MUSTELID & VIVERRID CONSERVATION

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European mink *(Mustela lutreola).* Photo by Väino Silm & Tiit Maran.

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

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

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Fisher *(Martes pennanti)*: Birth, growth and development in captivity

Tom LaBARGE, Alan BAKER and Don MOORE

Introduction

The North American Fisher *(Martes pennanti)* is found in the Canadian and Transition Life Zones, but its original southern range has been reduced by overharvest and other anthropogenic factors (Strickland *et al.*, 1983). Translocations of hundreds of fisher to supplement depressed populations have occurred since the 1930's and are reviewed by Berg (1981).

We have worked with these animals in captivity since 1986 and have found them to be a challenging species. Although relatively common now throughout most of its range, the fisher is rarely exhibited and is difficult to breed in captivity - the last captive-bred and born fishers were recorded in the literature in the 1920's (Hodgson, 1925). However, there are a few fisher which claim the status of 'captive born' by virtue of the fact that some wild caught females arrived in captivity pregnant. We were fortunate to acquire a pregnant female in January 1989 and we subsequently had one of the few litters of fishers born in captivity in many years.

Parturition has been previously recorded from late February through early April; litter size is 1-4 with a mean of 2.7 (Coulter, 1966). On March 15, 1986 our wild-caught female gave birth to two male and one female kits in a remote, quiet area of our facility. The decision was made to remove the kits later for hand-rearing in order to socialize them to humans, with the hope that hand-reared fisher may be calmer in captivity, therefore breed successfully there. The following notes summarize the growth and development of these hand-reared individuals.

Growth and development

Coulter (1966) detailed the growth and development of his three mother-raised fisher, born in captivity March 3rd. Newborn fisher are altricial, sparsely-haired and weigh less than 40 grams. The mother-reared young gain about 5-10 g per day, so that by 40 days of age they should weigh about 220 g (cf. our animals, which weighed 360-410 g on day 34, Table 1). The young started crawling in the eight week; their eyes opened at 53 days. They were walking at 63 days, and climbing at age 70 days. The dam did not give the young meat until 62 days, at which time the deciduous canine teeth had erupted. Nursing continued until day 114; the young were 124 days old before they could effectively kill prey. Littermates were very aggressive when competing for food (Coulter, 1966). Coulter was as careful about handling his litter as we were, due to the great probable risk that an adult mustelid will kill or abandon her litter if it is handled: his kits were not handled until their 37th day, and his early weight data comes from dead neonates whelped in captivity. However, Coulter's and our nest boxes were arranged such that we could monitor or observe neonates with minimal disturbance to the dam.

For the first three days, our dam's nestbox was not checked at all; monitoring of neonates was by listening for faint "baby noises" (short, high-pitched cries as in domestic kittens). We first checked the kits visually on day 4; like Coulter's, at that time they were blind, approximately 8-10 cm in length and covered with a very thin coat of light gray hair. By week 2, we observed that the kits were growing fast, and their fur color was light silvery-gray. Around day 21, the kits began to change color to a dark brown, mostly around their heads and underparts.

Table 1. Recorded weights (grams) of 2.1 Fisher kits at the Burnet Park Zoo, Syracuse, N.Y. 1989

AGE (days)	Male #M89016	Male #M89017	Female #M89018
34	408.5	381.5	362.5
35	408.7	375.5	356.1
36	420.0	384.5	368.0
37	444.5	403.5	368.0
38	459.9	417.3	393.7
39	479.9	434.1	407.0
40	504.8	459.0	427.0
41	502.5	460.0	429.7
42	519.5	473.0	441.5
43	522.0	477.1	447.0
44	534.5	479.5	457.9
45	539.9	498.5	460.0
47	549.0	527.0	466.0
48	576.5	544.5	479.0
49	588.0	555.5	486.0
50	584.5	559.0	496.5
51	602.5	564.5	515.0
55	680.0	635.0	570.0
57	730.0	679.0	605.0
61	815.0	776.0	677.0
63	903.0	844.0	732.0
65	979.0	897.0	776.0
68	1087.0	1017.0	874.0
70	1175.0	1089.0	911.0
72	1240.0	1176.0	980.0
76	1338.0	1349.0	1076.0
78	1443.0	1377.0	1142.0
82	1590.0	1530.0	1220.0
Average gain/day	x = 24.6 g	x = 23.9 g	x = 17.9 g

At 34 days, the dam was separated from the kits, which were pulled for hand-rearing. During hand-rearing, the kits were weighed daily at 8:00 am using a triple-beam metric balance. Weight gain alone is not necessarily an accurate indication of development (that is, body **weight** may increase, but less rapidly than relative body **length** increase: the result is a real loss in body **condition**). Nonetheless, long-term weight monitoring provided us with an accurate measure of growth; body condition was assessed subjectively based on our collective experience with other neonate mammals.

At 34 days, total length of the kits was 34-36 cm. Length measurements were discontinued early because of the difficulty of keeping these active animals restrained (Coulter also noted that

Fig. 1 Three Fisher *(Martes pennanti)* kits aged ca. 35 days. The eyes are still closed. Photo Burnet Park Zoo, Syracuse, NY.

after day 68 his weight measurements were disrupted and finally discontinued due to the excitement and stress that accompanied any form of physical or mechanical restraint of young fishers). We did take heart girth measurements on our kits for a while (Table 2).

We felt tooth eruption in the kits at day 40, when premolars began to show. The deciduous canines started to erupt at the same time, but were not fully erupted until day 50 or so.

Date of eye opening was very variable in our kits. Male #M89017 had opened eyes at 48 days of age (Fig. 2). Male #M89016, largest of the litter, opened both eyes at day 54. Female #M89018 opened her eyes on day 55. This is close to the data presented by Coulter (1966) and Powell (1982), who indicated eye opening at 48-53 days.

Most of our results are consistent with Coulter's. However, he indicated that sexual dimorphism in body size may not be apparent until after the fourth month. We noticed a marked relative size difference between our males and female at age three months; we feel this may be when growth rate changes dramatically (Table 1). At age 6 months, the males weighed 4.4 and 4.5 kg each; the female weighed 2.5 kg. Wild caught adults weigh 3.5-5.5 kg (males) and 2.0-2.5 (females); their body length is 90-120 cm (males) and 75-95 cm (females) (Strickland *et al.*, 1983). We try to keep our captive individuals within these wild animal weight ranges.

Hand-rearing techniques

Hand-rearing was based on the advice of Frank Webb of New York and Tom Hoenig of Massachusetts, who had the opportunity to hand-rear fisher themselves. Webb and Hoenig were in agreement that if possible the kits should be removed from the mother sometime between the 4th and 5th week of age prior to the opening of their eyes. This strategy gives the kits mother's milk for as long as possible; milk replacer is then used only for adequate nutrition during the period of socialization with humans.

On April 18, the fisher kits were removed for hand-rearing. Esbilac, a commonly used bitch's milk replacement, was chosen as the formula. In our literature search we haven't come across any published milk composition analysis for fisher, but Esbilac closely resembles the composition in protein/carbohydrate/fat content for the ferret (*Mustela putorius* forma *furo*), a well known mustelid species (Borden, Inc. technical staff, pers. comm.). Table 3 gives a summary of the feeding record for one of the hand-reared fisher kits (male #M89016).

Rubbing the anal region with a paper towel soaked in warm water proved sufficient to stimulate defecation and urination in the kits. This procedure was performed after each feeding until the animals were able to defecate on their own.

Introduction of the animals to the milk replacer formula was with a 6 cc syringe if the kits refused a pet nurser bottle. Soon, however, we were using a Four Paws Pet Nurser bottle and nipple to "suckle" the kits. Bottles were cleaned, washed and sterilized between feedings. Milk was made fresh daily to prevent feeding of milk contaminated with bacteria.

The first solid food given was a soupy mixture of Esbilac and strained chicken baby food. We fed this mixture in increasing amounts until, near weaning date, we mixed in a small amount of Nebraska Brand Canine Diet (a coarsely-ground, whole horsemeat mix) to the solid food mix. All solid food given was pre-heated to human skin temperature until the kits were weaned.

From the age of 34-82 days (12 days "post-weaned"), our hand-reared kits gained an average of 17.9 g (female) to 24.6 g (male) per day (Table 1). Coulter's recorded gains for days 40 through 68 were 8.4 and 10.5 g/day for mother-reared kits (both females). Our kits continued eating a baby food/canine diet mixture for three weeks after weaning. Then, they were given canine diet with vitamin supplement. The diet was also occasionally supplemented with small amounts of hard-boiled egg and chopped herring.

Gradually the diet was changed to include increasing amount of Fisher Chow mixed into the horsemeat. Fisher Chow is a 50:50 mixture of Big Red Cat Chow and Rise floating Fish Diet made to simulate commercial mink chow, and ground to a coarse

Table 2. Heart girth measurements (cm) of 2.1 Fisher kits at the Burnet Park Zoo, Syracuse, N. Y. 1989

AGE (days)	Male #M89016	Male #M89017	Female #M89018
43	15.5	14.5	12.5
51	15.5	15.0	14.0
58	16.0	15.0	15.0
66	16.0	16.0	15.5
71	17.5	17.5	17.0

Table 3. Feeding record of neonate male Fisher #M89016 from day 34 to day 70, Burnet Park Zoo, Syracuse, N. Y. 1989

Age (days)	WT.(g)	Formula	Interval	Daily amount offered / taken
34	408.5	Esbilac	6 x day	60 cc / 45 cc by syringe
35	408.7	"	"	66 cc / 64 cc "
36	420.0	"	"	70 cc / 68 cc syringe & bottle
37	444.5	"	"	80 cc / 78 cc by bottle
38	Loose fecal. Reduced daily intake to 75 cc.			
42	519.5	"	5 x day	75 cc / 75 cc by bottle
45	539.9	"	"	77 cc / 77 cc "
49	588.0	"	"	78 cc / 78 cc "
50	First vaccinations given. Began giving a small amount of Gerber strained chicken 2cc with milk replacement. Used a 50:50 Milk/Baby food mix.			
52	602.5	Esbilac+	4 x day	85cc milk+10cc mix Bottle & dish
56	680.0	"	"	91cc milk+16cc mix "
61	815.0	"	"	100cc milk+35cc mix "
65	Bottle removed. Diet changed to a 3:1 mixture of baby food and milk replacement. Small amounts of Nebraska Brand Canine diet added to mixture. Discontinued heating diet.			
68	1087	Mixture	3 x day	110 cc mix Dish
70	1175	"	"	120 cc mix "
	Vaccination boosters given. Animals considered weaned, amount of milk replacement in diet reduced slowly as more Canine diet is added.			

powder. It was added in increasing amounts over a two week period until the diet mixture was 2:1 Canine Diet to Fisher Chow.

By the age of three months the kits were restricted to 2X/ day feedings. The diet was gradually increased to accommodate growth. By the age of six months each animal was receiving 142 g of diet per day. The average adult fisher at our zoo receives 142 to 227 g of diet daily depending on body weight and condition.

Summary

Our hand-reared fisher kits are well-acclimated to the presence of humans, and to our captive conditions and thus should be less stressed during the breeding season. Because they were reared together and are now within sight of others of their species, hand-rearing should have caused few behavioral changes in them. The female should be easily handled for the determination of precise estrous cycling, and all animals will be more easily handled for health exams and medical procedures.

Successful captive propagation of fisher, although desirable, is not the final goal of our work. Our goal is to understand the captive management needs and reproductive biology of this relatively common species as a model for other, endangered, mustelid species, particularly those in the genus *Martes*. More generally, the above postpartum monitoring, infant handling and hand-rearing techniques were successful, and should be applicable to a variety of mustelids and viverrids in the wild and in captivity.

Fig. 2. Young male Fisher *(Martes pennanti)* ca. 50 days old, just after his eyes opened. Photo Burnet Park Zoo, Syracuse, NY.

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Big Red Cat Chow & Rise Floating Fish Diet, products of Agway, Inc., Butternut Drive, DeWitt, NY 13214, USA.

Esbilac Milk Replacer, product of Borden, Inc., Pet/Vet Products, Rt. 1 Box 127, Elgin, ILL 60120, USA.

Four Paws Pet-Nurser bottle and nipple. Four Paws, Inc., Central Islip, NY 12788, USA.

Burnet Park Zoo, Syracuse, NY 13204, USA.

The Gola Project in Sierra Leone: Report on the viverrids

Glyn DAVIES

Surveys were conducted in the Gola Forest Reserves, eastern Sierra Leone, by Glyn Davies in 1984-85 (Davies, 1987), and there is currently a more detailed ecological research programme going on in the reserves, focussing on Gola North (Fig. 1). The main emphasis of the investigation has been on primates and duikers, which account for the bulk of the mammalian biomass in the forests, and are commonly hunted. However there have also been detailed surveys on the avifauna, and sightings of all mammals have been accumulated by project members. The distribution of viverrids is shown on Fig. 2.

Owing to their stealthy foraging strategies and often nocturnal habits, there are relatively few sightings of any small carnivores. Therefore only simple statements can be made about their ecology, based on the habitats in which they have been recorded; there are no feeding records nor can the population densities be calculated from available data (Fig. 2).

Forest genet *(Genetta pardina)*

Seen thrice in the daytime, once in young farmbush (two years after farming), once on a logging road in forest from which commercial timber was extracted three years earlier, and once in the closed-canopy forest on Tiwai. They are expected to occur in primary forest as well as in these disturbed habitats, but generally they appear sparsely distributed in the forest zone.

African linsang *(Poiana richardsoni)*

Not recorded in recent times in the Gola forests, although it occurs in similar habitats in Liberia and may well occur in Sierra Leone.

African civet *(Civettictis civetta)*

This is the commonest of the viverrids. It has been recorded in all parts of Sierra Leone, from the guinea savannah of the north to the rain forests of the Golas. They are found in farms, coffee/cocoa plantations and town gardens.Animals are often seen crossing or travelling along roads, and there are sufficient records to map the nation-wide distribution, as their occurence in the Gola area.

Two-spotted palm civet *(Nandinia binotata)*

Reported from the closed-canopy secondary forest on Tiwai Island, and seen in the primary forest in the centre of Mogbai. It has a distinctive booming "hoo, hoo, hoo" call which has been heard at night in coffee/cocoa plantations around Gola.

Cusimanse *(Crossarchus obscurus)*

This engaging mongoose is commonly detected by the piping contact calls made between members of foraging parties (4-12 indiv.) as they rummage through leaf-litter, presumably in search of insects and fallen fruits. When alarmed, a single high-pitched "peep" is given and all the rustling sounds stop as animals pull their noses out of the leaves and look about for danger. I have watched animals leap up on the sides of tree trunks to get a clearer look at whatever danger threatens.

They occur in primary forest, logged forest, farmbush and plantations, indeed anywhere where there is leaf-litter to forage through. All records collected during this project are from the wetter zone of the country, but how they fare in guinean savannah is unclear.

Slender mongoose *(Herpestes sanguineus)*

Another common and widely distributed mongoose, which specializes in stealing chickens from villages at night. It is a tenacious hunter which has been recorded in all habitats: cocoa/coffee plantations, farmbush, logged forest, closed-canopy secondary forest, but not closed-canopy forest in the centre of Gola North. Solitary animals and pairs have been seen, but no larger parties.

Marsh mongoose *(Herpestes paludinosus)*

Solitary individuals of this mongoose have been recorded foraging on the forest floor on Tiwai and in the closed-canopy forests in the central part of Gola North. One individual was also watched in logged forest, walking along a stream bed and feeling beneath submerged rocks and logs for crustaceans. There are records of the species in young farmbush, and two adults with a juvenile crossed a road in an intensive farmed area.

Ichneumon *(Herpestes ichneumon)* & White-tailed mongoose *(Ichneumia albicauda)*

They are both expected in the drier savannah areas of Sierra Leone, but have also been recorded in non-forest habitats well into

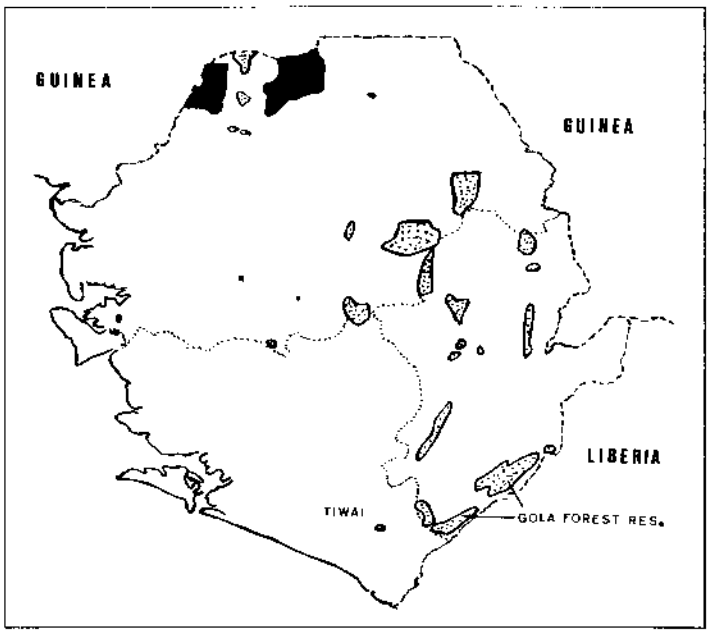

Fig. 1. Sierra Leone showing the Forest Reserves (dotted), the proposed National Park (black), and the Gola Forest Reserves with adjacent Tiwai Island.

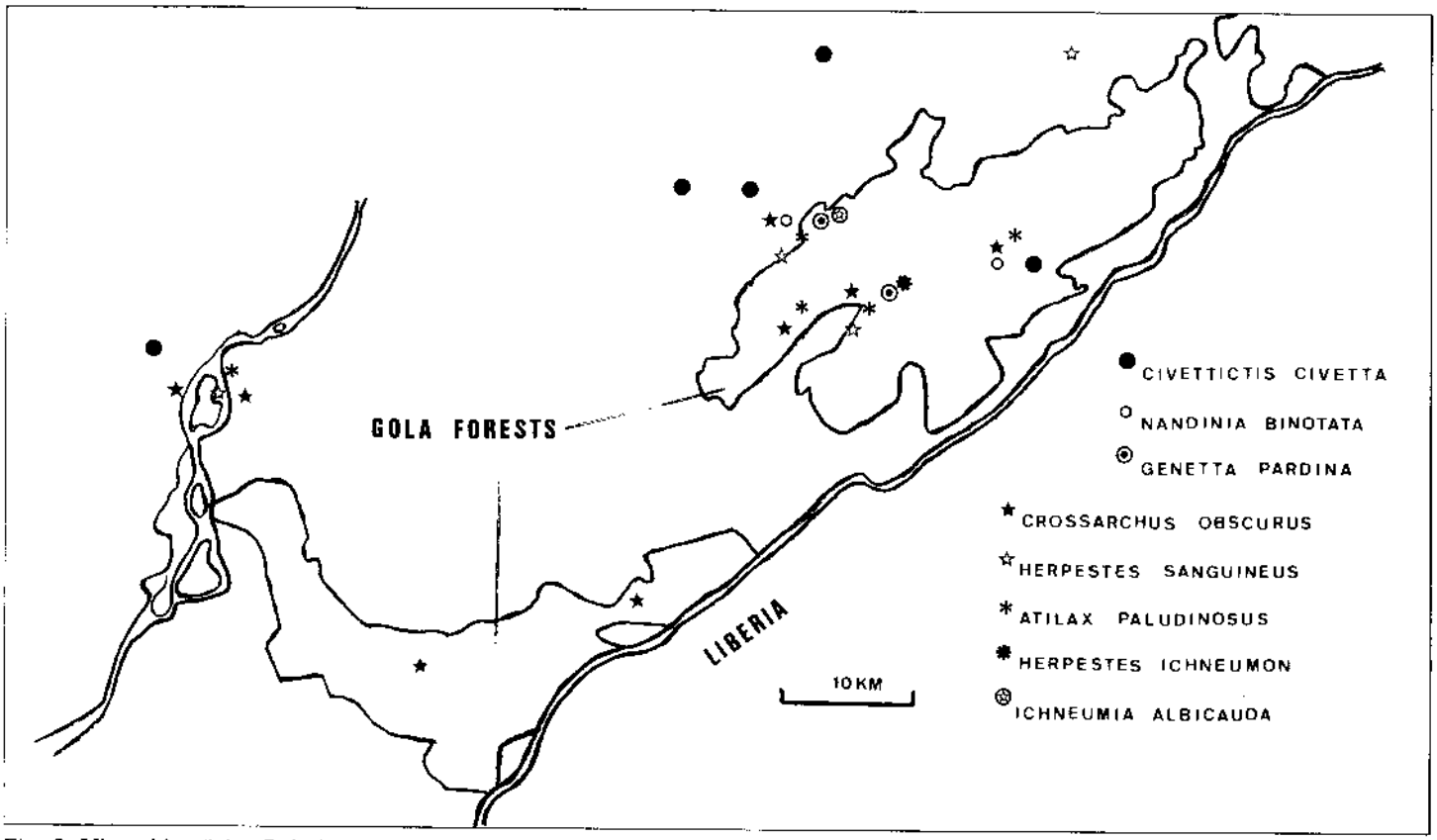

Fig. 2. Viverrids of the Gola Forests: species and/or signs recorded.

the forest zone. This exemplifies how savannah-preferring species extend into the forest zone along corridors of farmbush scrub.

Conservation of these viverrids does not seem to depend on preservation of primary forest since, with the possible exception of the African linsang, all adapt to exploit non-forest habitats. However, much more information is needed on population densities and ecology before conclusive statements can be made about species' conservation, especially since these mammals, like most others in Sierra Leone, are eaten.

During a one-year survey of Kenema (pop. 15-20,000), the nearest town to Gola, civets were sold for meat in the market on most days (2-8 carcasses/morning) and genets were also sold. It may, therefore, be necessary to monitor the effect of hunting on the rarer species before we can feel comfortable about their future.

Acknowledgements

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The African weasel: A Red Data Book species in South Africa.

David T. ROWE-ROWE

With a mass of 340 g for adult males and 250 g for adult females (Rowe-Rowe, 1978a), the African weasel *(Poecilogale albinucha)* is, together with the dwarf mongoose *(Helogale parvula)*, Africa's smallest carnivore. This small mustelid occurs in suitable habitat in sub-Saharan Africa from South Africa, northwards to Mozambique, north-eastern Zimbabwe, Malawi, Zambia, Angola, Zaire, Rwanda, Burundi, Tanzania, and Kenya.

Habits

The African weasel (Fig. 1.), also known as the African striped weasel and the white-naped weasel, is terrestrial and predominantly nocturnal, occasionally seen during daylight. These weasels are usually solitary, but may occur in groups of two to four: generally an adult female and her young. The weasel is a good burrower, often excavating its own holes. Other shelters, such as hollow logs and rock crevices, are also used. In defence, like the zorilla *(Ictonyx striatus)*, the weasel ejects a foul-smelling fluid from its anal glands. Six different vocalizations by adults and three by blind young have been recognized (Channing & Rowe-Rowe, 1977), and categorised according to function. Sonagraphic analysis indicated that the language is similar to that of the zorilla.

Food

The diet consists almost exclusively of small rodents, with small insectivores and young birds on the ground occasionally taken (Rowe-Rowe, 1978b). The weasel has evolved as a specialist killer of small mammals, being capable of killing rodents up to its own size. The predator employs a well-directed bite at the back of the neck, usually accompanied by lateral rolling (to knock the prey off its feet), curling around the prey, clasping it with the fore-feet, and treading vigorously against it with the hind-feet (to break the spine).

This weasel does not eat snakes, eggs, or insects, as has been stated in some of the general mammal handbooks.

Reproduction

In South Africa the breeding season extends over spring and summer (Rowe-Rowe, 1978c). Copulations are extended, lasting 60 to 80 minutes. The gestation period of 32 days appears to be the shortest recorded in any carnivore without delayed implantation. Litters consist of between one and three altricial, hairless young. The canine teeth erupt at ca. 35 days, when the young begin to eat solid food, and the eyes open at ca. 52 days. When about 13 weeks old the young are able to kill small mammals, and are full-grown at 20 weeks. One litter per season is normal, but if all of the young die at an early stage, the female may mate again and have a second litter.

Conservation

Poecilogale albinucha is listed in the South African Red Data Book as 'rare' (Smithers, 1966). The categories used in the South African Red Data Books are the same as those used in IUCN Red Data Books. 'Rare' thus refers to 'Taxa with small populations

Fig. 1. Adult male African weasel *(Poecilogale albinucha)*. Photo D. T. Rowe-Rowe.

which are not at present endangered or vulnerable, but which are at risk'. As a specialist feeder on small mammals, and because of its low population density, and apparent association with particular habitats which are being altered or lost, the African weasel does appear to be 'at risk'.

Distribution of the African weasel in South Africa is limited mainly to the moist grassland areas which have an annual rainfall in excess of 600 mm.

South Africa's human population of almost 32 million (27/km2) is increasing at the rapid rate of 2.8% per annum. There is therefore an increasing need to produce more food, and the country's moist grassland areas have suffered under this pressure. Large tracts of grassland have come under the plough to grow food crops (mainly maize), or cash crops such as sugar cane or pineapples, while each year more moist grassland is planted with introduced softwood (*Pinus* spp.) and hardwood (*Eucalyptus* spp.) trees for paper-pulp and timber. Overgrazing, particularly in subsistence farming areas is also a serious problem, as numbers of grassland small mammal prey species decline in the absence of sufficient cover. Another threat emanates from the increasing number of dogs in rural areas. The dogs compete with the weasels for food, and often kill them.

Each of the four provinces in South Africa has its own nature conservation ordinance. In the Cape Province *Poecilogale albinucha* is listed as a protected animal: i.e. it is protected in nature reserves in which it occurs and it may not be hunted without a permit outside of reserves. In the other three provinces (Natal, Transvaal, Orange Free State) the weasel is protected in nature reserves, but unprotected outside of them. Trade in live animals is not allowed, however. The numbers of protected areas in which African weasels have been recorded are 10 in Natal, possibly occurring in another 12 reserves, at least four in Cape Province, and one in Transvaal. So far, it has not been recorded in reserves in the Orange Free State.

In the province of Natal the African weasel is used by the Zulu people in tribal medicine. Wearing the skin, or a piece of skin, brings good luck. Sometimes the skin or other parts of the weasel's body are burnt; inhaling the smoke or taking the ash as snuff gives protection against physical harm and brings luck. Seeing a live weasel also brings luck. In certain areas part of the weasel is used in a love charm (where people have knowledge of the weasel's courting and mating behaviour), while some rural inhabitants place the skin above the door to keep rodent pests out.

Dealers in tribal medicines are generally of the opinion that the weasel is becoming scarcer: possibly as a result of continued high demand and fewer animals in the wild (A. Cunningham, Univ. of Natal, pers. comm.).

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Fifth International Theriological Congress, Rome 22/29 aug. 1989.

Papers

Alkhalili, A.D. Post-embryonic development of the Indian grey mongoose, *Hepestes edwardsi ferrugineus* (Geoffroy, 1818) on Bahrain Islands.

Baker, C. The use of behavioural characters in the systematics of some southern African Herpestinae.

Creel, S. Evolutionary and mechanistic aspects of reproductive suppression in the dwarf mongoose, *Helogale parvula*.

Maddock, A.H. Resource partitioning in an assemblage of viverrids.

Masi, E., Dessi-Fulgheri, F., Piazza, R. & Messeri, P. Social vocalizations of the banded mongoose.

Taylor, M. E. Craniometric analysis of the African mongooses in the subgenus *Galerella*.

Taylor, P. J. & Meester, J. Craniometric evidence for the existence of two species of yellow mongoose *(Cynictis)*.

Waser, P. M. & Rood, J. P. Dwarf mongoose dispersal: age and sex specific benefits and risks.

Posters

Cavallini, F. & Nel, J. A. J. Home range and activity of the cape gray mongoose *Galerella pulverulenta*.

Colyn, M. & Van Rompaey, H. Population structure analysis of the genus *Crossarchus* F. Cuvier 1825 in central Africa: A craniometric study.

Fuller, T. K., Biknevictus, A. R. & Kat, P. W. Movements and behaviour of large spotted genets near Elmenteita, Kenya.

Palomares, F. & Delibes, M. Comparative ecology of the common genet and the ichneumon in southwestern Spain.

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Wirth, R. Conservation in viverrids.

The distribution and status of the badger in Glamorgan, Wales.

H.I. GRIFFITHS[1,4], D. C. HICKS[2,4], and V. A. MORRIS[3,4]

Introduction

The Eurasian badger *(Meles Meles* L.*)* has a long history in the British Isles and is known from fossil assemblages dating from around 120,000 years ago (Sutcliffe, 1985). However, modern populations are thought to derive from the reinvasion of Britain that followed the end of the last (Devensian) glaciation at approximately 10,000 B. P. (Yalden, 1982).

The badger is Britain's largest terrestrial carnivore, and, although traditionally regarded as a benevolent animal, it has periodically been the subject of persecution by gamekeepers, farmers, and sportsmen. With the decline in the numbers of gamekeepers since the 1914-1918 war, badger populations have risen markedly (Cresswell *et al.*, 1989). However in many parts of Britain and in Glamorgan in particular, the badger still suffers extensive persecution - primarily through its pursuit in illegal field sports.

Distribution and status

There have been a number of attempts to produce distribution maps of the range of the badger in Great Britain (Neal, 1972; Clements *et al.*, 1988). Only in the latter of these two reports detailed data were presented for much of Wales, although the authors freely admit that distributions for South Wales are based largely on inadequate data or guesswork.

Since its inception in 1983, The Glamorgan Badger Group has been collecting information on the status of the badger in the three counties of Mid, South, and West Glamorgan (Fig. 1). At the time of collation for this report (January, 1990), there were approximately 185 active badger setts known to exist within the area. The major concentration of animals is in the sparsely populated arable region of the Gower Peninsula, West Glamorgan. In most other parts of Glamorgan, badgers are largely confined to stretches of forestry administered by the Forestry Commission or to isolated pockets of woodland amongst arable farmland and pasture. The badger is scarce in the fertile coastal belt of South Glamorgan and largely absent from the old industrial mining valleys of the Rhymney, Rhondda, and Cynon, and from the areas surrounding major towns. The former distribution of the badger in the three counties is largely unknown and sett censusing is an ongoing concern, particularly in West Glamorgan and in the northern forestry of Mid Glamorgan.

Nationally, the major anthropogenic threats to badger populations are habitat destruction, culling and illegal sports, although in some areas badgers may also suffer heavy mortality from road traffic accidents (Cheeseman *et al.*, 1989; Neal, 1986). Habitat destruction usually takes the form of changes in land use, urban encroachment or the expedition of large civil engineering projects. Although badger populations have been lost to all of these agencies in the past, none currently pose a significant threat to badgers in Glamorgan. In Britain the culling of badgers is strictly controlled although the Ministry of Agriculture, Fisheries and Food (M. A. F. F.) are authorised to exterminate badgers infected with *Mycobacterium bovis* to control bovine tuberculosis

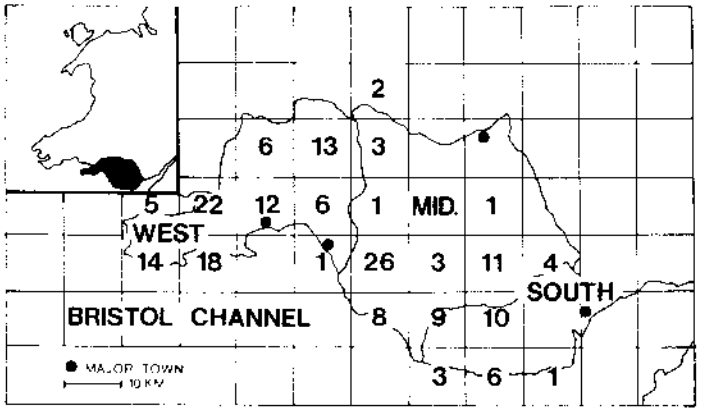

Fig. 1. The distribution of active badger setts in the three counties of Glamorgan.

(Cheeseman *et al.*, 1989). M. A. F. F. may also occasionally grant licences for the culling of pest badgers that destroy crops, poultry, or property. In Glamorgan, bovine T. B. is absent (Anon., 1988) and no licences have been issued for badger culling, although there was a single unsuccessful application in 1983 (Welsh Office Agriculture Department, Pers. comm.). It would seem therefore that badger sports are the sole remaining threat to populations in South Wales.

Badger-related sports include badger-digging (the disinterring of badgers with the aid of dogs) and badger-baiting (the fighting of captive badgers against dogs). These "sports" characteristically involve the use of the larger "working" breeds of terrier, such as the Patterdale and Fell terrier, both traditionally used for the digging of foxes. Badger"sports" are sadly still widespread in Britain. Recently, Cresswell *et al.* (1989) reported that nationally 10.5% of active main setts had been dug and considered that this could account for the loss of some 9,000 badgers per annum. The effects of badger-digging in Glamorgan are shown in Fig. 2. At 54% and 38% respectively, the percentages of setts attacked in both Mid and South Glamorgan far exceed the national average. The high-density area of West Glamorgan appears to be less markedly affected, with approximately 10% of setts known to have been dug, although this may well reflect inadequacies in reportage rather than any true improvement over the situation in the rest of the three counties. South Wales has a strong tradition of terrier sports (Harcombe, 1989) and this is reflected in the high rates of attack upon badger setts reported in the area.

Badgers and the law

British animal legislation is complex but statutes of direct relevance to the badger are usefully reviewed by Skinner *et al.* (1989). In practice badgers are protected from digging and other acts of cruelty and exploitation by the Badgers Act 1973 as amended by the Wildlife and Countryside Act 1981 and the Wildlife and Countryside (Amendments) Act 1985. The Protection of Animals Act 1911 also protects from abuse badgers that are deemed captive under the terms of the law. Animals inhabiting forestry have further protection under the terms of Forestry Commission bye-laws that outlaw any form of pursuit or harassment of wild animals in lands under their jurisdiction.

Unfortunately, much of this legislation is poorly constructed and difficult to enforce, with the result that many of the

prosecutions brought by the police eventually fail in the courts (for an example see Cook, 1989). Furthermore, as awareness of Badger legislation increases, badger offences become more difficult to detect and to prosecute. Badger diggers have been known to take a dead fox to a dig to facilitate the legal defence that they were digging for foxes, not badgers (the fox has no protection under U. K. law). In the event of a prosecution, lawyers who specialise in the defence of these cases are now available to the accused.

Although the Badgers Act allows magistrates to impose short prison sentences and fines of up to £2,000 per offence, in practice the courts are reluctant to inflict stringent penalties, and fines in excess of £500 per offence are unusual. When compared with the reports of the large wagers that accompany badger contests and of prices in excess of £500 commanded by captive animals on the black market, such fines are hardly punitive. Until such times as badger legislation is revised or magistrates assume a stronger stance on penalties, the only way to prevent badger-digging is to monitor continuously those setts regarded as being at high risk. This is certainly beyond the remit of official agencies and beyond the means of local conservation or animal welfare groups.

Conclusions

The effects of localised, intensive digging upon badger populations are as yet unclear. However, badgers have been eradicated from a number of sites in South and Mid Glamorgan as a direct result of badger-digging. There is no doubt that South Wales is a major focus of badger sports and this is further shown by the recent convictions of South Wales men for badger-related offences in the neighbouring counties of Dyfed, Powys and Gloucestershire and also the counties of Devon, Somerset, Cornwall, Dorset, and Avon.

Cresswell *et al.* (1989) have estimated that there are currently some 250,000 adult badgers in Britain. This perceived abundance has led to some calls for the relaxation of Badger legislation to permit the hunting of badgers on a quota basis (Harcombe, 1985). In the light of the extremely high rate of attack upon the badger populations of Glamorgan in defiance of protective legislation, any relaxation of the protected status of the badger is undesirable and would certainly result in the rapid loss of the badger from large areas of South Wales.

Acknowledgements

We would like to thank all those members of the Glamorgan Badger Group who have contributed to the sett recording scheme and the League Against Cruel Sports for their assistance. We would also like to thank the Chief Constable of South Wales for his permission for one of the authors (D. C. H.) to contribute to this paper. Dr. David Thomas of the School of Pure and Applied Biology in Cardiff kindly commented on an earlier draft of the manuscript.

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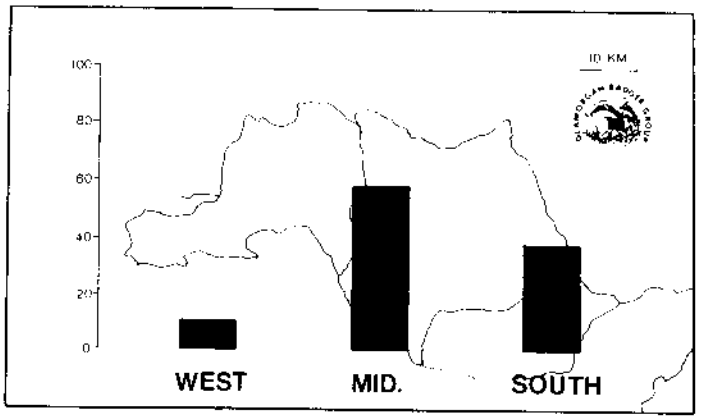

Fig. 2. Percentages of badger setts attacked in each of the three counties of Glamorgan.

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The Indian Grey Mongoose (*Herpestes edwardsi*) in the Circeo National Park: a case of incidental introduction.

Giuseppe M. CARPANETO

The Indian grey mongoose, *Herpestes edwardsi* (Geoffroy, 1818), is one of the commoner and more widespread viverrid species: it ranges from the Arabian east coast southwards to southern India and Sri Lanka and eastwards to Assam. Moreover, because of its snake-eating and rodent-eating behaviour, it was often introduced by man into new areas, forming well established populations remote from the original range: i. e. in Malaya, the Ryukyu Islands, Mauritius, and the Greater and Lesser Antilles. Several native animals (endemic species) of these countries were endangered by the presence of this invader.

The Circeo National Park (south of Rome, in central Italy) has always lead a difficult life owing to various and hard problems: illegal housing, exceeding road network, arson, water pollution, stray and feral dogs, wild boars in excess, etc. During the last thirty years mongooses have represented a further, till now unresolved, problem of wildlife management.

In the early 1950's (likely 1952), near S. Felice Circeo, the owner of a hotel purchased some mongooses and kept them free-ranging in his garden, in order to eliminate both vipers and rodents. Shortly afterwards he lost control of these animals, who spread into the surrounding countryside. Subsequently, four specimens were trapped by rangers and kept in captivity for exhibition to visitors; one of them was preserved in the local museum collection and, today, it is the only material evidence of the fact. According to Toschi (1965), other skins were sent to the British Museum (Natural History) and identified by R. W. Hayman as *Herpestes edwardsi*; under this name the species was quoted in the Italian fauna (Toshi, 1965; Biondi, 1985; Vigna Taglianti, 1988). The erroneous quotation of Corbet (1978) who mentioned the presence of *H. ichneumon* in the Circeo N. P. was later rectified by himself (Corbet, 1984).

In the subsequent years ('60's and '70's) the Park direction had many problems to face so that the problem of the mongooses was neglected. These animals had all the time to spread all over Mt. Circeo and downwards to the Pontine Plain (Fig. 1). In fact, between 1978 and 1980, the mongooses reached their maximum expansion and were frequently observed on the southeastern shore of Sabaudia Lake (loc. Bagnara and Molella). The same time, according to the rangers, the polecat *(Mustela putorius* L.) became rare in that area, probably because of the competition with the newcomer.

The Indian grey mongoose, in the Park, showed a diurnal behaviour and did not fear man: some individuals were often seen in the picnic areas of Mt. Circeo, feeding on tourists' leftovers, or accepting food from them.

In the early 1980's, the number of mongooses decreased suddenly without any reliable explanation: no observation has been made since 1984 up to the present. In order to verify their apparent extinction, a specific investigation was carried out by Maurizio Biondi (pers. comm.) who set a number of traps with meat or fruit as bait during the spring and summer of 1984. Only black rats were collected this way, showing that *Rattus rattus* is common and widespread in the area while the mongoose might be extinct or very rare.

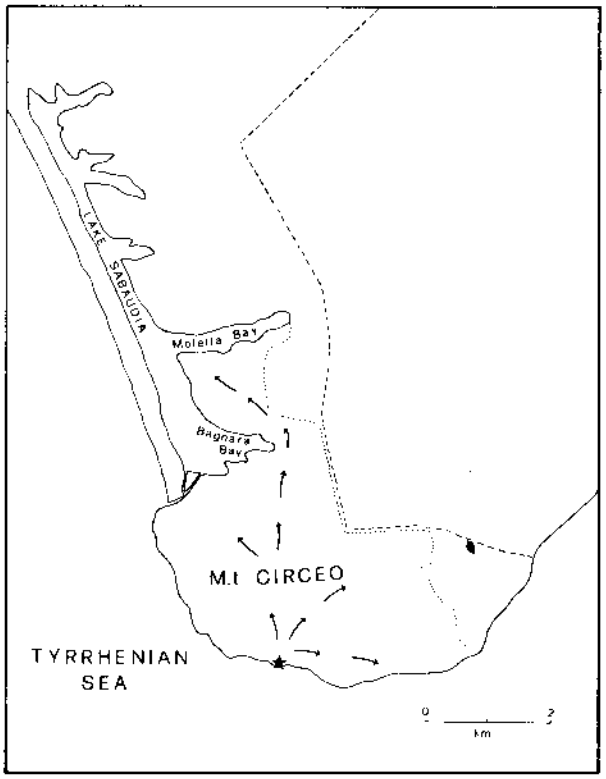

Fig. 1. Spread of the Indian grey mongoose *(Herpestes edwardsi)* in Circeo National Park. Black star: starting area (ca. 1952); dots: presumed range in the period of maximum expansion (1978-1980); dashes: border of the national park.

No information is available on damage caused to wildlife by the introduced mongooses (besides the above mentioned decrease of the number of polecats). Groundnesting birds are very scarce in the area but we lack data on the situation before the mongoose "invasion". No census of free-ranging mongooses was ever made. Furthermore it would be difficult to distinguish between the damage caused by the mongoose and that by the black rat. The effects of the latter on wildlife have proved to be devastating everywhere, and the mongoose evidently has not been an efficient remedy against it.

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Estrogen-based conditioned aversion to control egg predation: A non-lethal alternative for mongooses.

Lowell K. NICOLAUS

Because mongooses *(Herpestes* sp.*)* sometimes consume the eggs and young of endangered species on oceanic islands and elsewhere, they have been the object of occasionally heroic poisoning and trapping campaigns. Since these activities are often far from selective, they risk unintended environmental damage including removal of rare or endangered mustelids and viverrids.

Recently, it has been shown that when free-ranging mammalian egg predators consume one or two meals of eggs containing a very small dose of oral estrogen (17 alpha-ethinyl estradiol) they form generalized conditioned aversion to eggs (Nicolaus *et al.*, 1989, in press; Semel & Nicolaus, in press). That is, the estrogen induces an illness lasting for approximately two hours and long after recovering from the illness predators avoid eggs whether they contain estrogen or not. This is because the effective dose of estrogen in egg is undetectably small and so the taste of the egg is itself associated with the illness.

When captive and free-ranging mongooses *(Herpestes auropunctatus)* consumed eggs containing the cholinergic agonist carbachol, they formed conditioned aversion to eggs (Nicolaus & Nellis, 1987). But, the taste and scent of eggs treated with carbachol appeared to change in the heat when placed into the field. As a result, the aversion was short-term (a matter of weeks) apparently because mongooses eventually discriminated between treated and untreated eggs.

This problem may be reduced by using estrogen. An egg with a volume approximately 35 ml constitutes a full meal for a 350 g female mongoose and nearly a full meal for a 500 g male (Nicolaus & Nellis, 1987). If such an egg contained 10 mg of estrogen, the dose for the female would be 28.6 mg per kg mongoose body weight and for the male the dose would be 20.0 mg per kg. These doses are within the range likely to produce conditioned taste aversion. Since female mammals may be somewhat less affected by estrogen than males (Gustavson *et al.*, 1989; Semel & Nicolaus, In press), the somewhat higher dose that the standard treated egg would deliver to female mongooses should be an advantage.

Since one or two moderate acute doses of oral estrogen are unlikely to produce sterility, the only lasting effect should be aversion to eggs within an otherwise intact population of mongooses.

Collaboration

Many among the readership may have access to free-ranging or captive mongooses that can be used for research on questions relating to an effective estrogen-based aversion technology. I would welcome hearing from anyone interested in collaborating in this work.

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ABSTRACTS

New records of two species of rare viverrids from Liberia

Three species of rare viverrids, the Liberian mongoose *(Liberiictis kuhni)*, African linsang *(Poiana richardsoni)*, and Johnston's genet *(Genetta johnstoni)* have restricted distributions in West Africa and are believed to be endangered. The Royal Ontario Museum and Toronto Zoo mounted an expedition to Liberia to determine whether *L. kuhni* was present in Sapo National Park and if not whether it was still present in previously known localities. None of the three species was found in Sapo N. P. but an adult female *L. kuhni* was collected from the Gbi National Forest, approximately 32 km south east of Tapeta, and according to the villagers of Mali, *L. kuhni* was also present in the Gio Forest to the east of Mali (about 45 km north of Tapeta). From questioning villagers in southern Nimba, northern Grand Gedah and Sinoe Counties it appeared that *Liberiictis* is no longer present in many areas where it once existed. Two specimens of *P. richardsoni liberiensis* were collected as native skins from eastern Liberia: one from Mali, and one from Bao Town. No trace was found of *G. johnstoni*.

Taylor, M. E. 1989. New records of two species of rare viverrids from Liberia. *Mammalia* 53(1):122-125.

The mongooses of the genus *Galerella* in Angola.

The author argues that *Myonax nigratus* Thomas 1928, and *M. shortridgei* Roberts 1932, both of them collected in Angola, represent two colour phases of the same species, to which he proposes the colloquial name Larger red mongoose; and that the prior scientific name of this species is *Galerella flavescens* (Bocage, 1889) (original name: *Herpestes gracilis*, var. *flavescens Bocage* 1889, *Jorn. Sci. Math. Phys. Nat.*, (2)1:179. Benguela, Angola). The author considers that *Galerella <sanguinea>* together with *G. pulverulenta* is a superspecies, represented in Angola at least by three species: *G. bocagei* in the central plateau, northeastwards to Lunda, *G. cauui* in the south, near the Ovamboland border, and *G. flavescens* which is rather common in Angola in semi-desertic areas of the southern littoral, extending eastwards to the fringes of the plateau, where it possibly meets or overlaps *G. cauui* and *G. bocagei*.

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