**1994 BASELINE BIOLOGICAL
STUDIES FOR THE DEVICE ASSEMBLY
FACILITY AT THE NEVADA
TEST SITE**

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1.0 EXECUTIVE SUMMARY

Biological surveys of plants, reptiles, birds, and small mammals continued in 1994, with emphasis on examining spatial and temporal variation in these groups in the Device Assembly Facility (DAF) vicinity. The DAF was still in a preoperational phase in 1994. To date, the main ecological DAF impacts have been removal of the perennial plant community by grading (for the access road, the building sites, parking lots, and construction staging areas), and addition of water to the sewage settling ponds. Grading removed the plants (creating habitat for weedy plant species), and removed habitat for animals. Adding water to the sewage ponds increased bird use of the DAF area.

As in 1993, *Uta stansburiana* (uta) densities were lower in graded areas immediately surrounding the DAF building complex relative to largely undisturbed areas nearby. *Uta* densities were also lower in largely undisturbed areas southwest of the DAF relative to undisturbed areas to the northeast of the DAF building complex. No chuckwalla or live tortoises were seen within 400 m of the DAF building complex. The small mammal community to the southwest of the DAF building complex contained the same number of species and had a similar species diversity to the one northeast of the DAF building complex. This contrasted with 1993 results when the small mammal community to the southeast differed greatly from the one to the northwest. Bird densities were markedly lower in 1994 relative to 1993, as they were test-site wide. Bird reproduction near the DAF was essentially nonexistent in 1994. Plant results were largely similar in 1993 and 1994. There was some evidence that preoperational DAF activities reduced plant growth near the facility. The results across all studied taxa suggest that the DAF is located in a transitional area with different floral and faunal communities on different sides. The ramifications of this for monitoring impacts are discussed.

2.0 INTRODUCTION

This report describes environmental work performed at the DAF in 1994 by the Basic Environmental Monitoring and Compliance Program (BECAMP). BECAMP initiated DAF studies in 1993 when study techniques were worked out and permanent plots were set up (Woodward et al., 1995). The DAF is located near the Mojave-Great Basin desert transition zone 27 km north of Mercury. The area immediately around the DAF building complex is a gentle slope cut by 1 to 3 m deep arroyos, and occupied by transitional vegetation (Beatley 1976). In 1994, construction activities were largely limited to work inside the perimeter fence. The DAF was still in a preoperational mode in 1994, and no nuclear materials were present. The DAF facilities were being occupied so there was water in the sewage settling pond, and the roads and lights were in use. Sampling activities in 1994 represent the first year in the proposed monitoring scheme (Woodward et al., 1995). The proposed biological monitoring plan gives detailed experimental protocols. Plant, lizard, tortoise, small mammal, and bird surveys were performed in 1994. Below we briefly outline procedures employed in 1994. Studies performed on each taxon are reviewed separately then summarized in a concluding section.

3.0 REPTILES

3.1 METHODS

Lizards and tortoises were the only reptiles sampled near the DAF in 1994. DAF lizard (25 to 29 July) plot surveys and summer transects (7-9 June) in the area immediately surrounding the DAF building complex shown in Figure 1. Plot surveys were performed on eight largely

Figure 1. Location of mammal and lizard study plots around the DAF

undisturbed vegetated areas east and west of the DAF building (collectively called Plot FRF013) and eight cleared areas immediately surrounding this building (collectively called Plot FRF012). The 16 study areas or subplots were each 20 x 50 meters. Lizard surveys concentrate on *uta* because these lizards are abundant and widespread. Lizards were noosed, measured to the nearest 0.5 mm from snout to vent (SVL), weighed to the nearest 0.05 g, marked and released at their capture locations. *Uta* ages were estimated from body size-age relationships of *uta* of known ages from areas near the DAF.

Mean number of *uta* or lizards (pooled across all species) were determined daily on each plot. Mean weight and SVL were calculated for all *uta* occupying each plot (sampled without replacement). Number of *uta*, number of lizards (pooled across all species), mean *uta* weight, and mean SVL were compared across graded and nongraded area with Mann-Whitney U tests (MWU). The relative numbers of males and females (the sex ratio) was compared between graded and vegetated areas with a chi-square test.

Transect studies consisted of three investigators walking abreast and recording the number of each lizard species present on the transect. The transect was composed of 15 x 50 m segments located in each subplot in FRF012 and FRF013, plus an additional 15 x 50 m segment on the end of each arm going away from the DAF building (Figure 1). Counts of number of *uta*, number of lizards (pooled across all species), or number of species were compared between the graded area near the DAF building and the nongraded vegetated area with a MWU. A Kruskal-Wallis-Wilcox (KWW) test was used to compare number of *uta*, number of lizards, or number of species across the four arms of the sampling array. Results are reported in figures as mean $\pm$ 2 se.

Tortoises and Chuckwallas

A circular area approximately 1 km in diameter and centered on the DAF building complex was searched for tortoises and chuckwallas in September 1994. Two investigators walked back and forth in a systematic fashion about 7 m apart looking for these species. Tortoise remains were marked with aluminum stakes and left in place.

3.2 RESULTS AND DISCUSSION

In the spring, *uta*, *Phrynosoma platyrhinos* (horned-toads) and *Callisaurus draconoides* (zebra-tailed lizards) were seen on cleared plots, while *uta*, *Sceloporus magister* (desert spiny lizards) and *Dipsosaurus dorsalis* (desert iguanas) were seen on vegetated plots. Only *uta* were abundant enough to merit analysis as an individual species. Number of *uta*/plot (MWU = 0, $P = 0.001$) or lizards/plot (MWU = 0, $P = 0.001$) were greater on vegetated plots relative to cleared plots (Figures 2 and 3). Although SVLs (MWU = 25.0, $P = 0.126$) and weight (MWU = 26.0, $P = 0.089$) did not differ between control and treatment plots, there did appear to be a tendency for the few lizards on cleared areas to be larger and presumably older (Figures 4 and 5). *Uta* ages did not differ between control and treatment areas (MWU = 22.0, $P = 0.307$, Figure 6). Sex ratios differed between the cleared and vegetated area (Fisher Exact probability test, $P = 0.049$) with about as many males (41) as females (49) on the vegetated area, but more males (4) than females (0) on the cleared area. Transect studies revealed sizeable differences in lizard numbers between the graded area and the vegetated areas. There were more *uta* on vegetated plots relative to cleared areas (MWU = 372, $P = 0.0001$, Figure 7). Similarly there were both more individual lizards (MWU = 383, $P = 0.0001$, Figure 8) and more lizard species per plot (MWU = 384, $P = 0.0001$, Figure 9) in the vegetated area relative to the cleared areas. Number of whiptails/plot did not differ between cleared and vegetated areas (MWU = 648, $P = 0.110$, Figure 10). Because of the circular layout, transect counts could be compared across the four cardinal directions. Number of *uta*/hectare (ha), (KWW = 14.13, $P = 0.003$, Figure 11) number of lizards/ha (KWW = 19.32, $P < 0.0001$, Figure 12), and number of lizard species/plot (KWW = 16.48, $P = 0.001$, Figure 13) all differed across the four cardinal directions, with western and southern arms of the array containing fewer *uta*, lizards, or lizard species. In the summer, two *uta* and three zebra-tailed lizards were seen on the cleared plots. In contrast, 58 *uta*, three zebra-tailed lizards, six *Cnemidophorus tigris* (whiptails), four horned-toads, and one desert spiny lizard were seen on the control plots. There were more *uta*/plot on the vegetated plots relative to the disturbed plots (MWU = 0.00, $P = 0.001$, Figure 14) suggesting that construction activity around the DAF complex has lowered *uta* densities. This effect appears to be due to vegetation removal. A similar result was obtained for comparisons of areas along roadsides that lacked perennial vegetation and nearby vegetated control areas near the DAF in 1993 (Woodward et al., 1995). *Uta* snout-vent lengths (MWU = 26.5, $P = 0.186$), body weights (MWU = 15.5, $P = 0.08$), and ages (MWU = 26.5, $P = 0.178$) did not differ between the control and disturbed areas. This lack of statistical significance may reflect the extremely small number (2) of *uta* on the disturbed areas. Sex ratios were also similar on the control and disturbed areas (control area 30 males, 28 females; disturbed area 1 male, 1 female, Fisher Exact Probability = 0.737).

The lizard studies suggest that removing perennial vegetation around the DAF complex has had a detrimental effect on *uta*, essentially removing them from this area. Other lizards were also largely lacking, although sample sizes for these species were too small to merit analysis. The sizeable spatial variation (in number of *uta*, number of lizards, or number of lizard species) on the four sides of the DAF mean that the different lines were not good estimators of each other at least in 1994. Timed lizard surveys in 1993 (Woodward et al., 1995)

Figure 2. Number of uta/ha present on graded or vegetated plots near the DAF

Figure 3. Number of lizards present on graded or vegetated plots near the DAF

Figure 4. Mean uta SVL on graded and vegetated plots near the DAF

Figure 5. Mean uta weight on graded and vegetated plots near the DAF

Figure 6. Mean uia age on graded and vegetated plots near the DAF

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Figure 10. Number of whiptails seen per hectare in graded and vegetated areas near the DAF

Figure 11. Number of uta/ha seen on transects on the four axes around the DAF

Figure 12. Number of lizards/ha seen on transects on the four axes around the DAF

Figure 13. Number of lizard species seen per transect section on the four axes around the DAF

Figure 14. Number of uta/ha present on plots in graded and vegetated areas near the DAF in summer 1994

also suggested that areas to the south of the DAF tended to contain relatively few lizards. This difference means that detecting a directional DAF effect (arising from something like a nuclear accident and downwind drift of nuclear material) will be more difficult, because one cannot simply compare the downwind estimates to estimates from the other arms of the sample array. Instead, detection of this sort of effect will require comparisons of differences in estimates in prior surveys to differences after the directional DAF effect occurred. Because of this result it is suggested that plot studies be extended from looking at two arms of the array every third year, to examining all four arms of the array every year.

Tortoises and Chuckwallas

Two investigators looked for tortoises and chuckwallas for 35 manhours in an area 1 km in diameter centered on the DAF building complex. No chuckwallas were seen. No live tortoises were seen in 1994. In 1993, only one live tortoise was seen (twice). Seven sets of tortoise skeletal remains (old partial skeletons) were seen in this circular area in 1994. Tortoises appear to use this area infrequently.

4.0 BIRDS

4.1 METHODS

Sewage Pond Effects

Bird use at DAF sewage ponds was recorded from April to October to assess effects of the presence of this sewage pond. The pond provided unlimited water availability to birds of the region, which otherwise would be limited. Pond use was estimated by recording bird visits per hour. Most birds were flushed from the pond area before a count began. A visit occurred when an individual entered, spent some time and left the area of the pond or its sloping banks. Birds were counted in 12 consecutive five-minute intervals at the sewage pond. Counts were recorded between 0800 and 1300 h.

Natural Habitat Sampling

The variable-circular-plot technique (Reynolds et al., 1980; see Woodward et al., 1995, for methods details) was implemented in 1994 to estimate bird density. Eight plots were searched on eight dates between April 6 and June 16, 1994. The black-throated sparrow, *Amphispiza bilineata* was chosen for initial monitoring efforts because it was locally abundant. Numbers of nests, eggs, hatchlings, and fledglings were recorded during field efforts on two plots (6 ha) staked off at 50-m intervals. One was located near the DAF sewage pond and another 1 km south of the pond. These plots were set up initially to determine if the sewage pond might increase the local breeding bird density compared to a plot distant from the pond. The plot areas were initially searched in early May to determine onset of breeding for the region. The plots were searched for nests three times each from the end of May to the middle of June. Some opportunistic searches were also made for nests in additional areas around the DAF in May-June.

4.2 RESULTS

During seventeen visits to the DAF sewage pond in 1994 we observed 35 species of birds (Table 1). Bird numbers were very low in 1994 compared to 1993, as indicated by total counts (Table 1) as well as by low numbers of bird visits per hour (Table 2). The most frequently occurring birds at the sewage pond were killdeer, spotted sandpiper, house finch, Say's phoebe, and common raven based on percent frequency of occurrence (Table 1). Many species had low frequency of occurrence (<12 percent), indicating they were observed on only one or two sample dates. The most abundant birds observed were unidentified teal (37) and the above listed species excluding Say's phoebe.

Total number of bird visits to the DAF sewage pond are given in Table 2. Numbers were very low in comparison to counts made during 1994. A mixed flock of juvenile and adult brown-headed cowbirds was observed at the DAF sewage pond on July 18 indicating that reproduction had occurred nearby. Total bird visits for all species combined averaged less than 6 birds per hour over the period of study (Table 2).

Birds in Natural Habitats at the DAF

Bird species breeding near the DAF facility in 1994 included house finches, black-throated sparrows, loggerhead shrikes, and ash-throated flycatchers. Repeated searches for nests in the two 6-ha areas were made but none were found. Only two house finch nests were located in the region, both of which were outside the 6-ha plots. On May 19, 1994, one of the nests had three hatchlings and one had three bluish eggs. Only one juvenile was known to fledge from both nests combined. Both house finch nests were located in cholla

Table 1. Bird species observed at the DAF Sewage Pond during 1994; N = 17 sampling dates (April-October); Percent frequency of occurrence = number of sample dates a species was seen divided by 17 and multiplied by 100

Species	Total Number	% Frequency of Occurrence
Blue-winged teal	7	11.8
Gadwall	5	5.8
American widgeon	2	5.8
Ring-necked duck	1	5.8
Turkey vulture	1	5.8
Red-tailed hawk	2	11.8
Snowy egret	7	17.6
Killdeer	15	41.2
Least sandpiper	2	5.8
Spotted sandpiper	20	52.9
Eared grebe	1	5.8
Wilson's phalarope	6	17.6
Mourning dove	13	23.5
Western sandpiper	10	5.8
Western kingbird	8	23.5
Common raven	15	41.2
Great-tailed grackle	1	5.8
Ash-throated flycatcher	3	5.8
Say's phoebe	9	41.2
Black phoebe	1	5.8
Yellow-headed blackbird	1	5.8
Sprague's pipit	1	5.8
American pipit	3	11.8
Brown-headed cowbird	15	11.8
Horned lark	7	17.6
House finch	36	47.1
N. rough-winged swallow	2	5.8
Barn swallow	2	5.8
Black-throated sparrow	15	29.4
Yellow-rumped warbler	2	5.8
Song sparrow	3	5.8
Brewer's blackbird	1	5.8
Savannah sparrow	2	5.8
Sage sparrow	3	5.8
Empidonax flycatcher	1	5.8
Unidentified teal	37	17.6
Unidentified duck	1	5.8
Unidentified swallow	2	5.8
Total	263	

Table 2. Total and m20n number of bird visits per hour at the DAF sewage pond across 15 dates by common passerine species during 1994

Date	Mourning	House finch	Black	Common	Sage
4 April	0	2	0	2	0
11 May	0	8	0	2	0
17 May	0	7	0	2	0
25 May	3	8	0	0	0
31 May	0	0	0	0	0
7 June	3	5	2	2	0
13 June	0	1	1	0	0
6 July	3	0	2	0	0
18 July	4	0	5	0	0
26 July	0	0	0	0	0
11 August	0	0	0	0	0
17 August	0	0	0	1	0
13 September	0	0	0	1	0
27 September	0	5	0	5	0
20 October	0	0	0	0	3
Mean±2 se	0.9±0.8	2.4±1.6	0.7±0.7	1.0±0.7	0.2±0.4

cacti. Black-throated sparrows also appeared to breed but in very low numbers. No nests with eggs or young were found, although several juveniles were observed in the region in late spring.

In June several cavities in Joshua trees were located that could have served as nesting sites for ash-throated flycatchers (which were observed nearby) or some other cavity nesting species. Fresh nest material was also found inside one cavity in a Joshua tree indicating that cavity nesting might have occurred. No fledgling ash-throated flycatchers were observed in 1994; however, some were observed in 1993. On June 16, two juvenile loggerhead shrikes were observed on bird plots about 1-2 km west of the DAF facility suggesting this species reproduced in the region during 1994. Some nonbreeding species observed in natural habitats around the DAF included cactus wren, Scott's oriole, lesser nighthawk, Say's phoebe, western kingbird, ladderback woodpecker, and common raven. The only species observed in 1994 not associated with the sewage ponds were Scott's oriole, cactus wren, lesser nighthawk and ladderback woodpecker.

Variable-Circular-Plot

While black-throated sparrows were commonly observed on plots and appeared fairly abundant around the DAF in 1994, an accurate estimate of density for this species could not be made. This is because birds were not singing on numerous sampling dates and were often located in small flocks on the ground and could easily go undetected. To implement the variable-circular-plot method it is necessary to locate and count birds using both sight and

sound. Birds were often difficult to see because they did not perch prominently in 1994, as they did in 1993. Hence, the detectability of black-throated sparrows was lower in 1994, making comparisons of breeding density to previous years unreasonable.

4.3 DISCUSSION

Bird numbers around the DAF were much reduced over 1993. For comparison, total number of bird visits recorded at the sewage pond during 1993 averaged over 400 birds per hour (Woodward et al. in prep.), while in 1994 it averaged about five visits per hour. Most notable were reductions in the number of mourning doves observed. This species averaged about 367 birds per hour in 1993 and averaged about one bird per hour in 1994.

Similarly, fewer numbers of house finches (2.4) and black-throated sparrows (0.7) were observed at the sewage pond in 1994 compared to 35 and 40 per hour respectively in 1993. Juvenile black-throated sparrows were also abundant at the sewage pond during summer of 1993; however, in 1994, none were observed. It is clear from these data that numbers of birds present in an area can fluctuate by orders of magnitude from year to year. The fluctuations appear to be most related to changes in availability of moisture. While black-throated sparrows appeared to be common, densities could not be estimated with any certainty in 1994. Overall breeding success of birds, however, appears to have been much lower based primarily on scant observations of nests and juveniles during spring and summer.

This year's data points out some of the difficulties associated with monitoring birds in deserts: namely, that large fluctuations in numbers make it difficult to assess impacts, and changes in detectability of birds make year-to-year comparisons of data untenable. The variable-circular-plot method was used as an experimental technique at the DAF facility in 1993-94, and it appears to work well only in wet years to define basic information needs. In dry years the method is not suitable for desert environments.

In summary, the sewage pond at the DAF facility appears to benefit bird species in the region during periods of moisture availability, and equally benefits numerous species for migratory rest stops. Negative impacts of the sewage pond, if present, could not be measured. To minimize impacts on biota at the DAF facility, it is recommended that removal of vegetation for operations of the site be kept to a necessary minimum.

5.0 SMALL MAMMALS

Small mammal studies around the DAF focused on abundance and species diversity at two areas outside the DAF construction impact area. The 1993 baseline inventory of small mammals suggested a marked difference between the areas northwest and southeast of the DAF (Woodward et al., 1995). The 1994 study looked at the regions northeast and southwest of the DAF compound and was limited to one survey at each site.

5.1 METHODS

Methodology was similar to that in 1993 (Woodward et al., 1995). Small mammal traps (Sherman) were laid out on the lizard transect lines east and west of the DAF (Figure 1). Transect lines were 440 m long with stakes at 10-m intervals. Two traps were placed near each stake (90/line), using available vegetation to shade traps from the morning sun.

Traps were baited on the evenings of May 31 and June 1, 1994, with a mixture of rolled oats and birdseed. Traps on the two 440-m lines were checked on June 1-2, 1994, and closed.

Captured animals were identified to species, marked (or the identifying number read if a recapture), sexed, aged (adult or juvenile), weighed to the nearest gram, and released at the capture location.

In 1993, two types of traps were used: sheet metal (Sherman) and wire mesh (A thru Z Consulting and Distributing). The wire mesh traps were difficult to use, were without any added benefit, and were therefore not used in 1994.

5.2 RESULTS

Rodent Abundance

Small mammals and related parameters are summarized in Table 3. The two sites were virtually identical in total number of individuals, trap success, and species diversity. The distribution of individuals by species, however, was slightly different, but not significant ($\chi^2 = 0.893$, $P = 0.345$). *Chaetodipus formosus* was most abundant northeast of the DAF and *Dipodomys merriami* was most common southwest of the DAF (Figure 15). Physiography of the two sites accounts for the differences as the areas north and east of the DAF cut through several well defined washes. The areas west and south have a few small, indistinct washes. The vegetation is also sparser to the southwest.

No new species were captured around the DAF in 1994. Two species captured on 1993 traplines, *Onychomys torridus* and *Peromyscus eremicus*, were not captured in 1994 (Figures 15, 16). Number of species per plot averaged 7.3 ± 2.3 (mean ± 2 se) in early June 1993 ($N = 3$) and 5.0 ± 0.0 in 1994 ($N = 2$).

Species diversity was slightly (but not significantly) higher on the northeast trapline than the southwest line ($t_{125} = 0.962$, $P = 0.338$). Mean number of captures per 10 stakes (20 traps) were higher on 1994 traplines than in 1993 (Figure 17).

Table 3. Small mammals captured in 1994 at two DAF locations

	Northeast Trapline			Southwest Trapline		
	Number	%T	♂/♀	Number	%T	♂/♀
<i>Chaetodipus formosus</i>	31	47.7	16/15	26	42.6	13/13
<i>Dipodomys merriami</i>	25	38.5	13/12	30	49.2	18/12
<i>Dipodomys microps</i>	5	7.7	2/3	---	---	---
<i>Perognathus longimembris</i>	---	---	---	1	1.6	1/0
<i>Neotoma lepida</i>	3	4.6	2/1	3	4.9	2/1
<i>Peromyscus maniculatus</i>	1	1.5	0/1	---	---	---
<i>Ammospermophilus leucurus</i>	---	---	---	1	1.6	0/1
Total Number Individuals	65	100.0	33/32	61	99.9	34/27
Number of Species	5			5		
Species Diversity (H')	0.4882			0.4323

Figure 15. Relative abundance of small mammals at the DAF in 1994

Figure 16. Relative abundance of small mammals at the DAF in 1993

Figure 17. Mean capture ± 2 se per 10 stakes in early June 1993 and 1994 at the DAF

Species of Special Concern

No studies were undertaken in FY94 to determine the presence/absence of spotted bats (*Euderma maculatum*). This species generally is associated with rocky cliffs near forested areas but may venture into open desert scrub habitat during the summer months. While the DAF site does not include roosting habitat for spotted bats, bats could make sporadic visits to the sewage ponds. Not enough is known about the distribution of this species on the NTS (or in Nevada); however, it is documented as occurring in the vicinity of one artificial pond (now dry) on the NTS, approximately 50 km northwest of the DAF on Pahute Mesa (EG&G/EM 1993).

6.0 PERENNIAL PLANTS

Monitoring of perennials around the DAF in 1994 had a primary goal of observing unexpected changes, as recommended in Woodward et al., 1995. Also intended was to detect expected changes, which included improved growth of perennials near the many DAF-related disturbances and establishment of new and perhaps weedy species in the disturbed areas. Because growth trends can be determined only after some time elapses, it was also an opportunity to determine preoperational trends in perennial plant size changes.

6.1 METHODS

Perennial plant transects marked in 1993 were remeasured on five sets of 20 plots arranged in concentric bands around the DAF. Five bands at 201-300 m, 301-400 m, 401-500 m, 501-600 m, and 1-1.5 km each included twenty 10-m² transects, with the outer ring expected to serve as control vegetation. A description of procedures for selecting the sites and parameters measured is in Woodward et al., 1995. Measurements were done as in 1993, with all plants lying within 1 m of a fiberglass tape measured and described. One species, *Erioneuron pulchellum* (desert fluffgrass, ERIPUL), was generally counted in each square meter and the median live and dead plants measured. A few single plants of *Erioneuron pulchellum* were measured individually to allow later monitoring of their growth. A few plants measured in 1993 were missing, no longer within the transect (a tape-positioning effect), or no longer attached to the ground. Such plants were not measured or recorded, though a note was made of reasons for deleting them.

One plot was within a newly fenced area around a building outside the main DAF security fence. The area was recently scraped and was considered for the purposes of this report to be bare. Intentions are not to sample that plot in the future, as it is considered inside the DAF security perimeter fence, and the BECAMP effort is intended to monitor effects on the ecosystem outside this fence. If monitoring continues, the plot should be replaced to maintain consistency in the study design.

Data analysis was done in Microsoft EXCEL, a change from 1993. Statistical tests (ANOVA, t-test) were done in EXCEL. Error terms in this report are $\pm$ two standard errors unless otherwise noted. No attempt was made to check for normal distributions before calculation of

error terms. The growth parameter k ($k = [\ln(\text{volume } 1/\text{volume } 2)]/\Delta t$ where Δt = elapsed time in years) was calculated for plants whose volume was measured at both censuses, and which did not change from live to dead (or dead to live) between censuses. Standard errors for that parameter were normally based on numbers less than the whole population present in 1994. Data were pooled into a single computer file, and analyzed on a plant-by-plant basis rather than by plot, except for analyses related to distance from the DAF.

Two species measured in the past with ephemeral plants were included in the perennial censuses in 1994. Both *Eriogonum inflatum* (desert trumpet, ERIINF) and *Astragalus lentiginosus* var. *fremontii* are short-lived herbaceous perennials that may live several years. If the DAF plots are monitored annually, valuable information on their growth and survival could be obtained with the perennial measurements.

Taxonomy of plants follows Munz (1974) with names updated following Kartesz and Kartesz (1982). Common names of plants follow Scott and Wasser (1980). The name change of *Ceratoides lanata* to *Kraschennikova lanata* follows Hickman (1993).

6.2 RESULTS

Population changes of perennial plants from 1993 - 1994 were generally minor. Most species were approximately constant in number, and volumes declined slightly (Table 4). Changes of a few plants can be expected due to variation in placement of the tape used to delimit the plots. In addition, a few plants are normally missed on a first census, and found at the next. These can explain most changes in number seen. However, there was a large decrease in numbers of *Erioneuron pulchellum* (Desert fluffgrass), a diminutive perennial grass that probably germinated in both 1992 and 1993, and possibly a significant decrease in numbers of *Sphaeralcea ambigua*.

Numbers of *Erioneuron pulchellum* declined 54 percent overall, which was reasonable considering the dry weather in 1994 and the small size and youth of the plants. There were differences in survival at different distances from the DAF (Table 5).

Survival of *Erioneuron pulchellum* was better near the DAF ($r = -0.917$, 3 d.f., $P = 0.03$). Detection of the now-dead plants in the dead grass population was erratic, and may indicate a problem with measurement of those numbers (Table 5).

One would expect mean size of *Erioneuron pulchellum* plants to mirror the survival data, such that mean size should increase more or decrease less where survival was better. This did not appear to be the case, as mean size of live plants decreased more nearer the DAF ($r = -0.3860$, $n = 52$, $P = 0.005$, Table 6).

In some respects the population of *Sphaeralcea ambigua* (desert globemallow, an herbaceous small shrub) behaved like *Erioneuron pulchellum*, although involving only small numbers of plants. Numbers of *Sphaeralcea ambigua* increased from 12 to 15 near the DAF, but decreased from 28 to 16 far from it. Qualitatively, mean size was higher near the DAF both years (Table 7), but decreased markedly at all distances between 1993 and 1994.

Table 4. Total live volumes (liters per 1000 m²) and numbers for perennial plant species found on one hundred 10-m² transects surrounding the DAF

Species and authority	Live volume		Numbers	
	93	94	93	94
<i>Acamptopappus shockleyi</i> Gray	55	43	4	4
<i>Ambrosia dumosa</i> (Gray) Payne	8,441	7,945	159	166
<i>Astragalus lentiginosus</i> var. <i>fremontii</i> (Gray) S. Wats.	-	2	-	1
<i>Atriplex confertifolia</i> (Torr. & Frem.) S. Watts	689	512	39	32
Cactus (unidentified seedlings)	0	0	0	3
<i>Coleogyne ramosissima</i> Torr.	165	146	1	1
<i>Dyssodia cooperi</i> Gray	1	1	1	1
<i>Echinocereus engelmannii</i> Parry	<1	0	1	0
<i>Ephedra nevadensis</i> S. Wats.	4,427	4,434	8	9
<i>Eriogonum inflatum</i> Torr. & Frem.	-	103	-	23
<i>Erioneuron pulchellum</i> (H.B.K.) Tateoka	355	90	5,831	2,676
<i>Grayia spinosa</i> (Hook.) Moq.	607	357	7	6
<i>Krameria parvifolia</i> Benth.	8,168	8,630	84	83
<i>Kraschennikova lanata</i> (Pursh.) A.D.J. Meeuse & Smit.	103	95	2	2
<i>Larrea tridentata</i> (Sesse & Moc. ex DC.) Coville	41,299	40,981	77	81
<i>Lycium andersonii</i> Gray	2,287	2,095	27	26
<i>Menodora spinescens</i> Gray	331	320	16	16
<i>Opuntia basilaris</i> Engelm. & Bigelow	1	1	1	1
<i>Opuntia echinocarpa</i> Engelm. & Bigelow	116	92	6	6
<i>Oryzopsis hymenoides</i> (Roemer & Schultes) Ricker	1	1	22	20
<i>Salazaria mexicana</i> Torr.	626	563	6	6
<i>Sphaeralcea ambigua</i> Gray	4,274	165	106	98
<i>Stephanomeria pauciflora</i> (Torr.) Nutt.	84	26	1	1
<i>Stipa speciosa</i> Trin. & Rupr.	<1	1	1	1
<i>Xylorhiza tortifolia</i> (Torr. & Gray) Greene	74	22	1	1
<i>Yucca brevifolia</i> Engelm.	22,813	19,391	5	5

Table 5. Changes in numbers of *Erioneuron pulchellum*, and dead grasses (dominated by *Erioneuron pulchellum*) at different distances from the DAF, 1993-1994

Distance	Live			Dead		
	1993	1994	% Change	1993	1994	% Change
0-300 m	711	462	-35	117	85	-27
301-400 m	1442	1024	-29	965	1313	+36
401-500 m	1509	592	-61	431	469	+9
501-600 m	1253	504	-60	776	1083	+40
1- 1.5 Km	916	94	-90	1166	530	-55

Table 6. Mean live size (liters $\pm$ 2 se) and percent change in mean size of surviving *Erioneuron pulchellum* versus distance from the DAF, 1993-1994

Distance	1993	1994	% Change
0-300 m	0.054 $\pm$ 0.022	0.023 $\pm$ 0.006	-57
301-400 m	0.067 $\pm$ 0.028	0.028 $\pm$ 0.006	-58
401-500 m	0.078 $\pm$ 0.030	0.063 $\pm$ 0.020	-19
501-600 m	0.056 $\pm$ 0.021	0.092 $\pm$ 0.026	+64
1000-1500 m	0.014 $\pm$ 0.005	0.036 $\pm$ 0.021	+157

Table 7. Changes in numbers and mean size (liters $\pm$ 2 se) of *Sphaeralcea ambigua* versus distance from the DAF, 1993-1994

Distance	Numbers			Mean Size		
	1993	1994	% Change	1993	1994	% Change
0-300 m	12	15	+25	82 $\pm$ 82	3 $\pm$ 5	-96
301-400 m	6	6	0	4 $\pm$ 4	0 $\pm$ 0	-98
401-500 m	25	24	-4	72 $\pm$ 42	3 $\pm$ 2	-96
501-600 m	35	37	+6	37 $\pm$ 17	1 $\pm$ 1	-97
1000-1500 m	28	16	-43	6 $\pm$ 4	1 $\pm$ 0	-91

Rainfall in calendar 1994 was considerably lower than in 1993 (126 vs 275 mm at the Cane Springs monitoring station) and most perennial plants shrank. A logarithmic growth coefficient partially corrects for differences in growth rates among plants of different size (Erikson 1976). Plant shrinkage varied with distance from the DAF, with the greatest shrinkage nearer the DAF (Table 8) (ANOVA, $F_{4, 421} = 2.94$, $P = 0.020$).

Vegetation parameters varied considerably with direction from the DAF. In 90 degree arcs centered on the cardinal directions, live perennial volume was lowest in the North and highest to the West of the DAF (Table 9). Shrinkage was greatest where live volume was highest, but differences in growth among directions were not statistically different (ANOVA, $F_{3, 417} = 1.76$, $P = 0.154$).

Table 8. Mean growth coefficients (k, defined in methods) ± 2 se versus distance from the DAF

	Distance, m				
Species	0-300	301-400	401-500	501-600	1-1.5 K
All	-0.67 $\pm$ 0.47	-0.07 $\pm$ 0.17	-0.43 $\pm$ 0.24	-0.16 $\pm$ 0.15	-0.30 $\pm$ 0.15
AMBDUM	-0.24 $\pm$ 0.23	+0.01 $\pm$ 0.29	-0.18 $\pm$ 0.24	+0.06 $\pm$ 0.15	-0.39 $\pm$ 0.24
KRAPAR	+0.18 $\pm$ 0.39	+0.10 $\pm$ 0.15	+0.09 $\pm$ 0.15	+0.08 $\pm$ 0.17	+0.01 $\pm$ 0.13
LARTRI	-0.10 $\pm$ 0.29	-0.08 $\pm$ 0.14	-0.03 $\pm$ 0.10	+0.09 $\pm$ 0.09	-0.02 $\pm$ 0.08
SPHAMB	-3.96 $\pm$ 2.15	-2.29 $\pm$ 3.14	-3.77 $\pm$ 1.02	-2.32 $\pm$ 0.87	-1.99 $\pm$ 0.99
DEDSHB	-0.03 $\pm$ 0.24	-0.26 $\pm$ 0.19	-0.19 $\pm$ 0.15	-0.18 $\pm$ 0.14	-0.30 $\pm$ 0.11

Table 9. Vegetative parameters at different directions from the DAF, 1994

	Area Sampled (m ²)	Species	# Live	% Cover	Volume L/100 m ²	% Dead Volume	% Dead #	k ± 2 SE
N	200	13	101	8.7	4,228	61	43	-.08 $\pm$.14
E	250	11	165	10.8	6,777	59	29	-.20 $\pm$.16
S	300	16	203	14.7	7,956	38	26	-.34 $\pm$.19
W	250	15	116	14.3	14,506	48	29	-.44 $\pm$.22

Plants closer to disturbance were expected to grow faster. In 1994 plants in plots positioned within 10.1 m of a disturbance had significantly lower mean growth coefficients ($k = -0.59 \pm 0.26$) than those farther from disturbance ($k = -0.18 \pm 0.09$) (t-test, $t_{127} = -2.64$, $P = 0.009$, assuming unequal variances).

Grazing did not appear to play a major role in perennial populations in 1994. Three species had more than 10 percent of the sampled population grazed, *Oryzopsis hymenoides* (5 of 20 grazed from 10 to 90 percent), *Eriogonum inflatum* (6 of 23 grazed 15 to 30 percent), and *Sphaeralcea ambigua* (10 of 98 grazed 10 to 95 percent). Occasional woody shrubs showed evidence of minor grazing (10 to 60 percent).

Fruiting by perennials was low in 1994. In *Erioneuron pulchellum* 17 percent within 300 m of the DAF fruited, but less than 5 percent fruited at any greater distance. Among *Larrea tridentata* 53 of 81 plants bore fruit at sampling (65 percent). Totals of six *Eriogonum inflatum*, four *Krameria parviflora*, three *Oryzopsis hymenoides*, and three *Sphaeralcea ambigua* fruited in the whole sampled population.

6.3 DISCUSSION

Conditions of perennial plants near the DAF did not change greatly from 1993-1994, evidenced by similar population numbers and somewhat reduced live volumes (Table 3, Woodward et al., 1995). The small shrinkage is consistent with observations elsewhere on the NTS, where live volumes have been found to correlate with four-year running mean rainfall (Hunter 1994c). The four-year mean in 1994 was approximately equal to that of 1993, as the added dry year 1994 balanced the lost dry year of 1990. Mean rainfall for the years 1993-1994 was approximately equal to the 20 year annual mean, and vegetation should have been in approximate equilibrium both years. (Of course, evidence of the death of shrubs in 1989-1991 associated with drought [high ratio of dead to live plants] is present and expected to persist for many years.)

Removal of vegetation associated with DAF construction is expected to be the major factor causing changes in plant species composition, density and live volumes in the vicinity of the DAF. In other areas, shrub removal has resulted in improved growth of plants near disturbance. For example, plants on Yucca Flat and Mid Valley burned sites grew significantly faster than on adjacent control transects, and plants adjacent to 5-01 road in central Frenchman Flat grew faster than did control plants in undisturbed vegetation approximately 500 m distant (Hunter 1994). In addition, data from a Frenchman Flat borrow pit and a shrub-removal plot in Mercury suggest water builds up in the soil in the absence of shrubs (Romney et al., 1981; Hunter unpublished manuscript). Similar processes were expected near the DAF, but were not found. Plants nearer disturbance at the DAF grew significantly less (shrank more) than those far from disturbance.

At the present time, shrinkage of plants near the DAF is puzzling. The growth measurements are fairly coarse, as they are associated with measurement errors of about 20 percent for plant volume (Hunter, unpublished observations). Statistical significance depended on large numbers of measurements. One year of relatively slight growth/shrinkage is not ideal for detecting effects, and the finding of significant unexpected shrinkage near the DAF was therefore surprising.

A mechanism of plant shrinkage near disturbed areas at the DAF is hard to imagine. Water should not have been as limiting near disturbance as in undisturbed desert. The absence of a significant directional effect on growth/shrinkage (Table 9) argues against a wind-dispersed factor. Prevailing winds on the NTS are primarily north-south (Black et al., 1994), and an inhibitor might have been expected to act in either one or both of those directions.

Radioactive clouds from above-ground weapons tests had strong directional effects as fallout killed vegetation in a narrow belt leading away from the ground zeroes (e.g. satellite photos in a report by Zimmerman et al. [1991]). Plants grow well near the paved surface of roads, indicating soil compaction and hydrocarbon vapors from oil or asphalt are not significantly harmful.

It should be noted that disturbance around the DAF is greater nearer the facility (Woodward et al., 1995), and hence the effects of the DAF itself are confounded by those of disturbance.

Mortality of *Erioneuron pulchellum* appeared to be reduced near the DAF, and fruiting of that species may have been enhanced. These are expected results of disturbance, so it appears the growth data were anomalous, but the mortality data were not.

We feel the perennial plant monitoring near the DAF should be continued as recommended in Woodward et al., 1995. An increased time-span of monitoring should improve detection and understanding of the growth effects. An increase in intensity of the effort does not seem warranted, although specific studies designed to explore the reduction in growth near DAF/disturbance might be useful. A better determination of the extent of the effect prior to the start of DAF operations might help distinguish preoperational from operational effects.

7.0 EPHEMERAL PLANTS

Poor germination of ephemeral plants in 1994 made extensive sampling pointless. Goals were to sample two points far from the DAF, as all 1993 plots were thought to be potentially affected by the extensive disturbance associated with DAF construction. One graveled area southwest of the DAF was sampled to determine if conditions there favored continuation of the high diversity seen in 1993. A scraped and compacted area west of the DAF was sampled to compare with the scraped and graveled area. Finally, the south edge of the paved road to the DAF was examined with the $\log_{10}$ technique used in 1993 in order to determine if the *Schismus arabicus* found invading along that road in 1993 was moving farther into the undisturbed vegetation.

7.1 METHODS

The two techniques used to sample ephemerals in 1994 were described in detail in Woodward et al., 1995. They were the standard BECAMP technique, which measures density within nested quadrats, the largest of which was 1000 m². The technique was modified by counting plants in portions or the whole 100 m² to get a rough density on some of the rarer species. The $\log_{10}$ technique involved estimating density of species observed in 1 m² areas laid along a tape stretched perpendicular to the paved DAF roadway. It was modified in 1994 by

improving the estimated log density to 1 decimal place below a log of 2 (100 plants/m²). In addition, a minimum density of 0.01 plants/m² (log = -2) was used for all those found in any one square-meter quadrat. Eight rather than ten lines were examined in 1994.

Plant taxonomy followed Munz (1974) with synonymy provided by Kartesz and Kartesz (1980).

7.2 RESULTS

Ephemerals in the control transects were dominated in both sites by *Bromus rubens*, which was the only species common enough to fall in the quadrats totalling one-half square meter. All others of the 7 or 16 species were thus of low density. Numbers and biomass were greater on the plot to the North (20-5), where total shrub live volume was lower (Table 10).

On the two scraped areas west and southwest of the DAF, *Bromus rubens* was not dominant, but numbers, numbers of species present, and biomass produced were comparable to those on the undisturbed areas (Table 11). The scraped and graveled area (DAF2) was also sampled in 1993, when it had an unusually high number of species. In 1994 it again had relatively high diversity, and numbers were significantly increased over 1993 ($t_{38} = 2.734$, $P = 0.009$), though average plant weight and total biomass (g/m²) decreased. The scraped and compacted plot differed from the scraped and graveled plot in 1994, as both numbers ($t_{38} = 3.31$, $P = 0.002$) and biomass ($t_{38} = 2.26$, $P = 0.03$) were lower on the former.

Table 10. Summary statistics on two 1000-m² control transects; Plot 10-5 was at 1242 m South and 20-5 was 1197 m North of the DAF

	10-5	20-5
Total species in 1000 m ²	16	7
Total species in 100 m ²	11	2
Species in 20 quadrats	1	1
Average species per quadrat ± 2 se	0.10 $\pm$ 0.14	0.5 $\pm$ 0.2
<i>Bromus rubens</i> n/m ² ± 2 se	6 $\pm$ 9	46 $\pm$ 32
<i>Bromus rubens</i> g/m ² ± 2 se	0.06 $\pm$ 0.10	1.6 $\pm$ 2.0
Total n/m ² ± 2 se	6 $\pm$ 9	46 $\pm$ 32
Total g/m ² ± 2 se	0.06 $\pm$ 0.10	1.7 $\pm$ 2.0
Average weight/plant mg ± 2 se	10 $\pm$ 2	21 $\pm$ 19
Surface % rock ± 2 se	34.9 $\pm$ 11.1	67 $\pm$ 15
Surface % litter ± 2 se	19 $\pm$ 9	18 $\pm$ 8
Surface % shrub cover ± 2 se	23 $\pm$ 18	23 $\pm$ 16
Surface % mound ± 2 se	17 $\pm$ 16	22 $\pm$ 17
Rabbit pellets n/m ² ± 2 se	36 $\pm$ 32	10 $\pm$ 8

Table 11. Summary statistics on two 1000-m² transects; DAF2 was on a scraped, graveled area southwest of the DAF, and plot 16-1 is on a scraped compacted area West of the DAF; DAF2 data are from the same location in 1993 and 1994; * = the two plots differ in this parameter in 1994 at $p < 0.05$; ** = $p < 0.01$, d.f. = 38.

	DAF2		16-1
	1993	1994	1994
Total species in 1000 m ²	52	19	9
Total species in 100 m ²	38	16	5
Species in 20 quadrats	4	6	2
Avg. Species per quadrat ± 2 se	0.55 $\pm$ 0.37	0.71 $\pm$ 0.21	0.10 $\pm$ 0.14
<i>Bromus rubens</i> n/m ² ± 2 se	4 $\pm$ 6	2 $\pm$ 4	0 $\pm$ 0
<i>Bromus rubens</i> g/m ² ± 2 se	0.3 $\pm$ 0.7	0.003 $\pm$ 0.007	0 $\pm$ 0
Total n/m ² ± 2 se**	22 $\pm$ 15	62 $\pm$ 36	4 $\pm$ 6
Total g/m ² ± 2 se*	7 $\pm$ 10	0.7 $\pm$ 0.6	0.04 $\pm$ 0.05
Average weight/plant mg ± 2 se	316 $\pm$ 42	11 $\pm$ 5	9 $\pm$ 2
Surface % rock ± 2 se	99.8 $\pm$ 0.4	100 $\pm$ 0	14 $\pm$ 25
Surface % litter ± 2 se	0.15 $\pm$ 0.22	3.0 $\pm$ 2.2	5.0 $\pm$ 2.5
Surface % shrub cover ± 2 se	0 $\pm$ 0	0 $\pm$ 0	3.8 $\pm$ 7.5
Surface % mound ± 2 se	0 $\pm$ 0	0 $\pm$ 0	0 $\pm$ 0
Rabbit pellets n/m ² ± 2 se*	0 $\pm$ 0	22 $\pm$ 16	0 $\pm$ 0

Rabbit pellets on the scraped and graveled area increased significantly from 0 in 1993 to 22 $\pm$ 15 in 1994. That is an indication of more palatable vegetation on the area.

Species present and approximate densities for all areas sampled in 1994 are in Table 12. Many species seen in 1993 were absent, and most present both years were at lower density in 1994.

Sampling of the roadside with the log₁₀ technique provided results similar to those of 1993. First, in terms of species seen per area searched, it found more than on the 1000-m² transects (33 spp./160 m² versus a maximum of 19/1000 m²). Most species seen, as is normal, were of low density. As in 1993, *Eriogonum deflexum* was concentrated along the scraped road verge, and *Bromus rubens* was absent from that area. *Schismus arabicus*, an exotic weedy grass thought to be present because of the DAF construction, was found at low densities from 1 to 14 m from the pavement edge, and on one line at 35 m from the road. It was also found, as in 1993, on the two scraped areas near the DAF sampled in 1994, but not on the two control transects.

7.3 DISCUSSION

Several aspects of ephemeral populations around the DAF can be explained by reference to other NTS studies. Removal of shrubs has been shown to increase ephemeral densities and biomass (e.g., Hunter 1994d, Table 14; Hunter 1994e, Table 12). Introduced weedy species have historically been associated with disturbed areas (e.g., Beatley 1966), and Brandt and Rickard (1994) have recently suggested that only moderate disturbance is necessary to maintain them in the landscape.

Table 12. Ephemeral species present and approximate densities in five sampled areas near the DAF in April 1994 (p = present in 1000 m²; densities estimated by several different techniques)

SPECIES	10-5	20-5	DAF2	16-1	ROAD	
					road	cont
<i>Astragalus acutirostris</i>					0.01	0.02
<i>Astragalus lentiginosus fremontii</i>	0.01		0.11	p	0.01	0.01
<i>Bromus rubens</i>	6±9	46±32	2±4	0.04	0.6	26.5
<i>Bromus tectorum</i>					0.01	0.01
<i>Calycoseris wrightii</i>			p		0.01	0.02
<i>Camissonia brevicornu</i>	p		p		0.01	0.01
<i>Caulanthus cooperi</i>		0.02				
<i>Caulanthus lasiophyllus</i>					0.01	0.01
<i>Chaenactis carphoclinia</i>	0.15				0.01	0.02
<i>Chaenactis stevioides</i>	0.01		0.08		0.01	0.01
<i>Chorizanthe rigida</i>			2±4			
<i>Cryptantha circumscissa</i>					0.01	0.01
<i>Cryptantha nevadensis</i>	0.06		0.07		0.01	0.04
<i>Cryptantha pterocarya</i>	0.05				0.01	0.02
<i>Cryptantha recurvata</i>	p				0.01	0.01
<i>Cryptantha virginensis</i>		p				
<i>Descurainia pinnata</i>	0.01		0.01			
<i>Eriogonum deflexum</i>	0.03	p	46±37	2±4	1.7	0.9
<i>Eriogonum inflatum</i>	0.03	p	0.08	0.04	0.01	0.03
<i>Erodium cicutarium</i>				p	0.13	0.01
<i>Eschscholtzia glyptosperma</i>			0.03			
<i>Gilia transmontana</i>			0.02		0.02	0.01
<i>Ipomopsis polycladon</i>	0.01		0.03		0.01	0.01
<i>Machaeranthera canescens</i>		p	p			
<i>Malacothrix glabrata</i>			0.01		0.01	0.01
<i>Mentzelia albicaulis</i>	p		0.03		0.01	0.04
<i>Monoptilon bellioides</i>					0.01	0.01
<i>Pectocarya platycarpa</i>					0.01	0.02
<i>Phacelia fremontii</i>	p		2±4	p	0.01	0.02
<i>Phacelia vallis-mortae</i>					0.01	0.01
<i>Prenanthes exigu</i>					0.01	0.02
<i>Rafinesquia neomexicana</i>		p				
<i>Salsola australis</i>	0.02		6±12	0.01	0.01	0.01
<i>Schismus arabicus</i>			2±4	2±4	0.04	0.04
<i>Sisymbrium altissimum</i>				p		
<i>Stephanomeria exigu</i>	p					
<i>Vulpia octoflora</i>					0.03	0.03

The high ephemeral diversity near the DAF may be associated with the low shrub densities and live volume. Ephemeral plants are sparse at higher altitudes on the NTS (e.g., Hunter 1994e, Table 6), in spite of greater rainfall, except on areas where the perennial plants have been removed, such as drill pads (e.g., Hunter 1994f, Table 9).

The introduced grass *Schismus arabicus* has been present on the NTS since the 1950s, but has not been common. It was not one of the common species found along the Mercury Highway in a study of roadside weeds in 1993 (Hunter 1994e). It was found to increase with summer irrigation (but not winter irrigation) on some plots in Mercury in the mid-1970s (Hunter et al., 1976, 1976 unpublished). It is a dominant grass in some warmer sandy areas of the Mojave Desert (Hunter et al., 1987). Given its seeming requirement for warmer weather than occurs on most of the NTS, its presence and expansion near the DAF may be related to the southern aspect and relatively low altitude of the DAF location.

Erodium cicutarium was present on the DAF roadside preferentially (Table 12), as was found in Hunter 1994e for Mercury Highway.

The log₁₀ technique, with the modifications in precision of estimates, worked well. Because it sampled plants over a relatively broad area, it was much better suited for detecting effects of the DAF and how far they might extend away from it than was the standard BECAMP technique. Use of a similar technique on lines radiating from the DAF instead of the paved road would be more likely to detect DAF-related damage, and the detection of more species with less search effort would be advantageous in light of the high species diversity of ephemeral populations near the DAF. It gives less precise data than the standard technique for common species, but those species are generally weedy and human influences on their populations are generally positive.

8.0 CONCLUSIONS

The DAF was still in a preoperational mode in 1994, with construction work largely restricted to the area inside the perimeter fence. Baseline studies in 1994, a dry year, largely support findings on DAF effects from 1993, a relatively wet year. To date, BECAMP has documented DAF environmental impacts on perennials, lizards, and birds. Perennials and lizards were removed from graded areas around the DAF buildings and from the road right of way. In 1993, bird use of the DAF sewage settling pond area was greater than that in nearby areas implying that the presence of this pond attracted more birds to this area.

The most notable difference between 1993 and 1994 was the 80-fold reduction in bird use of the sewage settling pond in 1994. Apparently, water availability in this pond significantly enhances bird use of the general area only in years like 1993, a good to above average rainfall year. The dry conditions in 1994 also, apparently, curtailed bird reproduction in the DAF vicinity. In the absence of reproduction, males were not displaying at territory boundaries and the variable-circular-plot technique cannot be used. This suggests that estimation of DAF effects on birds (away from the sewage pond) will be difficult in drought years.

Small mammals, lizards, and plant populations vary a great deal near the DAF, such that abundances of several species differ greatly from one side to the other (Woodward et al., 1995, and this report). These differences have repercussions for assessing any changes that might arise from a nuclear mishap and radioactive breach of the DAF building complex, as they imply that directional differences in the flora and fauna occurred prior to the mishap.

Thus, sample sites on different sides of the DAF would not represent suitable controls for comparison with downwind sites impacted by a radioactive breach of the building. This means that comparisons will need to be made between impacted sites and the same sites earlier that year or in prior years.

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