

**RESULTS OF THE 1998  
BLACK-FOOTED FERRET RELEASE EFFORT  
IN AUBREY VALLEY, ARIZONA**

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# RESULTS OF THE 1998 BLACK-FOOTED FERRET RELEASE EFFORT IN AUBREY VALLEY, ARIZONA

Richard A. Winstead, Angela L. McIntire,  
and William E. Van Pelt

## INTRODUCTION

This report describes Arizona Game and Fish Department (AGFD) activities directed toward reintroducing the black-footed ferret (*Mustela nigripes*) into Aubrey Valley, Arizona, during calendar year 1998. Field activities included: prairie dog density surveys; monitoring of diseases, such as canine distemper and plague, which may have a detrimental effect on establishing a self-sustaining ferret population; use of on-site, acclimation pens as a practical tool for releasing ferrets into the wild and for breeding animals on-site; and monitoring of released ferrets.

This reintroduction project is a cooperative effort among AGFD, Arizona State Land Department, The Phoenix Zoo, U.S. Fish and Wildlife Service (USFWS), The Navajo Nation, The Hualapai Nation, and private land managers. AGFD and USFWS are charged with project leadership, with AGFD assuming primary responsibility for initiating field activities.

AGFD's ferret reintroduction activities are evaluated on an annual basis to help ensure that objectives outlined in the release protocol are being accomplished (Van Pelt 1996). Annual evaluations may determine that protocols or procedures need to be modified to allow for unforeseen circumstances or events.

## BACKGROUND

Once occurring in 12 western states, the black-footed ferret was listed by USFWS as endangered on March 11, 1967. It was also included on *Threatened Native Wildlife in Arizona* (AGFD 1988) as endangered.

Since 1987, AGFD has been involved with black-footed ferret reintroduction activities (Yarchin et al. 1988, Belitsky et al. 1994). Beginning in 1990, matching funds were made available to AGFD through Section 6 of the Endangered Species Act, and more recently, the AGFD Heritage Fund, to intensely evaluate existing habitat for possible reintroduction of black-footed ferrets in Arizona. After evaluating eight different prairie dog complexes, the Aubrey Valley was selected as Arizona's highest ranking site for potential ferret reintroduction (Van Pelt 1995).

Brown (1982) characterizes Aubrey Valley as a Plains and Great Basin Grassland Community, with annual precipitation averaging 25 to 30 cm. The valley floor is approximately 220 km<sup>2</sup> in area and ranges in elevation from 1600 to 1900 m. Bounded on both sides by pinyon-juniper ridges, it runs along a 41 km northwest-southeast axis. The valley is 12 km wide near mile marker 124 on U.S. Highway 66.

While evaluating potential ferret habitat, a statewide scoping effort was initiated to determine and discuss with the public their attitude toward black-footed ferret reintroduction. Through this process, it was determined that the designation of a nonessential experimental population (as prescribed in Section 10j of the Endangered Species Act of 1973, as amended) would be essential to development of a viable ferret reintroduction project in Arizona.

In October 1993, after recommending Aubrey Valley as the fourth reintroduction site to the Black-footed Ferret Interstate Coordinating Committee, AGFD and USFWS initiated the nonessential experimental population designation process. In November 1995, a proposed rule was published in the Federal Register (USFWS 1995). A hearing was held in Seligman, Arizona on December 12, 1995, to facilitate public comment. The public comment period closed on January 2, 1996. A final rule designating the Aubrey Valley Experimental Population Area (AVEPA) was published on March 20, 1996 (USFWS 1996).

The AVEPA is described as the Aubrey Valley west of the Aubrey Cliffs, starting from Chino Point and running along the crest of the cliffs north to Indian Route 18. The boundary then runs along Route 18 to the line bordering townships 27 and 26 north. It then runs east to the line bordering ranges 10 and 11 west, at which point it turns south to the line bordering townships 24 and 25 north. From that point, the boundary runs east to the corner section marker and turns south to the Hualapai Indian Reservation boundary. It then follows the reservation boundary until it reaches U.S. Highway 66, where it turns east and runs along the highway approximately 6 km to a northern point of the Juniper Mountains. It then follows the Juniper mountains back to Chino Point (Fig. 1).

## METHODS

The Arizona reintroduction effort includes use and evaluation of a release strategy that involves on-site, acclimation pens (Van Pelt 1996, Van Pelt and Brennan 1997). In 1998, reintroduction efforts included experimental breeding trials within acclimation pens and releases of pre-conditioned ferrets into the wild. Field activities focused on refinement of on-site protocols for breeding ferrets in large enclosures (Van Pelt et al. 1998a).

To establish on-site breeding protocols, personnel involved with black-footed ferrets in Arizona received training for black-footed ferret husbandry and breeding techniques at the National Black-footed Ferret Conservation Center and The Phoenix Zoo. Information obtained during these training exercises was modified to develop protocols applicable for large, on-site pens.

Pregnant females allocated in 1996 did not produce any kits and led to the decision to attempt breeding ferrets on-site. However, methods employed in 1997 also failed to produce viable kits (Van Pelt et al. 1998b). In 1998 breeding protocols were modified to include confinement of females in a buried nest box connected by an artificial tube to an above ground cage. Biologists were able to confirm whelping and monitor the status of the kit development by this process.

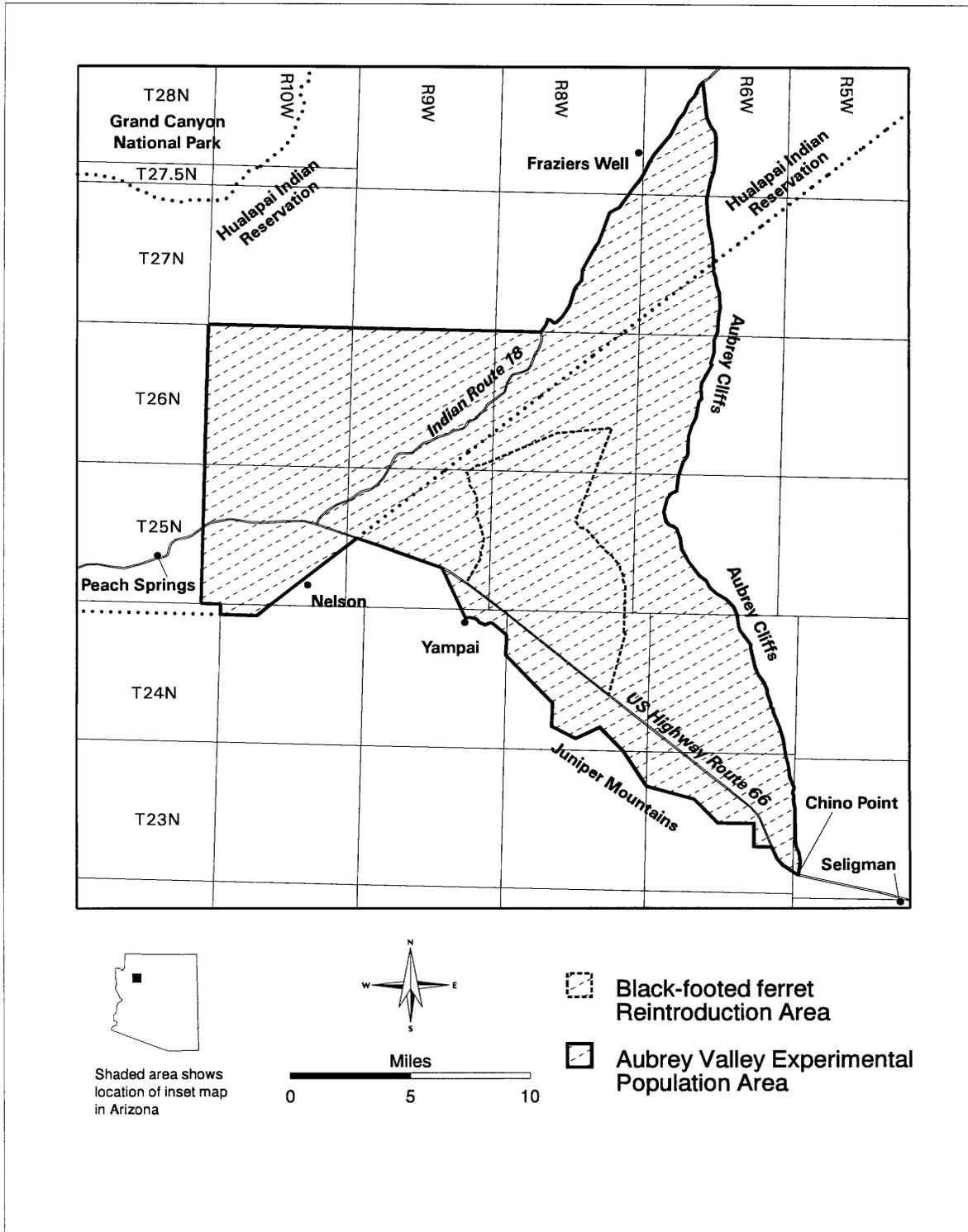


Figure 1. Delineation of the Aubrey Valley Experimental Population Area.

Ferrets were trapped once a week to determine reproductive condition. Changes in testicular and vulval size and condition were monitored. Cytological samples were taken from females and used to predict time of estrus (Harder and Kirkpatrick 1994). Experienced Phoenix Zoo personnel stained the samples and interpreted results. Pairing occurred when observed cornified epithelial cells approached 90% of all cells counted. A pairing was considered successful if samples taken after pairing showed a decrease in these epithelial cells. Biologists also looked for orange saliva staining on the back of the female ferret's neck.

Females who whelped were put into two test groups to assess whether length of confinement in a nest box and cage setup affected survival rates of kits. The first group was to be released into acclimation pens at 15 days of age and the second group was to be released at 30 days. Group assignment was based on the order in which whelping occurred and alternated between the groups (the first litter was placed in the 30-day group).

In addition to breeding efforts, previously established monitoring programs were continued in 1998. This included techniques described by Biggins et al. (1993) for monitoring prairie dog densities and procedures outlined by Clark et al. (1984) for nocturnal ferret surveys. Established disease monitoring efforts for plague and canine distemper will continue in 1999 with the assistance of the Arizona Department of Health Services Vector and Zoonotic Diseases Division (VZD), the U.S. Department of Agriculture Animal Damage Control (ADC) division, and the University of Arizona (UA). Methods were similar to those described by Williams (1991).

## RESULTS

### PEN DESIGN

Acclimation pens continue to need maintenance. Exposure to the elements has stretched fencing material and resulted in electrical shorts that need to be located and remedied on a daily basis. Adding insulators and adjusting for stretching were adequate to remedy shorts. In addition, the monofilament line strung to deter raptors occasionally snapped and needed replacement.

In 1998, thicker flashing was obtained to repair or replace old flashing. Nearly twice as thick, it resists wind damage better than the old flashing. The electric fence was modified to better deter climbing by ferrets and to exclude predators. Interior and exterior wires were isolated as separate systems. Eventually, they will be powered by separate solar fence chargers. Work will continue in 1999.

To minimize escapes while pen modifications were in progress, ferrets were held in one or more whelping cages connected by an artificial tube to a prairie dog burrow. This holding set-up allowed ferrets access to warm underground shelter as well as a confined area on the ground surface. Although ferrets occasionally dug around the tubes and escaped into the surrounding acclimation

pen, only two subsequently escaped into the wild. This methodology proved effective in reducing ferret losses.

#### PEN INTEGRITY

The pens have continued to be successful at excluding terrestrial predators. However, prairie dogs burrowing under the fencing continue to be a challenge. Pen breaches are located using a leaf blower and blowing non-toxic smoke into burrows. Burrows that compromise the pen's integrity are sealed with chicken wire and back-filled. To prevent further digging into pens, all prairie dogs within approximately 10 m of the pens are trapped and removed.

Pens that had the outer electrical fencing replaced with barbed wire have been very successful at keeping livestock away. This remedy will be used on other pens that warrant it, if livestock continue to damage perimeter fences.

The original intent of the acclimation pens was to hold animals for three months pending release. We have been quite successful at holding animals for this period of time, and 94 animals in the last 3 years have been held for more than 90 days. By incorporating minor pen modifications, such as monofilament line for raptor protection, the pen design was improved to allow for holding animals longer and to attempt on-site breeding. Other actions implemented to increase holding times included intense spotlighting after the arrival of new animals to guard against escapes, prairie dog trapping in the immediate area surrounding pens, filling and marking possible problematic burrows, and creating new solutions to prevent burrow escapes. These actions were necessary to make the transition from short term holding to a more long-term holding capacity. The past misfortunes and current successes of our pen design have been of value to other sites that use acclimation pens.

#### PRAIRIE DOG MONITORING

The Aubrey Valley prairie dog complex is comprised of 16 colonies. The complex was not remapped in 1998 because boundaries did not appear different from those of 1997. In 1997, the total prairie dog acreage in Aubrey Valley was estimated to be 29,656 acres (12001 ha) (Fig. 2).

Based on studies of white-tailed (*C. leucurus*) and black-tailed prairie dog (*C. ludovicianus*) towns, Biggins et al. (1993) proposed guidelines for analyzing prairie dog town densities. They defined a measure of good ferret habitat in white-tailed prairie dog towns to be the proportion of transects in a hectare with at least 25 active burrows.

Biggins et al. (1993) found burrow densities in Meeteetse, Wyoming varied from 39 to 108 burrows per hectare for white-tailed prairie dogs (*C. leucurus*,). Surveys in Arizona show similar ranges for the Gunnison's prairie dog (Van Pelt 1995). Pizzimenti (1975) discussed the relationship of Gunnison's prairie dogs to other species of prairie dogs. He considered Gunnison's prairie dog to be

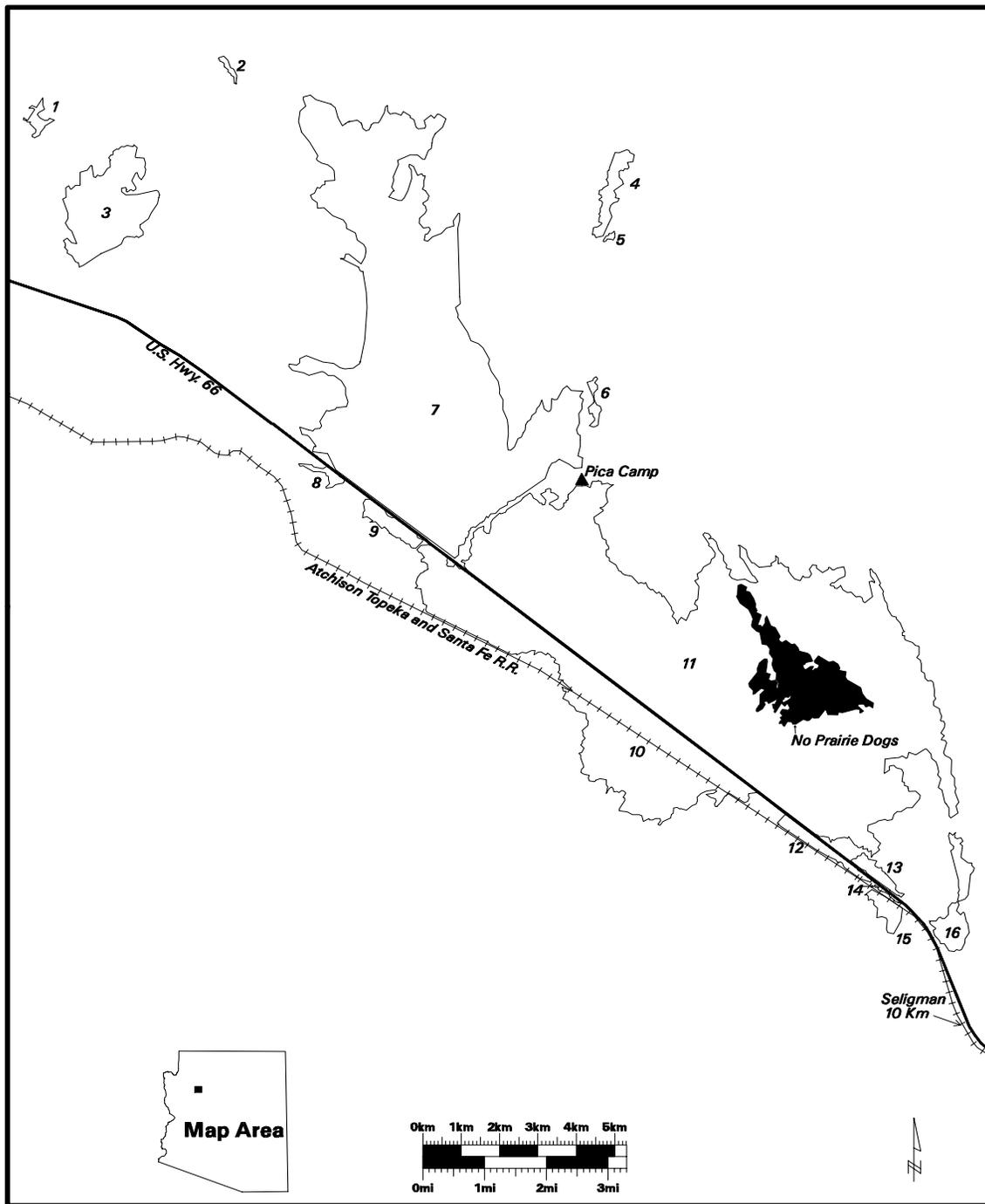


Figure 2. Prairie dog towns within the Aubrey Valley Complex.

1. Reservation	5. Owl track	9. Mission	13. North Caterpillar
2. Prairie Hills	6. Valley	10. South Audley	14. Streamline
3. Grand Canyon	7. Pica Camp	11. North Audley	15. Railroad Corner
4. Cliff	8. Devil Horn	12. Tin Shack	16. South Caterpillar

a member of the subgenus *Leucocrossuromys* or white-tailed prairie dogs. Therefore, Gunnison's prairie dog densities are assumed to compare closely to the white-tailed prairie dog when evaluating habitat.

Between May and July 1998, prairie dog activity and burrow density were sampled at 64 established transect blocks located throughout the AVEPA (Tables 1, 2, and 3). We ran 390 transects, with 56% of completed transects being classified as good ferret habitat. Active burrow densities ranged from 0 to 121 per hectare, with an overall mean of 33.

Using burrow densities, prairie dog density estimates for AVEPA ranged from 5.11 to 9.48 prairie dogs per hectare, with a mean of 8.02. Estimated prairie dog density was used to determine black-footed ferret carrying capacity. Carrying capacity is reported in terms of black-footed ferret families. A ferret family is defined by Biggins et al. (1993) as 1 female, 3.3 young and 0.5 male. The 1998 ferret family estimate for AVEPA is 79 families. This is up 39 ferret families from 1997. Project biologists attribute the increased carrying capacity to mild winter conditions and above average rainfall.

#### PRAIRIE DOG TRAPPING AND QUARANTINE

Quarantining is necessary to prevent the spread of plague into AVEPA from other areas. In 1998, a room was added to the quarantine facility in Seligman to provide space for 70 prairie dogs in four additional cages, providing a total capacity of 270 in 16 cages. Because cages in this room are less than 24 inches apart, all prairie dogs here are treated as being in a single cage and are subject to a concurrent quarantine period. After completing a 14-day quarantine period, prairie dogs are euthanized using CO<sub>2</sub> and processed at the facility or were used live for feeding ferrets. In 1998, 882 prairie dogs survived quarantine, 21 escaped, and 19 were cannibalized.

#### DISEASE MONITORING

Thirty coyotes and one badger were collected as part of the plague and canine distemper monitoring effort. Collection periods occurred in January, March, June, and October. Results from titers indicate that both diseases have been active during some time in the past, but no recent activity was observed in 1998.

The VZD has monitored plague activity in Arizona since 1974. Documenting human cases, testing carnivore blood samples for titers, and testing flea pools collected from prairie dog burrows monitors outbreaks. To date, fleas collected from the Aubrey Valley have tested negative for plague, but titer samples from carnivores collected within and adjacent to the AVEPA have tested positive.

Seasonal interns were hired to trap prairie dogs and maintain the quarantine facility. They trapped in Flagstaff where the prairie dog population is very dense and trapping success is far greater than in and around Aubrey Valley. Prairie dogs were also trapped in Aubrey Valley, primarily near acclimation pens. These animals were fed live to ferrets without being quarantined. Live trapping

Table 1. Completed prairie dog transects- North and South Audley, Aubrey Valley, Arizona.								
Location	Active Burrows Per Hectare						Transects completed 93/94/95/96/97/98	Site #
	1993	1994	1995	1996	1997	1998		
T24N R7W SEC 15	6	1	11	2	7	28	8/10/5/5/5/6	8
SEC 16	5	4	6	3	19	9	10/8/5/5/5/6	9
SEC 20	25	23	42	41	46	41	5/5/4/5/5/6	10
SEC 22	59	31	32	7	13	44	8/10/5/5/5/6	7
SEC 26	39	22	33	11	53	34	10/10/5/5/5/6	6
SEC 29	31	31	33	2	1	7	8/10/5/5/5/6	11
SEC 30	55	56	32	33	51	48	8/8/4/5/5/6	20
SEC 31	60	59	21	25	9	23	19/20/5/5/5/6	18
SEC 31	63	51	20	16	27	32	5/5/5/4/5/6	17
SEC 32	42	36	33	5	7	23	33/20/5/5/5/6	12
SEC 32	42	69	46	34	15	44	7/10/5/5/5/6	13
SEC 35	35	24	24	15	21	18	10/10/5/5/5/6	5
R8W SEC 12	51	72	17	37	17	36	5/5/5/5/5/6	25
SEC 11	31	27	19	39	14	42	5/5/4/5/5/6	61
SEC 14	50	57	14	33	21	34	5/5/5/5/5/6	62
SEC 13	17	82	47	51	20	34	4/5/5/5/5/6	24
SEC 22	47	43	-	17	-	6	5/5/0/5/0/6	52
SEC 23	42	26	21	29	11	42	10/8/5/5/5/6	23
SEC 24	80	86	16	26	15	29	8/10/5/5/5/6	22
SEC 25	68	40	22	50	47	114	8/10/4/5/5/6	21
SEC 36	27	24	18	40	13	15	10/10/5/5/5/6	19
T23N R7W SEC 3	32	35	35	11	19	38	8/8/5/5/5/6	4
SEC 3	28	23	21	11	9	9	13/10/5/5/5/6	1
SEC 3, 4	55	54	25	29	22	49	8/10/5/5/5/6	2
SEC 4	24	40	27	36	51	41	14/20/5/5/5/6	3
SEC 5	30	15	20	0	1	2	10/10/5/5/5/6	14
SEC 5	63	26	60	12	34	22	5/5/5/5/5/6	16
SEC 6	40	14	14	7	9	18	15/20/5/5/5/6	15
<b>Totals</b>	41	38	26	22	21	32	264/262/131/139/135/174	28

Table 2. Completed prairie dog transects- Pica Camp, Aubrey Valley, Arizona.								
Location	Active Burrows Per Hectare						Transects completed 93/94/95/96/97/98	Site #
	1993	1994	1995	1996	1997	1998		
T24N R8W SEC 3	19	50	15	7	14	-	10/10/6/5/5/0	27
SEC 3	10	9	19	11	16	25	8/8/5/5/5/6	26
SEC 3	10	54	1	34	43	66	8/10/5/5/5/6	45
SEC 4	11	9	52	47	43	50	10/8/5/5/5/6	39
SEC 4	44	15	100	69	62	47	10/10/6/5/5/6	38
SEC 4	16	61	31	27	31	69	10/10/5/5/5/6	40
SEC 5	40	23	26	41	40	54	10/10/5/5/5/6	36
SEC 5	68	21	41	18	60	86	8/10/6/5/5/6	37
SEC 9	106	19	39	57	26	59	8/10/5/5/5/6	42
SEC 9	60	35	32	26	32	76	10/10/5/5/5/6	43
SEC 9	33	102	31	20	17	73	10/10/5/5/5/6	41
SEC 10	41	56	31	54	36	56	10/10/5/5/5/6	44
T25N R8W SEC 21	12	29	20	27	22	19	7/10/4/5/5/6	33
SEC 28	12	56	36	42	34	43	6/10/5/5/5/6	32
SEC 33	56	78	27	15	26	24	7/10/6/5/5/6	31
SEC 34	22	66	73	39	47	121	20/20/6/5/5/6	30
SEC 5	26	29	2	25	17	33	5/5/5/5/5/6	47
SEC 15	5	2	12	15	2	5	6/10/6/5/5/6	35
SEC 21	12	6	26	20	12	12	5/5/5/5/5/6	60
SEC 22	16	10	20	14	16	7	6/10/5/5/5/6	34
SEC 34	32	16	70	31	31	41	10/10/5/5/5/6	29
SEC 35	16	30	12	27	28	64	5/5/5/5/5/6	28
<b>Totals</b>	30	35	33	30	30	49	189/211/115/110/110/126	22

Location	Active Burrows Per Hectare						Transects completed	Site #
	1993	1994	1995	1996	1997	1998	93/94/95/96/97/98	
T23N R7W SEC 10	40	41	14	16	9	9	9/5/5/5/5/6	55
SEC 10	23	24	18	7	35	31	9/5/5/5/5/6	54
T24N R7W SEC 14	30	6	18	17	57	64	18/5/4/5/5/6	56
SEC 6	11	18	10	6	1	1	5/5/5/4/5/6	58
SEC 6	7	9	2	2	0	0	4/5/6/4/5/6	59
SEC 7	5	40	12	1	3	17	5/5/6/5/5/6	57
R8W SEC 8	42	26	-	2	9	2	18/10/0/5/5/6	51
T25NR8W SEC 36	21	23	22	0	4	3	8/10/5/5/5/6	53
R9W SEC 4	-	29	10	-	3	3	0/5/6/0/5/6	46
SEC 21	38	35	14	0	0	0	5/5/6/5/5/6	48
SEC 14	-	18	4	4	11	16	0/5/5/5/5/6	63
SEC 15	-	53	1	7	14	45	0/5/5/5/5/6	64
SEC 22	65	106	3	0	0	0	5/10/6/5/5/6	49
SEC 26	36	23	0	0	1	0	5/5/4/5/5/6	50
<b>Totals</b>	29	32	10	5	11	14	91/85/68/63/70/84	14

near pens did not provide adequate numbers of prairie dogs for daily feeding. To supplement live-feeding, additional prairie dogs were shot, cleaned, and immediately fed to ferrets.

Two hundred black-tailed prairie dogs were received from Dog Gone during August and October. Also 72 frozen prairie dogs were obtained from Sybille during February, March and April. We sent 80 prairie dogs to the Phoenix Zoo for distribution to the captive-breeding program.

In order to maintain ferrets on-site in 1998, we used approximately 1559 prairie dogs (1013 kg), of which 159 were fed live. Approximately 67 rabbits (52 kg) were also used when prairie dogs were in short supply. Rabbits were collected from Aubrey Valley or were purchased from a domestic rabbit breeder.

In 1998, 30 coyote blood samples were tested for plague and one (3%) tested positive (Table 4). As observed in past surveys, plague is active in the Seligman area, but no recent activity has been observed within Aubrey Valley.

Canine distemper has been monitored in the Aubrey Valley area by AGFD since 1993. Blood samples and coyote specimens were sent to the University of Arizona for analysis and histological interpretation. In 1998, 29 coyotes were submitted for analysis (Table 4). Thirteen (44%) had titer counts indicating past exposure to distemper. Canine distemper was probably not active in 1998, because no viral inclusions were observed in any tissues. Negative distemper results from a female coyote (reference number 98-1805) could not be matched with other results and may represent an additional specimen.

Two kangaroo rats and one prairie dog found dead near an acclimation pen in March also were submitted for disease testing. No plague or tularemia was found.

#### FERRET ALLOCATION

In 1998, 96 ferrets were involved in the Arizona recovery effort (Tables 5 and 6). We started the year with 32 ferrets, six retained from December 7, 1996 (held a median of 518 days) and 26 received between August 15 and December 7, 1997 (held a median of 279 days). Thirty-eight ferrets (11 adults, 27 kits) were newly allocated in 1998 and shipments of ferrets occurred on August 11 (11 individuals), August 24 (11), September 10 (5), September 15 (1), and November 10 (10). Arizona held them for a median of 52 days. On-site breeding trials were successful and produced 26 ferrets in May, June, and July.

Sixteen mortalities were documented including eight newborn kits. One litter of two was born dead or died shortly after birth, one litter of four lost two within the first day, one litter of three died within the first five days and one litter of two lost one within 14 days. There were eight confirmed deaths of adult ferrets. Two were killed by raptors when snow broke or stretched the monofilament fishing line covering the top of the pens. One female died from septicemia (*Escherichia coli*) and was pregnant with four fetuses. Another ferret died from an unknown infection. The causes of death for the remaining four ferrets are unknown. All cultures were negative for plague and tularemia.

Probable escape routes were found for 11 ferrets. An additional female was recaptured after being in the wild for approximately one year after an earlier escape. She was bred and held for 14 days before escaping again.

Fifteen animals are considered missing-in-action. Missing-in-action is defined as not being able to determine if ferrets died underground, were killed, or escaped. Included in this group are two females who were missing with their five kits approximately 55 days after whelping.

Table 4. Results from the 1998 canine distemper and plague sampling effort in Aubrey Valley, Arizona.

Collection Date	Distemper titers	Plague titers	Estimated age
January 28, 1998	1:4	Negative	Adult male
	1:32	Negative	Adult female
March 28, 1998	1:512	No sample	Adult female
March 29, 1998	1:64	64	Juvenile female
	1:8	128	Adult female
June 9, 1998	1:28	Negative	Adult male
June 11, 1998	1:8	32	Adult male
June 14, 1998	1:8	32	Adult male
	1:256	Negative	Adult male
	1:16	32	Adult female
June 15, 1998	No sample	Negative	Adult male
June 16, 1998	1:512	Negative	Adult female
	1:512	Negative	Adult female
June 17, 1998	<1:4	Negative	Adult female badger
June 19, 1998	1:512	Negative	Adult female
June 21, 1998	No sample	Negative	Adult female
	1:1024	Negative	Adult female
	1:256	64	Adult male
	1:256	Negative	Adult male
June 24, 1998	1:4	Negative	Adult female
	1:256	Negative	Adult female
October 16, 1998	1:128	<1:32	Adult male
	1:128	<1:32	Adult female
October 19, 1998	1:256	<1:32	Juvenile male
	1:4	<1:32	Adult female
October 21, 1998	1:16	<1:32	Adult male
	1:256	<1:32	Adult female

Table 4 continued. Results from the 1998 canine distemper and plague sampling effort in Aubrey Valley, Arizona.			
Collection Date	Distemper titers	Plague titers	Estimated age
October 22, 1998	1:128	<1:32	Adult female
	1:32	<1:32	Adult male
	1:4	<1:32	Adult male
	1:32	<1:32	Adult male
Negative-1:64	16	29	Coyote Juvenile/Total 2/30
1:128-1:4096	13	1	
No samples	2	1	
<b>Grand Totals</b>	31	31	

Table 5. Status of ferrets held in Aubrey Valley, 1996-98.									
Year	Held Over	Allocated	Births	Releases	Escapes	Missing	Deaths	Transfers	Year End Total
1996		83	0	35	5	12	10	1	20
1997	20	33	0	0	1	15	5	0	32
1998	32	38	26	26	11	15	16	3	25
Sum		154	26	61	17	42	31	4	

Table 6. Description, history, and status of black-footed ferrets used in Arizona reintroduction effort in 1998.						
Studbook	Transponder	Age	Sex	Arrival	Days held	Status
785	005326547	4	F	12/07/96	518	Transfer to research 05/08/98
817	015042513	4	M	12/07/96	401	Mortality 01/10/98; possible raptor
832	016857038	4	F	12/07/96	518	Transfer to research 05/08/98
867	016051591	4	F	12/07/96	483	MIA; last observed 04/03/98
1028	005269854	3	F	12/07/96	655	Released 09/22/98; 3 newborn kit mortalities
1285	012369267	2	M	12/07/96	650	Mortality 09/17/98
1135	021068863	3	M	08/15/97	194	Mortality 02/24/98; possible raptor

Table 6 continued. Description, history, and status of black-footed ferrets used in Arizona reintroduction effort in 1998.						
Studbook	Transponder	Age	Sex	Arrival	Days held	Status
1905	017383512	Kit	F	08/15/97	504	In pen
1NE98F1	015382054	Kit	F	05/28/98	142	Born on-site; released 10/16/98
1NE98F2	029771263	Kit	F	05/28/98	142	Born on-site; released 10/16/98
1NE98F3	029600044	Kit	F	05/28/98	142	Born on-site; released 10/16/98
1NE98F4	029782365	Kit	F	05/28/98	142	Born on-site; released 10/16/98
1NE98F5	029590800	Kit	F	05/28/98	142	Born on-site; released 10/16/98
1912	016804076	Kit	M	08/15/97	479	Mortality 12/06/98
1922	015891854	Kit	M	08/15/97	237	MIA; last observed 04/08/98
1923	016378094	Kit	M	08/15/97	335	MIA; last observed 07/15/98
1027	116276790	3	F	10/21/97	337	Released 09/22/98
1047	011045528	3	M	10/21/97	281	Transfer to zoo 07/28/98
1089	006097375	3	F	10/21/97	175	MIA; last observed 04/31/98
1136	016050331	3	F	10/21/97	309	MIA; last observed 08/25/98; 2 newborn kit mortalities
1143	020847820	3	F	10/21/97	437	In pen
1179	017352606	3	F	10/21/97	192	Escaped; last observed 04/30/98
1244	021814861	3	F	10/21/97	277	Escaped; last observed 07/24/98
1499	018352787	2	M	10/21/97	337	Released 09/22/98
1056	006288079	3	F	11/14/97	313	Released 09/22/98
1061	000805515	3	M	11/14/97	151	Escaped; last observed 04/13/98
1113	021043545	3	F	11/14/97	341	Released 10/20/98; 2 newborn kit mortalities
7SW98F1	029637849	Kit	F	07/03/98	110	Born on-site; released 10/20/98
7SW98M1	011874823	Kit	M	07/03/98	104	Born on-site; released 10/14/98
1200	116338593	3	F	11/14/97	296	MIA; last observed 09/05/98
5SE98F1	029781881	Kit	F	06/09/98	119	Born on-site; released 10/05/98
5SE98F2	029592574	Kit	F	06/09/98	206	Born on-site; in pen
5SE98M1	017383828	Kit	M	06/09/98	139	Born on-site; released 10/25/98
1301	020615539	2	M	11/14/97	211	Escaped; last observed 06/12/98

Table 6 continued. Description, history, and status of black-footed ferrets used in Arizona reintroduction effort in 1998.						
Studbook	Transponder	Age	Sex	Arrival	Days held	Status
1351	014593560	2	F	11/14/97	184	Mortality 05/16/98
1437	116338471	2	F	11/14/97	413	In pen
1SE98F1	029589585	Kit	F	06/06/98	209	Born on-site; in pen
1SE98M1	029591104	Kit	M	06/06/98	209	Born on-site; in pen
1SE98M2	029630518	Kit	M	06/06/98	133	Born on-site; released 10/16/98
1614	017628256	1	M	11/14/97	413	In pen
1001	005295279	3	M	12/07/97	117	Mortality 04/02/98
1079	000370826	2	F	12/07/97	224	MIA; last observed 07/18/98
1090	000595096	3	F	12/07/97	128	Escaped; last observed 04/13/98
1134	001591115	3	F	12/07/97	250	MIA with 1 kit; last observed 08/13/98; 1 newborn kit mortality
1137	116349571	3	F	12/07/97	213	MIA with 4 kits (2.2); last observed 07/07/98
2555	029046260	Kit	M	08/11/98	30	Released 09/09/98
2556	029052015	Kit	M	08/11/98	2	Escaped; last observed 08/12/98
2573	029100045	Kit	M	08/11/98	61	Released 10/10/98
2574	029110288	Kit	M	08/11/98	5	Mortality 08/15/98
2575	029014832	Kit	M	08/11/98	61	Released 10/10/98
2576	029108591	Kit	M	08/11/98	41	Released 09/20/98
2577	028771783	Kit	M	08/11/98	54	Released 10/03/98
2580	028628026	Kit	M	08/11/98	13	Released 08/23/98
2581	029073852	Kit	F	08/11/98	3	Escaped; last observed 08/13/98
2582	029117798	Kit	F	08/11/98	7	Escaped; last observed 08/17/98
2583	028621335	Kit	F	08/11/98	7	Escaped; last observed 08/17/98
1257	013367259	3	F	08/24/98	130	In pen
1303	011526102	3	F	08/24/98	130	In pen
1358	013377548	3	F	08/24/98	130	In pen
1368	015819575	3	F	08/24/98	130	In pen
2468	116344497	Kit	M	08/24/98	17	Mortality 09/09/98

Table 6 continued. Description, history, and status of black-footed ferrets used in Arizona reintroduction effort in 1998.						
Studbook	Transponder	Age	Sex	Arrival	Days held	Status
2469	116235792	Kit	M	08/24/98	16	Released 09/08/98
2531	029111551, 028633799	Kit	M	08/24/98	18	Released 09/10/98
2532	028775638, 028627306	Kit	M	08/24/98	30	Released 09/22/98
2533	028637861, 029103576	Kit	M	08/24/98	30	Released 09/22/98
2534	029114881, 029056335	Kit	M	08/24/98	53	Released 10/15/98
2535	028768073, 028624333	Kit	F	08/24/98	130	In pen
1273	012868095	3	F	09/10/98	113	In pen
1302	116247760	3	F	09/10/98	113	In pen
1437	025890042	3	F	09/10/98	113	In pen
1494	020258783	3	F	09/10/98	113	In pen
1546	010371635	3	F	09/10/98	113	In pen
1492	019822514	3	F	09/15/98	108	In pen
1619	018011566	2	M	11/10/98	52	In pen
2444	116238125	Kit	F	11/10/98	52	In pen
2475	116337347	Kit	F	11/10/98	52	In pen
2485	116349761	Kit	M	11/10/98	52	In pen
2509	010368775	Kit	M	11/10/98	52	In pen
2510	011039106	Kit	M	11/10/98	52	In pen
2547	116272326	Kit	F	11/10/98	41	Escaped; last observed 12/20/98
2548	115656523	Kit	F	11/10/98	49	Escaped; last observed 12/28/98
2549	115665580	Kit	F	11/10/98	52	In pen
2550	115767243	Kit	F	11/10/98	52	In pen

Arizona released 26 ferrets into Aubrey Valley and transferred three to other facilities. Releases occurred during September and October. The remaining 25 animals were maintained in the acclimation pens at the release site for breeding in 1999.

#### PRE-CONDITIONING

Twenty-six ferrets were released into Aubrey Valley after being held in acclimation pens for a median of 114.5 days. Releases included 15 male (14 kits, 1 adult) and 11 female (7 kits, 4 adults) ferrets. Ten of the released kits were born on-site (3 males, 7 females). All had opportunities to kill prairie dogs while held in captivity.

#### ON-SITE REPRODUCTION

Six males were used to breed 14 females, with the first pairing of ferrets occurring on April 15 and the last on June 17 (Table 7). Nine females were successfully bred and five missed their due dates. One female did not become pregnant, recycled, and was successfully paired with a different male. Eight litters, ranging in size from two to five, were produced. Of the 26 kits born, 18 survived and were released from nest boxes into acclimation pens.

In 1998, Arizona weaned 69% of the kits produced (Table 8), which is similar to the 67% average for the seven captive breeding facilities. One litter in the 30-day group was released early because temperatures in the nest box were high enough to have harmed the kits or dam. Arizona learned that no difference in survival was observed between kits released into acclimation pens at 15 and 30 days of age. Releasing litters from nest boxes at an earlier date will minimize human contact and possible heat stress to ferrets while still providing opportunity to determine litter size and sex ratio.

#### FERRET MONITORING

In 1998, spotlight surveys were conducted for 18 nights in blocks of six consecutive nights during the months of July, August, and September. Post-release surveys were conducted for six nights in blocks of three consecutive nights during November. These surveys totaled 782.75 person-hours, including 91.5 hours of backpack surveying. There were eight confirmed black-footed ferret sightings (6 different individuals), eight probable sightings of ferrets, and 16 possible sightings. A probable sighting is defined as a sighting in which the body of the ferret was observed but the PIT tag did not scan. A possible sighting is defined as green eyeshine close to the ground and displaying ferret movements.

Incidental spotlighting documented long-term survival when a female ferret missing since April 1997 was observed in January 1998. She was recaptured in May after 13 months in the wild. Also, a male ferret observed during surveys in November had escaped approximately five months earlier.

Dam, Sire	Pairing Date	Birth Date	Litter Size	Kit (# and sex)		Comments
				Deaths	Survivors	
1137, 1922	?	05/19/98	4		2M, 2F	Sire escaped into dam's pen
1056, 1285	04/15/98	-				
1905, 1614	04/16/98	05/28/98	5		5F	
1143, 1499	04/23/98	-				
1027, 1301	04/24/98	-				
1437, 1285	04/25/98	06/06/98	3		2M, 1F	
1351, 1614	?	-				Dam escaped into sire's pen, died, had 4 fetuses
1200, 1614	04/29/98	06/09/98	3		1M, 2F	
1148, 1923	05/03/98	-				Dam escaped before whelping
1113, 1912	05/07/98	-				
1028, 1285	05/07/98	06/19/98	3	3U		
1134, 1614	05/07/98	06/19/98	2	1U	1U	
1079, 1301	05/07/98	-				
1136, 1923	05/12/98	06/23/98	2	2U		
1244, 1614	05/15/98	-				
1113, 1301	05/21/98	07/03/98	4	2U	1M, 1F	
1056, 1614	06/17/98	-				Recycled, second pairing
<b>Totals</b>			26	8	18	

Dam, Sire	Litter Size <sup>1</sup>	Birth Date	Release Date	Days Held	Survival
<b>15-Day Group</b>					
1905, 1614	5F	05/28/98	06/12/98	15	5 Survived
1200, 1614	1M, 2F	06/09/98	06/24/98	15	3 Survived
1134, 1614	2U	06/19/98	07/03/98	14	1 Missing, 1 Dead
<b>30-Day Group</b>					
1137, 1923	2M, 2F	05/19/98	06/17/98	29	4 Missing
1437, 1285	2M, 1F	06/06/98	06/28/98	22	3 Survived
1113, 1301	1M, 1F, 2U <sup>2</sup>	07/03/98	08/05/98	33	2 Survived
<sup>1</sup> M(ale), F(emale), U(nknown)					
<sup>2</sup> Died within 2 days of birth					

An electronic monitor attached to a flexible optic cable was acquired to monitor ferrets underground. On several occasions a dam and her kits were observable. This device also was used to determine the suitability of individual burrows for cage/burrow set-ups.

#### DISCUSSION

Raptor protection measures continue to be very successful. Raptor mortalities occurred only when snow broke or stretched the monofilament fishing line covering the top of acclimation pens. Older lines are replaced after several months when they weaken from exposure to sun and wind. Replacement line (50-pound test) stretches less than previously used lighter line. We will investigate ways to provide more support within the center of acclimation pens.

We demonstrated that ferrets could be held for extended periods of time for acclimation and breeding. Placing ferrets inside of cages connected to natural burrows successfully minimized escapes. It also allowed ferrets to be housed within fewer acclimation pens and, thereby, reduced travel and time required caring for animals during winter. Ongoing modifications to pen electric fence systems should reduce escapes when ferret are free roaming in acclimation pens.

Changes in breeding protocol enabled us to successfully produce kits on-site in Aubrey Valley. The methodology allowed optimal pairing of ferrets to occur, monitoring of dam and kits with minimal disturbance, and unhampered release into acclimation pens. Tests showed that ferret kits released from nest boxes at 15 days survived as well as those released at 30 days. In 1999, on-site breeding will continue using the same protocol. However, we plan to determine cytology results on-site instead taking microscope slides to the Phoenix Zoo for interpretation.

We were able to release ferrets into Aubrey Valley after pre-conditioning them in acclimation pens. Releases included 10 that were produced on-site. The rearing and release of these kits is possible as a supplement to ferrets received from outside sources. Provided a sufficient number can be produced, Arizona may be able to have a large release of kits for the first time.

Numerous ferrets were observed for the first time and short- and long-term survival in the wild was documented. Getting sufficient personnel to conduct spotlighting surveys continues to be difficult, particularly during weekday nights. Scheduling needs to conform to dates that fit the annual pattern of ferret activity and when personnel and volunteers are available. In 1999, spotlighting will occur primarily on weekend nights having the brightest moon illumination.

#### RECOMMENDATIONS

- 1) Continue on-site breeding of ferrets to enhance releases of allocated ferrets.
- 2) Continue acclimation pen modifications to reduce escapes and predation. This could include installation of supports for monofilament lines used as raptor deterrents and additional electric fence wires on the inside of each pen section.
- 3) Continue replacement of electric fence with barbed wire fence where livestock may damage acclimation pens.
- 4) Install additional solar fence chargers and isolate electric fence components to minimize concurrent loss of power to entire pens.
- 5) Test feasibility of internal radio transmitters as a monitoring tool for released ferrets. Tests may include signal range determinations of transmitters above and below ground, suitability of various locations for the receiver, and the degree of signal attenuation after a transmitter is implanted in an animal.

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