SMALL CARNIVORE CONSERVATION

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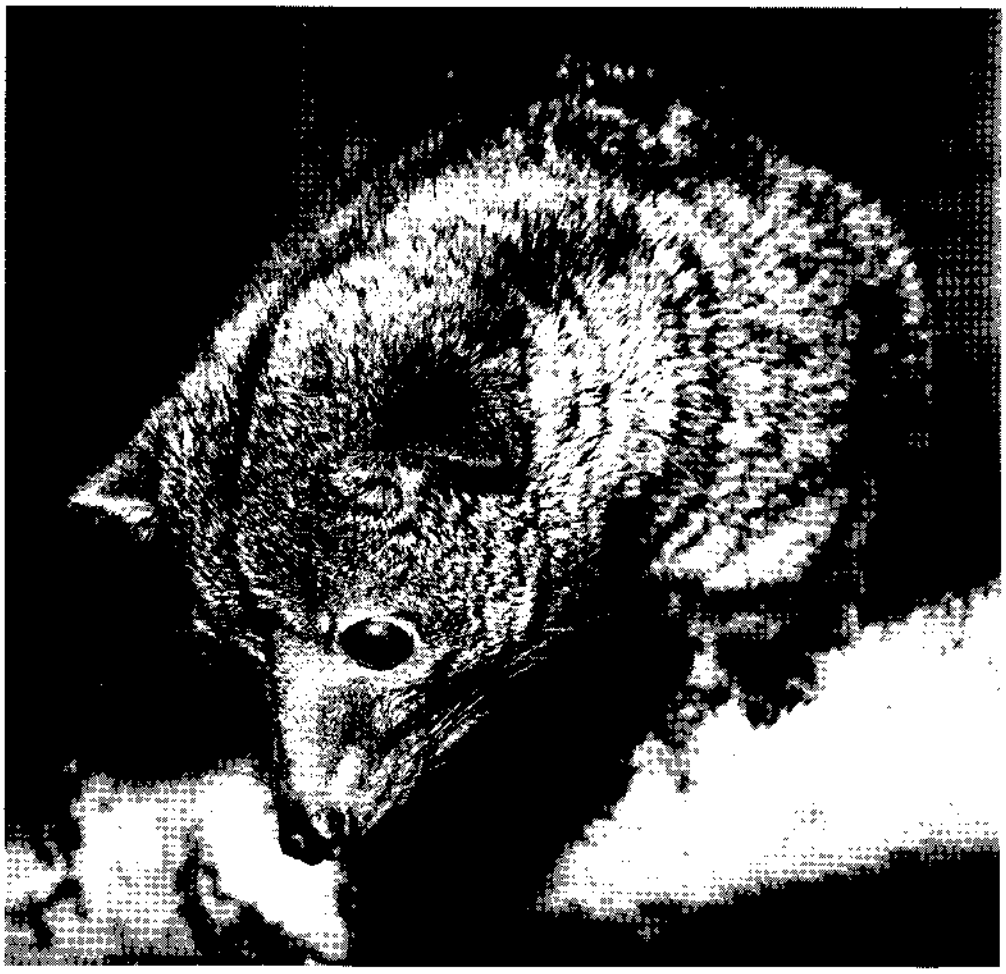

Two-spotted palm civet *(Nandinia binotata)* - Photo: H. Van Rompaey

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

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Jan Verbertlei, 15
2650 Edegem
Belgium

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Black-footed ferret (*Mustela nigripes*): Conservation update

Richard P. READING[1], Tim W. CLARK[2], Astrid VARGAS[3], Louis R. HANEBURY[4], Brian J. MILLER[5], Dean E. BIGGINS[6], and Paul E. MARINARI[3]

INTRODUCTION

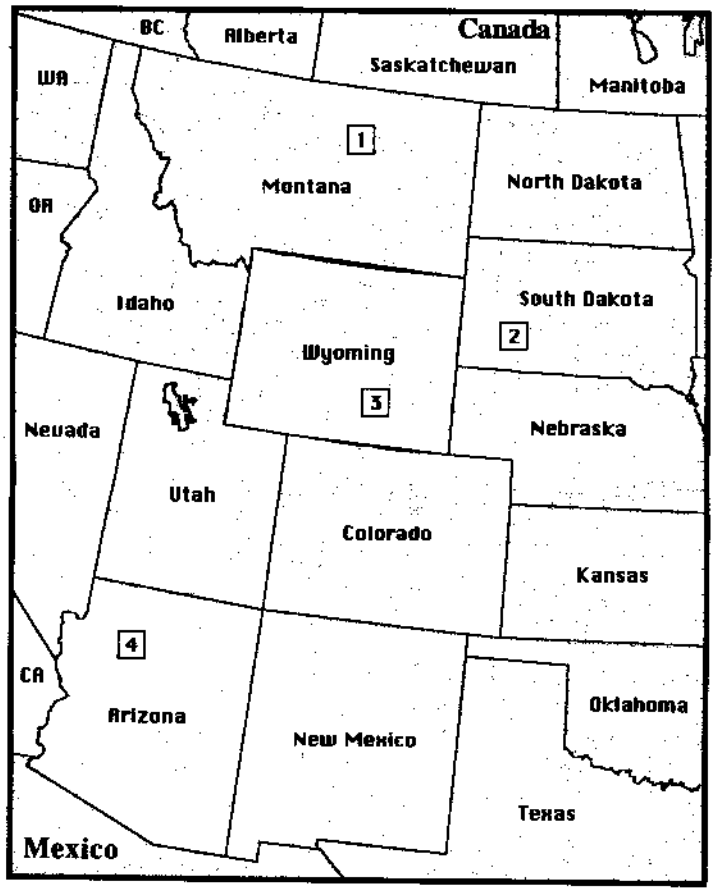
Black-footed ferrets (*Mustela nigripes*) remain one of the world's most endagered mammals despite recent advances and 15 years of conservation efforts. No wild population is known, although a captive propagation program initiated in 1987 has succeeded in greatly increasing the number of captive animals and ferrets have been reintroduced into four sites within their former range (Fig. 1). From October 1995 to March 1996, the black-footed ferret recovery program is being reorganized and the 1988 Recovery Plan (U.S. Fish & Wildlife Service, 1988) will be revised. We briefly review the history of ferret decline and early recovery efforts, discuss recent successes and failures, and conclude with discussion of future recovery challenges.

A BRIEF HISTORY OF FERRET DECLINE AND EARLY RECOVERY EFFORTS

Black-footed ferrets are obligate associates of prairie dogs (*Cynomys* spp.), upon which they depend for food and in whose burrows they find shelter (Forrest *et al.*, 1985). Ferret decline began as prairie dog numbers and distribution declined throughout the short and mid-grass prairies of North America due to large-scale conversion to agriculture, prairie dog eradication, and the effects of the exotic disease plague (*Yersinia pestis*)(Miller *et al.*, 1990). Prairie dogs are largely perceived as competitors with domestic livestock for forage by livestock interests despite several range studies which question the extent of competition (O'Meilia *et al.*, 1984; Uresk & Paulson, 1989; Archer *et al.*, 1987), economic analyses that indicate that eradication programs are not cost effective (Collins *et al.*, 1984), and ecological research that illustrates the importance of prairie dogs as ecosystem regulators (Krueger, 1988; Whicker & Detling, 1988; Reading *et al.*, 1989). Prairie dog poisoning programs, some government sponsored, and prairie conversion to cultivation continue today. These factors, combined with plague, have created a highly fragmented distribution of relatively small complexes of prairie dogs covering less than 2% of their former range (Miller *et al.*, 1994a, 1996; Roemer & Forrest, 1996). With the loss of their habitat, ferret populations became small and fragmented, and began disappearing from a variety of deterministic and stochastic factors (Thorne & Williams, 1988; Harris *et al.*, 1989).

After a small ferret population disappeared from South Dakota in the 1970s, the species was feared extinct until a population was discovered near Meeteetse, Wyoming in 1981. This population was studied until 1985, when both plague and canine distemper devastated the population to near extinction (Thorne & Williams, 1988; Clark, 1994). Biologists captured 18 ferrets, many closely related, just prior to extinction of the wild population, and a captive breeding program was initiated (Miller *et al.*, 1988). Captive propagation succeeded in increasing ferret numbers, and today over 350 individuals are distributed among seven facilities in the United States and Canada. The Black-footed Ferret Recovery Plan, drafted after the Meeteetse population crash, calls for establishing at least 10 separate populations

Figure 1. Black-Footed Ferret Reintroduction Sites. 1. South Phillips County, Montana; 2. Conata Basin, South Dakota; 3. Shirley Basin, Wyoming; and 4. Aubrey Valley, Arizona.



of 30 or more over-wintering adults with a minimum of 1,500 total individuals (US Fish & Wildlife Service, 1988).

Reintroduction of ferrets bred in captivity began in 1991 with release of young of the year into Shirley Basin, Wyoming. Reintroduction has since expanded to other sites in Montana, South Dakota, and Arizona, and several animals have survived to reproduce. Despite progress, ferrets remain far from recovered and the program has been plagued by unproductive conflict (May, 1986; Weinberg, 1986; Clark & Harvey, 1988; Clark & Westrumn, 1987; Clark, in press; Alvarez, 1993; Reading & Miller, 1994; Miller *et al.*, 1996). Many biological and non-biological challenges remain (see Clark, 1989, in press; Seal *et al.*, 1989; Miller *et al.*, 1996; Reading & Clark, 1996).

RECENT DEVELOPMENTS IN FERRET RECOVERY

CAPTIVE BREEDING

After a relatively slow start in mid-1980s, the captive population began to increase in late 1980s and early 1990s before leveling of (Fig. 2). As the captive population grew, it was eventually split. About half the animals remain in the recently

named National Black-footed Ferret Conservation Center at Sybille, Wyoming, but by 1992, ferrets were also being maintained and bred in the Omaha Zoo, Nebraska; the National Zoo's breeding facility at Front Royal, Virginia; the Toronto Zoo, Ontario; the Phoenix Zoo, Arizona; the Louisville Zoo, Kentucky; and the Cheyenne Mountain Zoo, in Colorado Springs, Colorado. Although the population has been stabilized, productivity has varied, especially in recent years (Figs. 2 & 3).

From the original wild caught animals, only 7 were represented in the breeding pool. Initial genetic analyses recommended maintaining 200 adults in the captive breeding program to maintain 80% of the genetic diversity of founders over 200 years (Ballou & Oakleaf, 1989), but this was later increased to 240. Ferrets produced in excess of those needed to replace loss of captive animals were available for reintroduction (Godbey & Biggins, 1994). Emphasis was placed on genetic management of the captive population because of the comparative ease of managing its genetics relative to wild populations (Russell *et al.*, 1994), and because mortality of reintroduced animals was expected to be high. Therefore, only genetically "surplus" animals (i.e. high inbreeding coefficients and high representation in the captive population) were chosen for release in the wild. Genetic studies to determine relatedness of "founders" were called for and funding was provided (Captive Breeding Specialist Group Meeting Minutes, 12 December 1985), but these studies have not been conducted and ferret lineages remain estimates based on the locations of animals captured from the wild. In addition, three ferrets of disputed paternity entered the breeding population in 1989. As a result, genetic management has been compromised.

Although the captive breeding program has produced many kits, the full effects of inbreeding may express themselves at anytime in the future. In 1993, low fertility, high loss of postnatal kits, and other factors prevented proposed reintroductions in Montana and South Dakota. Genetic relationships should be investigated as soon as possible.

Ferret reproduction was quite successful in 1996. From the 316 kits born and 234 which survived to weaning, approximately 125 were allocated for reintroduction into the three active release sites (Montana, South Dakota, and Arizona, see below). The captive breeding program retained 106 kits (the most genetically valuable) to maintain adequate numbers of ferrets. An increasing proportion of older animals in the captive population is creating problems of space within captive facilities. Several of these older animals are being provided to zoos as display animals, and by late 1996, 11 zoos maintained ferrets as display animals.

Figure 2. Black-Footed Ferret Captive Propagation.

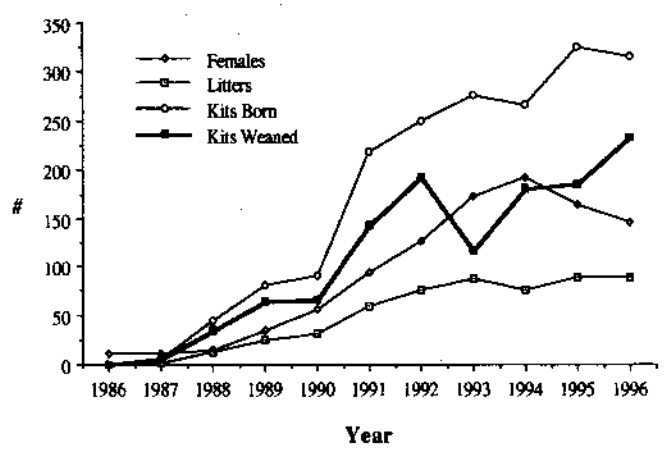
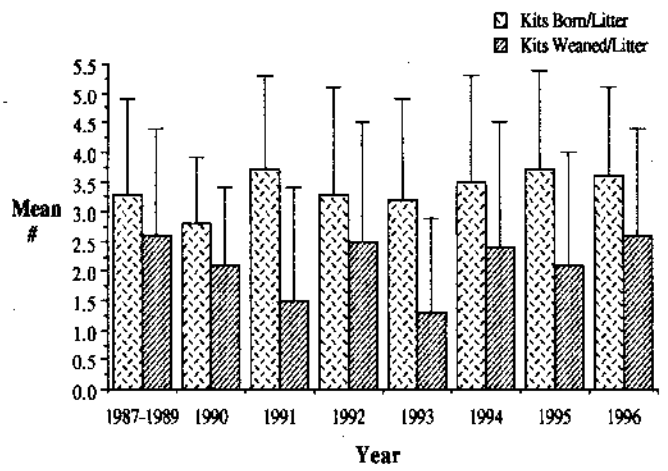


Figure 3. Mean (±S.D.) Black-Footed Ferret Kits Born and Weaned Per Litter.



A variety of research on captive animals has contributed substantially to ferret recovery. Studies directed at increasing reproduction rates of captive ferrets examined reproductive physiology (Seal *et al.*, 1989; Carvalho *et al.*, 1991; Williams *et al.*, 1991,1992a), artificial insemination (Howard *et al.*, 1991, 1996), reproductive behavior (Miller, 1988; Miller *et al.*, 1996), development biology (Vargas, 1994; Miller *et al.*, 1996; Vargas & Anderson, 1996a, 1996b), captive management (Miller *et al.*, 1991), and disease prevention protocols, including the development of vaccinations (Williams *et al.*, 1992b; Williams *et al.*, in press). Additional studies on black-footed ferrets and closely related Siberian polecats (*M. eversmanni*) examined methods of increasing post-release survival. Studies included raising animals in enriched environments and in arenas with resident prairie dogs to stimulate a more natural environment (Miller *et al.*, 1990a, 1990b, 1992; Biggins *et al.*, 1991, 1993a; Vargas, 1994), providing young with opportunities to kill prey (Miller *et al.*, 1990a, 1992; Vargas, 1994; Vargas & Anderson, 1996a), providing aversive stimuli in the presence of potential predators (Miller *et al.*, 1990b), and exploring the possibility of food imprinting (Vargas & Anderson, 1996b). These latter studies were conducted in collaboration with test reintroductions of Siberian polecats and actual reintroductions of black-footed ferrets to examine effects on survivorship.

REINTRODUCTION

Prior to reintroducing black-footed ferrets, biologists experimented with trial releases of Siberian polecats. Siberian polecats which had experience killing prey, which had less contact with people, and which were raised in arenas as opposed to cages were better predators and exhibited more developed predator avoidance behaviors (Biggins *et al.*, 1990, 1991, 1993a; Miller *et al.*, 1990a, 1990b, 1992, 1993). Similarly, more recent releases of black-footed ferrets found that animals raised in enriched environments and those with previous experience killed prey more effectively (Vargas, 1994). Only recently have these techniques been incorporated into reintroduction protocols (Miller *et al.*, 1996).

Other research focused on reintroduction sites. Research on prairie dogs examined colony dynamics and habitat preferences (Conway, 1989; Reading *et al.*, 1989; Reading, 1993). Other

studies developed standardized monitoring and evaluation methods for complexes of prairie dog colonies (Biggins *et al.*, 1993b). Trial releases of Siberian polecats found greater survival in areas with smaller predator populations (Biggins *et al.*, 1991), and therefore populations of potential ferret predators were assessed and monitored (Reading, 1993). Both canine distemper and plague epidemics are potentially disastrous for ferrets, necessitating disease studies (Thorne & Williams, 1988; Williams, 1990; Williams *et al.*, 1992b, 1994, in press). Because carnivores such as coyotes (*Canis latrans*) can survive such epidemics, studies focused on sampling carnivores for disease (Williams, 1990).

Local support is crucial for conservation efforts. An evaluation of local values, attitudes, and concerns found that people were often antagonistic towards ferrets (Reading, 1993). This antagonism stemmed from the dependence of ferrets on prairie dogs, which many people view as pests that compete with livestock for forage, and from ferrets' endangered status, which elicited fears of loss of control over public grazing lands and restrictions on land uses under the Endangered Species Act (Reading & Kellert, 1993). Results of these and other studies permitted site ranking on a number of biological and social science criteria and development of proactive strategies to improve a site's suitability for ferret reintroduction.

Reintroduction began in 1991 with the release of 49 ferret kits (32 males, 17 females) into Shirley Basin, Wyoming. These animals were deemed excess to the captive population and were selected as the most genetically redundant animals from captivity. All animals were young of the year, released during autumn, when young ferrets would normally disperse from their natal prairie dog colonies. They were all held on the release site in raised cages for a minimum of 10 days to permit acclimation, given access to cages for several days post release, and provided with supplementary food (Wyoming Game & Fish Department, 1991). None had pre-release acclimation to the local environment.

Of the 49 ferrets, 37 were monitored by radio-telemetry for several months post-release, and then via occasional spotlighting and snow tracking (U.S. Fish & Wildlife Service, 1992). Release cages were used after release and about half of the ferrets moved relatively large distances (4-17 km) from the release site. Some ferrets killed prairie dogs and four survived the winter, with two producing litters. This progress was tempered by a lack of experimental design and the use of only one release technique (Miller *et al.*, 1996). This limited the ability of the program to develop improved techniques and increase success rates.

During the second release in 1992, 90 black-footed ferret kits (55 males, 35 females) were released into the same site. Controversy over the use of telemetry resulted in a study designed to test the effects of telemetry on ferret survival. Unfortunately, confounding variables prevented reliable evaluation of the results. In addition, 17 animals raised in outdoor arenas were compared with 73 cage-reared ferrets. Pre-conditioned arena animals dispersed less and survived significantly longer than cage-reared animals, with seven individuals from each group surviving the first month (Biggins *et al.*, 1993a; Vargas, 1994). Dispersal from the release site was extensive and mortality was high, with 26% of the released animals killed by predators within 18 days (Godbey & Biggins, 1994). A minimum of eight animals survived the winter and at least four litters were born the following summer, but animals were not individually identified.

A second site in Montana was biologically ready to receive ferrets in 1992, but political pressure at the state governors level delayed the release (Reading & Miller, 1994; Miller *et al.*, 1996). In 1993, all field preparations for a third release site in South Dakota were completed. However, because of a large decline in captive production, not enough ferrets were produced for either Montana or South Dakota that year. So Shirley Basin, Wyoming, was the only site to reintroduce animals. Forty-eight kits (29 males, 19 females) were released that autumn. By late 1993, Wyoming estimated 24 surviving ferrets, including 4 from the 1993 release, 9 born to animals released in 1992, 2 from the 1992 release, and 9 that were not captured (Luce *et al.*, 1994). By the summer of 1994, that number observed had dropped to 6 animals of unknown origin (none were captured). By October, about 10 individuals (including both adults and kits) were observed.

Black-footed ferrets were reintroduced into three sites in 1994. Forty-one (24.17 total; 24.13 kits and 0.4 adults) were released into Wyoming, an additional 36 (22.14 total; 20.12 kits and 2.2 adults) were released into the Conata Basin of South Dakota, and 40 (16.24 total; 13.22 kits and 3.2 adults) were released in south Phillips County, Montana. The fate of ferrets released in Wyoming is unknown. By early December, at least 8 ferrets (3.4.1 unknown) were still alive in South Dakota, of which 5 were pre-conditioned animals raised in outdoor arenas and 2 were cage-reared without pre-conditioning. By July 1995, at least 4 adults (0.3.1) had produced 5 kits in 2 litters. In Montana, at least 9 animals (3.6) survived the winter, producing a minimum of 5 kits in 3 litters. At least 5 of the 6 surviving females were pre-conditioned. The Montana reintroduction included the most rigorous study to date of release techniques. It found significantly higher short-term survival for pre-conditioned ferrets than for cage-reared animals ($P<0.001$: D. Biggings, unpubl. data). However, at least half of the ferrets (20) were killed by coyotes, and 11 of these were killed within 3 days after release. Telemetric data revealed that all ferrets were highly active the first few days following release, increasing their susceptibility to predators. An overall assessment of data from Montana and South dakota (1994) and Wyoming (1992,1993) showed a significant effect of pre-conditioning on short-term and long-term survival (Biggins *et al.*, in review).

A dramatically different reintroduction protocol was attempted in the spring of 1995 when South Dakota experimented with 2 releases of older 4- and 5-year-old animals. This experiment tested the potential contribution of adult reintroductions to the overall recovery effort. If successful, reintroduced animals would breed in the wild, while simultaneously freeing cage space in the captive breeding program for prime aged breeders (i.e. 1-3 year old). The first release consisted of 12 females reintroduced in April and the second release included 14 animals (12.2) reintroduced in June. Only the second group was monitored with telemetry and of those, 12 were found dead soon after release and the other 2 signals lost. Primary cause of death was predation by coyotes. Due to the high losses, further planned releases were canceled.

During 1994-95, plague decimated the complex of white-tailed prairie dog (*C. leucurus*) colonies in Shirley Basin, Wyoming. With a greatly depleted prey base, Wyoming Game & Fish Department decided not to release additional animals into the site that autumn. As a result, ferrets were only reintroduced into Montana and South Dakota in 1995. Thirty-three (18.15) ferrets were released in South Dakota that autumn. An additional 7 (6.1)

animals were released in February to reduce over-winter mortality prior to breeding. Montana released 37 (23.14 total; 20.11 kits and 2.3 adults) animals. By late November/early December, at least 16 ferrets (4.7.5) survived in South Dakota, including 9 animals (3.6) reintroduced in 1995, 2 released (1.1) in 1994, 3 kits born in 1995, and 2 unidentified animals. Survivorship of animals known to be alive through December increased from 22% in 1994 to 30% in 1995. In Montana, both lethal control of coyotes and temporary electric fences were used to reduce ferret mortality during the first couple weeks after release. All ferrets were intensively monitored using radio telemetry for several weeks and then monitored periodically using spotlights. Thirty-day survivorship increased from 25.7% (9 of 35) in 1994 to 58% (18 of 31) in 1995. In December 1995, a minimum of 28 ferrets (15.13) survived on or near the release site in Montana, and by May, 1996, a minimum of 19 animals were identified in the area. Summer survey in 1996 located a minimum of 10 litters with at least 15, including litters from wild-born females.

Arizona became the recovery program's fourth reintroduction site when 4 male ferrets were released into large (980 m^2) fenced enclosures on a reintroduction site in Aubrey Valley, Coconina County in March, 1996. Thirty-five ferrets (15.20) were later released into the enclosures, including 12.17 four-year-old, 1.1 two-year-old, and 2.2 one-year-old animals. The 10 on-site enclosures were constructed to exclude terrestrial, but not avian ferret predators and each is sub-divided into 4 smaller pens. The state received an additional 15 kits in autumn 1996 and will compare survival and behaviors of kits with those of adults.

South Dakota reintroduced an additional 67 kits and 4 adults and Montana released an additional 43 kits in autum 1996. Concern for maximizing survivorship led the U.S. Fish & Wildlife Service to require pre-conditioning for as many ferrets as possible beginning in fall 1996. Although predator control activities in Montana increased short-term survival, long-term survival was not affected. Pre-release conditioning appears to be the most important factor influencing survival of reintroduced ferrets. Ferrets transferred at an early age to large, dirt filled pens, or born in such facilities, fare best.

PROGRAM ORGANIZATION AND MANAGEMENT

Organization and management of ferret recovery efforts has been the subject of intense research and analysis (May, 1986; Weinberg, 1986; Clark & Harvey, 1988; Clark, 1989, in press; Clark & Westrum, 1987; Thorne & Oakleaf, 1991; Alvarez, 1993; Godbey & Biggins, 1994; Reading & Miller, 1994; Miller *et al.*, 1994b, 1996). Despite broad recognition of many of the program's organizational problems, participants interpreted the underlying reasons for these problems differently. Until recently, little attention was given to addressing these organizational problems, despite many recommendations.

The U.S. Fish & Wildlife Service (hereafter Service) designated Wyoming Game & Fish department the lead agency for ferret recovery soon after discovery of the Meeteetse, Wyoming, population in 1981 (Clark, 1989, 1994). The state agency vigorously managed and controlled the program from 1981-1985, when the Service took the lead in what had become a large, complex, and multi-organizational program. The program has continued to grow as the number of captive facilities and reintroduction sites has grown. At the same time, Congressional allocations for endangered species recovery programs have declined in response to opposition from some sectors (although the general public apparently still strongly supports endangered species conservation).

After 15 years, and because of unresolved organizational problems, an increasingly national (even international) recovery program, and reduced funding, participants requested the Service to assume greater involvement in the ferret recovery program (Miller *et al.*, 1996). This, coupled with Wyoming's financial difficulties and lingering uncertainty of the Wyoming reintroductions, led to several changes in the management of the program by the Service beginning in 1995. In early 1995, the Service formed a committee of agency representatives to oversee ferret recovery efforts. In early 1996, the Service assumed direct responsibility for the captive breeding facility at Sybille, Wyoming. The Service renamed the facility the National Black-footed Ferret Conservation Center and assigned captive breeding and reintroduction specialists to assist a new part-time Recovery Coordinator. Recently, ferrets were allocated to reintroduction sites by the Service, which were required to have detailed proposals and protocols.

In 1995, the Service also contracted the American Zoo and Aquarium Association (AZA) to conduct a programmatic evaluation of the ferret recovery program. The AZA held a series of three Black-footed Ferret Analysis and Action Planning Meetings -on captive breeding, reintroduction and habitat conservation, and program administration and accountability -from late 1995 through early 1996. The working documents produced from these meetings are intended to help the Service improve the program, guide recovery efforts, and draft a recovery plan (Hutchins & Wiese, 1996). To improve coordination and management of recovery efforts, the Service began establishing a formal recovery implementation team in July 1996.

THE FUTURE OF FERRET CONSERVATION

Black-footed ferrets appear to be moving toward recovery, but a variety of challenges remain. Perhaps the largest biological obstacle to recovery is posed by disease epizootics, including canine distemper and plague. Ferrets are highly and fatally susceptible to canine distemper (Williams *et al.*, 1988). A temporary vaccine for canine distemper is now available and a vaccine for lifetime immunity is being researched. Perhaps of greater concern is plague. Until recently, ferrets were thought not to be susceptible to plague; however, the loss of several ferrets at two separate captive facilities has dramatically proven otherwise. In addition, prairie dogs continue to suffer marked declines across most of their range from this introduced, exotic disease and from other causes (e.g. poisoning and shooting). A plague epidemic halted reintroduction in Shirley Basin, Wyoming, after a 50+% decline in prairie dog numbers in one year. Another epidemic has been underway for 3+ years near the Montana reintroduction site, formerly the largest complex of prairie dogs in the United States. Although the rate of decline in Montana has been slower than in Wyoming, the cummulative decline has been similar and threatens that reintroduction. To hamper the spread of plague in Montana, prairie dog burrows were dusted with 2% permethrin dust to kill flea vectors in 1993 and in 1996. Plague epidemics periodically affect most known complexes of prairie dog colonies, with notable exceptions of South Dakota and perhaps Mexico, but it may eventually reach these areas as well. Therefore, combating plague probably poses the most significant biological challenge to the conservation of ferrets and the entire prai-

rie dog ecosystem. For example, future reintroductions may entail releases on smaller sites that are more easily managed for plague.

Captive breeding continues to produce kits for reintroduction, but continued inbreeding could lead to problems with fertility, survivorship, and deformities in the future. Unfortunately, options are limited by the extremely small number of founders; only five are represented currently. Resolving issues of relatedness by performing the requisite genetic studies might aid the situation. The recovery program should also develop contingency plans in case inbreeding depression begins to affect the captive population.

Several non-biological challenges also face ferret recovery. Antipathy for prairie dogs remains prevalent among some people, especially relevant groups such as ranchers and many employees of agriculture, wildlife, and public land management agencies (Miller *et al.*, 1990c, 1993; Reading, 1993; Reading *et al.*, in review). Inducing these people to support, or at least not to oppose, ferret and prairie dog conservation programs is crucial to long-term success. Similarly, several groups actively oppose endangered species conservation programs because of real and perceived restrictions associated with the U.S. Endangered Species Act (ESA). Anger and fears associated with several sensitive issues, including private property rights, states'rights versus federalism, and public land management, have produced a strong backlash against the ESA and individual recovery programs (Reading & Kellert, 1993; Reading *et al.*, in review). Successful, long-term conservation requires addressing these concerns effectively.

Organizational challenges to ferret recovery significantly affected program performance in the past and a number of issues remain to be solved. Among the most fundamental of these problems is an inability to "double-loop" learn (Clark, 1996), utilize the potential of high performance teams (Westrum, 1994), and to prototype effectively (Clark *et al.*, 1995). While some issues are being addressed in the current programmatic evaluation and re-organization effort, many important organizational challenges remain (e.g. an effective decision process, see Clark & Brunner, 1996). Several past problems had their origins in differing standpoints of participants -including personality, disciplinary, organizational, parochial, and epistemological biases. These are manifest individually and organizationally in different values sought, organizational cultures, operating philisophies, goals, and control issues over ferrets and other resources and have limited the rationality potentially available to the recovery program. Several of these variables remain unrecognized, undiscussed, or unchanged and must be successfully addressed to reduce further polemics, goal displacement, and unproductive conflict (Miller *et al.*, 1996; Clark, in press). This is especially true as the number of key factors and reintroduction sites increases, as the program increasingly relies on non-governmental sources of funding, and on other key contextual trends and conditions.

On a more positive note, the world's largest prairie dog complex in Chihuahua, Mexico, is being incorporated into a new protected area. Theoretically, this complex could support over 1,200 black-footed ferret families (Ceballos *et al.*, 1993). Currently, biologists from the Universidad Nacional Autonoma de México are assessing the site more fully and government officials from the U.S. and Mexico are preparing the necessary paperwork to permit future reintroductions. In addition, research during reintroductions and captive breeding continues to refine methods, improving chances for future success at lower costs. Finally, many dedicated professionals are commited to the recovery of this charismatic ambassador of the threatened prairie dog ecosystem, substantial progress has been made, and hopes remain high that wild, free-ranging populations of black-footed ferrets will once again roam the prairies of North America.

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[1]Denver Zoological Foundation & Northern Rockies Conservation Cooperative, City Park, Denver, CO 80205, USA

[2]Yale School of Forestry & Environmental Studies & Northern Rockies Conservation Cooperative, P.O.Box 2705, Jackson, WY 83001, USA

[3]National Black-footed Ferret Conservation Center, U.S. Fish & Wildlife Service, 410 E. Grand Ave., Suite 315, Laramie, WY 82070, USA

[4]Bowdoin National Wildlife Refuge, U.S. Fish & Wildlife Service, HC 65, Box 5700, Malta, MT 59538, USA

[5]Universidad Nacional Autonoma de México, Fundacion Ecologia de Cuixmala, Apartado Postal 161, Melaqué, Jalisco 48980, México

[6]National Biological Service, 4512 McMurry Avenue, Fort Collins, CO 89525, USA

Small carnivores (mustelids, viverrids, herpestids, and one ailurid) in Arunachal Pradesh, India

Anwaruddin CHOUDHURY

During frequent trips to Arunachal Pradesh in north-eastern India (between 1989 and 1995) to determine current wildlife distributions and status (especially those of endangered mammals and birds) I was able to gather some valuable data on small carnivores (Ailuridae, Mustelidae, Viverridae, and Herpestidae). The data include direct sightings in the wild, records of wild-caught animals held as captives, examinations of dead specimens (including preserved skins), and reports by experienced hunters, forest officials, and other observers. Unfortunately, these families of small carnivores have been often overlooked during field surveys (aimed primarily at larger mammals and birds), so many observations were not documented in detail.

There is little information published on the status and abundance of these animals in this region. A status report on the small carnivores of Assam (adjacent to Arunachal Pradesh) has been published recently (Choudhury, 1997a), and accounts on the small carnivores of Assam can also be found in Choudhury (1994, 1997b). No specific field study solely on these small carnivores has been undertaken so far in this area. General information on these groups (including their tentative status in Arunchal Pradesh, then referred to as Assam or NEFA) can be found in some synoptic works, notably Prater (1948), Ellerman & Morrison-Scott (1951), and Corbett & Hill (1992).

The state of Arunachal Pradesh (26°40'-29°27'N, 91°35'-97°24'E) covers an area of 83,700 km², and forms part of a rich biogeographic unit that represents one of the world's biodiversity 'Hotspots' (Myers, 1988, 1991). The state is mostly hilly and mountainous, being part of the Eastern Himalayas. The mountains towards the east of the Siang River are known as Mishmi Hills. Areas further east and south-east are dominated by the Dapha Bum and Patkai mountain ranges. Small plains areas occur along the larger rivers, notably the Siang, Dibang, and the Lohit. The highest areas, especially the Great Himalayas, remain snow-capped throughout the year.

Arunachal Pradesh has one species of ailurid, 12 species of mustelid, 7 viverrids, and 3 herpestids (Choudhury, unpubl.). In this paper I present the information available on these different species.

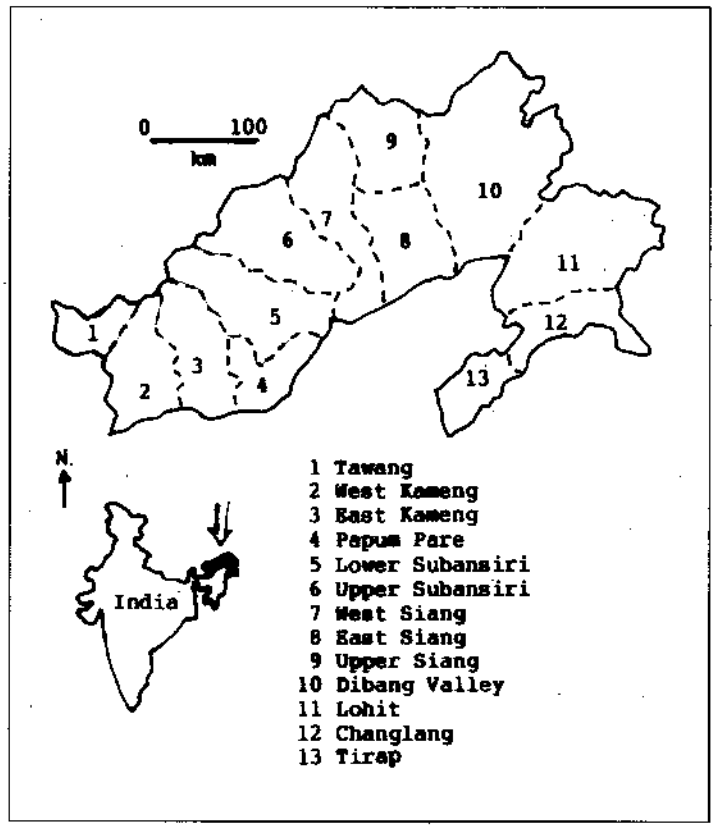

Fig. 1. Map of Arunachal Pradesh showing the districts.

Species notes

AILURIDAE

Red panda, *Ailurus fulgens*

Not uncommon, even in suitable localities. So far it has been recorded from Tawang, West Kameng, East Kameng, Upper Subansiri, Lower Subansiri, Upper Siang, West Siang, East Siang, Dibang Valley, Lohit and Changlang Districts (Choudhury, in press). There are no records from Papum Pare and Tirap Districts, mainly because of their low elevation. Geographically, it is distributed in Eastern (or Arunachal) Himalaya, the Mismi Hills, and the Dapha Bum Range. It occurs above 1,500 m ASL in subtropical and moist, temperate forest with bamboos, and also in subalpine forest, although Corbett & Hill (1992) and Roberts & Gittleman (1984) mentioned that it can occur above 2,200 m ASL. I have examined skins from the Mehao Sanctuary of Dibang Valley District, and from near Tawang.

Some other specific localities from which the species has been recorded in recent times include the Mouling National Park, Dichu Valley in Lohit District (Singh *et al.*, 1995, 1996), and in Thingbu Circle of Tawang District (Singh, 1991). Other protected areas where the species is found are the Eaglenest Sanctuary of West Kameng, Dibang Sactuary of Dibang Valley District, Kamlang Sanctuary of Lohit District, and Namdapha National Park. Its presence in Pakhui Sanctuary remains to be confirmed.

MUSTELIDAE

Yellow-bellied weasel, *Mustela kathiah*

Not uncommon. This hill-dwelling species is found in all districts except Tawang and Tirap. The districts where it is found are West Kameng, East Kameng, Upper Subansiri, Lower Subansiri, Papum Pare, Upper Siang, East Siang, Dibang Valley, and Changlang. It occurs mainly between 1,000 and 2,000 m ASL, but in winter, it may descend to a little lower than 1,000 m ASL.

Siberian weasel, *Mustela sibirica*

A high elevation species occurring in the mountains of Eastern Himalaya (Tawang, East Siang, Upper Subansiri, Lower Subansiri, Upper Siang, West Siang), the Mishmi Hills (East Siang, Dibang Valley, Lohit), and the Dapha Bum Range (Lohit and Changlan Districts). Since it occurs mostly above 2,400 m ASL, it is unlikely to be found in the Districts of Papum Pare and Tirap.

Back-striped weasel *Mustela strigidorsa*

Found only in the higher hills (above 1,000 m ASL and usually below 2,000 m ASL), especially in the middle ranges of Eastern Himalaya (West Kameng, East Kameng, Upper Subansiri, Lower Subansiri, Upper Siang, and West Siang Districts), the Mishmi Hills (East Siang, Dibang Valley and Lohit Districts), and the Dapha Bum Range (Tirap and Changlang Districts).

Beech marten *Martes foina*

Found in the northern part of the state, extending from Tawang to Lohit Districts, and occurring in the middle and higher ranges of the Eastern Himalaya and Mishmi Hills (usually above 1,500 m ASL). May also occur in the Dapha Bum Range. Rarer than *Martes flavigula*.

Yellow-throated marten *Martes flavigula*

Common all over Arunachal Pradesh, except for the snow-capped mountains. However, its distribution is restricted to forested areas, both tropical and subtropical. Sightings are not very frequent although in Namdapha National Park (at an elevation of ca. 200 m ASL)it has been seen often, and it has also been observed near Nampong in Changlang District. Corbett & Hill (1992) mention that it occurs between 300 and 3,000 m in the Himalayas. This marten is usually seen singly, although two animals are also encountered on occasion. It occurs from near the edge of hills to the higher mountains. In less disturbed forests such as Namdapha, it can also be seen during the daytime. In the Dichu Valley of Lohit District, it has been recorded between 2,000 and 2,700 m ASL (Singh *et al.*, 1995).

Eurasian badger, *Meles meles*

So far there are no records or evidence of this species from any corner of the state, however, its occurrence in SE Tibet (Corbett & Hill, 1992) close to the boundary of Arunachal Pradesh gives ample scope for future investigations. Potential areas for the Eurasian badger are Tawang, Upper Subansiri, Lower Subansiri, West Siang and Upper Siang Districts.

Hog-badger, *Arctonix collaris*

Perhaps the commenest of all the badgers and ferret-badgers, this species is widespread in the forests, as well as in well-wooded parts of the countryside. Most records have been of lone animals.

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

So far there are no specific records of this species but it is likely to occur in the foothills and grasslands all over Arunachal Pradesh. Observation is very difficult because of the species' nocturnal habits.

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

This species is found all over Arunachal Pradesh, however, its exact status in unclear. As in *Melogale personata*, observation is very difficult.

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

Not uncommon, especially in the hill streams and including the larger rivers such as the Siang, Dibang and Lohit. Otters occur in the mountains also (above 2,500 m ASL). They have been seen singly, in twos (often pairs) or in small groups. In Dichu Valley of Lohit District, otters were observed at an elevation of 1,100 m ASL (Singh *et al.*, 1995).

Smooth-coated otter *Lutra perspicillata*

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

Short-clawed otter *Aonyx cinerea*

Not uncommon in wetlands, but less numerous than *L. perspicillata*. Found mainly in the plains and foothills, including these of the Namdapha National Park.

VIVERRIDAE

Large Indian civet, *Viverra zibetha*

Very common and widespread all over Arunachal Pradesh except for the snow-capped mountains. Found in the plains as well as in the hill forests, plantations, scrub jungle, and in the vicinity of villages. Usually seen singly.

Small Indian civet, *Viverricula indica*

Also very common all over Arunachal Pradesh except for the high mountains. It prefers the vicinity of human habitations and regularly takes domestic chickens and ducks. It is common even in busy towns such as Itanagar (the capital of Arunachal Pradesh), Pasighat and Tezu.

Spotted linsang, *Prionodon pardicolor*

The rarest of all the small carnivores covered by this paper. Observation is very difficult, and there are very few recent records of specimens. A skull and skin have been recorded in Upper Siang (Katti *et al.*, 1990), and the linsang has been reported from the Mouling National Park (Singh *et al.*, 1996). It possibly also occurs in the forests of the foothills and hills.

Common palm civet, *Paradoxurus hermaphroditus*

Very common all over, including within forests and well-wooded villages. The "toddy cat" is a familiar and well-known thief of domestic chickens.

Masked palm civet, *Paguma larvata*

Also common, but less abundant than the toddy cat. It occurs all over Arunachal Pradesh, especially in the forests and light woodlands of the foothills and hills.

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

Not uncommon in the forested plains, hills and lower slopes of the mountains all over Arunachal Pradesh. In fact, it occurs in all districts, although it is more common in foothills and hills with good tree cover. Some specific areas where the species has been recorded include Panir RF (RF= Reserve Forest) of Papum Pare District, Dibang RF of Dibang Valley District, Namdapha National Park of Changlang District, Kamlang Sanctuary of Lohit District, Pakhui Sanctuary of East Kameng District, Eaglenest Sanctuary of West Kameng District, and Mehao Sanctuary of Dibang Valley District.

Small-toothed palm civet, *Arctogalidia trivirgata*

Found in the hills and foothills of eastern Arunachal Pradesh, especially in the districts of Tirap, Changlang, Lohit, and perhaps Dibang Valley. Although not uncommon at suitable localities, its exact status is unclear.

HERPESTIDAE

Small Indian mongoose, *Herpestes auropunctatus*

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

Indian grey mongoose, *Herpestes edwardsii*

So far there are no specific records of this species from Arunachal Pradesh, however, the species might occur in the lower hills and foothills of western areas.

Crab-eating mongoose, *Herpestes urva*

Not uncommon in forested areas on both the plains and hills. This species inhabits wetlands and forest streams. It is not observed near human habitations and sighthings are rare. The species is less agile than the other two mongoose species, but it vanishes amongst undergrowth whenever allerted to the presence of humans. The species is usually seen in groups of two or more.

There is a record (pelt) of the Stripe-necked mongoose (*Herpestes vitticollis*) from the Dichu Valley (1,100 m ASL) of Lohit District (Singh *et al.*, 1995). However, this is obviously a case of misidentification of *H. urva*, as the distribution of *H. vitticollis* is confined to south-western India and Sri Lanka!

Discussion

As in the case of Assam (Choudhury, 1997a) potential researchers tend not to show much interest in these animal groups. Since most small carnivores are nocturnal, shy, and little known, general curiosity in these groups of animals is yet to be developed fully. Despite this, there is an urgent need for 'base-line' studies of biodiversity-rich areas like Arunachal Pradesh. They may be followed-up by detailed ecological studies of different species. For baseline surveys that ascertain exact status and distribution (especially of the least-known and most endangered species) camera-trapping may be a good idea.

From the species notes in this paper, it appears that the exact status of many species is still unclear (e.g. *Mustela sibirica, M. kathiah, M. strigidorsa, Melogale* spp., *Prionodon pardicolor*, and *Arctogalidia trivirgata*). Moreover, although the occurrence of *Meles meles* has yet to be reported, its possible presence cannot be ruled out in the extreme north because of records from adjacent areas of Tibet. Considering the large-scale deforestation here, forest-dwelling species such as the red panda, spotted linsang, and binturong may, perhaps, be becoming rarer day by day. A number of records of the red panda and binturong (mostly of animals killed or caught by locals) were from degraded forest, suggesting its vulnerability to forest destruction. The case of the red panda is more serious as its entire habitat is within the temperate climate zone. Here there is a slower rate of vegetation growth, but the rate of deforestation is similar to that seen in the tropical forests!

Most of the mustelids, viverrids and herpestids, and even the lone ailurid, are considered edible by many of the tribal groups inhabiting the different parts of Arunachal Pradesh. Frequently these animals are trapped with the help of crude snares, or shot for the pot with guns. Because most species are cryptic and nocturnal, such hunting does not represent a serious threat, as the numbers involved always remain very low. Species such as *Viverricula indica*, *Paradoxurus hermaphroditus*, and *Herpestes auropunctatus* appear to be in no danger from any corner, and their survival is assured because of their adaptability within a diverse range of habitats (including human habitations). The protected area network present in Arunachal Pradesh also helps the conservation of some of these animals (Fig. 1). Because of the large size and diverse habitat (tropical to subtropical) some protected areas, such as Namdapha National park (1,985 km^2), Dibang Sanctuary (4,149 km^2), Kamlang Sanctuary (783 km^2), and Pakhui Sanctuary (862 km^2), are believed to contain populations of many species of small carnivore that are viable for long-term survival.

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The Rhino Foundation for Nature in NE India, c/o The assam Co. Ltd., G. Bordoloi Path, Bamunimaidam, Guwahati 781 021, (Assam) India. Fax: 91-361-550 902

Dynamics of the nutritional energetics of female mustelids (Mustelidae)

Igor L. TUMANOV and Elena A. SORINA

Regular changes in the environment cause corresponding adaptive reactions in organisms, these reflecting a great many complicated ecological inter-dependencies. These may be expressed by the transformation of different functional systems, so determining their new qualitative structure. As a result of these changes, adequate compensatory reactions occur within an organism and this maintains their normal vital activities and common homeostasis. This is why the study of the adaptive reactions displayed at different intensities in one or other organ systems provides an opportunity to show their adaptive character, and also assists in a general research trend towards discovering means of ensuring the successful commercial breeding of stable numbers of economically important species under new living conditions.

The research that has been carried out by the authors attempts to follow seasonal changes in body weight, levels of food consumption, and various physiological indices in small female mustelids kept under captive conditions for four years. Functions that are connected with seasonal environmental periodicity and which act to ensure survival through the most difficult periods of the year clearly occupy a special place amongst a species' adaptive strategies.

The animals used in our experiments were: four European mink (*Mustela lutreola* L.), three American mink (*M. vison* Schreb.), two polecats (*M. putorius* L.), two least weasels (*M. nivalis* L.), a single stoat (*M. erminea* L.) and a pine marten (*Martes martes* L.).

During the period of research the animals (all female) were weighed monthly whilst receiving a controlled food ration (following a generally-accepted methodology). Their physiological status was determined by the examination of vaginal smears (Danilov & Tumanov, 1976; Ternovsky, 1977). Rectal temperatures were measured by a TEMP-60 medical electrothermometer. Ambient temperatures during the experiments were 18-20°C in summer and 12-15°C during the other seasons.

In the context of the promotion of the successful captive breeding of small carnivore species, the data collected significantly supplement the information available on seasonable changes in the nutritional energetics and physiology of rare and valuable fur-bearer species (Slonim, 1952; Tumanov & Levin, 1974; Segal, 1973, 1975; Heidt *et al.*, 1968; Chappel, 1980; King, 1980, 1983; Buskirk *et al.*, 1988; Buskirk & Harlow, 1989; Korhonen *et al.*, 1990; Tumanov, 1993b).

Body weight

Seasonal changes in the live weight and level of energetic potential are comparatively well-known in small carnivores. It should be noted that, in wild females, the body weight and the amplitutes of such fluctuations are lower than those seen in males in the wild. This feature appears to be explicable by the marked reduction in female body weights during the periods of the rut, parturition, and lactation. During the short autumn season they cannot accumulate sufficient fat reserves, so determining a proportion of the weight fluctuations observed and, to a large extent, their low survival in nature in comparison to males (Tumanov, 1993b). At the same time, one should note that females kept in captivity, but which were reproductively active, did show seasonal weight fluctuations, but of a lower amplitude than did males. Seemingly, these sexual differences should be considered as a hereditary, albeit conservative, reaction of both males and females, as stipulated by corresponding differences in the levels of their metabolic processes.

Observations on caged females showed that their body weights increased markedly in autumn. This was due either to fat formation or to energy resources within the the organism, as are required during the normal course of moulting and living through the cold season. For example, during the period September to December (as compared with June-July) average increases in body weight were 4.8% in the least weasel, 3.9% in European mink, 5.6% in American mink, 0.4% in the marten, 14.8% in the stoat, and 20,2% in the polecat .

In the cold season the females' fat reserves were spent gradually as their weights decreased but, by the end of winter or early spring, the levels of these indices increased noticeably again (Figs. 1-2). After finishing a spring moult plus, in many species a reproductive period, animals were less fat, whilst in summer body weights and fat reserves were at their lowest. The seasonal dynamics of body weights were followed for each year of the research project (Figs. 3-4).

Daily food consumption

The dynamics of the daily food consumptions of females of the mustelid species investigated are similar in character to those seen in the indices of changes in body weights throughout the seasons (Figs. 5-6). In summer, when outside air temperatures were high, the animals ate comparatively little. As reported in males, a marked decrease in daily food consumption was observed in June and July in females. Then, at the beginning of August, animal food requirements began to increase, usually reaching their maxima in September and October (or in November in the case of the least weasel and stoat). In September-December (in comparison with June-July) daily food consumption increased by 2-3% in the least weasel, by 12.5% in American mink, and by 20.1% in the European mink. In females of the other species it was higher, reaching 23.4% in the stoat, 26.1% in the pine marten, and 30.4% in the polecat. The nature of the fluctuations in the amounts of food eaten by predators each day was approximately equal in different years (Figs. 7-8).

Thus, in autumn when mammals began to feed intensively, their fat stocks or energy potentials increased sharply. It appears that the winter survival of small carnivores in nature is determined by the presence and acceptability of high-calorie foods in autumn (September-November) when the animals' food requirements are highest. Females particularly rely on their fat reserves because they need to 'refund' their energetic expenses from the reproductive period. During winter the animals ate comparatively little. This should be considered as a stable, adaptive response aimed at the more economical expenditure of reserves of accumulated energy during the autumn period, and at the animals' survival during the coldest months of winter.

In spring, before moulting and reproduction, the requirement for high-calorie foods increased again, and was accompanied by an increase in animal body weights before the cycle started again.

Rectal temperatures

Rectal temperature serves as an index of the intensity of metabolic processes taking place within the living animal. Its seasonal dynamics were recorded in females of each of the species under consideration (Figs. 9-10). Temperatures were highest in spring and summer, and lowest in winter. Thus a female's body temperature in June was higher than that in December by an average of 0.4-2.2°C in each year of the investigation. In most mammals the period from March to July is characterized by the highest levels of this index. After this it decreases somewhat, then increases again during the rutting period in October and November (Figs. 11-12).

Throughout winter the temperatures of all the species were at their lowest, independent of ambient temperatures. For example, if in June-July average rectal temperatures were 38.8°C in female pine martens, 37.7°C in American mink, and 36.7°C in the polecat, then in December-January they decreased to 38.4°C, 36.9°C, and 34.8°C, respectively.

Thus seasonal body temperature dynamics, which are indicative of the intensity of metabolic processes within the living organism, are now sufficiently well-known in small carnivores. They are connected closely with changes in food consumption, fat deposits, and body weight (which is characterized by a notable increase in the energy metabolism of mustelids during the spring-summer period when compared with that in the winter period [Tumanov, 1993b]). Apparently, the low body temperature levels and, the on-the-whole low levels of winter metabolic processes, allow the animals to spend accumulated fat reserves economically during the cold season.

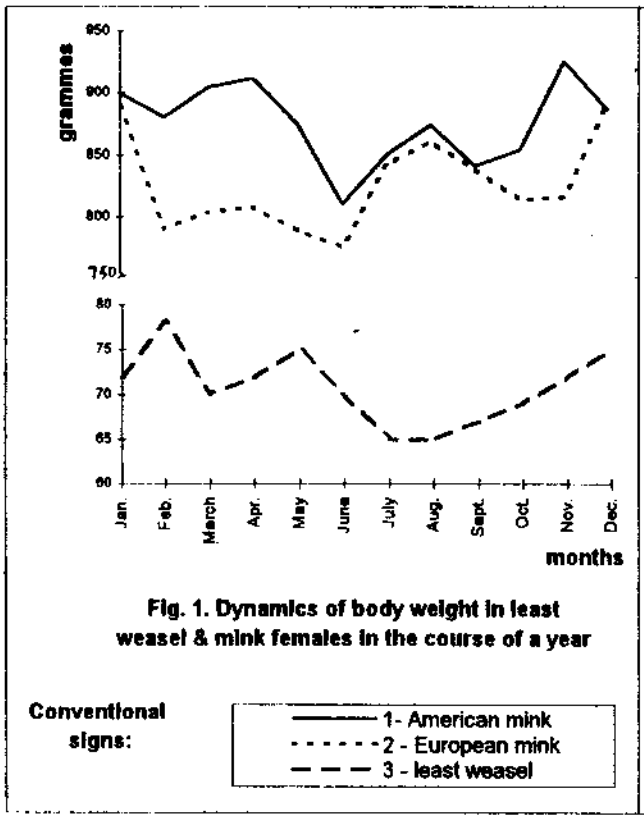


Fig. 1. Dynamics of body weight in least weasel & mink females in the course of a year

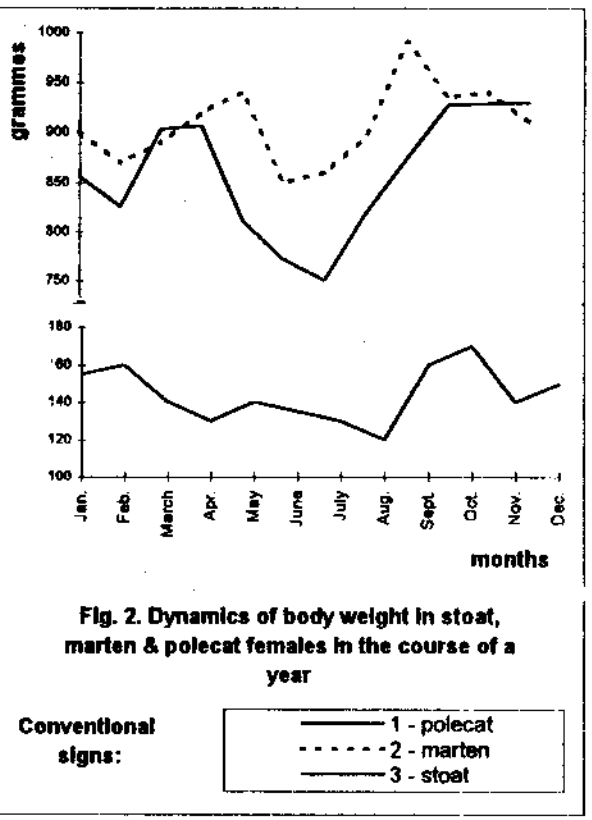


Fig. 2. Dynamics of body weight in stoat, marten & polecat females in the course of a year

Conventional signs:

1- American mink
2 - European mink
3 - least weasel

Conventional signs:

1 - polecat
2 - marten
3 - stoat

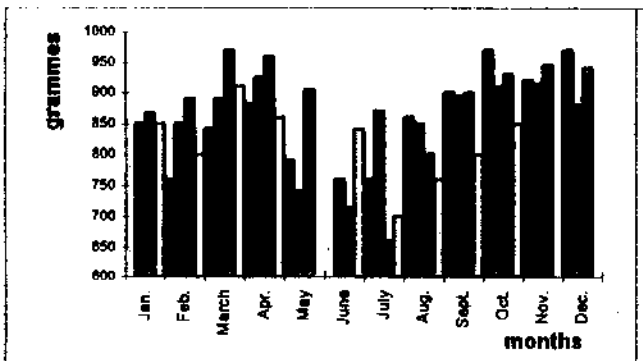


Fig. 3. The long-term dynamics of body weight of the polecat female N 1

Conventional signs for fig.3 & 4:

1986 r. 1987 r.
1988 r. 1989 r.

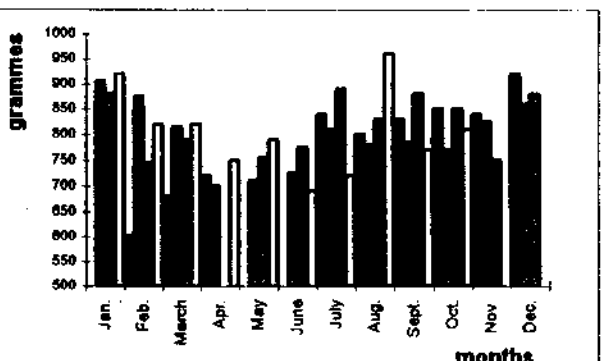


Fig. 4. The long-term dynamics of body weight of the European mink female N 1

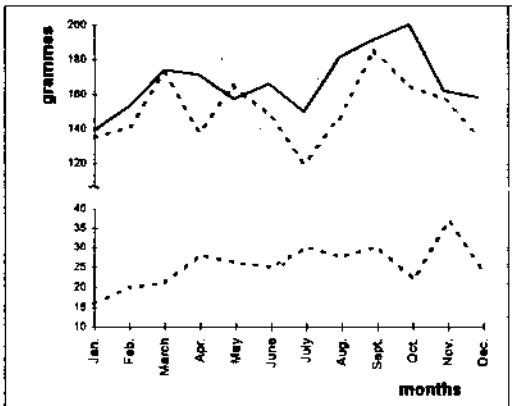
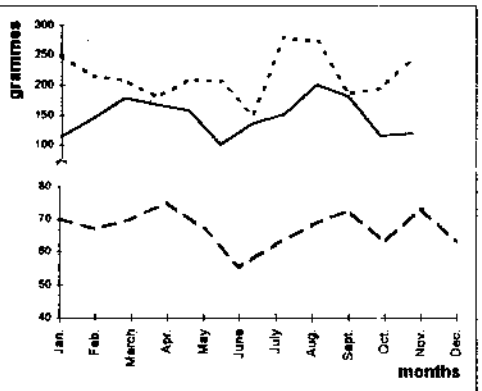


Fig. 5. Daily food consumption in least weasel and mink females in different months

Conventional signs:
1- American mink
2 - European mink
3 - least weasel



FW. 6. Daily food consumption in stoat, marten & polecat females in different months

Conventional signs:
1 - polecat
2 - marten
3 - stoat

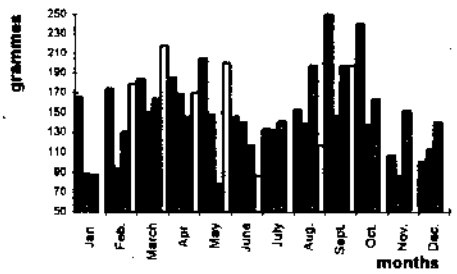


Fig. 7. Daily food consumption in the polecat female N 1 in different years

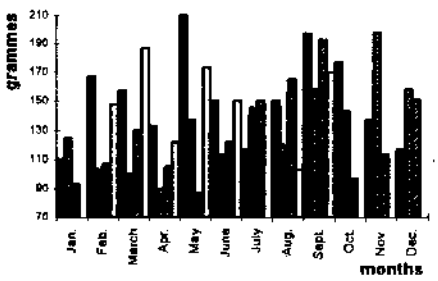


Fig. 8. Daily food consumption in the European mink female N 1 in different years

Conventional signs for fig.7 & 8:
1986 r. 1987 r.
1988 r. 1989 r.

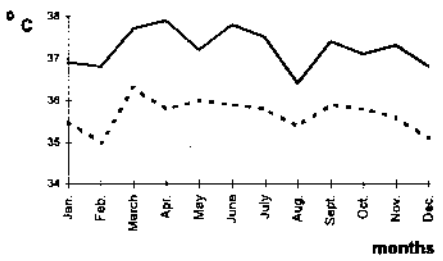


Fig. 9. Seasonal dynamics of rectal temperature of the mink femals

Conventional signs:
1- American mink
2 - European mink

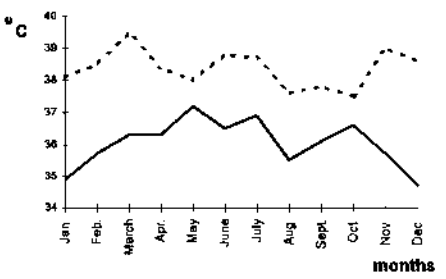


Fig. 10. Seasonal dynamics of rectal temperature of the marten and polecat females

Conventional signs:
1 - polecat
2 - marten

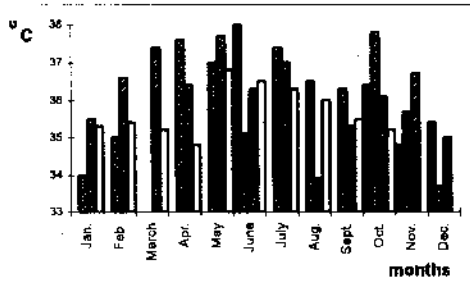


Fig. 11. The long-term dynamics of rectal temperature in the polecat female N 1

Conventional signs for fig.11 & 12:
1986 r. 1987 r.
1988 r. 1989 r.

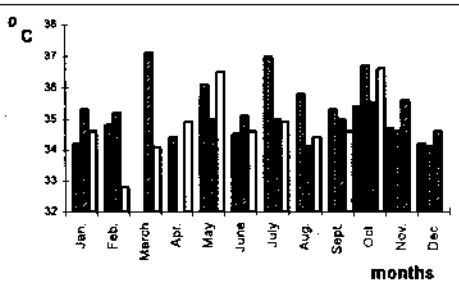


Fig. 12. The long-term dynamics of rectal temperature in the European mink female N 1

Species	Years	Readiness to mating (+) by months											
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Least weasel	1986	-	-	-	-	+	+	+	+	-	-	-	-
	1987	-	-	-	-	+	+	-	-	-	-	-	-
	1988	-	-	-	-	+	+	-	-	-	-	-	-
	1989	-	-	-	+	+	+	-	-	-	-	-	-
Stoat	1986	-	-	-	+	+	-	-	-	-	-	-	-
	1987	-	-	-	+	+	-	-	-	-	-	-	-
	1988	-	-	-	+	+	-	-	-	-	-	-	-
	1989	-	-	-	+	+	-	-	-	-	-	-	-
Polecat	1986	-	-	-	+	+	-	-	-	-	-	-	-
	1987	-	-	+	+	+	+	-	-	-	-	-	-
	1988	-	-	+	+	-	-	-	-	-	-	-	-
	1989	-	-	+	+	+	-	-	-	-	-	-	-
American mink	1986	-	+	+	-	-	-	-	-	-	-	-	-
	1987	-	-	+	-	-	-	-	-	-	-	-	-
	1988	-	-	+	-	-	-	-	-	-	-	-	-
	1989	-	-	+	-	-	-	-	-	-	-	-	-
European mink	1986	-	-	-	-	+	+	+	-	-	-	-	-
	1987	-	-	+	+	+	-	-	-	-	-	-	-
	1988	-	-	+	+	+	-	-	-	-	-	-	-
	1989	-	-	+	+	+	-	-	-	-	-	-	-
Marten	1986	-	-	-	-	-	-	+	+	-	-	-	-
	1987	-	-	-	-	-	+	+	-	-	-	-	-
	1988	-	-	-	-	-	-	+	+	-	-	-	-
	1989	-	-	-	-	-	+	+	-	-	-	-	-

Table 1. Reproductive period duration in females of small mustelids kept in captivity

Amongst the species investigated, the highest body temperatures were observed in the pine marten and the stoat, both of which showed a high level of motor activity. The lowest temperatures were in the European mink which was, in comparison, less active. It is interesting that in the latter case, rectal temperatures were lower than those of the American mink in all seasons. On the whole, the average annual disparity between the two mink species was 1.6°C in this test, although it reached 2.1°C in individual months (Fig. 9). This similarity was seen in males of the species also. Perhaps such specific differences in levels of thermoregulation may also cause the corresponding disparity in the intensities of the animals' metabolic processes. It seems that the American mink, when compared with the aboriginal species, has a higher level of heat exchange, which allows it to settle far outside the boundaries of the present range of the European mink, i.e. places with more severe climates.

Reproductive features of the species

In the course of the evolutionary development of the carnivores studied here, special biological rhythms have formed which allow animals to bear a litter and rear the young in those periods when both climatic and trophic factors are favourable. The members of one species mate in spring. Others, such as those with delayed embryo implantation are ready to rut later, either at the beginning of summer, or even throughout the entire season. Despite this, due to the varying durations of gestation, the birth of cubs under natural conditions always takes place when it is warm. Thus females have the ability to reduce energetic expenses to survive the difficult winter period, allowing the timed emergence of the immature young, and their ability to gain weight from the food available in the spring-summer season. At the end of the reproductive period (when body weights are markedly reduced), females still have time to moult and accumulate the energy reserves required before the onset of cold weather, so decreasing the irradiative loss of heat from the animal to the environment.

The small mustelids divided clearly into three groups with respect to their durations of pregnancy (Danilov & Tumanov, 1976). Species with long embryonic delays are attributed to the first group (stoat, pine marten). Animals with relatively short, but labile pregnancies, belong in the second group (the American mink), whilst carnivores with short, clearly-determined periods of pregnancy belong in the third group (least weasel, polecat, European mink). There are also some rather significant differences in the time of rut (Table 1).

For instance, in our experiments, female American mink demonstrated a readiness to mate earlier than the other species. Their phases of proestrus and oestrus fell within the short period between February-March. The process of ovicell maturation in the European mink and the polecat proceeded markedly later. The proestrus phase was observed in the females of both species between the end of February and April, oestrus in March-June, and sometimes in July. Still later, female stoats entered a state of readiness for mating. This before-rut state was usually observed in March-April, and the rut itself in the second part of April and in May.

The longest reproductive period was observed in the least weasel. Whilst kept in cages the proestrus phase was seen in April-May in different years in the two females, and oestrus from April to the beginning of August. The pine marten entered into reproductive activity later than the other species. Judging from the analyses of vaginal smears, proestrus came in May-June, and oestrus in June-July, sometimes lasting until the beginning of August in different years.

The morphological changes observed in the sexual organs of the study species, and which characterise physiological status during the year, have a cyclical character and common scheme, even though they are displaced at time. Furthermore, female sexual cycles are synchronous with those of the males, with differences such as that in the oestrous period (i.e. a female's ability to mate productively) occurring over a shorter period than does active spermatogenesis in males.

Finally, a close mutual connection should be noted between periods of sexual activity and the feeding energetics of a species. Thus, in females of all the mustelid species examined, the start of the rut was accompanied by increases in rectal temperature levels, body weights, and daily food consumptions. The last of these continues to be high throughout the summer season in the case of pregnant females and those rearing young.

Conclusion

The seasonal dynamics of body weight and daily food consumption of small mustelids demonstrate periodicity in energy metabolism levels. These changes are well-displayed in carnivores and present a stable, adaptive response by the organism, which is aimed at the economic expenditure of accumulated energy reserves during favourable periods of the year.

Usually at the end of a year, when reproduction and cub growth are completed, both the amount of daily food consumption and female body weights increase. Energy reserves are accumulated in the body, these being required for the normal course of autumn coat changes and satisfactory over-wintering. When the level of metabolic processes decreases in the cold season, the need for food and energy expenses of mammals are reduced, which promotes the survival of natural populations. In winter females are usually less active and leave their refuges less often to search for prey, so spending their internal reserves economically.

Before the reproductive season and spring moult, an animal's feeding intensity and body weight increase again. In summer after the rut, females are usually less fat. In the spring-summer period the intensity of metabolic processes in the organism reaches its maximum, which is confirmed by the seasonal dynamics seen in their rectal temperatures.

Thus, significant energy requirements and the permanent thermal deficit connected with them, are compensated for in small mustelids by the lability of their adaptive reactions. This is revealed in the synergeistic seasonal dynamics of body weight, food consumption, and basic physiological parameters.

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The status of small carnivore species in Niokolo-Koba National Park, Senegal

Claudio SILLERO-ZUBIRI and Jorgelina MARINO

The Niokolo-Koba National Park of south eastern Senegal (13°N, 13°W) constitutes one of the largest conservation areas of West Africa and sustains a wide array of wildlife. The mammalian carnivore community of Niokolo-Koba is particularly diverse, with about 23 species belonging to six carnivore families being found there (Sillero-Zubiri *et al.*, 1997), which represents 31% (75 species) of the carnivore diversity of continental Africa (Kingdon, 1997; Wilson & Reeder, 1994). This includes a rich community of small carnivore species, consisting of 3 of 10 species of Mustelidae, 6 of 24 species of Herpestidae, and 5 of 14 species of Viverridae found in continental Africa.

Most mammal populations found in Niokolo-Koba have peripheral distributions due to the park's location in the extreme west of Africa on the northern edge of the Sub-Sahelian woodland belt. They are also often isolated from other populations in the east and south. This is typically shown by the endangered African wild dog, *Lycaon pictus*, in which the isolated Niokolo-Koba population is the westernmost and northernmost of the species. In addition, some of the small carnivores found here are rare or restricted to the region (e.g. Hausa, Gambian mongoose).

Most small carnivore species occur at low densities, or are shy or nocturnal, and thus their presence and abundance are very difficult to determine. However, information may be gathered *ad libitum*, for instance while driving in the park carrying out other research. During the two dry seasons between November 1995 and June 1997 we recorded all sightings of carnivore species in different sectors of the Niokolo-Koba and analysed their frequency of occurrence per distance covered and search time. This report presents a summary of the information gathered, including data on the distribution and conservation status of each species. An estimate of the relative abundance of some of the species is provided.

STUDY AREA AND METHODOLOGY

Together with the adjacent Badiar National Park and N'Dama Forêt Classée in Guinea, the Niokolo-Koba forms the Transfrontier Park Niokolo Badiar, covering 10,000 km^2 of Sudanian savannah. The region is relatively flat, with small lines of hills reaching about 200 m separated by wide flood plains which become inundated during the rains. The park is crossed by the River Gambia and its tributaries the Niokolo-Koba and the Koulountou. The climate is of a Sudanian type; annual rainfall averages 1,000-1,100 mm with a single rainy season lasting from June to October. The vegetation varies from a southern-Sudanian type to Guinean, with woodland predominant and dry forests. River courses are bordered by gallery forests.

Daily field searches were carried out from a vehicle, driving at a speed of 20-30 km/h, in all areas of the Niokolo-Koba and occasionally in Badiar, although most field work was concentrated in a core area around Hotel Simenti and Camp du Lion in the centre of the Park. Observations are mostly restricted to Niokolo-Koba, since only very few carnivore species were positively identified while driving in Badiar. Searches were also carried out during night drives and during stationary searches at marshes. For each observation, the species, location, number of animals, sex and age class, habitat preference, and activity were recorded.

The assessment of frequency for the most frequent species was obtained from sighting rates per unit of search effort, *i.e.* by logging kilometres travelled and hours spent searching in different study zones. The taxonomic nomenclature closely follows Wilson & Reeder (1994), Haltenorth & Diller (1980), and Crawford-Cabral (1980-81). Conservation status derives from the latest IUCN Red List (IUCN, 1996).

RESULTS

The distance covered searching for wildlife in Niokolo-Koba and Badiar totalled 24,153 km and involved 1,447 hours of active search. These totals include 1,419 km and 106 hours of night searches (19:00-06:30h).

All small carnivore species known, or suspected to occur in Niokolo Badiar, are presented in Table 1, including an indication of their frequency and habits. Each of these species is treated separately below. Frequencies of encounters for the more common species are given in Table 2. Their names in four local languages are included in Appendix 1.

MUSTELIDAE

African clawless otter *Aonyx capensis*

Distribution: Very patchy distribution over most of sub-Saharan Africa, up to 3,000 m. In Senegal, common in rivers and streams of Basse Casamanse.
Habitat: Rivers, streams, marshes, lakes and dams, also estuaries and mangroves. Dependent on permanent water and some form of shelter, especially when breeding.
Diet: Fresh water crabs form major part of diet. Frogs, fish, small mammals, birds, and molluscs taken to a lesser extent on a seasonal basis.
Conservation: IUCN not listed. Very widely distributed. Vulnerable to persecution for fur and fishermen. Susceptible to domestic dogs.
Observations: Seldom seen due to riverine, nocturnal habits. Two observations of single adults during this study. One at 17:00 h on the shore of the River Gambia. The other at 09:30 h from a boat, swimming in the River Gambia.

Zorilla *Ictonyx striatus*

Distribution: Sub-Saharan Africa, except for forest and moist woodlands. Subspecies *Ictonyx striatus senegalensis* in West Africa.
Habitat: Very patchily distributed. Commonest in upland grasslands and steppe country.
Diet: Invertebrates. Rodents in some localities during certain seasons.
Conservation: IUCN not listed. Not endangered. Very widespread, although localized.
Observations: One observation of a single adult, at 19:50 h in bushland. The zorillas' late night activity means that they may be rarely seen.

Honey badger or Ratel *Mellivora capensis*

Distribution: Patchy distribution through the whole of Africa except for the driest centre of Sahara and the Mediterranean littoral.
Habitat: Open woodland, waterless desert, steppe, high mountains, and coastal scrub. Occasionally in forests.
Diet: Opportunistic omnivore, specializing in the excavation of social insects, larvae, scorpions, and small mammals. Wherever possible it will take reptiles, birds, and even fish.
Conservation: IUCN not listed. Possibly susceptible to dog and cat diseases. Persecuted by apiculturists.
Observations: One observation at 20:25 h crossing a road. Frequent visitor to garbage dumps at Simenti Hotel and Camp du Lion. Often heard scrabbling for food left-overs with mongooses and civets at Camp du Lion.

HERPESTIDAE

Marsh mongoose *Atilax paludinosus*

Distribution: All well-watered regions of sub-Saharan Africa. Absent from arid and semi-arid regions. In West Africa subspecies *Atilax paludinosus pluto*.
Habitat: River courses and lake-shore areas in otherwise inhospitable regions. Shelter required for breeding, may excavate termitaries.
Diet: Fresh water crabs, snails, mussels, frogs, lungfish and catfish, insect larvae, reptiles, small mammals, birds and their eggs, and fruits.
Conservation: IUCN not listed. Not endangered. Widespread and common.
Observations: Two definite observations recorded. Both were of single animals observed during the morning hours: one in a stream bed in dry forest, the other in tall dry grass in bushland.

Egyptian mongoose *Herpestes ichneumon*

Distribution: Very widely distributed in Africa, although absent in waterless regions and true forest.
Habitat: Commonest in flat, grassy areas on flood plains, coastal littorals, lake shores, and broad river valleys. Speedy colonist of seasonally flooded areas.
Diet: Broad range of prey including rodents, reptiles,frogs, birds, and various insects.
Conservation: IUCN not listed. Widespread, commonest in areas with few other mongoose species. Vulnerable to domestic dogs.
Observations: Twelve observations recorded totalling 19 individuals. Mostly in the early morning (08:00-10:00 h) or evening (18:00-19:00 h), with one night observation (20:30 h). Day time frequency of encounters 0.05 per 100 km or 0.01 per hour. Group size averaged 1.6 ± SD 0.9. Single (n=7), in pairs (n=4) or small family groups (one observation of 4, including 2 young). The species favoured close vegetation such as bushland and woodland.

Slender mongoose *Galerella sanguinea*

Distribution: South of the Sahara to southern Africa (Orange River), from sea level to 2,500 m.
Habitat: All wooded, savannah thicket and forest habitats. Use termitaries, hollow trees, burrows, and hollows for shelter.
Diet: Rodents, insects, reptiles, frogs, birds (nestlings and eggs). Diurnal foragers.
Conservation: IUCN not listed. Not endangered.
Observations: Twenty-five observations recorded, mostly seen in the afternoon, between 16:00 and 18:00 h. Also in the mornings, between 09:00 and 11:00 h. Day time frequency of observation was 0.11 per 100 km, or 0.02 per hour. All observations consisted of single individuals. The species was always observed in close vegetation such as woodland, bushland, and dry forest, not far

Table 1. List of small carnivore species present in Niokolo Badiar. Habits: **D**: Diurnal; **C**: Crepuscular; **N**: Nocturnal. Categories of Frequency: **C**: species is very common; **F**: Frequent; **R:** Rare; **?** Presence suspected, but not observed during this study.

Species	French Name	English Name	Freq.	Activity
Mustelidae				
Aonyx capensis	Loutre à joues blanches	Cape clawless otter	R	D/N
Ictonyx striatus	Zorrille commun	Zorilla	R	N
Mellivora capensis	Ratel	Honey badger	F	N
Herpestidae				
Atilax paludinosus	Mangouste des marais	Marsh mongoose	R	D/N
Herpestes ichneumon	Mangouste ichneumon	Egyptian mongoose	C	D/C
Galerella sanguinea	Mangouste rouge	Slender mongoose	C	D
Ichneumia albicauda	Mangouste à queue blanche	White-tailed mongoose	C	N
Mungos gambianus	Mangue de Gambie	Gambian mongoose	F	D
Mungos mungo	Mangue rayée	Banded mongoose	C	D
Viverridae				
Civettictis civetta	Civette	Civet	F	N
Genetta genetta	Genette vulgaire	Common genet	C	N
Genetta thierryi	Genette de Thierry	Hausa genet	R	N
Genetta pardina	Genette pardine	Large-spotted	R	N
Nandinia binotata	Nandinie	Two-spotted palm civet	?	N

from permanent water. Present throughout the park, often seen along tracks running parallel to the rivers Gambia and Niokolo-Koba.

White-tailed mongoose *Ichneumia albicauda*

Distribution: Widespread in sub-Saharan Africa, except in South-West Africa and rain forests.
Habitat: Versatile, flourishes in grassy savannahs, woodlands, grassy forest clearings, cultivated areas, and suburbs.
Diet: Mainly invertebrates. Frogs, small mammals and reptiles frequently taken. Fruits very infrequently.
Conservation: IUCN not listed. Not endangered. Prone to rapid fluctuation in numbers.
Observations: Thirty-eight observations, of which 36 were at night (19:30-01:00 h). The other two were made in the early morning and at 17:00 h respectively. A night frequency of 2.5 per 100 km, or 0.3 per hour. Mostly solitary, but with two observations consisting of pairs. Predominantly seen in bush land and woodland, but also occasionally in open savannah and marshes. White-tailed mongooses were frequent night visitors to human habitations, searching for garbage and food left-overs. Regularly seen at Camp du Lion and Hotel Simenti.

Gambian mongoose *Mungos gambianus*

Distribution: West Africa, from Senegal to the River Niger.
Habitat: Moist savannahs, forest cultivation mosaics, grasslands and woodlands.
Diet: Invertebrates, with some vertebrates. Diurnal colonial species, foraging in packs of up to 25 animals.
Conservation: IUCN not listed. Little known, but apparently widespread and locally common.
Observations: Eighteen observations totalling a minimum of 120 individuals. Mainly seen in the mornings (08:00-10:00 h), but with four observations in the evening (18:00-19:00 h). Day time frequency of observation along roads was 0.08 per 100 km, or 0.01 per hour. Usually in small bands of 3-10, although one group of 40 was observed. Single individuals were observed five times. Average group size was 6.7 ± SD 8.9. This group size distribution is probably underestimated, due to the fleeing behaviour and preference for thickets of this shy species. They prefer woodlands, using termite mounds as shelter.

Banded mongoose *Mungos mungo*

Distribution: Woodlands, savannahs, and grasslands of East and Central Africa. Also in a broad belt between the Sahara desert and rain forest.
Habitat: Various, from forest-cultivation mosaics to arid Acacia scrub and open short grasslands. Closely associated with termitaries. Colonists of cultivation and large-scale clearances.
Diet: Termites and beetle larvae. Cryptic litter fauna in more forested habitats. Forages in loose formation, maintaining contact with others.
Conservation: IUCN category of threat DD (Data Deficient). Not endangered.
Observations: Forty-eight observations, totalling a minimum of 356 individuals. Seen throughout the day, with nearly half of the sightings concentrated between 16:00-19:00 h. An overall day time frequency of encounters of 0.22 per 100 km, or 0.04 per hour. Group size varied from 1-20., with an average of 7.4 ± SD 5.3. This is probably an underestimate, since some animals may have avoided detection by fleeing through thick vegetation. Prefer woodland (50%) or bushland (21%), but also seen in gallery forest (10%) and dry forest. Seen throughout Niokolo-Koba. Three observations in N'Dama Fôret Classée.

VIVERRIDAE

African civet *Civettictis civetta*

Distribution: Sub-Saharan Africa, absent from southern Africa.
Habitat: Most abundant in forested or partly-forested mosaics. Along watercourses in dry, open country.
Diet: Omnivorous. Vertebrates and plants, mainly roots, shoots, and fruits.
Conservation: IUCN not listed. Not threatened. Widespread and common. Susceptible to road kills, particularly on fast roads such as the National Road (two found dead on this road).
Observations: Thirteen observations, totalling 14 individuals. Always at night, between 20:00-24:00 h. A night time frequency of 0.92 per 100 km, or 0.12 per hour. Mostly solitary, once one pair noted. Frequented marshes and savannah; less often bushland. Frequent visitor to garbage dumps at Simenti and Camp du Lion.

Table 2. List of small carnivore species seen in Niokolo Badiar during this study, including number of observations, mean group size and frequency of encounters per 100 kilometres and per hour.

Species	n	Total	Group Size	Day Drives /100Km	Day Drives /h	Night Drives /100Km	Night Drives /h
Mellivora capensis	1	1	1	-	-	0.07	0.01
Atilax paludinosus	2	2	1	0.01	0.00	-	-
Herpestes ichneumon	12	19	1.6 ± 0.9	0.05	0.01	-	-
Galerella sanguinea	25	25	1	0.11	0.02	-	-
Ichneumia albicauda	38	40	1.0 ± 0.2	0.01	0.00	2.54	0.34
Mungos gambianus	18	120+	6.7 ± 8.9	0.08	0.01	-	-
Mungos mungo	48	356+	7.4 ± 5.3	0.22	0.04	-	-
Civettictis civetta	13	14	1.1 ± 0.3	-	-	0.92	0.12
Genetta genetta	25	26	1.0 ± 0.1	-	-	1.76	0.24
Genetta pardina	10	10	1	-	-	0.70	0.09

Common genet *Genetta genetta*

Distribution: The most widely distributed genet species within Africa. Throughout Africa, excluding the Sahara and rain forest. In West Africa subspecies *Genetta g. senegalensis*.
Habitat: Wide range of drier habitats, from seasonally arid woodlands to near desert.
Diet: Varied, with small mammals as main staple, birds, reptiles, invertebrates, and fruit.
Conservation: Twenty-five nocturnal observations, between 20:00-22:30 h. Night time frequency of 1.76 per 100 km, or 0.2 per hour. Mostly single animals, with one observation of a pair. Prefer close vegetation such as woodland and bushland, but also found in marshes.

Hausa genet *Genetta thierryi*

Distribution: Sparsely distributed from Guinea to Cameroon (eastern limits uncertain). Subspecies in Senegal *Genetta t. villiersi*.
Habitat: Moist to dry savannahs with woodland islands.
Diet: Not known.
Conservation: IUCN not listed. A rare species, poorly known.
Observations: The status of this species in Niokolo-Koba is uncertain. No unequivocal sightings recorded during this study, but it might have been confused with *Genetta pardina*.

Large-spotted genet *Genetta pardina*

Distribution: from Senegal to the the River Volta.
Habitat: Rain forest, riverine vegetation, secondary growth, moist woodlands. Well adapted to cultivation and suburbia.
Diet: Fewer vertebrates, more invertebrates and fruit than *Genetta genetta*.
Conservation: IUCN not listed. Not endangered.
Observations: Ten observations, all during night counts (between 19:40-00:30 h). Time frequency of occurrence of 0.70 per 100 km, or 0.09 per hour. All single animals favouring woodland, but also in bushland.

DISCUSSION

Twelve small carnivore species were definitely present in the park. The presence of another (Hausa genet) was likely but not confirmed. An additional species, the two-spotted palm civet (*Nandinia binotata*) might also be present. Several nocturnal species were common (civet, common and large-spotted genet, and white-tailed mongoose) and some were even commensal at park camps (civet, white-tailed mongoose, and honey badger). The Hausa genet is probably the most important small nocturnal carnivore present in the park, in terms of its restricted distribution and rarity. Although there were no definite sightings for the species during this study, it was probably mistaken for one of the more common genet species. The Hausa genet favours dry savannah and should find ample range in Niokolo Badiar.

During the day, banded, slender, Gambian, and Egyptian mongooses were the small carnivores most likely to be seen. The Gambian mongoose is a particularly interesting species as it is the least known of all cooperative breeding African carnivores. All other social Herpestidae have already been studied in detail and contributed towards the development of cooperative breeding theory. The Gambian mongoose would provide a suitable subject for a post-graduate study. It would be possible to habituate packs regularly seen in Niokolo-Koba for regular observation.

The two-spotted palm civet (*Nandinia binotata*) is a widespread rain forest species, present in a scattered, patchy distribution in equatorial and montane forests. Its distribution extends from West Africa, where it is found in rain forest regions from The Gambia extending east to Sudan and south to Mozambique. It is also found in gallery forest and in forest-cultivation mosaics. It has an omnivorous opportunistic diet, preferring fruits but also eating carrion. The species is present in the wetter areas of Casamance and Guinea to the west and south of Niokolo-Koba, and therefore presumably also present in the gallery forests of Niokolo Badiar Park. There are no sightings reported from the Niokolo Badiar but it is conceivable that it may occur in gallery forests along the Gambia, Koulountou or Koliba Rivers.

Appendix I. List of vernacular names for some carnivore species present in Niokolo Badiar.

English name	Pulaar	Mandingue	Bassari	Woloof
Cape clawless otter		jito wulo	ilawou	
Zorilla		gnino	akdjié kdjé	
Honey badger	daga mere	daamo	inguingr	kundé
Mongooses (in general)	gas-dombal	totono	-	sikkoor
Marsh mongoose			yanthire	
Egyptian mongoose		(solibarendio)	emuuel	
Slender mongoose		(kerahun)	lindima	
White-tailed mongoose		badiadiéwato	agneroun	
Gambian mongoose			eungouin	
Banded mongoose		kansolo	anen	
Civet	sunka ou wuiru	wato (sunkaune)	amblemé	gayndé-kaq
Genet	mbaalo lohode	konkinwo	yanglo	njappaan

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Wildlife Conservation Research Unit
Oxford University
South Parks Road, Oxford OX1 3PS, UK
Email: claudio.sillero@zoo.ox.ac.uk

Small carnivores in Laos

On page 4 of J. W. Duckworth's *Small carnivores in Laos: A status review with notes on ecology, behaviour and conservation* (Small Carnivore Conservation 16:1-21), under "Surveying market trade and trophies and remains in villages", the author aims at a reconstruction of way of collecting data. The reader may get the impression that, while collecting specimens reported in my paper in 1995 in the Zeitschrift für Säugetierkunde, I have been insufficiently aware that people may not always have given the right information on the provenance of particular specimens. The village "Ban Lak" is given as an example. Duckworth corrects this; it should be "Ban Lak 52", and according to him vendors would have mentioned it as provenance in order for me to go there if I wanted a specimen too.

I wish to make the following comments. I do not speak Lao, and I have bought specimens in markets and villages, accompanied by a Laotian colleague, who specifically asked where they came from. I have indicated in *all* the relevant species accounts in my paper which specimens were obtained in markets. At the road stall in Vientiane where people sold specimens from Ban Lak 52, I bought single, fresh specimens of four rodent species only: *Callosciurus finlaysoni, C. inornatus, Bandicota indica*, and *Leopoldamys sabanus*. The accounts of these species specify that Ban Lak here is a village 52 km from Vientiane along the road to Luangprabang. I am grateful to Mr. Duckworth for telling us that this Ban Lak 52 is a major wildlife trading post. I did not know that - nor did my Laotian colleagues, apparently. However, the freshness of the four specimens involved suggested that they had been caught the night before the morning of the purchase, i.e. in all likeliness not far from Ban Lak 52.

Wim Bergmans, Nederlands Comité voor IUCN, Plantage Middenlaan 2B
1018 DD Amsterdam, The Netherlands

Black-footed ferret '1997 breeding season': Summary update

- Captive breeding program currently has 281 (104.177) black-footed ferrets distributed among following facilities: Phoenix Zoo (AZ), Cheyenne Mountain Zoo (CO), Henry Doorly Zoo (NE), Louisville Zoological Gardens (KY), Conservation and Research Center of NZP (VA), Metro Toronto Zoo (Canada), and National BFF Conservation Center (WY).

- Breeding season is progressing successfully, with 93 kits currently alive out of 136 born. Many females are expected to whelp throughout May and June.

- Expecting to wean approximately 277 kits in 1997, SSP program will retain approximately 110+ ferret kits, aiming a 3:5 sex ratio. The remaining kits will be targeted for release.

- Preliminary allocation for reintroduction involves: South Dakota, 80+ ferrets (kits and adults); Montana, up to 10 kits; Wyoming has not received ferrets since 1994 due to habitat problems and disease concerns. Arizona final allocations are dependent on successful kit production, stability of habitats, and status of disease.

- Approximately 500 ferrets (juveniles and adults) have been released into the wild since 1991. Estimated number of free-ranging ferrets ranges between 45-68 breeding adults (20-30 in Montana, 20-30 in South Dakota, and 5-8 in Wyoming).

Presented by Astrid Vargas & Della Garell at the AZA Small Carnivore TAG Midyear Meeting
16 June 1997, Cleveland Metroparks Zoo.

Parasites and diseases of Irish badgers (*Meles meles*)

Paddy SLEEMAN and Thomas KELLY

Introduction

Records of parasites and diseases recorded for badgers (*Meles meles*) from Ireland are listed, and compared to those from Britain and elsewhere. A knowledge of parasites and diseases of animals, such as badgers, may be useful both for tasks such as reviewing biological control agents (Dobson, 1988), roles for parasites in vaccine delivery and in assessing the costs of coloniality. It would also be of interest to compare interspecific transmission from badgers to other species, such as those that share the setts, for example foxes (*Vulpes vulpes*).

MACROPARASITES

Fleas (Siphonaptera): *Paraceras melis melis*, the badger flea is common and widespread. There are records for eleven Irish counties. Its main host is the badger but it is also regularly found on foxes and sometimes on dogs (Sleeman *et al.*, 1997) and once on a young fallow deer (Sleeman, 1983). In Britain apart from *P. melis melis* two other flea species have been reported on badgers, both rarely. One is *Pulex irritans*, which is usually associated with humans and their dwellings, and the other is *Chaetopsylla trichosa* which is believed to have been accidentally introduced from the European mainland (George, 1974). All these species have been recorded from badgers in France (Beaucornu, 1973).

There is experimental evidence from Britain suggesting that badgers move from one sleeping chamber to another to avoid bedding infested by ectoparasites, in particular fleas, a fact that would explain why such chambers are continually being created (Butler & Roper, 1996).

Lice (Mallophaga):

The biting louse *Trichodectes melis* is common and widespread. It has been found on about 50% of wild Irish badgers and appears to reach highest prevalence in autumn (Sleeman, 1997a). It is also common and widespread in Britain (Hancox, 1980) and elsewhere in Europe (e.g. Mehl, 1972).

Flies (Diptera):

Myiasis has been reported from Britain (Hancox, 1991) and central Europe (Porkert, 1966). Given the frequency of blowflies at Irish setts (Sleeman *et al.*, 1997), it is likely that myiasis also occurs here.

Ticks (Ixodidae):

In Ireland and Britain, *Ixodes canisuga* and *I. hexagonus* appear to be common, but *I. ricinus* is occasional (Hancox, 1980, 1988; Martyn, 1988; Kelly *et al.*, 1977). In Ireland, where the latter species is very common, in particular on pasture (Walton, 1965; Sleeman, 1983) it might be expected to be more frequent on badgers. However, as badgers are nocturnal and *I. ricinus* quests during the day the two species may avoid coming into regular contact.

Parasitic worms (Nematoda, Cestoda, Trematoda)

Apart from one reported examination of a badger skull for damage by the nematode *Skrjabingylus nasicola* (none was found)(Sleeman, 1988) there is no published reference to parasitic worms in Irish badgers. The absence of such evidence in Irish badgers is not surprising as the examination of 613 badger skulls from Scandinavia failed to find any such damage (Hansson, 1968, 1970). Records of parasitic worms from Britain include the roundworms *Molineus patens* (intestinal), *Uncinaria stenocephala* (intestinal), *Capillaria erinacei* (stomach), *Aelurostrongylus falciformis* (lungs); the tapeworms *Mesocestoides lineatus* and *Dilepis undula*, and the fluke *Itygonimus lorum* (Jones *et al.*, 1980).

MICROPARASITES

Sarcocystis:

No reports from Ireland, but sarcocysts have been reported from badgers in Germany (Odening *et al.*, 1994).

Babesiosis:

No reports from Ireland, however, a piroplasm has been reported from badgers in Oxfordshire, England (Anwar & Da Silva, 1989).

Tuberculosis:

Widespread, found in badgers in all 32 Irish counties. However, it can be locally absent, but it is uncertain whether these absences reflect lack of adequate sampling (Toolan, 1982).

Tuberculosis was first reported from wild badgers in Switzerland (Bouvier *et al.*, 1962). It was discovered in badgers in the south west of Britain in 1971 and it is now known to be widespread there (Cheeseman *et al.*, 1989; Nolan & Wilesmith, 1994). Prevalence in badgers is variable in time and space and it has been suggested that it is higher in Irish badgers than in those in south west England (Downey, 1990; Lynch *et al.*, 1993). However, when like with like are compared, that is badgers collected in the same manner in legal culling programmes on reactor farms, the overall prevalence appears to be rather similar (Table 1).

There is good circumstantial evidence that the disease is transmitted to cattle, probably from infected moribund badgers and by infected badgers visiting cattle houses (Sleeman & Mulcahy, 1993).

Location	Number of badgers	Number positive for TB	% Range	Mean%
Britain 1972-1987	11,860	588	0.4-11.5%	3.9%
S.W. Britain 1971-1989 (7 counties)	9,180	1,371	4,1-18%	14.9%
Ireland (Rep.) 1985-1988 (22 counties)	2,633	434	0.3-37.1%	16.4%

Table 1. Prevalence of TB in badgers.

Comparative studies of the genetics of tuberculosis in both cattle and badgers show that the same strains occur in both species locally confirming transfer between species (Collins *et al.*, 1994; Skuce *et al.*, 1996; Skuce, 1997).

Rabies:

Rabies has been found in badgers in Europe, but the species is not considered to be the primary host (Hancox, 1980). Nevertheless, rabid badgers are prone to attacking humans and domestic animals, and given current high densities of badgers in both Ireland and Britain if rabies was introduced badgers could be a significant sylvatic host. Rabies was finally eradicated from these islands in 1922 and as long as the present quarantine arrangements are in place, and observed, there is little risk of this disease being reintroduced. There is a report of a wild badger attacking people in Co. Clare in September 1901 (Pentland, 1902). This individual was probably rabid, as rabies was endemic in domestic dogs at that time (Sleeman, 1997b).

Leptospirosis:

Leptospirosis has been reported from badgers in Northern Ireland (W. A. Ellis, pers. comm.) and in Britain (Twigg *et al.*, 1968).

Discussion

The provisional list of parasites and diseases reported here could be supplemented with focused surveys for specified organisms-similar, for example to O'Crowley & Wilson's (1991) investigation of mink (*Mustela vison*) diseases in Co. Wicklow. It would be useful to compare the data with records from other species (e.g. foxes, rabbits, deer, and cattle) to identify potential cross-transmission situations. For theoretical studies it would be useful to establish the costs of group living in terms of parasitism for badgers. As there is variation in densities of badgers regionally and within groups it should be possible to provide an axis against which costs could be estimated. This question has already been addressed from the point of view of reproduction in female badgers (Cresswell *et al.*, 1992). Comparable work on colonial birds is reviewed by Loye & Zuk (1991).

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

Longevity of the Two-spotted palm civet, *Nandinia binotata*, in captivity

Harry VAN ROMPAEY

The two-spotted palm civet is a solitary, nocturnal, arboreal viverrid which although usually placed in subfamily Paradoxurinae, is now more often considered to be the sole representative of subfamily Nandiniiae. The species ranges all over the forested areas of sub-Saharan Africa (from The Gambia up to Mozambique), and although they must be one of the most widespread and numerous African viverrids, few non Africans (even amongst those having spent the greater part of their lives in Africa) have heard of this animal. Their nocturnal and arboreal habits make them unsuitable as pets. (In fact, no wild animal should be kept as a pet but once taken from their natural habitat one can only try to give them a comfortable, carefree life).

On 15 January 1981 I received two male *Nandinia* which had been bought in Kinshasha, Congo (former Zaire) on 9 October 1980. Their estimated age at that time was 4 to 5 weeks so their approximate date of birth must have been close to September 1st 1980.

The two males (which seemed the same age) probably originated from the same litter and were named Kilim and Jaro. At that time their head + body length was ca. 37 cm and the tail length ca. 43. By June the 1st they reached their adult size of H + B length 52 cm and T length 57 cm, and weighed about 2.5 kg. A faecal examination made on their arrival showed no parasites.

They both had the same dietary preferences: banana, pear, mango, and grapes with other fruits only eaten if necessary. In the first years their meat ration consisted of boiled chicken wings of which the bones were also devoured. Later on beef, horse, and lamb meat was given, and equally liked.

Both males lived in harmony, ate out of the same platter, and were never seen to fight. Jaro, much brighter, more skilful and enterprising than Kilim acted as the leader. He would sometimes nip Kilim just to show him who was in charge but no bite ever drew blood. On the whole they seemed to enjoy each other's company and most of the time slept together under an overturned cat basket on a platform ca. two metres above ground level.

When still young they (especially Jaro) proved to be great acrobats and even walking on a metal wire was no great feat (Fig. 1). The mobility of the ankle joint is so great that supination through 180° is possible and they can grasp a branch equally well with fore and hind paws as well as hang upside down (Fig. 2). Although not in possession of a prehensile tail (as does the binturong, *Arctictis binturong*) they try to use it as such while resting or feeding on a branch. If given time it is probable this species may develop a fully prehensile tail.

On April 25, 1985 Jaro had lost his appetite for a few days and weighed only 3 kg of his previous 3.6 kg. The following day he was anaesthetized and X-ray photographs and blood samples were taken at the Veterinary Department of Antwerp Zoo (for which I give my sincere thanks). No abnormalities were noted, but on 27 April he died without having fully recovered consciousness. The autopsy showed renal dysfunction. The cause was never found.

Fig. 1. The daring young men on the flying trapeze.

As Kilim's visible behaviour afterwards did not change it is hard to say if he missed his companion or not. Although branches and planks were arranged to make climbing and getting down to the floor very easy, Kilim must have fallen regularly as limping was frequently observed. These limping bouts were not treated and always disappeared spontaneously after a few days to a few weeks. In December he was reluctant to put down either of his hind feet and ulcers were observed on both soles (one left and two right). Measures were taken to prevent the feet from coming into contact with urine. As he did not enjoy being handled, an ointment (containing cod liver oil and zinc oxide) was smeared over the length of ca. 40 cm of a horizontal plank which he had to pass to get to his food (so that he could not avoid getting ointment on his soles). Recovery was quick. The naked part of the soles, and especially of the hind foot, of *Nandinia* is quite extended and, as experience has shown, very sensitive. The utmost care must be taken so that the soles do not come into contact with irritating substances such as urine or detergents.

On February 2, 1996 Kilim was observed to have difficulty chewing his food. The following day he developed a hard, two cm. diameter swelling between the two branches of his mandible. For the next five days 1/4 of a Claramid tablet (=37.5 mg roxithromycinum) was given twice a day (mixed in mashed banana). After two days the abscess ruptured and after five days it disappeared. Half the dose was continued for three more days.

The evening of February 2, 1997 Kilim was found dead at his sleeping site. The night before he had enjoyed a hearty meal and behaved completely normal. No autopsy was performed as considering his advanced age and sudden death without symptoms the cause of death was most likely heart failure.

He had been in captivity for 16 years, 3 months and 23 days and his approximate age was 16 years and 5 months. Longevity records are given of 7 years 1 month by Mitchell (1911); 9 years 3 months 24 days by Crandall (1964); 10 years 4 months 1 day (and still alive) by Flower (1931); and 15 years 10 months by Jones (1980, 1982). The longevity survey (1960) states a maximum lifespan of 222 months (18 years 6 months) without giving any particulars.

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Jan Verbertlei 15, 2650 Edegem, Belgium

Fig. 2. Drinking with your ankles in 180° supination can be fun.

Review of IUCN Red List Categories and Criteria

As you are aware, in 1994 IUCN adopted a new system of categories and criteria for placing species on the IUCN Red List. Thanks to a tremendous effort on the part of the Specialist Groups in general, and a number of individuals in particular, this system was applied in the 1996 Red List of threatened Animals, and has been used in SSC Action Plans and regional assessments.

The SSC is now undertaking a review of the effectiveness and applicability of the new criteria as called for in Resolution 1.5 at the World Conservation Congress in Montreal in October 1996. At that time, IUCN members asked SSC to pursue this review, paying particular attention to marine species and ecosystems, species under active management programmes, and the formulation of criteria based around population declines.

At the last Steering Committee Meeting, we decided to pursue a more structured approach to the compilation and documentation of the Red List(s). In effect, we decided to move from the production of a product to the establishment of a Programme. The review process is being undertaken through the new Red List Programme, under the overall direction of Steering Committee member Dr. Russell Mittermeier. The technical aspects will be considered by a review group chaired by Steering Committee member Dr. Georgina Mace. The review process will have a number of stages, the first of which involves gathering views on and experiences with the criteria from a wide community of users.

Input from our Specialist groups is crucial. Comments will be most useful if they are received by November 1, 1997. Please have written comments forwarded to Mr. David Brackett, c/o Canadian Wildlife Service, Ottawa, Ontario, K1A 0H3 Canada. These can also be sent via fax (+1-819-953-7177), or e-mail (ssc_iucn@ec.gc.ca).

Once comments are received they will be considered by the review group who will provide a summary. This document will identify problems with the criteria and categories and annotate those needing amendment. Outstanding issues requiring further discussion and analysis will be referred to technical workshops which will be held in collaboration with IUCN members and partners. You may have seen the recent letter from the Director General, offering IUCN Members the opportunity for comment.

It is the hope of the Species Survival Commission that this review will highlight both the positive and problematic aspects of the new systems, ultimately ensuring that the red Listing criteria are as accurate and robust as possible. Thank you for your cooperation in this process.

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2650 Edegem
Belgium

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

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