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SOME GUIDELINES FOR MANAGEMENT OF THE BLACK-FOOTED FERRET

Tim W. Clark

ABSTRACT.—Management guidelines are specified for monitoring and protecting the Meeteetse black-footed ferret (*Mustela nigripes*) population and habitat and for dealing with a series of special management considerations. The Meeteetse ferret population and habitat status are summarized as background. An annual management schedule is outlined, including methods and sources of existing baseline data with which to compare future results. The public support and organizational arrangements needed for successful overall management and recovery of the species are briefly discussed.

This paper outlines some management guidelines for the Meeteetse, Wyoming, black-footed ferret (BFF) population and its habitat. It can serve as a framework for management of other populations, if any can be located or established from Meeteetse BFF stock via captive breeding/translocation. Initially, study plans for the Meeteetse BFFs specifically called for development of management guidelines (Clark 1981, 1984a, b, Black-footed Ferret Recovery Team 1978). These guidelines specify directions for monitoring and protecting the BFF population and its habitat and for meeting certain management considerations. Furthermore, they can focus future discussion by land and wildlife managers as more specific management needs are identified.

BACKGROUND

These management guidelines are based on growing information about BFFs and their chief prey, prairie dogs (*Cynomys* sp.). An annotated BFF bibliography by Casey et al. (1986) lists 351 references, including study results on the Meeteetse BFFs through mid-1985. An earlier summary of BFF biology given by Henderson et al. (1969) and Hillman and Clark (1980) included results of the South Dakota studies (1964–1974). Several prairie dog bibliographies exist: Clark (1971) listed 225 references, Hassien (1973) listed 437, and Clark (in manuscript) lists about 200 citations from 1973 through 1985. History of the Mee-

teetse BFFs and their environment is given by Clark et al. (*Description and history*, 1986), and BFF habitat use patterns are given by Forrest et al. (*Black-footed ferret habitat*, 1985).

MANAGEMENT GUIDELINES

The Meeteetse BFF population was discovered in late September 1981 (Clark and Campbell 1981), and substantial baseline data now exist after 3.5 years of intensive study. Many BFF study methods have been developed and refined and many management needs identified for the population, its habitat, and a series of special considerations.

The Ferret Population

The status of the Meeteetse BFF population is summarized in Table 1. Collectively, field observations from 1981 to 1985 suggest that the BFF population is reproductive, stable, or increasing. It appears to be producing young in excess of number needed to sustain itself. But even an informal risk assessment of the BFF population and its habitat status requires that initial conclusions about the population be evaluated more critically. For example, initial estimates of minimum viable population (MVP) sizes of BFFs, based on conservative genetic estimates, indicate that the Meeteetse BFFs are below numbers recommended for even short-term population viability (estimate that 200 BFF's are needed, whereas 1984 counts showed only 43 adults

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TABLE 1. Status of the Meeteetse black-footed ferret populations (1981-1984).

Parameter	Status			Source
Size (July-August) ¹	1982	1983	1984	Clark 1983, 1984b, 1985a
	61	88	129	
Distribution	BFFs found in a 333 sq km area containing 37 white-tailed prairie dog colonies; total colony area 2,995 ha			Clark et al. <i>Description and history</i> , 1986; Forrest et al. <i>Black-footed ferret habitat</i> , 1985
Density	Mean 1 adult/56.6 ha; prairie dog colonies over 100 ha contain 2 or more BFFs year-round			Forrest et al. <i>Black-footed ferret habitat</i> , 1985
Age and sex structure:	1982	1983	1984	Clark 1983, 1984b; Forrest et al. 1984
Adults/young	21/40	28/60	43/86	
Replacement index	1.90	2.14	2.00 ²	
Female/male:				
Adult	—	—	20/9 ³	
Young	—	—	23/29	
Totals	—	—	43/38	
Natality	1982	1983	1984	Clark 1983, 1985; Forrest et al. 1984; Forrest et al.
No. litters	12	18	25	<i>Black-footed ferret habitat</i> , 1985
No. young	40	60	86	
Young/litter	3.33	3.33	3.44	
Mortality	Estimated 55%-75% of total population disappears annually			Forrest et al. <i>Life history characteristics</i> , 1985
Immigration/emigration	Unknown, but 15 cases show a mean of 2.5 km			Forrest et al. <i>Black-footed ferret habitat</i> , 1985

¹Minimum counts based on spotlighting surveys (1982 and 1983 counts are believed to be less than actual numbers).

²Replacement index = no. young divided by no. adults.

³Includes 4 adults (2F and 2M) for 1983.

present; Groves and Clark 1986). Computer simulations of demographic and environmental stochasticity, which may be more important than genetic considerations, are expected to show a MVP different from the 200 estimate. A population target for recovery must be based on a thorough examination of MVP.

This management scheme for the Meeteetse BFF population proposes three monitoring activities: (1) spotlight counts in summer, (2) capture-mark/recapture in fall, and (3) snow tracking and sign searches in winter. The techniques for each monitoring activity, expected data products, and sources of existing baseline data are described in Table 2. Plans of action for protection from (1) harassment, (2) diseases, and (3) predators/competitors are also outlined (Table 2).

The Ferret Habitat

The status of BFF habitat at Meeteetse is summarized in Table 3. Because prairie dog colonies compose BFF habitat (Linder et al. 1972; Clark et al. *Description and history*, 1986; Clark et al. *Descriptive ethology*, 1986; Forrest et al. *Black-footed ferret habitat*, 1985; Houston et al. 1986), BFF habitat management focuses on monitoring and protecting prairie dogs. White-tailed prairie dogs (*C. leucurus*) and the small mammals that

live in their burrows serve as food for BFFs (Campbell et al., unpublished data), and prairie dog tunnels are used for shelter and litter rearing by BFFs. White-tailed prairie dog ethology and ecology have been described by Clark, Hoffman, and Nadler (1971) and Clark (1977). Black-tailed prairie dogs (*C. ludovicianus*) have been described by King (1955), Koford (1958), Hoogland (1981). Gunnison's prairie dogs (*C. gunnisoni*) have been described by Fitzgerald and Lechleitner (1974).

BFF habitat management includes four monitoring activities: (1) recording prairie dog emergence and breeding in late winter, (2) determining prairie dog reproductive success in late spring, (3) mapping active and inactive prairie dog colonies in the region each fall, and (4) surveying alternative prey populations in late summer/early fall. The techniques for each monitoring activity, expected data products, and sources of existing baseline data are described in Table 4. Protection from (1) drastically altered land uses, (2) vegetative alteration, and (3) prairie dog poisoning and shooting are also called for.

Specific Considerations

A host of special considerations surrounding the Meeteetse BFFs require attention, including multiple land use precedents and mandates,

TABLE 2. An outline of annual monitoring and protection management needed for the Meeteetse black-footed ferret population.

I. MONITORING

A. USE SPOTLIGHT TECHNIQUES

1. Season: Summer, 5 July–30 August
2. Baseline data sources: Basic spotlight methods described by Clark et al. (*Handbook of methods*, 1984), Campbell et al. (1985)
3. Management parameters:
 - a. Determine litter numbers, distribution, and sizes (results of 1982–1984 litter surveys given in Table 1 with primary data sources)
 - b. Check litter behavior and development (some behavioral data in Clark et al. [*Descriptive ethology*, 1986])
 - c. Determine minimum population numbers (results of 1982–1984 estimates in Table 1 with primary data sources)

B. USE CAPTURE/MARK/RECAPTURE TECHNIQUES

1. Season: Fall, 1 August–15 October
2. Baseline data sources: Basic capture, handling, and marking methods described by Thorne et al. (1985), Fagerstone et al. (1985), Forrest et al. (1984); results of 1982–1984 surveys shown in Table 1 with primary data sources
3. Management parameters:
 - a. Estimate population size
 - b. Determine age and sex structure
 - c. Determine measurements and body weights
 - d. Sample ectoparasites
 - e. Determine inter- and intracolony dispersal and movements
 - f. Take other data from captured animals

C. USE SNOWTRACKING AND SIGN SEARCHES

1. Season: Winter, 1 December–1 April
2. Baseline data sources: Basic snowtracking and sign search methods described in Clark et al. (*Handbook of methods*, 1984; Clark et al. *Seasonality of black-footed ferret diggings*, 1984; Clark et al. *Descriptive ethology*, 1986), and Richardson et al. (1986) results also in these sources
3. Management parameters:
 - a. Determine minimum numbers
 - b. Determine distribution
 - c. Quantify movements
 - d. Quantify hunting behavior
 - e. Sample intra- and intercolony movements
 - f. Estimate onset of breeding

II. PROTECTION

A. ASCERTAIN LEVELS OF HUMAN ACTIVITIES

1. Problem: Harassment
2. Baseline data sources: Use levels should be managed as necessary to approximate pre-1980 activities, yet allow for needed conservation research; general discussions of research impacts by Clark (1981), Clark et al. (*Handbook of methods*, 1984), and Groves and Clark (1986); Campbell et al. (1985) described spotlight effects on BFFs
3. Management parameters:
 - a. Facilitate site visits by conservation biologists, landowners, and others

- b. Limit research impacts
- c. Limit tourists, media, sightseer visits
- d. Monitor traditional land uses

B. MONITOR DISEASES USING STANDARD RECOGNIZED TECHNIQUES

1. Problem: Diseases, parasites, disorders
2. Baseline data sources: Thorne 1984, U.S. Public Health Service, local veterinarians, ranchers
3. Management parameters (Thorne 1984):
 - a. Sylvatic plague
 - b. Canine distemper
 - c. Rabies
 - d. Pseudotuberculosis
 - e. Leptospirosis
 - f. Botulism
 - g. Staphylococcosis
 - h. Tuberculosis
 - i. Streptococcosis
 - j. Mange
 - k. Ear mites
 - l. Ring worms
 - m. Ticks
 - n. Fleas
 - o. Human influenza
 - p. Others

C. USE STANDARD MONITORING TECHNIQUES FOR PREDATORS AND COMPETITORS

- (observation, scent stations, live trapping, nesting checks, mark/recapture, radiotelemetry, etc.)
1. Problem: Predators/competitors
 - a. Avian—owls, hawks, eagles
 - b. Mammalian—long-tailed weasels, skunks, badgers, bobcats, coyotes
 2. Baseline data sources: B. Phillips (unpublished data) on raptor populations in the BFF area
 3. Management parameters:
 - a. Estimate predator/competitor populations
 - b. Estimate effects of predators and competitors on BFFs

oil/gas development, hunting/trapping, livestock grazing, road and fence construction, catastrophes (e.g., diseases), cooperation of the local public and ranchers, and private/state/federal interorganizational arrangements needed to monitor and protect BFFs and their habitat.

MULTIPLE LAND USES.—The Meeteetse BFFs occupy an area managed under various state, federal, and private multiple land use philosophies and mandates. Many traditional land uses (e.g., livestock grazing) are compatible with BFFs. The extent to which each land use can enhance or harm BFFs must be examined from a comprehensive, analytical, “cumulative effects” viewpoint (e.g., see U.S. Forest Service et al. 1985). A model predicting cumulative effects should be developed, constantly updated, and used to inform all management decisions.

TABLE 3. Status of the Meeteetse black-footed ferret habitat (1981–1985).

Parameter	Status	Source	
Location	Park Co., western Big Horn Basin, Wyoming	Clark 1985a; Clark et al. <i>Description and history</i> , 1986; Forrest et al. <i>Black-footed ferret habitat</i> , 1985	
Geology/Soils	Dominated by Absaroka volcanics, soils shallow (1 m), well drained and clay-loam, derived from shale parent materials	Clark et al. <i>Description and history</i> , 1986	
Topography	Broad flat plains at foot of Carter Mountain dissected by creeks, elevation 1890 m	Clark et al. <i>Description and history</i> , 1986	
Climate	Ranges from 40.5 C to -43.3 C, 173 days each year below 0 C, winds estimated average 13–16 kph, snow usually less than 10 cm accumulation, precipitation averages 30 cm per year		
Vegetation	Junegrass (<i>Koeleria cristata</i>) and sagebrush (<i>Artemisia tridentata</i>)	Collins and Lichvar 1986	
Prairie dog colonies	37 colonies exist in the ferret area, total 2995 ha, mean 80.9 ha (\pm 217.2 ha, range 0.5–1307.0)	Clark et al. <i>Description and history</i> , 1986	
Prey	Analysis of 86 scats showed 87% prairie dogs	Campbell et al. in ms.; Clark et al. <i>Descriptive ethology</i> , 1986; Powell et al. 1985	
Ownership:	<u>Private</u> <u>State</u> <u>Federal</u>	Clark et al. <i>Description and history</i> , 1986	
Surface	35.6%	31.0%	33.4%
Subsurface	12.0%	31.0%	57.0%
Potential conflicts	Oil/gas full field development, some development has already occurred	Clark et al. <i>Description and history</i> , 1986	

A “zone” management plan can facilitate management decisions: (1) Zone I is the BFF-occupied prairie dog complex and a 1.2 km buffer zone, (2) Zone II is the nearby unoccupied prairie dog colonies, and (3) Zone III is the remaining prairie dog colonies in the Big Horn Basin. The BFF zone management plan and cumulative effects analysis could be patterned after the Yellowstone grizzly bear and the northern Rocky Mountain wolf habitat management plans and cumulative analysis models (U.S. Forest Service 1979, U.S. Forest Service et al. 1985, Northern Rocky Mountain Wolf Recovery Team 1985). The Montana Bureau of Land Management (BLM < n.d. > 1982) devised a habitat management plan for the prairie dog ecosystem, and the Wyoming Bureau of Land Management, Cody Resource Area (in preparation) is preparing a similar plan for the Big Horn Basin. These plans can serve as background for a management team to produce more specific and protective plans for the Meeteetse BFFs. Hubbard and Schmitt (1985) listed several recommendations for conserving prairie dogs, including (1) conserve prairie dogs statewide, (2) detour impacts around prairie dog colonies, (3) protect prairie dogs against plague, and (4) apply single use management (i.e., conserve prairie dogs) to key areas.

OIL/GAS EXPLORATION AND EXTRACTION.—The Meeteetse region contains several oil/gas fields (Clark et al. *Description and history*, 1986), and geophysical exploration has been conducted throughout the Meeteetse BFF area on numerous occasions since the early 1950s. Oil/gas exploration and extraction could have detrimental effects on BFFs by destroying prairie dogs and prairie dog habitat and by directly harming BFFs (U.S. Fish and Wildlife Service 1982). The two common oil/gas exploratory techniques are vibroseis, which uses large truck-mounted vibrating devices to generate shock waves, and explosive charges, which are detonated on or below the surface. These shock waves may affect prairie dogs and BFFs by collapsing tunnel systems, causing auditory impairment, disrupting social systems, or other mechanisms. U.S. Fish and Wildlife Service (1982) proposed study of seismic activities, and such studies are now underway (George Menkens, personal communication).

Extraction of oil/gas may affect BFFs and their habitat detrimentally. Full field development would be most detrimental. Among the potential problems are (1) pad construction and well operation will reduce BFF habitat, (2) leakages and spills could kill BFFs and eliminate habitat, (3) increased vehicle traffic may result in road-

TABLE 4. A management outline for annual monitoring and protection of the Meeteetse black-footed ferret habitat.

I. MONITORING

- A. Make visual counts of prairie dog numbers and distribution
 1. Season: Spring, 5 May–5 June
 2. Baseline data sources: Clark et al. (*Descriptive ethology*, 1986), Fagerstone (1986)
 3. Management parameters:
 - a. Determine total numbers, age structure, aboveground litter sizes, and distributions
 - b. Check litter behavior and development (Clark 1977)
 - c. Estimate biomass
- B. Remap extent of prairie dog burrow mounds throughout the area, noting areas of active/inactive colonies
 1. Season: Fall, August–September
 2. Baseline data sources: Clark et al. (*Description and history*, 1986), Forrest et al. (*Life history characteristics*, 1985)
 3. Management parameters:
 - a. Determine total increase or decrease in prairie dog colonies
 - b. Determine the cause of increase or decrease
- C. Note prairie dog emergence times and onset of reproductive activities, quantify prairie dog breeding numbers and distribution
 1. Season: Winter, February–March
 2. Baseline data sources: Clark et al. (unpublished data), Clark (1977)
 3. Management parameters:
 - a. Direct observation
 - b. Sampling

II. PROTECTION

- A. LAND USE INSTABILITY
 1. Season: Annually
 2. Baseline data sources: Clark et al. *Description and history*, 1986
 3. Management parameters:
 - a. Map land use patterns
 - b. Determine history of land use patterns
- B. VEGETATIVE INSTABILITY
 1. Season: Annually
 2. Baseline data sources: Collins and Lichvar 1986
 3. Management parameters:
 - a. Map plant communities
 - b. Monitor dynamics of plant communities
 - c. Monitor livestock interactions
- C. FIRES
 1. Season: Annually
 2. Baseline data sources: Fire history unknown
 3. Management parameters:
 - a. Determine fire history
 - b. Develop fire prevention strategy
- D. PRAIRIE DOG POISONING AND SHOOTING
 1. Season: Annually
 2. Baseline data sources: Clark et al. 1985, Fagerstone 1986
 3. Management parameters:
 - a. Determine history
 - b. Prohibit or limit poisoning and shooting

killed BFFs, (4) increased human presence may significantly increase the potential for BFF mortality via diseases (e.g., canine-borne diseases) and BFF spatial displacement, and (5) overhead power poles will serve as raptor perching sites, thereby increasing the raptor population and their hunting effectiveness.

Many management options exist to avoid the harmful effects of these oil/gas related actions on BFFs—lease trades and extensions by the federal and state regulatory agencies, directional drilling, burying power lines underground, restricting times of human activities to midday, and other techniques should all be considered as means to eliminate detrimental impacts on the BFFs and their habitat.

BIG GAME HUNTING/TRAPPING.—Big game hunting (i. e., pronghorn, *Antilocapra americana*) has occurred each fall in the BFF-occupied area for many decades. Historic hunting levels have been compatible with BFFs and have been closely monitored by ranchers. Trapping with steel jaw traps for coyotes (*Canis latrans*), badgers (*Taxidea taxus*), skunks (*Mephitis mephitis*), and mink (*Mustela vison*) is not compatible in BFF-occupied areas.

LIVESTOCK GRAZING.—Domestic livestock alter range vegetation and affect the myriad plants and animals of the grassland ecosystem “more extensively, rapidly, and profoundly than any other of man’s range management activities” (Autenrieth 1983:24). Grazing of the Meeteetse rangelands favors the continued existence of prairie dogs, and therefore BFFs. If rangelands were overstocked by domestic livestock so that prairie dogs were in immediate and direct competition with livestock, the BFF population would be expected to suffer.

ROADS/FENCES.—Roads and fences can affect BFFs directly and indirectly. Additional roads along with uncontrolled access may increase the probability of BFF road-kills. Fences and high gate posts increase raptor perching sites and may thereby expose BFFs to increased predation. Roads and fence construction should be kept to a minimum. However, in the area of existing oil wells and sludge discharge pits, ferret-proof fences could ensure that BFFs would not fall into a pit full of lethal petroleum waste products.

CATASTROPHES.—Specific plans to meet potentially catastrophic events (e.g., sylvatic plague outbreak) should include the worse case option to live capture all the remaining Meeteetse BFFs and either translocate and/or take them into captivity. A network of cooperative research institutions, zoos, and other facilities needs to be established and readied to receive BFFs on very short notice. This presupposes that adequate monitoring procedures are in place to detect catastrophic events as early in their eruption as possible.

LOCAL PUBLIC AND RANCHERS.—Most BFF conservation actions must be carried out with the consent and cooperation of private landowners. The western Big Horn Basin of Wyoming, the area occupied by the BFFs, consists of many relatively large ranches, many established in the 1870s-1880s. A sensitive conservation program must encompass landowner rights and values. Flath and Clark (1984) described an approach that guides the program in Montana to locate and recover BFFs. Frequent contacts in an informal setting with ranchers to discuss potential problems has been important in guiding management directions (Clark 1984a, b). A respect for property rights and a landowner role in the pace and direction of conservation is essential.

ORGANIZATIONAL ARRANGEMENTS.—Several organizational interests are focused on the Meeteetse BFFs—private, national, and international conservation groups, universities, and an array of state and federal agencies (Clark 1984b). Even though all parties seek BFF conservation and recovery, there are great differences in interest, contributions, plans, and methods to save the BFFs, etc. This fact was noted by Bogan (1985:28.1), who said, "The first [need for the Meeteetse BFFs] is the reconstitution of an advisory board to oversee black-footed ferret research and management. Such a board would include more researchers than at present and would be more inclusive in its consideration of research and management of ferrets." Because the design of coalitions of organizations (e.g., formal organizational arrangements permitting or precluding integration and coordination, joint decision making and goal setting) greatly affects the coalition's performance, it is essential that the coalition surrounding the BFF be congruently arranged (i.e., matched) to en-

hance BFF recovery (Nadler and Tushman 1980). The broad design characteristics for such a program and the rationale behind them were given by Clark (1985b). Briefly, program overview should be structured along flexible, "organic" rather than rigid, "mechanistic or bureaucratic" principles (Hrebiniak 1978) because organic organizations are best able to meet the inherent high uncertainty characteristic of the BFF program. Decision-making processes should be open and more formal to avoid the "group think" trap whereby an organization prematurely seeks closure on ideas and discussion of the range of options available to recover and manage a species (Janis 1972). Furthermore, program management must be consistent with the Endangered Species Act and various state laws.

DISCUSSION

Many more options existed historically to manage BFFs than exist today. Because only a single extant population is known, an energetic proactive management program is needed to ensure their conservation and eventual full recovery. These management guidelines outline actions to monitor and protect the Meeteetse BFF population, its habitat, and some special considerations. They are not exhaustive in terms of detail. As other BFF populations are found or established, these guidelines can serve to manage them, too. However, a specific management plan will be needed for each new population. The primary value of general management guidelines, like these for BFFs, is found in the discussion they may stimulate about the basic requirements and problems needed for successful species management (Autenrieth 1983). As our understanding of BFFs increases, the management guidelines given here may require modification and refinement.

Another BFF management requirement not addressed above needs mention. Specific captive breeding/reintroduction plans need to be developed, as called for in 1978 (Black-footed Ferret Recovery Team) and again in 1982 (Clark 1984a), following direction discussed by Richardson et al. (in press), Forrest et al. (*Black-footed ferret habitat*, 1985), and Houston et al. (1986). Potential translocation sites are under evaluation in Montana (J.

Cada, personal communication), Utah (R. Haysanyagaer, personal communication), New Mexico (J. Hubbard, personal communication), and Wyoming (Collins 1985, B. Miller, personal communication). Cooperative planning will allow for a "timely," well organized captive breeding/translocation effort.

There is a risk that the Meeteetse BFFs could become extinct at any time. The extinction risk (as well as the direction and pace of BFF recovery) is difficult to assess because of uncertainties surrounding the BFFs. "Risk" means simply exposure to a danger and is often defined to include the concept of the likelihood (i. e., probability) of damage (Westman 1985). It is strongly recommended that a formal risk assessment be made of both the probability that the Meeteetse BFFs may become extinct and the overall management strategy needed for full species recovery. A meeting involving all the private, state, and federal interests could conduct the needed analysis. Behan and Vaupel (1982) offer procedures to conduct such a risk assessment. These management guidelines, the minimum viable population estimates by Groves and Clark (1986), and the cumulative effects analysis called for are all forms of risk assessment models and could serve, in part, as background for the more formal risk assessment called for here.

Conservation of the Meeteetse BFF population and its habitat as described in this management outline focused almost exclusively on the biological challenge, but it did mention two parallel challenges—sociological and organizational. Essential to conservation of the BFFs is successfully meeting the sociological and organizational challenges simultaneously with the biological challenge.

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