybrid diet (G=8.1, P<0.01). Amongst frogs, common frogs and edible frogs, *R. esculenta* complex, hibernating in streams and other aquatic ecosystems were basically preyed on by European mink. Also, European mink more frequently consumed aquatic prey (fish and crayfish) than did hybrids (G≥4.4, P≤0.04). Quite on contrary, hybrids relied more on terrestrial prey such as toads and small rodents (G≥12.5, P<0.01).

Daily activity pattern. Hybrids were more frequently active at night and twilight than in the daytime (Fig.3). In comparison with European mink, hybrids were more nocturnal, while polecats were more nocturnal than hybrids (Sidorovich, 1997). In total, hybrids were active for 45% of the fixes taken in the warm season and 47% in the cold season. The European mink was registered as a more active predatory species (59% active fixes), whereas polecat were less active - 34% active fixes (Sidorovich, 1997).

Discussion

In this discussion, I would first like to give rough answers to the two questions asked in the introduction. The first question was how often are polecat-European mink hybrids present in riparian habitats in eastern Europe and in which conditions do they appear? I agree that hybridization between the European mink and polecat was common in the past; there is enough published information to show that (Ognev, 1931; Novikov, 1939; Heptner *et al*., 1967; Tumanov & Zverev, 1986; Ternovsky & Ternovskaja, 1994). Nevertheless, nobody studied under which ecological conditions polecat-European mink hybrids appeared. It might be typical and independent of density of the hybridized mustelid species, or mainly initiated by the low density of the European mink population caused by overexploiting by trappers, as happened both many decades ago (Novikov, 1939) and recently (Sidorovich, 1997). The data obtained during long-term monitoring on the Lovat upper reaches in NE Belarus suggest the second hypothesis. In conditions of rather dense, and stable European mink populations, polecat-European mink hybrids are rarely present in riparian habitats in eastern Europe - less than one hybrid per 100 (mink both species) and polecats. When the European mink population attained a low density (approximately ≤1 individual per 10 km of river stretch), polecat-European mink hybrids appear to be common - approximately 1-2 hybrids per 100 (mink both species) and polecats, and 0.5-2 hybrids per European mink.

The second question was to determine the main ecological features of polecat-European mink hybrids. What are they ecologically? Is such a hybrid something between the hybridized species or does it realise one of their ecological niches? My first rough answer is as follows. Taking into account the above-presented results, it is more likely to say that, ecologically, polecat-European mink hybrids are indeed something between the European mink and polecat. Hybrids acted both as a semi-aquatic predator like the European mink, and as a more terrestrial predator, like the polecat. They changed feeding habits between being a generalist predator basing its diet on amphibians, small rodents and birds (like the polecat) to being a frog eater similar to the European mink. Even in daily activity hybrids were intermediate between the two hybridized species.

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Type of habitat	Warm season, n=847 fixes	Cold season, n=664 fixes
Brooks (<2 km long)	8	22
Brooks (2 -10 km long)	7	38
Fast or moderately flowing, small rivers without a floodplain or with narrow somewhat swamped floodplains	28	22
Slowly flowing, small rivers with fairly wide marshy floodplains	3	-
Glacial lakes	1	-
Swamped black alder forest	17	9
Non-swamped forest	5	4
Grassy marshes with or without pools	22	2
Non-swamped meadows	9	3

Table 2. Habitat selection by radiotracked polecat-European mink hybrids on the R. Lovat's upper reaches, Gorodok district, NE Belarus, 1998-2000.

Table 3. Diet composition (expressed as occurrence percentage of various food items in the scats analysed (%OC), and in percentage of food biomass consumed (%BC)) of the polecat-European mink hybrid, the European mink and the polecat on the R. Lovat's upper reaches, Gorodok district, NE Belarus, 1998-2000. B - index of food niche breadth (Levins, 1968). μ - index of food niche overlap after Pianka (1973). Both B and a were calculated for %BC of the 13 listed food items.

Food category	Hybrid		European mink		Polecat	
	%OC	%BC	%OC	%BC	%OC	%BC
Insects	4.1	0.2	3.9	0.2	2.0	0.1
Molluscs	0.7	0.2	0.5	0.2	0.8	0.1
Crayfish	0.3	0.4	7.5	10.0	0.2	0.2
Fish	2.7	6.3	5.3	7.6	0.2	0.2
Frogs	72.1	64.3	78.8	69.7	24.6	15.8
Toads	2.4	6.5	0.2	0.6	10.3	20.1
Reptiles	0.7	0.9	0.2	0.3	6.7	6.0
Small rodents	6.1	7.8	4.0	5.4	21.0	19.3
Small insectivores	3.1	0.7	0.8	0.2	6.1	1.0
Hedgehogs	0.3	1.3	-	-	2.2	7.3
Birds	7.1	10.5	3.7	5.8	21.6	23.0
Birds' eggs	0.3	0.4	-	-	3.3	3.6
Ungulate and other carcasses	0.1	0.5	-	-	1.0	3.3
Index of food niche breadths, B	2.28		1.96		6.0	
Number of scats analysed	242		273		153	
Number of prey individuals recovered	708		845		505	
Index of food niche overlap μ:						
Hybrid	-		0.98		0.58	
European mink	0.98		-		0.47	
Polecat	0.52		0.40		-	

a) in the warm period (April-October)

Food category	Hybrid		European mink		Polecat	
	%OC	%BC	%OC	%BC	%OC	%BC
Insects	2.0	0.1	4.8	0.2	2.4	0.1
Molluscs	0.3	0.1	0.8	0.3	3.0	0.7
Crayfish	-	-	8.8	11.8	-	-
Fish	2.6	1.3	4.9	7.1	-	-
Frogs	47.0	37.8	70.3	66.9	26.8	17.8
Toads	3.6	8.8	-	-	4.9	9.9
Reptiles	3.3	3.7	0.3	0.4	2.7	2.5
Small rodents	32.1	37.1	6.1	8.3	38.7	37.0
Small insectivores	6.1	1.2	1.0	0.3	7.2	1.2
Hedgehogs	0.3	1.3	-	-	1.6	5.6
Birds	1.8	4.8	3.0	4.7	8.1	8.0
Birds' eggs	-	-	-	-	-	-
Ungulate and other carcasses	0.9	3.8	-	-	4.6	17.2
Index of food niche breadth, B	3.4		2.1		4.6	
Number of scats analysed	202		224		123	
Number of prey individuals recovered	660		627		370	
Index of food niche overlap μ:						
Hybrid	-		0.78		0.90	
European mink	0.75		-		0.48	
Polecat	0.89		0.45		-	

b) in the cold period (November-March)

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Pattern of variation in the feeding habits of the Badger *Meles meles* in the Abruzzo National Park (central Italy)

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Introduction

The distribution of the badger *Meles meles* showed a progressive expansion throughout much of Europe in the last decades (Griffiths & Thomas, 1993; Bevanger & Lindström, 1995; Kauhala, 1995). This success has been allowed by the extraordinary adaptability of the species (Neal & Cheesemann, 1996). The badger in fact can live in a wide range of habitats, from sea cliffs to mountainous ridges, exploiting a huge variety of foods (Kruuk, 1989; Neal & Cheesemann, 1996). The patterns of variation in habitat use and feeding strategy have been one of the main topics of more recent ecological studies. In particular, several works deal with the spatio-temporal variability of the feeding habits of badger populations, both on geographical and local scales (Goszczynski et al., 2000). However, few studies have investigated the pattern of variation of the diet at an intra-population level and in relation to environmental parameters (Mouches, 1981; Hofer, 1988; Lambert, 1990). In Italy only few works have analysed temporal variation in feeding habits in coastal and Alpine habitats. This work attempts to investigate the diet of the badger: (1) at population level in an Apennine habitat at the altitudinal limit of the species range, and (2) at the intra-population level, comparing the feeding habits of individuals living in distinct sub-areas with different habitat characteristics.

Study area

This study was carried out in the Abruzzo National Park (hereafter ANP) located in the central Italian Apennines at 41°48'N, 15°45'E. The study area covers approximately 76 km^2 and ranges from 1,000 to >2,000 m a.s.l. The climate is Mediterranean (Montelucci, 1971); annual average rainfall is 1,314 mm (minimum in August, 41 mm; maximum in November, 2,580 mm) and the annual mean temperature is 9°C (minimum in January, 0.9°C; maximum in August, 17.5°C) (Conti, 1995). Woodland with a predominance of beech *Fagus sylvatica* covers most of the study area (59%). Open areas (meadows, pastures, cultivated and uncultivated fields) are also widespread (36%). Various shrubs are scattered in these open areas, with a prevalence of *Cornus mas* and *C. sanguinea*, *Crataegus monogyna* and *C. laevigata*, *Juniperus* spp., *Prunus* spp., *Rosa* spp. and *Rubus* spp.

Methods

Faeces were collected during systematic surveys at monthly intervals from March 1997 to May 1998 from typical latrine sites or from the ground. Faeces were analysed following the routine methods of Kruuk & Parish (1981) and Bradbury (1977). The results were expressed as relative frequency of occurrence (number of items of a given food category / total number of items). To study the intra-population variation in the diet, two habitat types were considered: wooded (deciduous forest with predominance of *F. sylvatica*) at 1,400-1,700 m a.s.l., and open (meadows, uncultivated and cultivated fields) at 1,100-1,250 m a.s.l. The distance between the two sub-areas was about 15 km. Faeces collected in these sub-areas were found near setts located approximately in the centre of an area >2 km^2 and characterised by the same habitat type. G tests of independence and Kolmogorov-Smirnov tests were applied to analyse seasonal and habitat variations in the trophic spectrum. Niche breadth was estimated by Levins' measure, B, and by Levins' standardised measure, B_{sta} (Krebs, 1989). Niche overlap was assessed by Horn's index of similarity. This index gives a little biased measure (Krebs, 1989) and is considered more appropriated than others (e.g. Morisita's measure) when we are interested in the overlap in foraging habitat (Horn, 1966).

Results

Diet analysis was based on a sample of 109 faeces. The overall diet of the badger consisted of 60.65 % animal foods 39.35% vegetable foods (Table 1). Animal food was represented mainly

Food category	%
Animal	60.65
Vegetal	39.35
Vertebrates	1.83
Invertebrates	58.82
Fruit	39.35
Mammalia	1.58
Rodentia	1.03
Artiodactyla	0.23
Lagomorpha	0.13
Insectivora	0.06
Unidentified	0.13
Aves and Reptilia	0.25
Insecta	42.04
Coleoptera	30.45
Orthoptera	10.87
Dermaptera	0.32
Hymenoptera	0.23
Hemiptera	0.02
Unidentified	0.15
Insecta (larvae)	11.46
Gasteropoda - Pulmonata	2.70
Anellida – Lumbricidae	2.51
Other invertebrates	0.11
Fruit	39.35
Rosaceae	19.20
Cornaceae	5.84
Rhamnaceae	4.91
Fagaceae	2.78
Grossulariaceae	0.13
Corylaceae	0.04
Papilionaceae	0.02
Unidentified	6.43

Tab.1. Annual composition of the diet of the badger in Abruzzo National Park. % = relative frequency of occurrence. Number of faeces: 109, number of items: 4,745.

by insects and their larvae, whilst vegetable foods included only fruit (mostly Rosaceae). Other categories were exploited only occasionally.

Seasonal variation

Regardless of the predominance of fruit and insects, the diet of badger showed consistent changes throughout the seasons (Fig. 1). Insects and their larvae were the main food in spring (73%) and summer (61%). Maximum exploitation of Coleoptera was recorded in spring, while the highest consumption of Orthoptera was in summer. Fruit was the staple food during autumn (68%). In winter the diet was dominated by various invertebrates (82%), mainly earthworms and insect larvae, however, the small size of the winter sample could have biased the results. Differences in the seasonal consumption of insects, fruit and earthworms were significant ($P < 0.001$). The annual trophic niche of the badger was $B = 2.887$ or $B_{sta} = 0.27$. No seasonal pattern in niche breadth was registered (Kolmogorov-Smirnov test, $D = 0.52$, P = n.s.), but niche breadth values were highest in winter ($B = 2.587$, $B_{sta} = 0.398$) and spring ($B = 2.915$, $B_{sta} = 0.383$) and lowest in autumn ($B = 1.981$, $B_{sta} = 0.163$).

Habitat variation

The diet of the badger was based on fruit and insects in both the wooded and open habitat (Fig. 1) but the exploitation of these feeding resources was either quantitatively and/or qualitatively different. Fruit consumption seemed not to be influenced by habitat type (P = n.s.), whereas insects were eaten more frequently in the wooded habitat ($P < 0.05$). Rosaceae represented the most common fruit eaten by badgers in both habitats, but fruit composition at the genus or species level was completely different (Fig. 2). Fruit composition was very diverse in wooded areas, whereas almost only *Prunus* sp. remains were found in scats collected in the open habitat. Coleoptera constituted the staple insect taxon in both habitats (P = n.s.), but Carabidae were more abundant in scats collected in woods ($P < 0.05$) and Melolontidae were almost exclusively found in those collected in open habitats ($P < 0.001$). Orthoptera consumption was higher in open habitats ($P < 0.01$) where badgers took mostly Gryllidae ($P < 0.001$), but grasshoppers were the most common orthopteran eaten in woods ($P < 0.001$).

In open habitats the badger's diet is more diverse ($B = 3.134$, $B_{sta} = 0.427$) than in wooded ones ($B = 1.656$, $B_{sta} = 0.131$). The degree of overlap between the two habitats, as showed by Horn's index, is 0.902.

Discussion

The badger's feeding habits are rather unusual amongst carnivores; the ratio between mean badger size and mean prey size is the highest of all European carnivore species (Guitan Rivera & Callejo Rey, 1983) - this means that badgers usually feed on very small prey. According to our study, small food items such as fruit and insects represented the bulk of the diet of this mustelid (93%). Fruit and insects are clumped and abundant feeding resources and badgers exploit them profitably. The badger's diet seems to be well balanced nutritionally. Fruit provides especially carbohydrates but is poor in lipids and proteins (Debussche *et al*., 1987). [Some edible fruits occurring in ANP, notably *Atropa belladonna*, *Solanum nigrum*, *Bryonia dioica* (Conti, 1995) would also have a fairly good protein component, but they include secondary toxic compounds so that mammals usually avoid them (Debussche & Isenman, 1989)]. Proteins and lipids are provided by insects for most of the year, but in autumn and winter (when insects are scarce) they are substituted by other animal prey such as small mammals and earthworms. The gut anatomy and dentition of the badger, atypical among mustelids (Stark et al., 1987; Neal & Cheeseman, 1996), allow it to exploit such a wide range of food.

Fruit and insects constitute the trophic basis for several Italian badger populations living in both coastal habitats (Ciampalini & Lovari, 1985; Pigozzi, 1991) and in mountainous

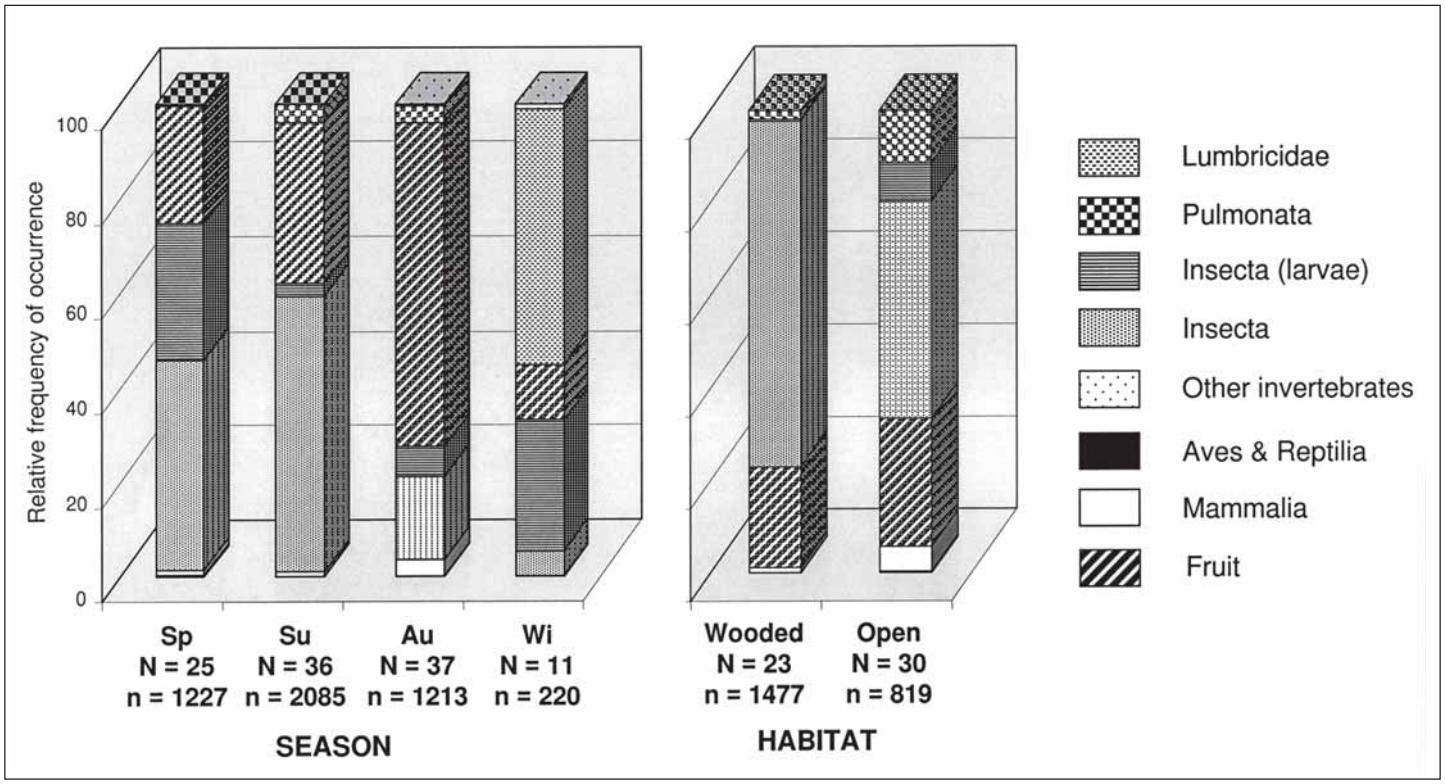

Fig.1. Seasonal and spatial variation in the diet of the badger in Abruzzo National Park. N = number of faeces; n = number of items; Sp = spring; Su = summer; Au = autumn; Wi = winter

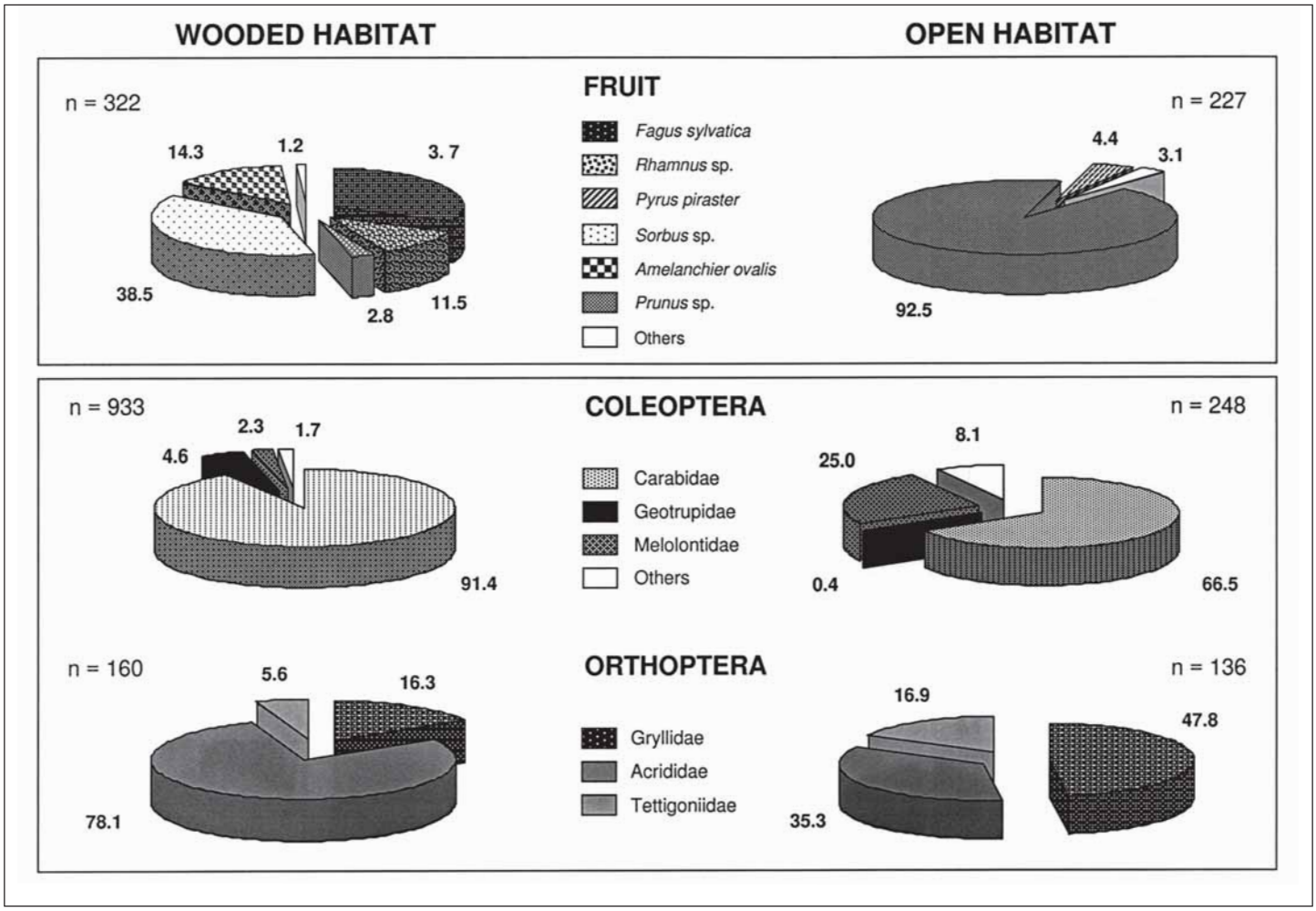

Fig.2. Coleoptera, Orthoptera and fruit composition per habitat in the badger diet in Abruzzo National Park, expressed as relative fraquency of occurrence.

ecosystems (Kruuk & de Kock, 1981; Biancardi *et al*., 1995) up to the upper altitudinal distributional limit of the species (Rinetti, 1987; Lucherini & Crema, 1995). Moreover, fruit and insects seem to be important feeding resources for other Italian generalist predators such as red fox (Cavallini & Lovari, 1991; Rosa *et al*., 1991) and stone marten (Brangi, 1995; Genovesi et al., 1996). It seems that fruit and insects together constitute a conspicuous and balanced trophic basis upon which a guild of generalist carnivores can rely for most of the year in Southern Europe (Prigioni, 1991; Neal & Cheeseman, 1996; Pandolfi *et al*. 1996).

The results of the present study show that the seasonality of the diet of the badger accords with temporal changes in food availability, and confirms the findings of several studies carried out both in Italy and in the rest of Europe (Neal & Cheeseman, 1996). Moreover, we recorded an inter-habitat variability in the diet - individuals from the same population but living in different habitats exploit different food resources. This intra-population dietary difference is typical of a generalist species and has already been described in the stone marten (Genovesi *et al*., 1996). Therefore, the belief that the badger is a specialist predator can once again be questioned as at any level the availability of food resources affects the feeding habits of this mustelid species.

Acknowledgements

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Recent publications

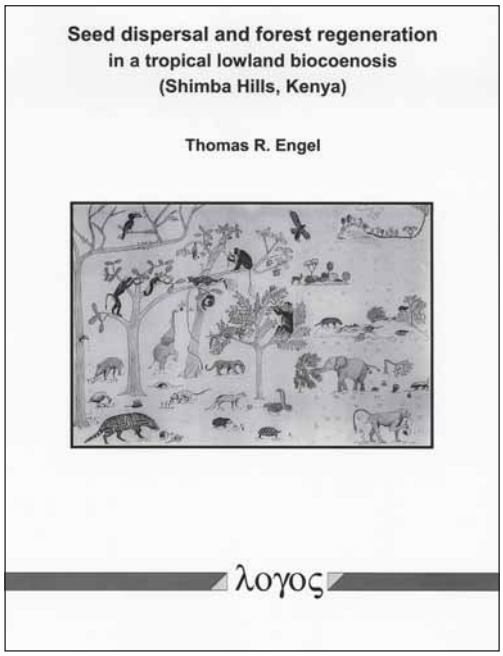
Thomas R. Engel. 2000. *Seed dispersal and forest regeneration in a tropical lowland biocoenosis (Shimba Hills, Kenya).* Berlin: Logos Verlag. 344 pp. ISBN 3-89722-423-2. Price: 79 DM. E-mail: thomas.engel@uni-bayreuth.de

In a recent synecological study of the impact of viverrids, herpestids and mustelids on natural forest regeneration and of communual latrine use has been investigated in the Shimba Hills National Reserve, in coastal Kenya. The author points out the roles of viverrids, herpestids and mustelids in forest regeneration and communal latrine use, which is photo documented (as are many other aspects too).

African civets (*Civettictis civetta*) are active dispersers of a minimum of 108 plant species (about 10% of the local angiosperm flora). The large-spotted genet (*Genetta* cf *rubiginosa*) disperses 41 plant species, the two-spotted palm civet (*Nandinia binotata*) 12 and the white-tailed mongoose (*Ichneumia albicauda*) disperses a minimum of five plant species. Seeds are deposited at latrine sites and, as a new result, some of these latrines are shared by African civets, genets and mongooses. In particular, the larger African civet faeces are highly attractive to dung visitors such as ants and especially dung beetles, which secondarily incorporate the seeds in the soil. Many latrines are used on a long-term basis. The latrines play an important role in the initiation of forest regeneration. Other mongoose species and ratels occur as well, but their impact on forest regeneration is still largely unknown.

The above, as well as a wealth of information on seed dispersal by other vertebrates (primates, bats, elephants, suids, rodents, reptiles, and birds) and invertebrates (beetles, ants, etc.) form part of this highly interesting work, a PhD thesis made for the University of Bayreuth. It took the author several years in East Africa to gather and sort out the enormous amount of data this book contains. It should be important for zoologists and botanists alike.

For book orders or downloads see "www.uni-bayreuth.de/departments/biogeo/thomas.htm".



Badgers (*Meles meles*) on Fenit Island, and their presence or absence on other islands in Co. Kerry, Ireland

Paddy SLEEMAN, Robert CUSSEN, Tim O'DONOUGHUE[1] and Eamonn COSTELLO[2]

Introduction

Badgers are common in Ireland and Britain and can act as a reservoir of bovine tuberculosis, an economically important disease (O'Boyle, 1998; Gallagher & Clifton-Hadley, 2000). Recent studies of badgers on Irish islands (e.g. Sleeman *et al*., 1999), have yielded useful information, as well as providing isolated populations that may be useful for the development of vaccines for tuberculosis (Southey & Gormley, 1998; Gormley & Southey, 2000). Islands have previously been used in the development of vaccines for rabies (Winkler & Bögel, 1992). Practical management strategies for badgers, such as culling options or vaccination, are continually needed (Krebs *et al*., 1997) and such island populations may have an important part to play in providing data on which to base such strategies.

Fenit Island

The badgers on Fenit Island were investigated as part of research on isolated badger populations for vaccine trials. The island is connected to the mainland by a sandy causeway 0.8 km long, which can be used by vehicles when the tide is out, or low (it is not, therefore, an island proper by definition). It is located 11 km west of Tralee, Co. Kerry in Barrow Harbour, and has an area of about 2 km^2 (Fig. 1). The island has thin but good soil, on a Lower Carboniferous limestone base -characteristic of this part of North Kerry (Carruthers, 1998). The main field boundaries are dry stone walls. There are eight principal landowners, and four cattle herds two of which are dairy herds. There is no recent history of tuberculosis in these herds (Department of Agriculture of Ireland, Kerry District Veterinary Office).

The island is wind swept and almost devoid of trees, except for some elder (*Sambucus nigra*), and some low scrub (mainly blackberries, *Rubus* spp.). In addition there are three small orchards. Other wild mammals found on the island include otters (*Lutra lutra*), foxes (*Vulpes vulpes*), rabbits (*Oryctolagus cuniculus*), Irish hares (*Lepus timidus*), common rats (*Rattus norvegicus*), wood mice (*Apodemus sylvaticus*) and pygmy shrews (*Sorex minutus*). The otters use at least three holts (Fig. 1). The island is in a proposed candidate Special Area of Conservation (SAC). We present results of our initial investigation of the island's badgers.

Other islands in Co. Kerry

Between 1993-1996 the following islands were visited and surveyed for signs of badgers: Innisfallen, Brown Island and Lamb Island, all of which are on Lough Leane (Map reference V 98), Killarney, Co. Kerry. However, no evidence of badgers was found. On Valentia Island, an offshore island connected by a bridge to the mainland (Map reference V 37 & V 47), a badger cub was reported to have been killed by dogs in June 1994. This female cub was subjected to post-mortem examination and had injuries consistent with having been involved in a road traffic accident, before meeting with the dogs on the island. A search of all suitable habitats over four days in 1995 failed to locate any signs of badgers on the island and it was concluded that there were no resident badgers. Therefore the cub had most likely been brought to the island by people. This prompts the interesting question as to how often, on mainland sites where such movements are undetectable, does badger movement by humans occur? Fenit Island is therefore the only island in Co. Kerry that to date has been identified as having a resident badger population.

Badger setts and territories on Fenit Island

We surveyed Fenit Island for badgers' setts and otter holts in winter 1999 and 2000. Eight setts found on the island, two of which were identified as main setts, both of which had spoil heaps sufficiently big to be visible from the adjacent mainland (Table 1, Fig. 1). The remainder of the setts are referred to as 'other setts'. The main setts were baited with a peanut, coloured plastic pellet and treacle mixture for ten days in spring 1999 and 2000 (see Delahay *et al*., 2000). The follow up survey indicated that there is a single social group, but with two main setts (Fig. 1). The badger latrines on the causeway between the mainland and the island are in patches of blackberries (*Rubus* spp.). It is probable that the blackberries on the causeway were dispersed to that site by badgers marking the site with latrines.

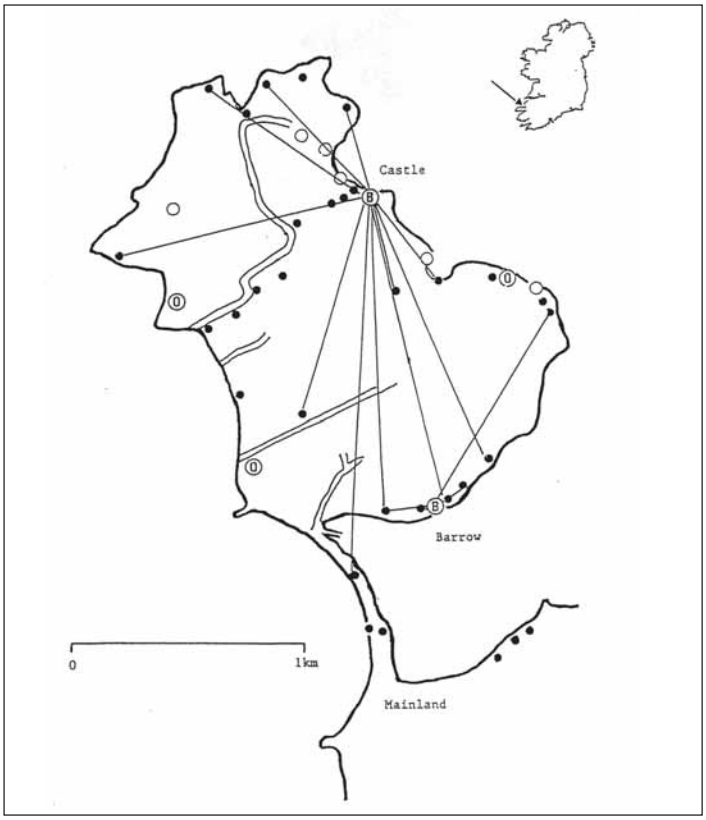


Fig.1. Fenit Island, Co. Kerry wich is joined to the mainland by a causeway. The two badger main setts are indicated by Ⓑ *other setts by a blank circle, otter holts by* Ⓞ*. Where badger latrines • were marked by fed plastic pallets, they were joined to the main sett at which the pellets were fed by a straight line (see Delahay* et al. *2000 for details).*

Name	Active entrances	Status	Other residents
Barrow	8-10, 3 with spoil heaps	Main	Foxes/rabbits/otters
Castle	3-5, 1 with spoil heaps	Main	Foxes/rabbits/otters
Castle complex	5, all with spoil heaps	Other	Foxes/rabbits
Castle complex	4, all with spoil heaps	Other	Foxes/rabbits
Castle complex	3, little spoil	Other	Rabbits
Cliff	3, little spoil	Other	None
Marsh	1, little spoil	Other	Rabbits

Table 1. Badger setts on Fenit Island (1999-2000)

Badger behaviour

Local residents have seen badgers on the north shore of Fenit Island during daylight foraging on the shore; marine intertidal invertebrates (isopods and amphipods) were found in badger dung in the summer of 1999. The utilisation of such invertebrates by badgers has not been previously recorded. Badger cubs were seen playing at Castle main sett by local residents.

Trapping, marking and sampling badgers

The badgers on the island were trapped under licence, under section 23 of the Irish Wildlife Act (1976), using plastic coated metal cage traps, based on a British Ministry cage trap design (Cheeseman & Mallinson, 1979). Trapping was carried out for a week in July 1999 and a week in July 2000, with 15-23 traps being deployed near setts pre-fed with peanuts before trapping. In two weeks of trapping a total of eight adult badgers were caught, consisting of four males and four females (Table 2). There were 200 trap nights in total and it is considered likely that all of the population was captured. Only one instance of traps causing wounds was observed, and this was caused by an incorrectly fitted door. Assuming that all the badgers were captured, the density is four badgers per square kilometre.

The animals were marked using ear-tags (Dalton, Rototags, UK) and passive transponders (Allflex, Vitre Cedex, France). In addition the pattern of black marking inside the mouth on the upper palate was recorded in badgers trapped in 2000 (Fig. 2), and some hairs were taken as controls for biomarker work. Blood samples were taken from each captured badger and tested for evidence of tuberculosis and also examined microscopically for the presence of trypanosomes. No evidence of either was found (for details of tests see Southey & Gormley, 1998 and references therein). This, and the absence of tuberculosis in cattle on the island suggests that this population is free of tuberculosis and therefore has potential as a vaccine development study population.

There were no cubs captured in 1999, and only one young female badger was captured, at Barrow main sett, in 2000. This is likely to have been born on the island in 1999. In addition, badger cubs were noted in previous years at Castle main sett. The island badgers were 'normal' mainland weights and lenghts, but slightly heavier than mean weights for mainland Irish badgers in July 1999; the mean weight of adult females on the mainland in July is 8.1 kg, those on Fenit I. had a mean weight of 8.9 kg (in 1999). The mean weight of adult males on the mainland for July is 8.2 kg, for those on Fenit I. it was (in 1999) 8.5 kg. On average the badgers on Fenit I. are 0.5-0.8 kg heavier than mainland badgers. They are much heavier than badgers found on other islands such as Rutland (Co. Donegal) and Coney (Co. Sligo) which are lighter and smaller than badgers on the mainland. Lice, fleas, and ticks were found on the Fenit I. badgers but in low numbers.

Conclusions

Currently, Fenit I. has little potential as a suitable location for the experimental delivery of vaccine because the number of badgers is too low to justify such a study. However, the study proved useful in attempting to improve methods of estimating badger numbers. It is now known that they occupy a single territory with two main setts. It could be argued that one of these 'main setts' is in fact a 'subsidiary' or 'other' sett. However, the Castle sett and its surrounding complex has a total of between 15-20 sett entrances (Table 1), and cubs have been seen at this sett. Similarly a young badger was captured at Barrow sett in 2000, and this sett had ten entrances in 2000. Both setts showed signs of activity in all our visits (in winter, spring, and summer 1999 and 2000), so there is little doubt that both are main setts, by definition. Given that several badger surveys (e.g. Cresswell *et al.*, 1990; Feore, 1994; Smal, 1995; Wilson *et al*., 1997), assume that there is only a single main sett per social group, this is an

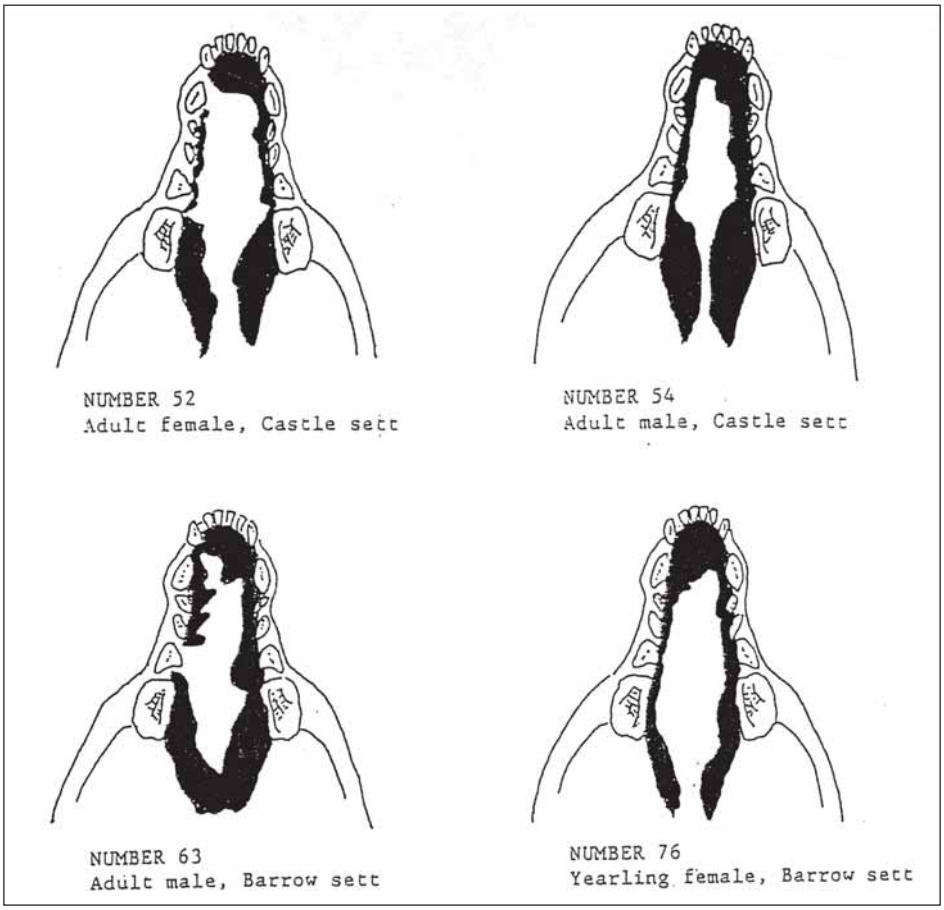


Fig.2. Upper palate marking of four badgers trapped on Feint Island in July 2000, note that each is unique and easily recognizable

Number	Ear tag	Sex	Weight (kg)	Length (cm)	Sett	Other comments
1	62	F	9.5	66	Barrow	No evidence of lactation
2	63	M	9.5	65	Barrow	Old ear wound
3	64	M	9.0	66	Cliff/Castle	Nose wound
4	65	F	8.0	64	Castle	White nose, no evidence of lactation
5	52	F	9.2	66	Castle	Trap wounds, no evidence of lactation
6	54	M	7.8	66	Castle	None
7	66	M	7.8	66	Barrow	None
8	76	F	6.0	63	Barrow	Yearling

Table 2. Badgers trapped at Fenit Island, July 1999 and July 2000

important exception. Further work ought to be done to establish if this is common, for example it may be frequent on this limestone landscape on the North Kerry mainland. It will have a role in further attempts to improve badger density estimates, in further sett surveys.

The black patterns marking the upper palate are individually very distinct for each badger (Fig. 2), and if these do not change over time they will provide a useful, cheap and reliable back-up for individual identification. Other techniques for marking and identifying badgers have drawbacks, either being short term e.g. ear tags (which come out due to being bitten), tattoos (which are difficult to do in the field), and passive transponders (which may possibly fail because of bites during fighting). Therefore an additional identification technique for this species would be very useful.

There could be several reasons for the poor rate of reproduction of badgers on Fenit I. since we recorded only one young animal during the two years in which we trapped the population. Firstly the setts are not sufficiently developed to allow reproduction to take place, which appears to explain the lack of reproduction in certain badger groups on Coney I., Co. Sligo. However on Coney I. the main setts of the non-breeding groups frequently move location (Sleeman *et al*., 1999), which does not appear to be the case on Fenit I.

Secondly otters which clearly occur in and around the badgers' setts both on Fenit I. and elsewhere around the Irish coast (Sleeman & Smiddy, 1999), may kill badger cubs; we disturbed an otter at Castle main sett in July 1999. There are indications from the location of the badger latrines (Fig. 1) that the badgers are avoiding otter holts in their breeding season. This hypothesis, that predation by otters on cubs is limiting badger reproduction on the island, could be tested by observing setts around January, February, and March, when cubs are born, and checking otter spraints (droppings) for remains of badger cubs.

Finally it is possible that starvation, or nutritional inbalance or absence of trace elements may be depressing reproduction. The idea that starvation may be affecting reproduction, given the weight of the adult badgers, does not appear to hold up. These ideas could be tested by analysis of blood. If slowly reproducing badger populations are common on similar mainland sites this has important implications for badger management strategies. The sharing of setts with rabbits and foxes has been frequently reported (Feore, 1994; Smal, 1995).

There are good reasons for continuing to study this and other Irish island badger populations and we would be especially grateful to learn about other Irish island badger populations.

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The palm civets of Sulawesi

Géraldine VERON

Three viverrid species are known to occur in Sulawesi: the Sulawesi giant palm civet *Macrogalidia musschenbroekii* (Schlegel, 1877), the Common palm civet *Paradoxurus hermaphroditus* (Pallas, 1777) and the Malay civet *Viverra tangalunga* Gray, 1832.

The Sulawesi palm civet is endemic to the island whilst the two others species are suggested to have been introduced by men (Weber, 1899; Dammerman, 1939; Groves, 1976). Wemmer *et al*. (1983) and Wemmer & Watling (1986) present new data on the morphology and the biology of the Sulawesi palm civet which was, before their two papers, considered to be the least known and rarest carnivore. In their paper of 1986, they outline the history of the discovery of this species.

The presence of the common palm civet *P. hermaphroditus* in Sulawesi has been mentioned by several authors (Groves, 1976; Musser, 1987; Nowak, 1991; Wozencraft, 1993) while others either doubt its presence or do not list the species as occurring in Sulawesi (Weber, 1899; Schwartz, 1911; Pocock, 1934). This species has not been recorded by Wemmer & Watling (1986) and they question whether populations presently exist.

We present here an account of a specimen of the Sulawesi palm civet not mentioned in previous papers and compared with other known specimens, and question the past and present status of the Sulawesi palm civet and common palm civet.

The oldest specimen of the Sulawesi palm civet *Macrogalidia musschenbroekii* (Schlegel,1877)

Macrogalidia musschenbroekii is often stated to have been described in 1879 by Schlegel (Wemmer *et al*., 1983; Wemmer & Watling, 1986; Corbet & Hill, 1992), but the first mention is in 1877 as noted by Wozencraft (1993). The older specimens mentioned in the literature are those brought by Van Musschenbroek and acquired in 1875 by the Leiden Museum, consisting of an adult male, a younger female, three very young specimens and two skeletons. Three more animals were then brought by von Faber in 1883. Fourteen specimens were mentioned as being known to science by Wemmer & Watling (1986) - nearly all collected by Dutch colonials.

In fact, 25 specimens can be found today in museums throughout the world: BMNH (London), 2; RMN (Leiden), 7 ; Amsterdam, 2; Basel, 5; Dresden, 3; Musium Zoologi Bogor, 5; MNHN (Paris), 1 (Wemmer & Watling, 1986; H. Van Rompaey, pers. comm.; P. Jenkins, pers. comm.; A. Suyanto, pers. comm.; and this study). The only recent specimens are those of the MZB (1978, 1981 and 1985; A. Suyanto, pers. comm.).

Only one specimen is present in the collection of the MNHN (Paris). This is a mounted specimen (C.G. 1868-1327) the skull of which I have recently rediscovered in the collection of skulls of *Paradoxurus.* This specimen was brought by M. Riedel from Celebes and acquired by the Museum in 1868, - i.e. before the "discovery" of the species by Van Musschenbroek in 1875 and its description by Schlegel in 1877, and is certainly the first specimen brought to the occident. Designed as "*Paradoxurus*", the skull is of a young specimen with milk dentition, but unfortunately has no precise locality other than "Celebes". Ten other series of specimens (many birds and few mammals) were sent by Riedel to the MNHN, nine from Celebes and one from New Guinea. Amongst these, two specimens acquired in 1870 (C.G. 1870-509 and 1870-510) of "*Paradoxurus*" are also from the Celebes. They were quoted as being in bad condition and have not been preserved in the collections, so we cannot know whether they belonged to *P. hermaphroditus* or to *M. musschenbroekii.*

Most of the specimens have been collected in the end of the 19th century after which, even though many collectors have been active in the region (Wemmer & Watling, 1986) subsequent naturalists failed to find more specimens, until the Sulawesi palm civet was seen by MacKinnon in 1978 in Gunung Ambang Reserve (Anon., 1980a; J. MacKinnon, pers. comm.). Since then this palm civet has been seen and captured several times (Anon., 1979, 1980a, 1980b; Wemmer *et al.,* 1983) and some animals were kept in the Ragunan Zoo in the early 1980s (J. MacKinnon, pers. comm.). Three of these have been preserved in the MZB after death. Since Wemmer & Watling (1986) gave the first detailed information on the biology of this little known animal, there has been very little information on the species and its status in the last 20 years is little known. However, its seems that the species is more abundant than ever thought, particularly in North Sulawesi, but still remains very rare (Wemmer & Watling, 1986; R. Lee, pers. comm.). A giant palm civet has been captured on a camera trap in Southeast Sulawesi recently (R. Lee, pers. comm.).

On the presence of the common palm civet *Paradoxurus hermaphroditus* in Sulawesi

Records of *Paradoxurus hermaphroditus* in Sulawesi are very scarce. According to Wemmer & Watling (1986) only five specimens (skins) are known in collections.

In his list of mammals occurring in Sulawesi, Weber (1899) did not mention the common palm civet, but quoted its presence only on the Sangi islands, located to the north of Sulawesi. Sarasin & Sarasin (1905) recorded some canines, milk teeth and a ramus fragment under the name *P. hermaphroditus*, but Dammerman (1939) and Hooijer (1950) thought that they probably belong to *Macrogalidia* and neither author found any remains of *P. hermaphroditus* in collections from the caves of Sulawesi (both local and introduced species are found in these caves). Dammerman (1939), Groves (1976) and Nowak (1991) thought that this species had been introduced on the island but it is not listed by Tate (1944) in his list of mammals from Sulawesi. De Vos *et al*. (1956) mentioned the introduction of the Malay civet to the Celebes, and the presence of *Paradoxurus hermaphroditus* throughout the Moluccas and the Lesser Sunda islands, but they do not mention the Celebes.

Pocock (1934) states that Schwartz who, in 1911 described the palm civet *P. celebensis* from Sulawesi, was doubtful about the accuracy of the locality of the type because at this time this specimen was the only one known from Celebes (type of the species: mounted skin B-1568 and skull B-1534, Dresden Museum). Wemmer & Watling (1986) mentioned another specimen (MZB

7105), which was collected in 1936 (A. Suyanto, pers. comm.). Both specimens of *P. hermaphroditus* have been found in the island's two major ports: Menado in the north and Udjung Pandang (Makassar) in the south (Wemmer & Watling, 1986). No other museum specimens are mentioned in the literature.

In the catalogue of the collection of the MNHN, three "*Paradoxurus*" with locality "Célèbes", collected by Riedel, are listed: one is a *Macrogalidia*, as mentioned above, and the two others have not been preserved.

Groves (1976) mentioned the presence of *P. hermaphroditus* and suggested that the absence of *M. musschenbroekii* outside the northern peninsula was a result of competition with the common palm civet, but Wemmer & Watling (1986) and J. MacKinnon (pers. comm.) consider this unlikely. Musser (1987) also mentioned the presence of *P. hermaphroditus* as an introduced species but, as in Groves (1976), no evidence of its presence or abundance is given.

This species seems, in fact, to be very rare on the island, but is sometimes trapped by market and subsistence hunters in western, north, and central Sulawesi (R. Lee, pers. comm.).

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Zoos & Aquariums Committing to Conservation

Brevard Zoo, 8225 North Wickham Road, Melbourne, Florida 32940 is pleased to announce that it will be hosting the 4th Biennial Zoos & Aquarium: Committing to Conservation conference. As with all past conferences the goal is to bring field researchers and zoo personnel together in an informal setting in order to promote a greater involvement of zoos and aquariums supporting in situ work. Session topics are *Building relationships with field researchers *The bushmeat problem: practical solutions *Developing in situ educational materials *Forming partnerships *Inspiration from the field *The Wildlands Project *The role of zoo veterinarians in field conservation.

The conference will be held November 28th through December 2nd 2001 at holiday Inn Cocoa Beach, 1300 N. Atlantic Avenue, Cocoa Beach, Florida 32931

Registration is limited to 300. Further information: Brevard Zoo: Elynn57@aol.com

People and Predators Conserving Problem Mammals

The symposium "People and Predators- Conserving Problem Mammals" will take place at the **International Theriological Congress (ITC8)**, to be held in South Africa on 12th –17th August 2001.

This symposium is just part of a major international conference which should be of interest to all mammalogists. It is to be held at Sun City, next to the Pilanesberg National Park, site of a recent introduction of African wild dogs.

The symposium will address a number of questions vital to the future conservation of problem carnivores. More details of the programme appear on the conference website at:

www.eventdynamics.co.za/itc

Owston's Palm Civet Conservation Program (OCP).

Program Summary
Cuc Phuong Conservation Project
Cuc Phuong National Park, Ninh Binh, Vietnam

March 2001

Introduction

Owston's Palm Civet (*Chrotogale owstoni* Thomas 1912) is a range restricted small carnivore (Family: Viverridae) native to the forests of northern Indochina (northern and central Vietnam, Laos, and southern China). Highly sought for its meat and alleged traditional medicinal properties, Owston's palm civet is threatened by the combined affects of illegal hunting and a significant reduction in natural habitat throughout its range.

C. owstoni is listed as Vulnerable on the IUCN Red List (2000) and listed under Appendix II of CITES. It is given high conservation priority in all of its known range countries. In Vietnam, it is protected under Decree 18 of Vietnam's wildlife protection laws.

The IUCN Mustelid and Viverrid Action Plan (Schreiber *et al.*,1989) recorded Cuc Phuong National Park as the only protected area in Vietnam where Owston's palm civet was known to occur. In 1995, Shelagh Heard-Rosenthal initiated doctoral research on the ecology and conservation of Cuc Phuong's resident civet species, and began a study on captive Owston's after five young animals were confiscated by wildlife authorities and brought to the park. This established the beginning of the OCP and Cuc Phuong Conservation Project the following year.

Since 1995, conservation efforts have focused on behavioral research and captive breeding, with nine new animals received by the project from provincial wildlife protection authorities. Captive breeding has resulted in the first successful births and rearing of this species in captivity.

Goals

In 2001, the project plans to expand its activities significantly as part of an effort to develop a more comprehensive approach to the species conservation. The focus of the project will combine captive research and breeding, with awareness-raising activities and training throughout the species known range, as well as participating in research into the status and ecology of remaining populations in the wild.

Objectives

The Owston's Palm Civet Conservation Program (OCP) will expand upon efforts begun in 1995 on the conservation and research of this endangered species.

Principal efforts focus on:

- The rescue of Owston's palm civets from the illegal wildlife trade.
- Closely monitored re-introductions of rehabilitated animals confiscated from the illegal wildlife trade
- Captive breeding aimed at building and maintaining a healthy genetic population
- Research on the behavior, reproductive cycle, and ecology of captive Owston's palm civets.
- Building the capacity of national counterparts to carry out basic biological research, maintain, and manage the Owston's palm civet program through training and involvement in the program's development.
- Enhancing law enforcement and monitoring of Owston's palm civets in the wildlife trade through ranger training, and provision of printed resources to regional wildlife protection departments.
- Increasing public awareness about the need to protect the Owston's palm civet and its habitat through development of an education program and associated printed resources. This will be delivered to protected area communities within the species known range.

ID	ORIGIN	SEX	DATE OF ACQUISITION	DATE OF LOSS	REASON FOR LOSS	TRAPPING METHOD
FWJ9501	Cuc Phuong	F	5/5/95	-		HAND-CAUGHT
FWA9502	Cuc Phuong	F	5/5/95	-		HAND-CAUGHT
FWJ9503	Hoa Binh	F	30/5/95	-		HAND-CAUGHT
FWJ9504	Hoa Binh	F	30/5/95	-		HAND-CAUGHT
MWJ9505	Hoa Binh	M	30/5/95	10/12/98	Suspected viral infection	HAND-CAUGHT
MWA9606	UO	M	26/11/96	18/5/98	Malignant neck Tumor	UNKNOWN
FWA9707	UO	F	21/11/97	-		SNARE TRAP
MWA9808	UO	M	18/5/98	-		SNARE TRAP
FWA9919	UO	F	12/7/99	-		SNARE TRAP
MWJ0026	Binh Dinh	M	3/7/00	-		SNARE TRAP
MWA0027	Nghe An	M	7/12/00	-		UNKNOWN
FWA0028	Nghe An	F	8/12/00	17/1/01	Escaped	SNARE TRAP
FWA0029	Nghe An	F	8/12/00	-		SNARE TRAP

Table 1: Owston's palm civets confiscated from the trade and rehabilitated at OCP.

Results

Trade confiscations

The Program started in 1995 with the acquisition of five animals, two from Cuc Phuong and three from Hoa Binh. Since that time an additional 8 animals have been rescued and rehabilitated. In the past the rescue rate was one or two a year however in 2000 four animals were confiscated by Forestry Protection Department officials and brought to the Program. With more concentrated efforts on training workshops for rangers, this figure is likely to grow (see Table 1).

Trapping Methods

In our experience snare and spring trapping are not the most common method for catching this species and only 46% of the animals brought to us have shown definite signs of being trapped by either of these methods. Three individuals brought to OCP have had to have portions of a leg removed due to trap wounds and other animals have been treated for similar injuries of a less severe nature.

The first five animals to be brought to the project were hand-caught yet it is not known how prolific this method is and if other techniques are in use. Later this year the Program hopes to carry out survey work with ex-hunters to determine these methods. Live traps used by Shelagh Heard-Rosenthal at Cuc Phuong never caught this species, and perhaps useful techniques can be learned from the hunters in future field studies.

Captive breeding

Few centers hold Owstons Palm Civet and with its successful breeding record, the results of the OCP are important. A total of 15 successful births have given valuable insight into the breeding behavior of this species as previously described (Heard-Rosenthal, 1999). There are currently two second generation animals on the fathers side and nine animals that have reached sexual maturity (See Table 2). Just prior to completing this article two additional second generation captive births from the fathers side have occurred.

Research next year on the breeding behavior will incorporate an analysis of sexual hormones which will examine triggers and signs of estrus and correlate behavior to the different stages (e.g. estrus, pregnancy, imminent birth). This will allow the OCP and other institutions holding Owston's palm civet to identify reproductive state.

Births

The breeding season has consistently been in the last weeks of January and the first weeks of February. However, the physical signs of estrus (i.e. swollen labia) have been observed throughout March. In November 2000 a male housed with a female attempted copulation on a frequent basis for two weeks but with no response from the female. Details of estrus will hopefully be confirmed in future studies on sexual behavior and hormone analysis outlined above.

Losses

Captive-bred animals

Eight of the captive-born Owston's have been lost. MC9717 was one of three born in 1997 and was rejected by its mother. FC9818 was killed by the male in a neighboring cage when the infant put its' head through the caging. The only unknown causes of loss were the two infants who died in 2000 (FC0024 and FC0025). It is suspected that this was due to intoxication through worms fed that originated from rice paddy fields. MC9715 and MC9716C were two of the first born Owston's and they dispersed from the enclosures after a period of two months in which they would leave the enclosures for up to a week. Since 1998, breeding cages have been built with smaller gauge wire to preclude any escapes by younger animals. MC9709C and FC9711 were part of the monitored release carried out in 2000, see below for more details.

Animals Confiscated from the wildlife trade:

There have been only two deaths of confiscated trade animals at the Program. The first was a male civet (MWA9606) who died of a malignant neck tumor. The second was also a male, (MWJ9505C) possibly caused by a viral infection, although no other animals became ill and no necropsy was carried out. A further loss was that of a female civet (FWA0028) who escaped through a fault in the Quarantine cage that has since been repaired.

Monitored release

In 2000 the OCP carried out the first monitored release of two of the project's captive born and raised. Le Trong Dat, a park biologist, and Barney Long, a Fauna and Flora International

ID	PARENTS	SEX	DATE OF BIRTH	DATE OF LOSS	REASON FOR LOSS
MC9709C	MWJ9505C X FWJ9502C	M	23/4/97	2/9/00	Monitored release
MC9710	MWA9606 X FWJ9503C	M	17/4/97	-	
FC9711	MWA9606 X FWJ9504C	F	28/4/97	14/9/00	Monitored release
FC9712C	MWJ9505C X FWJ9502C	F	23/4/97	-	
MC9713C	MWJ9505C X FWJ9501C	M	27/4/98	-	
MC9814	MWA9606 X FWA9707	M	25/4/98	-	
MC9715	MWA9606 X FWJ9504C	M	28/4/97	12/99	Dispersed from cage
MC9716C	MWJ9505C X FWJ9501C	M	27/4/97	12/99	Dispersed from cage
MC9717	MWA9606 X FWJ9504C	M	28/4/97	29/4/97	Died neonate
FC9818	MWA9606 X FWA9707	F	25/4/98	4/7/98	Attacked by neighboring adult
MC9920	MWA9808 X FWJ9504C	M	29/4/99	-	
MC9921	MWA9808 X FWJ9504C	M	29/4/99	-	
MC9922C	MC9709C X FWJ9503C	M	22/4/99	-	
FC9923C	MC9709C X FWJ9503C	F	22/4/99	-	
FC0024	MC9814 X FWJ9501C	F	1/5/00	11/9/00	Suspected accidental poisoning
FC0025	MC9814 X FWJ9501C	F	1/5/00	13/9/00	Suspected accidental poisoning

Table 2: Captive births of Owston's Palm Civet at the OCP.

Biologist, conducted the release in Cuc Phuong National Park. The two civets (MC9709C and FC9711) were prepared over a month prior to release being kept in a forest cage at the release site. Radio tracking of the animals was conducted for 12-hour periods each day. Ten days after the release the male was found dead with injuries suggesting an attack by a predator. Two weeks later, the female was also found dead with similar injuries. The release gave a valuable insight into the wild behavior of the captive civets (Le Trong Dat & Long in press). In the future a similar study may be conducted using animals confiscated from the trade. Such a study will allow comparisons to be made and will provide further insight into preparing captive animals for release.

Awareness program

The Cuc Phuong Conservation Projects' Conservation Awareness Program (CAP) has been working closely with the OCP to raise public awareness of the threats, status and importance of Owston's palm civet in the wild through plays, puppet shows and other educational materials. The Program reaches 15,000 school children, and over 20,000 adult residents in 45 communities in the buffer zone of Cuc Phuong National Park.

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Advising Organizations

Cuc Phuong National Park

Fauna And Flora International, Indochina Program

Endangered Primate Rescue Center (EPRC)

IUCN/SSC Mustelid, Viverrid & Procyonid Specialist Group

Paris Natural History Museum

Alexander Koenig Research Institute and Museum of Zoology

University of Veterinary Science, Austria

University of East Anglia

Owston's Palm Civet Conservation Program (OCP),

Cuc Phuong National Park, Vietnam

Program Update

In 2001 the Program will expand its focus from purely captive breeding and research to encompass education and training as additional components. The education component will be part of the Conservation Awareness Program already established as part of the Cuc Phuong Conservation Project; lesson plans, a book and a play are all planned for the coming year.

Training will focus upon a Vietnamese Graduate who will be trained in research techniques, captive management, and welfare. It is intended that this Graduate will assume the role of Program coordinator in the future. Further training workshops for Forestry Protection Departments on the identification of endangered small carnivores, ecology and conservation will also expand this year to more provinces within the known range of Owston's Palm Civet.

Upcoming research will concentrate on the captive behaviour of the animals following on from the work already carried out by Shelagh Heard-Rosenthal. By looking at behavior and environmental enrichment techniques the study aims to the captive condition of the animals as well as understanding some of their wild habits. Olfactory and acoustic communication of the species will begin next year to examine the complex communication tools of this species. Finally, in cooperation with the University of Veterinary Medicine in Austria, the first studies on the hormonal processes during the reproductive cycle will be carried out. These results will be compared against behavioral observations.

This year will also see the first edition of the OCP Newsletter outlining current news, developments, research and training. Please contact the Program if you wish to receive an electronic copy.

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The use of Xylazine and Ketamine in Owston's palm civets *Chrotogale owstoni*

Ulrike STREICHER

All data were collected on animals belonging to the Owston's Palm Civet Captive Breeding Project at Cuc Phuong National Park, Vietnam. This project is part of the Cuc Phuong Conservation Project, which is administered by Fauna and Flora International.

Introduction

Owston's palm civet *Chrotogale owstoni* belongs to family Viverridae. Their distribution stretches from central Vietnam to northern Lao PDR and the southern provinces of China (southYunnan and south-west Guanxi) (Schreiber *et al*., 1989). They have occasionally been placed together with the Banded palm civet *Hemigalus derbyanus* as one taxon, *Hemigalus* (Corbet & Hill, 1992) . Whereas they have several things in common with the banded palm civet such as the complex fur pattern, the median dental cavity and the bend in the row of the incisors, the last one is much more distinct in *Chrotogale*. These characteristics result in a longer rostrum/facial skull in *Chrotogale*. Furthermore *Chrotogale* has much smaller incisors (Corbet & Hill, 1992) and a very large diastema on the occlusal side of the canines.

Bodyweight in kg	Dosage Xylazine in mg	Dosage Ketamine in mg	Body temperature in °C	Heart rate in beats per minute	Respiration rate in breaths per minute	Remarks	mg per kg bodyweight Xyla	Keta
2,1	6	30	-	-	-		2.9	14.3
2,5	4	20	-	-	-	Vomitus	1.6	8.0
2,4	4	20	-	-	-		1.7	8.3
2,4	3	15	37,0	76	40		1.3	6.3
1,9	3	15	38,9	80	76		1.6	7.9
2,4	2	10	36,8	84	80		0.8	4.2
3,6	4	20	38,0	68	52		1.1	5.6
4,0	4	20	37,7	72	64	Vomitus	1.0	5.0
3,8	6	30	37,7	72	56		1.6	7.9
2,7	6	30	35,9	60	60	Vomitus	2.2	11.1
2,4	4	20	38,1	88	42	Vomitus	1.7	8.3
2,3	3	15	37,7	88	48		1.3	6.5
2,7	3	15	38,6	64	60		1.1	5.6
2,4	5	25	37,2	84	76	Vomitus	2.1	10.4
2,4	5	25	38,2	114	96	Vomitus	2.1	10.4
2,1	6	30	37,1	60	44		2.9	10.3
2,1	4	20	36,8	116	80	Vomitus	1.9	9.5
3,4	4	20	37,3	64	56		1.2	5.9
2,7	7	35	37,7	78	74	Vomitus	2.6	12.2
1,2	2	10	37,6	90	84		1.7	8.3
1,6	5	25	38,5	90	60		3.1	15.6
1,6	3	15	38,2	90	60	Vomitus	1.9	9.4
2,4	5,5	27	38,0	78	64	Vomitus	2,3	11.3
1,0	3	15	38,1	108	78		3	15
2,2	5	25	37,0	56	52		2.3	11.4
2,3	4	20	36,6	84	60		1.7	8.7
2,5	5	25	36,6	64	44	Vomitus	2	10
2,1	4	20	36,4	68	36		1.9	9.5
1,9	5	25	38,2	84	44		2.6	13.2
2.2	4	20	36,8	120	60		1.8	9.1
2.0	4,5	22	35,2	96	36	Vomitus	2.3	11
2.3	7	35	35,0	48	36	Vomitus	3	15.2
2.1	4	20	36,1	108	82		1.9	9.5
3.3	6	30	37,8	54	48		1.8	9.1
2.5	5	25	35,0	90	72		2	10
2.1	4,5	22	35,6	96	66		2.1	10.5

Table 1: Anasthesia in Owston's Palm Civet

Little is known about their wild ecology and the species is classified as "Vulnerable" in the IUCN Red List (2000). Nowhere within its distribution has Owston's palm civet previously been assumed to be numerous (Heard-Rosenthal, 1999). However, due to its terrestrial life it has been photographed more often than any other civet species in recent camera trap surveys (Long, 1999) and villagers report the species to be common in northern Vietnamese provinces (Long, pers. com.). According to Vietnamese law they are protected since 1992.

The Owston's Palm Civet Conservation Breeding Project was initiated in 1995 with animals confiscated from the wildlife trade. Animals currently kept by the project include confiscated animals and animals that have been bred in captivity. The animals have to be anesthetized occasionally for routine measurements, surgical procedures and to put on radiocollars. Therefore a Xylazine/Ketamine mixture is used and the experiences are described below.

Material and methods

Animals of all ages and both sexes were anesthetized. There weights had to be estimated and the animals were accurately weighed under anesthesia. Owston's palm civets are generally not very aggressive and their teeth are only small, but feeling threatened and having no possibility to escape the animals can be amazingly aggressive. Thick leather gloves have to be used to handle them. If animals are very uncooperative or there is no-one to assist, it is possible to lift the animal by the tail and let it briefly hang freely while injecting into the gluteal muscles. This can be done only with extreme care and it must be ensured that the animal is not clinging to any piece of furniture with its front legs. In the latter case a panicking animal might develop such a strong pulling force that it could damage its spine. Squeezing cages could only be used in a few cases, but to good result.

The drug was injected intramuscularly with a fine needle. The anesthetic effect was normally achieved after 4-10 minutes. If the animal did not seem sufficiently anesthetized after 10 min it was injected a second time with half of the previously injected volume. After injection it proved very helpful to put the injected animal back into the sleeping box with a familiar cage mate. This way the animal went to sleep very quietly and quickly. Taking an animal out of a sleeping box shared with a non-anesthetized animal being in the same box never caused any problems.

Normally the animals reached a level of anesthesia which allowed all kinds of necessary procedures. The head of the sleeping animal was covered with a towel during anesthesia. If working in high environmental temperatures (>30°C) the animal was left on the ground during work. Working in lower environmental temperatures the animal was put on an insolating surface to avoid hypothermia.

Results

An average amount of 1.9 mg Xylazine and 9.5 mg Ketamine per kilogram bodyweight was used (see Table 1). Young and very excited animals always needed higher dosages. About half of the anesthetized animals showed slight vomitus during the beginning of anesthesia. There was good relaxation of the muscles and there was no excessive salivation. Occassionally there was a respiratory heart arrhythmia. Remarkably low body temperatures were measured on cold days. The duration of the anesthesia was sufficient for major surgical pocedures (e.g. amputations) but it greatly varied between individuals.

Whereas some animals showed normal reflexes and started to get up after 30 minutes, other animals needed up to two hours to reach the same level of activity. The animals recovered quietly and without complications.

In one case an animal was anesthetized for obstetrics. In this case the anesthetic effect was partly reversed with an antagonist (Antisedan®, Smithkline Beecham) to shorten the recovery period. A cub was manually delivered and it showed asphyxia in the beginning. After extended massage and application of a respiration stimulans (Respirot®, Arkovet) it started to breathe normally. Several hours later the second cub was born normally and showed no respiratory problems.

Discussion

As in many other viverrids, Owston's palm civets can be efficiently anesthetized using a Xylazine/Ketamine combination. Only an average dose of 1,9 mg Xylazine and 9,5 mg Ketamine per kg bodyweight is necessary to anesthetise animals sufficiently for even major surgical procedures. This is considerably less than the dosage generally given to small mammals (Bush, 1996). The observed side effects were minor and second dosages proved unproblematic. Heard-Rosenthal (1999) reports notable side effects when using Zoletil to anesthetize Owston's palm civet (long recovery period with occasional vomitus, panting, salivation, panting und foot peddling), so the Xylazine/Ketamine combination proved a good alternative.

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Methods used to record growth and health in captive Owston's palm civets (*Chrotogale owstoni*) at Cuc Phuong National Park, Vietnam

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Introduction

Carrying out regular growth and health checks on the animals under anesthesia is important not only to facilitate any medical treatment or renewal of tagging/tattooing but also allows the persons involved to gain a more intimate knowledge of the animals.

Data derived from the measurements and dentition can be used to calculate captive growth rates and thus age classes, and are also valuable for providing age estimates on animals confiscated from the wildlife trade.

All animals brought to OCP after confiscation from the trade are anesthetized 2 weeks into their quarantine period of four weeks. Measurements are taken and the animals are given a full ecto-parasite check. Any specimens found are preserved in ethanol and sent for identification. Fecal samples are collected from the first day of arrival and examined to determine the presence of any endo-parasites. Any specimens found are preserved in ethanol and sent away for identification. The animal is then administered a de-worming injection (Streicher, 2000).

Owston's palm civet are susceptible to diseases found in canids and felids such as canine distemper and feline panleukopenia, rabies, and canine leptospirosis (Rettig & Divers, 1978). However, vaccinations for these are not administered as it would prevent data on diseases endemic to the wild population being discovered (Long & Heard-Rosenthal, 2000). The OCP is currently seeking test-kits for these diseases.

Anesthesia Methods

All animals are anesthetized every four months; it is unadvisable to carry out anesthesia any more than this as it is possible that a build-up of toxins could occur in the liver. Also, it is important that the health checks will not interfere with important events in the breeding cycle e.g. estrus or birth.

Experience has shown that the least stressful way to inject an animal is to carry it out whilst the animal is in their nest box. The nest boxes have a single entrance and a hinged roof that can be lifted open. It is sometimes easier to carry out the procedure by bringing the nest box onto the floor of the cage with the nest box door closed.

This method requires two people: one to carry out the injection and the other with a piece of wood or stick. Both participants should wear thick leather gloves. By slowly opening the lid of the nest box the orientation of the civet can be determined, and the person with the injection can move to be on the rear side of the animal.

The stick should be positioned in front of the animal's head; the animal is then distracted by gently moving the stick in front of its head; the person with the syringe can then attempt to make the injection. The best place for the injection is in the muscles of the hind legs.

Another method which has proven successful is to hold the animal by its' tail and bring its hind quarters just out of the nest box; while one person holds the lid of the nest box just above the animals back making sure the animal will not strike the other person. The injection can then be made in the muscles of the hind leg.

Once the animal has been injected both people can leave the cage quietly to allow the animal to fall under anesthesia. This happens in approximately five minutes.

Further details on concentrations and problems associated with anesthesia are discussed in Heard-Rosenthal (1999) and Streicher (2001).

Measurements

The following measurements are taken from each animal:

- **Weight (g)**
- **Head/body length:** Taken from the tip of the nose from the outstretched head to the base of the tail.
- **Tail:** Taken from the base of the tail to the tip of the outstretched tail.
- **Head Circumference:** Taken around the head immediately in front of the ears.
- **Neck length:** Taken from the base of the skull to the shoulder blades.
- **Right ear length:** The longest point on the outside of the ear.
- **Girth behind shoulders:** Taken around the chest immediately behind the front legs.
- **Shoulder height:** Taken from the tip of the outstretched right front leg to the top of the shoulder.
- **Male scent patch length:** Longest length from front to rear.
- **Male scent patch width:** Widest point from the left side to the right.
- **Female scent patch length:** Longest length from the scent patch on the right side of the vulva.
- **Female scent patch width:** Widest length taken from the scent patch on the right side of the vulva.
- **Right front foot length:** Longest point from the back of the footpad to the tip of the paw.
- **Right front foot width:** Widest point of the footpad.
- **Right hind foot length:** Longest point from the back of the footpad to the tip of the paw.
- **Right hind foot width:** Widest point of the footpad.
- **Testes length:** Distance from the base of the testes to the top of the testes.
- **Testes Width:** By pinching just above the testes measure taken across both testes.
- **Nipple Length:** Left and right back nipples.
- **Upper right canine:** Taken from bottom tip of tooth to gum line.

- **Lower right canine:** Same as above.
- **Upper left canine:** Same as above.
- **Lower left canine:** Same as above.
- **Tartar Level:** (1-4) 1=low 4=high.
- **Tooth Wear:** (1-4) 1=low 4=high.
- **Coat Condition:** General description.
- **Dental formula**

In addition to taking these measurements a hair sample (50 hairs) is taken from each animal and sent away for genetic analysis. (Long & Heard-Rosenthal, 2000)

Photos are also taken of each animal for identification purposes. The following shots are taken: Full dorsal view; dorsal-anterior view; left lateral view; right lateral view; frontal close up of head.

Once all measurements have been taken and the appropriate samples gathered the animals are returned to the shaded floor of their enclosure. The animals are not put back into their nest boxes as there is the chance that they will fall out when in the drowsy state following anesthesia.

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MOTION

Pine marten (*Martes martes*), Weasel (*Mustela nivalis*) and Polecat (*Mustela putorius*) are three small carnivores registered in the national listing of species susceptible of being classified as 'Vermin' in French departments.

• Marten, weasel and polecat are not causing sufficient damages to agricultural, aquacultural and forestry activities to come up to the criteria of the vermin classification. Actually these are predators integrated into ecosystems with population densities varying with those of their prey species. The weasel is essentially a vole specialist and thus favourable to agricultural activities. The same is true for polecat with Norway rat and muskrat, whose damages are considerable.

• Marten, weasel and polecat are still badly known and understudied in France and their classification as vermin may endanger their survival. If we add trapping during reproduction time and without capture limitation to the natural death rate, plus shooting during hunting time, destruction by cars or diminution of the favourable natural areas which accommodate them them (natural forests, hedges, damp areas) it is easy to understand why their status is poor.

• The classification as vermin of these species, for which we know neither their precise distribution, density nor the natural demographic fluctuations, induces a trapping activity without date restriction, quota or limit on the number of trappers. Martens, weasel and polecat could be threatened by their status as vermin. Marten and polecat particularly have seen their numbers significantly fall in some French provinces; we have evidence for their total disappearance in a few districts.

• We know of no examples in France of damage, attributed to carnivorous 'vermin' species which have been reduced following trapping activities. Today, modern concepts of ecology demonstrate that trapping is not the solution. It is still an 'alibi method' which allows hunters to eliminate competitors and the authorities to show that they are doing something.

• During these past ten years trappers have produced no statistics or serious scientific knowledge, even when they have essential information at their disposal. Trapping, then, has been unproductive.

• The department of Isère, for example, has relegated the vermin species listing of weasel and polecat for several years (also marten in 1999), without driving human activities into a slump.

• More and more people acknowledge the positive role of predators in ecosystems. They limit the rapid multiplication of rodents and eliminate ill animals and carrion. More and more people like to see the unusual scene of a weasel chasing voles or the one, now rare, of a polecat or a marten in the wild. It is therefore justified to consider those new needs of the majority of citizens and not to entrust wildlife management to a hunter minority.

The general meeting of the French Mammal Society in Meylan (France) of 15 October 2000 asks the Department of the Environment to take out Marten, Weasel, and Polecat from the list of species susceptible to being classified as vermin.

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Mustelidae

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