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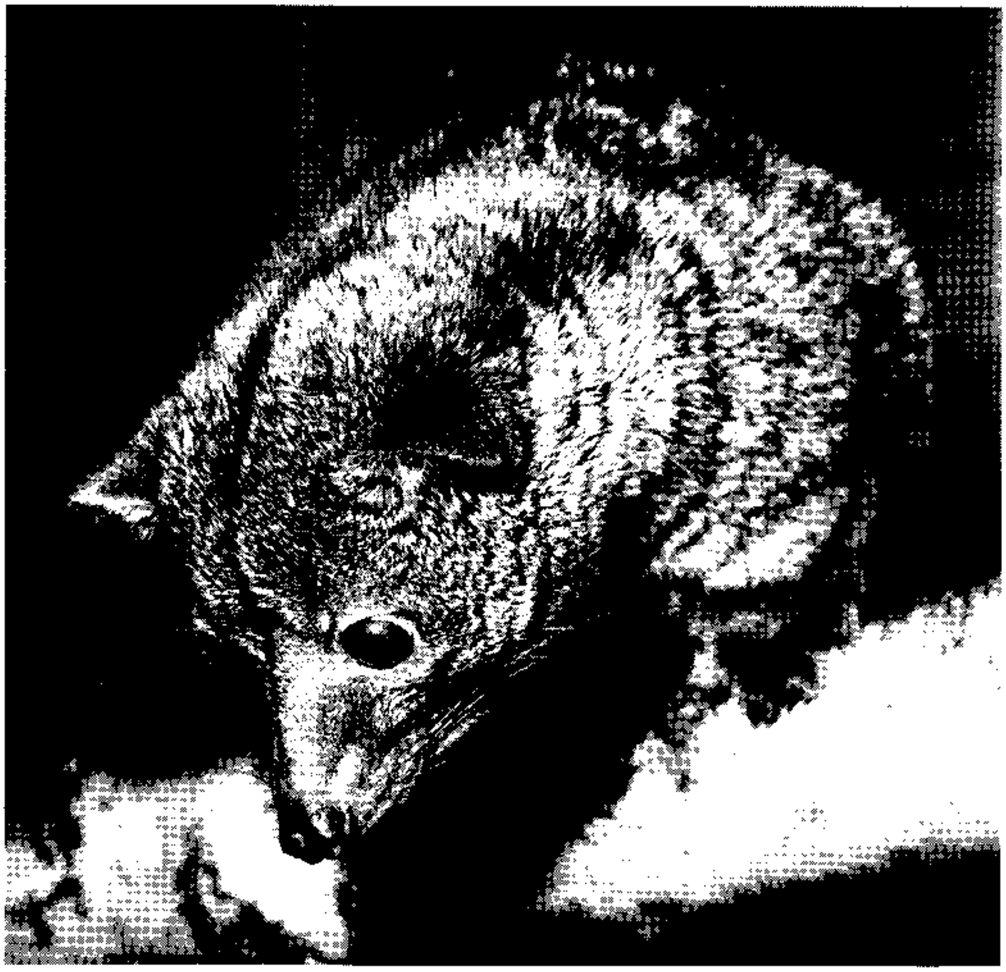

Two-spotted palm civet *(Nandinia binotata)* - Photo: H. Van Rompaey

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

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

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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

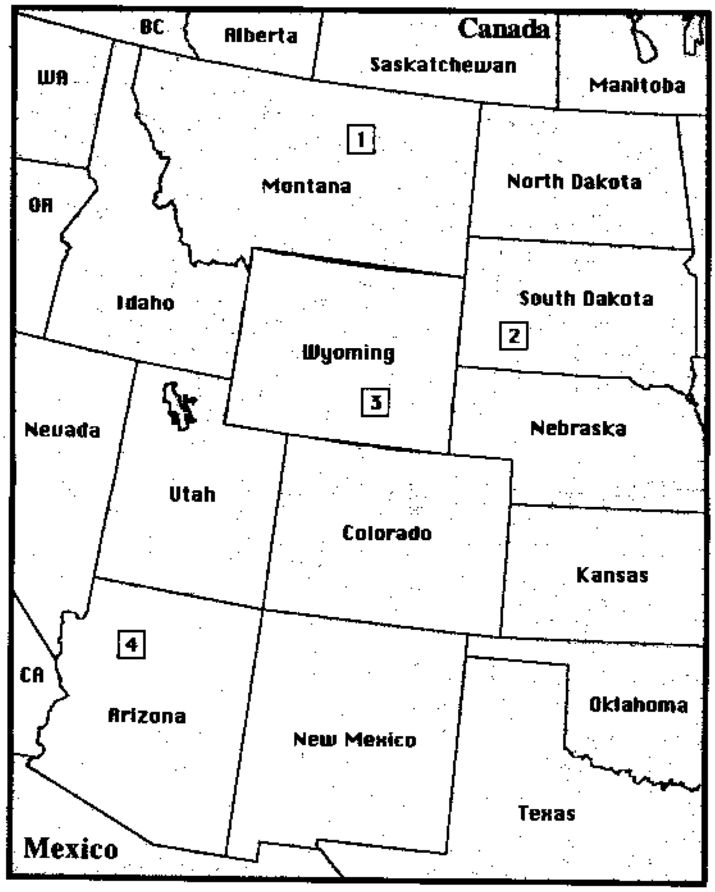


Figure 1. Black-Footed Ferret Reintroduction Sites. 1. South Phillips County, Montana; 2. Conata Basin, South Dakota; 3. Shirley Basin, Wyoming; and 4. Aubrey Valley, Arizona.

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

Figure 2. Black-Footed Ferret Captive Propagation.

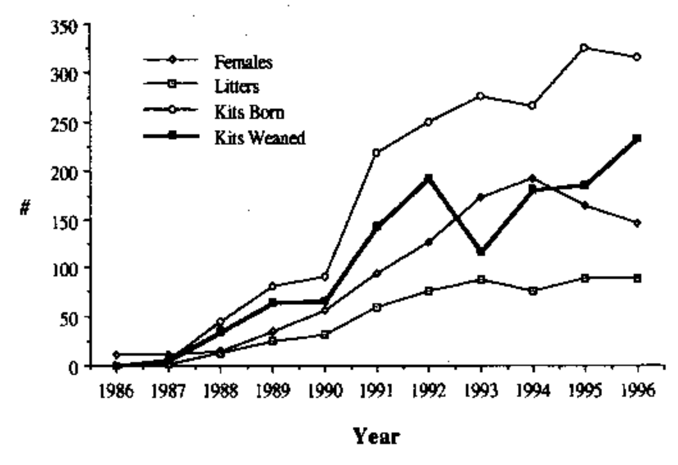
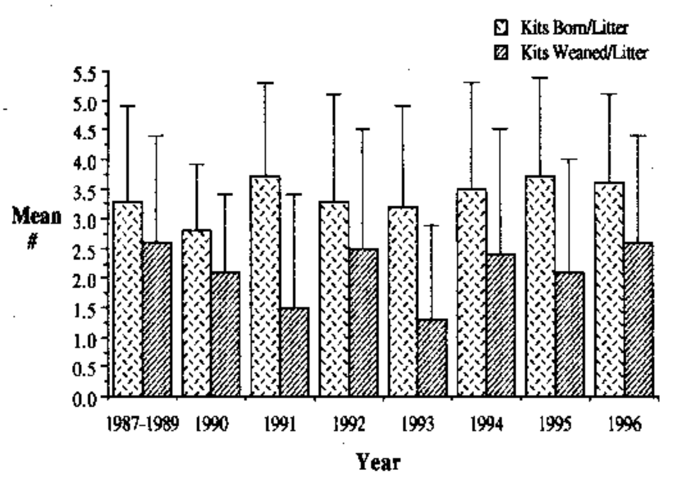


Figure 3. Mean (±S.D.) Black-Footed Ferret Kits Born and Weaned Per Litter.



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.

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

Anwaruddin CHOUDHURY

During frequent trips to Arunachal Pradesh in northeastern 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 km^2, 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.

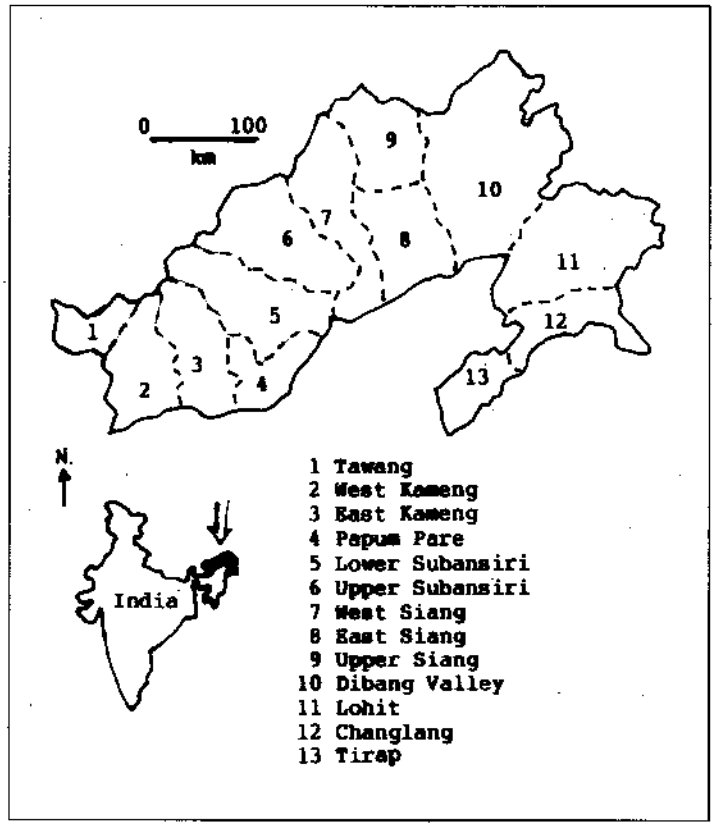

Fig. 1. Map of Arunachal Pradesh showing the districts.

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 Chanlang 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.