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STATUS OF THE FLORA AND FAUNA ON THE NEVADA TEST SITE, 1988

Results of Continuing Basic Environmental Monitoring January through December 1988

Compiled By
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ABSTRACT

In 1987 the U.S. Department of Energy (DOE) initiated a program to monitor the health of the Nevada Test Site (NTS) plants and animals in support of the National Environmental Protection Act. The program, part of DOE's Basic Environmental Compliance and Monitoring Program (BECAMP), monitors perennial and ephemeral plants, the more common species of rodents and lizards, and the horses, deer, raptors and other large animals on the NTS. This is a report of data collected on these flora and fauna for the year 1988, the second year of monitoring.

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ACRONYMS

BECAMP - Basic Environmental Compliance and Monitoring Program

DOE - Department of Energy

FRF - Frenchman Flat

ha - hectare

MER - Mercury Valley

MID - Mid Valley

NTS - Nevada Test Site

PAM - Pahute Mesa

RAM - Rainier Mesa

RED - Redrock Valley

ROV - Rock Valley

YUF - Yucca Flat

EXECUTIVE SUMMARY

This is a report of work performed by Reynolds Electrical & Engineering Company (REECo) [illegible] Monitoring Program (BECAMP) Task 3, to monitor the flora and fauna on the Nevada Test Site (NTS). It reports on the second year of efforts to monitor the status of plants and animals on the NTS.

Monitoring efforts were focused in two ways. The primary efforts were to sample ephemeral and perennial plants, resident small mammals, and common lizards on plots scattered throughout the NTS in both baseline and disturbed areas. In addition, wildlife usage was monitored at springs and other water sources on the NTS.

Plots sampled during 1988 included five baseline plots; two areas with vegetation removed by 1950s' atmospheric nuclear weapons tests; the area surrounding the 1962 Sedan nuclear plants were absent. Lizard reproduction was good in 1988. Observations were also recorded on 14 other lizard species and the desert tortoise, which is found on the southern parts of the NTS.

Small mammals trapped on areas cleared of vegetation by nuclear blasts, fire, gophers or scraping all showed a tendency to reduced numbers of two common species, the Great Basin kangaroo rat (*Dipodomys microps*) and the little pocket mouse (*Perognathus longimembris*). Merriam's kangaroo rat (*D. merriami*), in contrast, was as common on disturbed areas as on control plots. Sampling in the 1960s and 1970s (Sedan and Rock Valley) showed changes have occurred in dominance among the common species, but no consistent trends were apparent. Among rarer species, range extensions were found for weasels (*Mustela frenata*) from Yucca Flat to Rock Valley and the dark kangaroo mouse (*Microdipodops megacephalous sabulonis*) from north of the NTS onto Pahute Mesa.

Observations of utilization by wildlife of the natural and man-made water sources on the [illegible]

SECTION 1
EXTENT OF LAND DISTURBANCE

by

Richard B. Hunter and Philip A. Medica

The Nevada Test Site comprises approximately 3600 square kilometers divided into 27 geographical areas (Figure 1.1) that range in size from 13 km^2 (Area 23, Mercury) to 649 km^2 (Area 25, Nevada Research and Development Area, NRDA).

The types of disturbance considered here include burned areas resulting from lightning-initiated fires or man-caused fires; blast zones from nuclear tests radex areas (radiation

Gophers create large bare patches in the Mojave Desert sections of the NTS. A crude estimate of the total area of these is 400 ha, which would be largely in Areas 5, 22 and 25.

The area most heavily impacted by weapons testing is the Yucca Flat valley floor, composed of approximately 57,000 ha. Of that area, about 5724 ha (10%) have been blasted free of vegetation, 2039 ha (3.6%) are affected by subsidence craters and drill pads, and 1403 ha (2.5%) are contaminated by radionuclides. Since many of these disturbances overlap, the total percent of the valley floor disturbed by testing must be somewhat less than 15%.

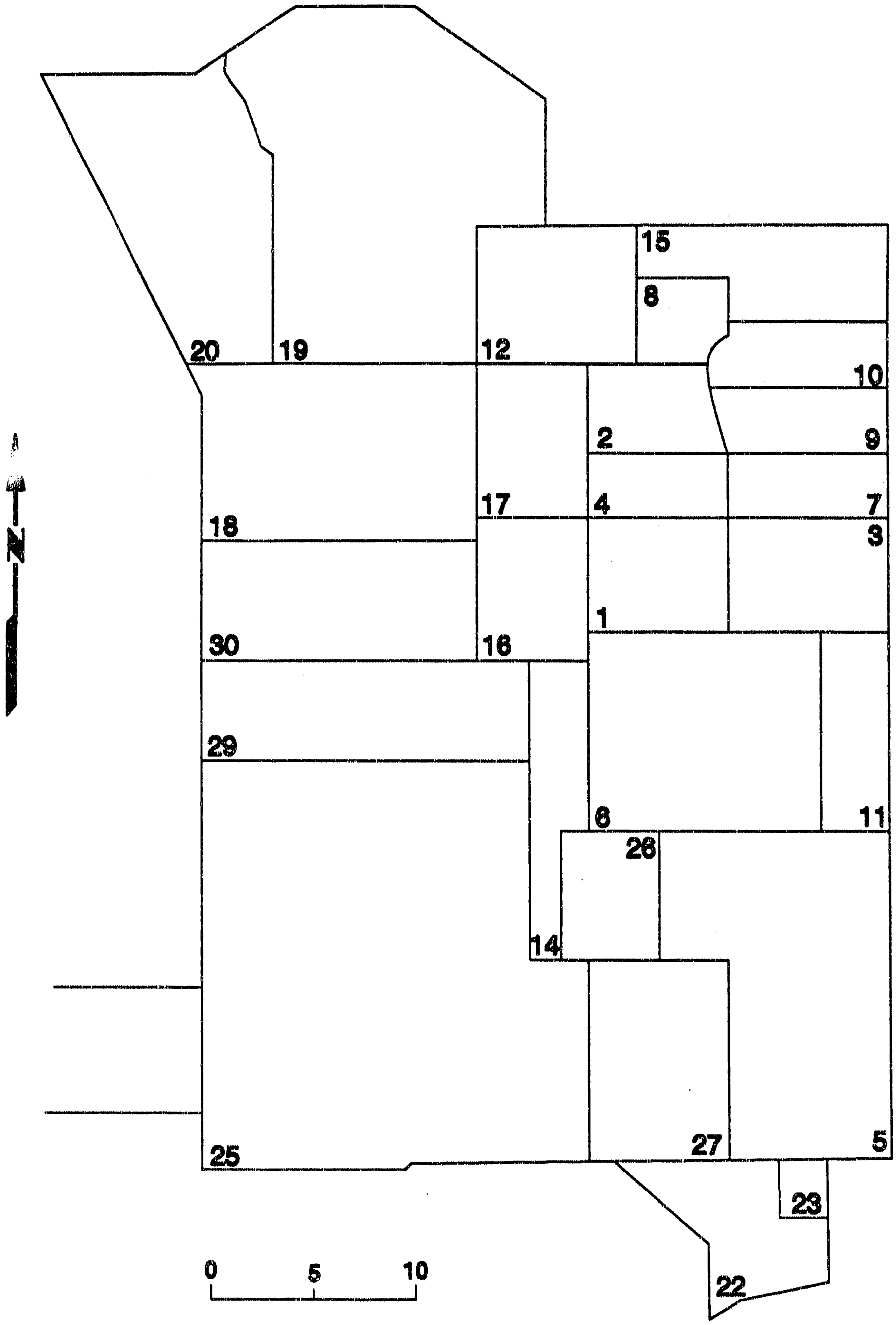


Figure 1.1 Area Designations on the Nevada Test Site

…Roads …d	Dirt ha	Waste Mgt. Areas ha
…5	15	
…2	8	
…5	9	8
…5	6	
…8	23	283
…6	37	
…8	4	
…0	4	
…5	7	
…9	4	
…7	17	
…7	10	
…4	13	
…2	0	
…1	16	
…9	–	
…4	25	
…8	62	
…2	30	
…9	1	
…7	–	
…8	63	
…5	5	
…0	10	
0	17	
0	31	
…6	405	291
…3	0.1	0.1

Table 1.1 (notes*)

Area:	Area designation on NTS maps.
Total area:	Based upon independent measurements on the NTS Map.
Blast zones:	Based upon map in BYU report, Allred et al. 1963**
Radex areas:	Based upon Radsafe Map, June 1984.
Alpha radex areas:	Based upon Radsafe Map, June 1984. (Area 11 area estimate is based upon the area beyond Barricade 11-2R).
Waste radex areas:	Based upon Radsafe Map, June 1984. Some radex areas may have been consolidated by now.
Tunnel radex areas:	Includes tailings, ponds, etc., in and around portals.
Craters:	Includes only the area within the crater (based upon approximations from NTS planning maps).
Drill pads at craters:	An estimate of the disturbed area around the crater. This estimate was usually made by simply doubling the area of the crater. This is a rough approximation.
Used and unused drill pads:	These include an estimate of one hectare at each mapped pad.
Estimated area of facilities:	Best guess by Medica and Hunter.
Burned Acres:	Fires since 1978; area estimated by Chief Gudeman, through January 1988.
Roads (Paved):	Measured on maps. Length X (18.3 m width).
(Dirt):	Measured on maps. Length X (6.10 m width). Many small dirt roads are not on the maps used. Skid lanes are not included. We consider this an underestimate.
Waste Mgt. areas:	Estimates by Neagle and Straight. January 1988.

*All calculations are based upon measurements made from maps and therefore should be

SECTION 2

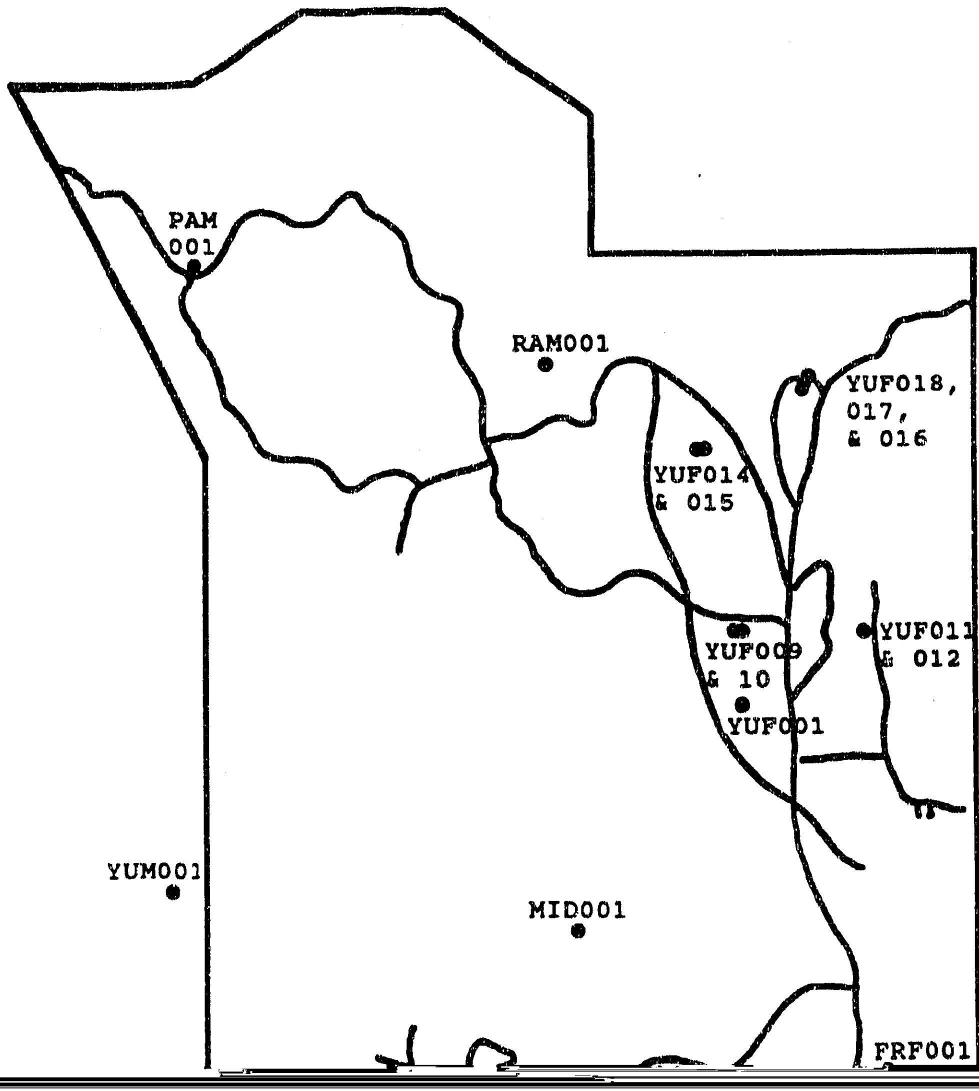
STATUS OF DESERT EPHEMERALS ON THE NEVADA TEST SITE IN 1988

by

Richard B. Hunter

INTRODUCTION

The desert areas of the Nevada Test Site (NTS) produce massive and beautiful displays of


PAM
001
RAM001
YUF018,
017,
& 016
YUF014
& 015
YUF009
& 10
YUF011
& 012
YUF001
YUM001
MID001
FRF001

and other herbaceous perennials were sampled with perennials if they could be conveniently measured during the summer. Summer annual plants were sometimes measured with the perennials on a site, but never harvested. Their presence was noted on perennial data sheets.

Taxonomy of ephemerals followed Munz (1974) and/or Cronquist et al. (1977), with synonymy following Kartesz and Kartesz (1980). Specimens were compared to those in the NTS/DOE herbarium curated by BECAMP personnel, and a voucher for each species collected in 1988 was deposited in that herbarium.

The error terms on density and biomass in Tables 1-26 are standard errors of the mean (sem). The average $\pm$ sem of the total number of plants per quadrat and g/m^2 per quadrat are also given. They were calculated without checking for normal distribution, and should be used with caution when comparing data from different points and times. They are included to give a representation of variability. Species which occurred in only one of twenty quadrats had standard errors equal to the mean, and only the most common species had standard errors less than half the mean.

Soil moisture was measured on Plots MER001a and MER001b using fiberglass-block electrical resistance sensors (Soil Test, Incorporated; Colman and Hendrix 1949) calibrated as described by Hunter and Greger 1986. The calibration technique involved equilibration to a constant reading of a soil and sensor in a closed container with periodic additions of water. Estimation of volumetric soil moisture was based on an assumed soil bulk density of 1 g/cc (particles < 2 mm), and available soil moisture was estimated as that greater than 5% moisture.

RESULTS

Results for the sites examined in 1988 appear in Tables 2.1 though 2.26 for the quadrats for which biomass was sampled. For rarer species presence-absence data are presented in Tables 2.27 through 2.30. The original data sheets are stored in the BECAMP Data Repository, and the data are expected eventually to be in the BECAMP data base managed by the Desert Research Institute (DRI).

Tables 2.1 through 2.26 are presented roughly in order of altitude, beginning with the Mojave Desert valleys and ending on the mesas. On two sites (FRF001, YUF001) replicate transects were done while training personnel to use the technique. I believe the differences between replicates reflect actual variations in ephemeral populations between adjacent sample locations, rather than errors made during training, with the possible exception of the number of rare species recognized (Tables 2.27, 2.28).

Estimates of available soil moisture in the top 30 cm of soil are given in Table 2.31 for Plot MER001a in Mercury, NV. The precipitation reported by NOAA/USWB in the periods between readings of soil moisture sensors is included.

DISCUSSION

It appears there are three modes with which man is interacting with annual populations on the Nevada Test Site. The greatest in terms of effect is not the activities of the Department of Energy; it is the introduction of non-native species to the Western United States in years prior to the establishment of the NTS. The second is the interaction between man and range fires, which have burned significant areas on the NTS. Since many range fires are caused by lightning, and all are controlled to some extent by DOE-supported fire-suppression efforts, the primary effect of the DOE proprietorship is probably to minimize the areas affected by burns. The third mode is the scraping of land for NTS construction and cleanup activities. The underground testing of nuclear weapons entails a small amount of land surface clearing for road construction and drilling activities. General support for NTS personnel also includes some clearing activities. In 1988 no observations were made to study the possibility that radiation from previous testing or toxic gas spills from current testing had any effects on germination, growth, or reproduction of ephemeral plants. There is a continuing possibility, not studied, that nitrogen oxides from air pollution might increase fertility of the desert soils, and thus growth of desert ephemerals (Heil et al. 1988).

Other agents affecting ephemeral plants on the NTS include the major influence on their growth - the weather - and also pocket gophers (*Thomomys umbrinus*) and other small burrowing rodents; granivorous rodents (e.g., *Dipodomys merriami*) and granivorous birds (e.g., Gambel's quail, chukar); and grazing animals (feral horses, deer, and rabbits).

Introduced species of ephemerals encountered in 1988 are indicated with asterisks in Table 2.27-2.30. Of those species, three are widespread on the NTS (*Bromus rubens*, *B. tectorum*, and *Salsola* sp.), and one (*Sisymbrium altissimum*) is apparently increasing in abundance (compare Tables 2.27-2.29 with Beatley (1965, 1966) and Rickard and Sauer 1982). The fifth, *Erodium cicutarium*, which was probably introduced into Mexico much earlier than the other species (Frenkel 1970), appears to be at an equilibrium status of being locally abundant on disturbed areas but largely absent from undisturbed sites.

The two abundant *Bromus* species now dominate most sites where annuals are common on the NTS. As discussed in Hunter and Medica (1989), they are associated with an increased fire frequency, due to the persistence of the dead plants after they die in the late spring. Note that the burned area in Mid Valley (MID001, Table 2.11) was dominated by *B. tectorum* the second spring after it burned. This suggested that fire was considerably more detrimental to the perennials and native ephemerals than to the *Bromus* species, and that the adaptation to fire propagation was advantageous to the brome grasses. *B. tectorum* spread

through the Pacific Northwest in the late 19th century (Mack 1981) with the introduction of grazing animals. Both *B. tectorum* and *B. rubens* were absent from Southern California and the Death Valley area in 1891, when the vegetation was surveyed by the Dept. of Agriculture (Coville, 1893).

Two sites repeatedly surveyed for *Bromus* species for which we have past data are plots in Rock Valley censused by the late Dr. Janice Beatley. A comparison of BECAMP data taken next to those plots (Table 2.32) shows a dramatic increase in the densities of *B. rubens* in Rock Valley. These densities were representative of other Mojave Desert sections of the NTS.

A comparison of annual net production by ephemerals on Beatley Plot 3 with an equation derived by Turner and Randall (1989) shows 36 $\pm$ 8 g/m^2 measured (Table 2.1), versus 26 g/m^2 predicted. For Beatley Plot 4 (Table 2.2), however, measured production was just 14 $\pm$ 4 g/m^2, and averaging the quadrat data from the two BECAMP Plots from Rock Valley then closely resemble the predicted values (25 $\pm$ 5 g/m^2). The two Beatley plots represent two fairly different habitats, while Turner and Randall's data were from a wide variety of sites in Rock Valley.

The causes of the dramatic increase in *Bromus rubens* densities were not clear. Experiments in the late 1960s and mid-1970s showed a marked tendency for *B. rubens* to increase dramatically when undisturbed desert was irrigated (Medica, personal communication; Romney et al. 1978), and the increase was enhanced significantly by added nitrogen (Romney et al. 1978; Hunter et al. unpublished data). Precipitation (September through March) during the major period of increase, 1975-1988, was 141 $\pm$ 13mm (sem), versus 103 $\pm$ 19 between 1964 and 1974. It is also possible, but purely speculative, that NO_x pollutants have increased the supply of nitrogen in the upper surface of desert soils and thereby increased growth and reproduction of these weedy species (Heil et al. 1988). These factors might have abetted the increase, but it is also reasonable that these grasses have not yet reached an equilibrium concentration since their introduction to the Mojave Desert in the early twentieth century.

The dense and heavy populations of *B. rubens* on the gopher area in Mercury Valley (MER002, Table 2.4) are an extreme population related to gopher removal of shrubs and soil disturbance associated with their burrowing activities. A similar situation was sampled in Frenchman Flat in 1987 (Hunter and Medica, 1989), with densities of 2644 $\pm$ 716 and biomass of 37 $\pm$ 8 g/m^2. The 1987 site was also an area with considerable gopher activity and reduced shrub densities.

Historical data are less available for *Bromus tectorum* (as opposed to *Bromus rubens)* on the NTS, but it appears to be increasing dramatically in abundance in some areas. Rickard and Sauer (1982), for example, found only *B. rubens* at the T2C site of the Shasta test in the northwestern part of Yucca Flat in 1957. It was absent from the area around Sedan crater in censuses of 1962, 1965, and 1975-6, appearing only in censuses of 1983 and 1986 (Hunter, unpublished data). In 1988 it was abundant around Sedan crater, most dramatically in the areas bared by the Sedan blast (YUF016, YUF017; Tables 2.21, 2.22), where it dominated the vegetation. In the area undisturbed by the Sedan event (YUF018, Table 2.23) *B. rubens* was the most common ephemeral.

A similar pattern occurred at the T1 ground zero. The blast area, in which only sparse perennials have reappeared, was dominated in 1988 by a mixed population of *B. tectorum* and

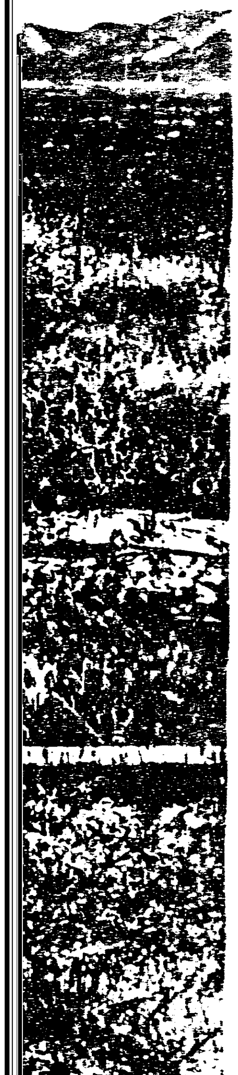
B. rubens (YUF009, Table 2.15). In contrast, a control plot just outside the blast area was dominated by *B. rubens* alone (YUF010, Table 2.16). A photograph of a revegetation site within the T1 blast area taken in 1983 (Figure 2.2) shows a good population of *B. rubens* with a few specimens of *B. tectorum*. In the interim it appears that *Bromus tectorum* increased significantly while *B. rubens* suffered from the competition. A comparison of information on the two *Bromus* species when they occurred together suggests some differences (Table 2.33). First, there was a tendency in disturbed areas for *Bromus rubens* to be smaller than in a shrub-dominated microhabitat. There was an opposite tendency in *Bromus tectorum*. It appeared, then, that disturbance favored the larger species, *B. tectorum*, while the absence of disturbance favored *B. rubens*. Thus a pattern appeared in which *B. tectorum* was dominant on roadsides and disturbed areas, while *B. rubens* was dominant within a shrub community.

As noted above, the dominance of the ephemeral flora on the NTS by the *Bromus* species is a relatively new phenomenon. The ecological consequences are therefore just beginning to be seen. One consequence noted in other areas is an increase in the extent of fires. To determine what densities of grass were needed to carry a fire, a sample was taken at a site within an area that burned in June 1988, in a valley between Forty Mile Canyon and Yucca Mountain. The area sampled was protected from the fire by a knoll and a dirt road, (Figure 2.3), and was very likely representative of the vegetation which had burned. The average densities were 1460 $\pm$ 380 plants per square meter of *B. rubens* and 700 $\pm$ 40 of *B. tectorum*. Total biomass of dead grass was 47 $\pm$ 13 g/m^2. Comparison of these data with those from areas sampled earlier in the spring suggested several areas would easily burn, if ignited. In particular, the Mid Valley burned area (Table 2.11) and the Mercury Valley gopher area (Table 2.11) should have had enough dry grass to carry a fire. These conditions appeared to be common on the NTS in 1988, and it seemed reasonable that the absence of range fires in most areas was not due to lack of fuel, but rather to the absence of factors causing ignition. A record of fire causes from 1978 to the present is maintained by the NTS fire protection services, and their data suggest most fires are caused by lightning and cigarettes thrown out of car windows, with a few ignited by tests of ammunition.

One area which has burned frequently in the history of the test site is Mid Valley. As noted above, the presence of heavy concentrations of *B. tectorum* on the site burned in 1986 (MID001b, Table 2.11) suggested that the fires there have favored that species.

Another plant species which may be adapted to fire is the Joshua Tree, *Yucca brevifolia*. By sticking up above the level of surrounding vegetation, it seems to attract lightning, while the long persistence of dried leaves along its stems makes the plant easily burned. As we showed in the reports of 1987 studies (Hunter and Medica 1989; Table 10, Figure 5), many *Y. brevifolia* of intermediate size produced new shoots at the base following a fire.

Another significant question relating to the *Bromus* species is whether they are competitively excluding the native desert "wildflowers" from their historic habitat by their dense growth. However, the nature of ephemerals in the Mojave Desert seems to be an adaptation to eedy grasses in the



massive germination and growth only in rare years, during which many species grow and reproduce much better than normal. Those events have occurred on the NTS in 1958, 1966, 1968, 1969, 1973, and 1978, but not in the 1980s. They require a wet fall as well as a wet spring (Beatley 1974). It is probable that the native ephemerals growing in "normal" dry years are not part of the main, successfully adapted populations of their respective species; therefore, comparisons of diversities in "normal" years would be misleading. Available data are probably not yet sufficient to document a decrease in diversity which might be caused by the introduced species. Some experimental work elucidating the nature of the native-introduced species interactions is probably warranted to answer this question.

The third major introduced species which continues to be of significance on the NTS is the tumbleweed, Russian thistle, *Salsola* sp. The taxonomy of this species is problematic, and we have therefore not given it a specific epithet in this report. Dr. Beatley used *S. paulsenii* and *S. iberica* to describe two intergrading morphological types present on the NTS (Beatley 1973; Wallace and Romney 1972, p. 152). It invaded the "ground zeros(GZ)" shortly after the atmospheric testing in the 1950s (Shields et al. 1963), and was still dominant on some of those sites until the late 1970s. It now occurs in abundance on disturbed areas in the year following the disturbance, as was seen in 1988 on one site studied, Waste Management Consolidation Site 3B (Table 2.17).

Russian thistle germinates in the winter or spring, but grows in the summer. The population density on YUF011 in April 1988 was $12 \pm 5/m^2$ and biomass was $0.7 g/m^2$. In August the site had a Russian thistle density still $14 \pm 2/m^2$ with biomass of $334 g/m^2$, showing a great deal of growth and essentially no occurrence of mortality. This cannot be taken as a representative productivity of Russian thistle for other sites where many seedlings germinated, because in other locations it appeared the seedlings died rather than grew, as at T1 GZ (YUF009, Table 2.15) and Sedan (YUF016, Table 2.21) and T2 GZ (YUF014).

At the present time it seems likely that a successional process is occurring on the "ground zeros" that is very similar to a sequence described by Piemeisel for farmland in Idaho (Piemeisel 1938, 1951). Over a period of several years he documented first invasion by *Salsola*, then its replacement by *Bromus* species; *Bromus* was itself replaced by the mustards *Sisymbrium altissimum* and a *Descurainia sp.* On the NTS the first step of that process apparently required about 20 to 25 years, and we are now in the *Bromus*-dominated phase. *Sisymbrium altissimum* appears now to be increasing in abundance but is not yet really common (Table 2.29).

Some of the introduced species are adapted to growing on disturbed sites, in particular *Salsola*, *Bromus tectorum*, and *Sisymbrium altissimum*. Nevertheless, because *Bromus rubens* is adapted to a shrub-dominated environment, the introduced species make up a large proportion of the ephemeral biomass even on undisturbed areas (Table 2.34). One cannot therefore suggest that the environmental effects of the introduced species might be mitigated by limiting the extent of disturbance. In 1988 the only introduced plant species with a significant population in general habitats was *Bromus rubens*.

[redacted]
increased in density, the native annuals have not at the same time decreased in density.

One must bear in mind always that the native species may only be represented accurately in unusual years when the majority of seeds might germinate, but at least we may judge the trend as suggesting that the increase in the introduced species has not caused a decrease in the native species.

Other introduced species may interact with desert ephemerals. A tree, *Tamarix ramosissima*, is present on the NTS and has caused problems for aquatic ecosystems in Death Valley.
[redacted]

Table 2.2 Ephemeral population characteristics on Plot ROV006, Beatley Plot 4 in Rock Valley, measured on March 29, 1988.

Species	n/m^2	g/m^2	mg/plant
Bromus rubens	514 ± 158	9 ± 2	24 ± 4

Table 2.4 Ephemeral population characteristics on Plot MER002, Mercury gopher

Species	n/m²	g/m²	mg/plant
Amsinckia tessellata	4 ± 4	.2 ± .2	42
Bromus rubens	3550 ± 366	70 ± 6	24 ± 3
Chaenactis fremontii	14 ± 8	.2 ± .1	23 ± 9
Eriogonum (unidentifiable)	8 ± 5	.006 ± .003	.8 ± .2
Euphorbia albomarginata	106 ± 32	1.4 ± .4	12 ± 6
Gilia transmontana	4 ± 4	.006 ± .006	3
Vulpia octoflora	6 ± 6	.04 ± .04	21
Mean Quadrat Totals	3692 ± 369	72 ± 6	

Table 2.5 Ephemeral population characteristics for Plot MER001a, Mercury water balance plot control, measured April 7, 1988.

Species	n/m²	g/m²	mg/plant
Bromus rubens	443 ± 130	9 ± 2	25 ± 4
B. tectorum	2 ± 2	.04 ± .04	24
Chorizanthe rigida	3 ± 2	.07 ± .06	22 ± 12
Cryptantha nevadensis	2 ± 2	.02 ± .02	15
Descurainia pinnata	3 ± 2	.02 ± .01	6
Eriogonum deflexum	2 ± 2	.02 ± .02	11
Erodium cicutarium	6 ± 4	.34 ± .26	44 ± 19
Gilia transmontana	10 ± 7	.20 ± .14	20 ± 8
Ipomopsis polycladon	24 ± 13	.24 ± .14	8 ± 2
Langloisia setosissima	2 ± 2	.02 ± .02	10
Vulpia octoflora	85 ± 32	5 ± 2	9 ± 3

Table 2.6 Ephemeral population characteristics on Plot MER001b, Mercury water balance plot with shrubs removed, measured April 5, 1988.

Species	n/m²	g/m²	mg/plant
Bromus rubens	1912 ± 475	16 ± 5	12 ± 2
B. tectorum	8 ± 6	.34 ± .26	52 ± 14
Chaenactis stevioides	29 ± 14	.3 ± .2	18 ± 8
Chorizanthe rigida	6 ± 5	.04 ± .03	8 ± 2
Cryptantha circumscissa	54 ± 42	.6 ± .5	13 ± 2
C. recurvata	2 ± 2	.07 ± .07	45
Descurainia pinnata	14 ± 7	.09 ± .07	6 ± 4
Eriastrum eremicum	5 ± 4	.05 ± .04	15 ± 11
Eriogonum deflexum	72 ± 17	.3 ± .1	5 ± 2
Erodium cicutarium	278 ± 42	10 ± 1	47 ± 7
Gilia transmontana	2 ± 2	.003 ± .003	2
[illegible]	[illegible]	[illegible]	[illegible]
Langloisia setosissima	3 ± 2	.09 ± .07	30 ± 1
Linanthus demissus	2 ± 2	.002 ± .002	1
Pectocarya platycarpa	6 ± 4	.09 ± .06	18 ± 10
Schismus sp.	294 ± 103	1.7 ± 0.8	4.4 ± 0.7
Vulpia octoflora	365 ± 78	1.5 ± 0.2	6 ± 2
Mean Quadrat Totals	3070 ± 522	32 ± 6	

Table 2.7 Ephemeral population characteristics on Plot FRF001a, Frenchman Flat baseline plot (Beatley Plot 23), replicate 1, measured April 13, 1988.

Species	n/m²	g/m²	mg/plant
Amsinckia tessellata	4 ± 4	2 ± 2	402
Bromus rubens	258 ± 153	13 ± 6	145 ± 114
B. tectorum	4 ± 4	.2 ± .2	39
Chaenactis fremontii	8 ± 6	.7 ± .6	92 ± 62
Cryptantha circumscissa	16 ± 9	.4 ± .2	30 ± 12
C. micrantha	18 ± 6	.4 ± .1	19 ± 2
C. recurvata	2 ± 2	.03 ± .03	15
Descurainia pinnata	12 ± 12	2 ± 2	134
Eriophyllum pringlei	4 ± 4	.08 ± .08	20
Gilia sinuata	16 ± 6	.3 ± .1	20 ± 6
Malacothrix glabrata	4 ± 3	13 ± 13	3172 ± 3152
Monoptilon bellidiforme	2 ± 2	.05 ± .05	25
Mean Quadrat Totals	348 ± 156	31 ± 17	

Table 2.8 Ephemeral population characteristics on Plot FRF001, replicate 2, measured April 13, 1988.

Species	n/m²	g/m²	mg/plant
Bromus rubens	152 ± 74	5 ± 2	50 ± 11
Chaenactis fremontii	2 ± 2	2 ± 2	748
Cryptantha circumscissa	6 ± 4	.05 ± .04	8 ± 1
C. micrantha	36 ± 15	.6 ± .2	20 ± 5
C. recurvata	2 ± 2	.05 ± .05	24

Table 2.9 Ephemeral population characteristics on Plot FKF002a, Frenchman Flat roadside, measured on March 30, 1988.

Species	n/m²	g/m²	mg/plant
Bromus rubens	4 ± 3	.2 ± .1	53 ± 5
Chorizanthe rigida	2 ± 2	.01 ± .01	5
Cryptantha micrantha	88 ± 25	2.0 ± 0.8	20 ± 8
Cryptantha recurvata	8 ± 6	.09 ± .07	10 ± 2
Eriogonum (unidentifiable)	4 ± 3	.06 ± .06	16 ± 14
Eriophyllum pringlei	2 ± 2	.03 ± .03	16
Erodium cicutarium	2 ± 2	.02 ± .02	101
Gilia cana	2 ± 2	.04 ± .04	19
Linanthus arenicola	2 ± 2	.002 ± .002	1
Nama demissum	24 ± 8	.3 ± .1	16 ± 6
Schismus sp.	2 ± 2	.03 ± .03	16
Mean Quadrat Totals	210 ± 78	5 ± 2	

Table 2.10 Ephemeral population characteristics on Plot FRF002b, Frenchman Flat roadside control, measured on March 30, 1988.

Species	n/m²	g/m²	mg/plant
Amsinckia tessellata	8 ± 4	1.7 ± 1.5	228 ± 166
Astragalus acutirostris	2 ± 2	.07 ± .07	37
Bromus rubens	34 + 22	2.5 + 1.6	116 + 33
Camissonia pterosperma	8 ± 4	.03 ± .02	4 ± 1
Chaenactis stevioides	38 ± 25	.85 ± .69	15 ± 9
Chaenactis xantiana	2 ± 2	.06 ± .06	33
Cryptantha circumscissa	2 ± 2	.02 ± .02	12
C. pterocaryaa	11 ± 8	.14 ± .10	12 ± 1
Descurainia pinnata	131 ± 92	3.5 ± 2.0	93 ± 35
Eriogonum maculatum	2 ± 2	.03 ± .03	14
Eriophyllum pringlei	21 ± 17	.07 ± .05	5 ± 3
Gilia sinuata	15 ± 7	.17 ± .08	14 ± 5
Langloisia setosissima	2 ± 2	.002 ± .002	1
Lepidium lasiocarpum	46 ± 46	1.5 ± 1.5	34
Linanthus arenicola	4 ± 4	.006 ± .006	2
Lupinus flavoculatus	2 ± 2	.01 ± .01	5
Malacothrix glabrata	17 ± 8	1.0 ± 0.6	50 ± 17
Mentzelia albicaulis	8 ± 6	.7 ± .5	88 ± 1
Nama demissum	4 ± 4	.004 ± .003	1 ± 0
Phacelia fremontii	2 ± 2	.01 ± .01	7
P. vallis-mortae	2 ± 2	.4 ± .4	235
Rafinesquia neomexicana	2 ± 2	.2 ± .2	103
Streptanthella longirostris	2 ± 2	.04 ± .04	22
Vulpia octoflora	11 ± 11	.16 ± .16	14
Mean Quadrat Totals	375 ± 151	13 ± 5	

Table 2.11 Ephemeral population characteristics from Plot MID001a, Mid Valley burned area, measured on May 5, 1988. (Herbaceous perennials are not included in the totals.)

Species	n/m²	g/m²	mg/plant
Allium nevadense	2 ± 2	.008 ± .008	4
Bromus rubens	114 ± 37	1.7 ± 0.7	26 ± 11
B. tectorum	3916 ± 752	89 ± 16	33 ± 7
Chaenactis stevioides	38 ± 25	.85 ± .69	15 ± 9
Chaenactis xantiana	2 ± 2	.06 ± .06	33
Cryptantha micrantha	6 ± 6	.002 ± .002	<1
Descurainia pinnata	24 ± 13	.11 ± .08	3 ± 1
Eriastrum eremicum	32 ± 32	.09 ± .09	29
Gilia sinuata	44 ± 25	.29 ± .13	11 ± 7
Gilia transmontana	44 ± 42	.25 ± .19	19 ± 14
(Phlox stansburyi)	(86 ± 19)	(16 ± 4)	(231 ± 57)
Salsola spp.	2 ± 2	.008 ± .008	4
Mean Quadrat Totals	4182 ± 768	92 ± 17	

Table 2.12 Ephemeral population characteristics on Plot MID001b, Mid Valley control area, May 5, 1988. (Herbaceous perennials are not included in the totals.)

Species	n/m^2	g/m^2	mg/plant
Astragalus purshii	2 ± 2	.02 ± .02	12
Bromus rubens	362 ± 84	4.3 ± 1.2	11 ± 1
B. tectorum	414 ± 152	8 ± 3	20 ± 2
Bromus unidentifiable	100 ± 39	.7 ± .4	6 ± 1
Chorizanthe thurberi	6 ± 3	.02 ± .02	4 ± 3
Cryptantha circumscissa	16 ± 11	.03 ± .02	2 ± 0
C. pterocarya	30 ± 20	.17 ± .11	6 ± 1
Descurainia pinnata	4 ± 4	.002 ± .002	<1
Eriastrum eremicum	6 ± 3	.03 ± .02	5 ± 2
Erodium cicutarium	2 ± 2	.05 ± .05	27
Euphorbia albomarginata	4 ± 4	.01 ± .01	6
Gilia sinuata	20 ± 10	.07 ± .04	4 ± 1
Gilia transmontana	2 ± 2	.03 ± .03	13
(Hilaria jamesii)	22 ± 13	5 ± 4	226 ± 140
Linanthus dichotomus	20 ± 7	.2 ± .1	8 ± 3
Microseris linearis	2 ± 2	.07 ± .07	35
Phacelia fremontii	2 ± 2	.02 ± .02	8
P. vallis-mortae	4 ± 4	.3 ± .3	160
(Phlox stansburyi)	36 ± 15	5.4 ± 2.4	160 ± 48
Vulpia microstachys	142 ± 77	1.4 ± 0.8	10 ± 2
V. octoflora	28 ± 16	.12 ± .08	3 ± 1
Mean Quadrat Totals	1166 ± 229	15 ± 4	

Table 2.13 Ephemeral population characteristics on Plot YUF001, Yucca Flat baseline plot, replicate 1, measured April 14, 1988.

Species	n/m²	g/m²	mg/plant
Astragalus lentiginosus	2 ± 2	2 ± 2	1221
Bromus rubens	1872 ± 556	18 ± 4	14 ± 1
B. tectorum	20 ± 11	.5 ± .3	23 ± 6
Chaenactis stevioides	16 ± 7	.14 ± .06	9 ± 2
Cryptantha pterocarya	2 ± 2	.05 ± .05	24
Descurainia pinnata	2 ± 2	.008 ± .008	4
Eriogonum nidularium	10 ± 10	.04 ± .04	4
Eriophyllum pringlei	8 ± 6	.03 ± .02	4 ± 0y
Gilia transmontana	2 ± 2	.01 ± .01	5
Lupinus flavoculatus	2 ± 2	.09 ± .09	47
Malacothrix glabrata	8 ± 6	.02 ± .01	2 ± 0
Phacelia fremontii	2 ± 2	.002 ± .002	1
Mean Quadrat Totals	1956 ± 557	21 ± 5	

Table 2.14 Ephemeral population characteristics on Plot YUF001, replicate 2, measured on April 14, 1988.

Species	n/m²	g/m²	mg/plant
Bromus rubens	1434 ± 304	22 ± 4	16 ± 2
B. tectorum	4 ± 3	.2 ± .1	38 ± 23
Chaenactis carphoclinia	2 ± 2	.1 ± .1	68
C. stevioides	8 ± 4	.2 ± .2	20 ± 8
Cryptantha circumscissa	2 ± 2	.004 ± .004	2
C. recurvata	4 ± 4	.02 ± .02	10
Descurainia sophia	2 ± 2	.01 ± .01	6
Gilia transmontana	2 ± 2	.01 ± .01	7
Lupinus flavoculatus	8 ± 5	.2 ± .1	22 ± 7
Machaeranthera canescens	4 ± 3	.004 ± .004	1 ± 0
Mean Quadrat Totals	1470 ± 306	23 ± 5	

Table 2.15 Ephemeral population characteristics on Plot YUF009, T1 ground zero, measured on April 26, 1988.

Species	n/m²	g/m²	mg/plant
Bromus rubens	1472 ± 356	14 ± 4	11 ± 2
B. tectorum	1884 ± 396	26 ± 5	17 ± 4
B. unidentifiable	268 ± 142	1.7 ± 0.9	7 ± 2
Euphorbia albomarginata	28 ± 15	.04 ± .03	6 ± 2
Salsola sp.	128 ± 34	.3 ± .1	2 ± 0
Mean Quadrat Totals	3880 ± 340	42 ± 4	

Table 2.16 Ephemeral population characteristics on Plot YUF010, T1 ground zero control, measured on April 26, 1988.

Species	n/m²	g/m²	mg/plant
Bromus rubens	188 ± 49	5 ± 2	42 ± 21
B. tectorum	2 ± 2	.01 ± .01	5
Chaenactis stevioides	4 ± 3	.03 ± .02	7 ± 1
Chorizanthe thurberi	6 ± 3	.2 ± .1	30 ± 8
Cryptantha circumscissa	12 ± 6	.11 ± .08	11 ± 8
Eriogonum nidularium	4 ± 3	.05 ± .04	12 ± 8
Eriophyllum pringlei	32 ± 10	.4 ± .1	15 ± 4
Euphorbia albomarginata	4 ± 4	.008 ± .008	2
Langloisia schottii	4 ± 3	.01 ± .01	4 ± 2
Salsola sp.	2 ± 2	.03 ± .02	1
Mean Quadrat Totals	258 ± 55	6 ± 2	

Table 2.17 Ephemeral population characteristics on Plot YUF011, 3B waste consolidation site, measured April 25, 1988.

Species	n/m^2	g/m^2	mg/plant
Salsola sp.	12 ± 5	.7 ± .4	65 ± 22
Mean Quadrat Totals	12 ± 5	.7 ± .4	

Table 2.18 Ephemeral population characteristics on Plot YUF012, 3B waste consolidation site control area, measured on April 25, 1988. (The unknown grass seedlings were probably perennials, and are excluded from the totals.)

Species	n/m^2	g/m^2	mg/plant
Bromus rubens	652 ± 358	15 ± 2	42 ± 7
Cryptantha pterocarya	2 ± 2	.2 ± .2	89
C. recurvata	12 ± 7	.2 ± .1	22 ± 6
Descurainia pinnata	2 ± 2	.04 ± .04	21
D. sophia	4 ± 3	.09 ± .06	54 ± 50
Eriastrum eremicum	4 ± 3	.2 ± .1	50 ± 8
Eriophyllum pringlei	2 ± 2	.03 ± .03	13
Salsola sp.	18 ± 7	.09 ± .06	4 ± 1
(Unknown grass seedlings)	24 ± 24	.03 ± .03	1
Mean Quadrat Totals	696 ± 334	16 ± 6	

Table 2.19 Ephemeral population characteristics on Plot YUF014, T2-1 ground zero, measured May 9, 1988.

Species	n/m^2	g/m^2	mg/plant
Bromus rubens	774 ± 169	8 ± 2	13 ± 2
Cryptantha circumscissa	20 ± 13	.12 ± .08	5 ± 2
Erodium cicutarium	140 ± 33	1.7 ± 0.4	13 ± 2
Salsola sp.	44 ± 14	.10 ± .04	2 ± 1
Mean Quadrat Totals	978 ± 151	12 ± 2	

Table 2.20 Ephemeral population characteristics on Plot YUF015, T2-1 control area, measured May 9, 1988.

Species	n/m^2	g/m^2	mg/plant
Bromus rubens	658 ± 344	9 ± 4	22 ± 5
B. tectorum	4 ± 4	.08 ± .08	20
Chorizanthe rigida	2 ± 2	.06 ± .06	29
Cryptantha micrantha	8 ± 8	.02 ± .02	3
Eriogonum nidularium	2 ± 2	.05 ± .05	27
Erodium cicutarium	82 ± 33	5 ± 2	132 ± 85
Gilia transmontana	2 ± 2	.1 ± .1	54
Salsola sp.	2 ± 2	.004 ± .004	2
Sisymbrium altissimum	2 ± 2	.03 ± .03	17
Mean Quadrat Totals	762 ± 360	14 ± 4	

Table 2.21 Ephemeral population characteristics on Plot YUF016, Sedan, 305 meters from ground zero, measured on April 28, 1988.

Species	n/m²	g/m²	mg/plant
Astragalus lentiginosus	3 ± 3	9 ± 9	3514
Bromus rubens	19 ± 11	.4 ± .2	23 ± 8
B. tectorum	1155 ± 431	29 ± 9	47 ± 12
B. unidentifiable	29 ± 15	.3 ± .2	26 ± 20
Cryptantha circumscissa	5 ± 5	.2 ± .2	28
Descurainia sophia	3 ± 3	.2 ± .2	86
Eriogonum nidularium	3 ± 3	.003 ± .003	1
Gilia sinuata	3 ± 3	.06 ± .06	24
Mentzelia albicaulis	3 ± 3	.3 ± .3	100
Salsola sp.	557 ± 217	2 ± 1	5 ± 2
Mean Quadrat Totals	1779 ± 525	42 ± 12	

Table 2.22 Ephemeral population characteristics on Plot YUF017, Sedan, 914 meters from ground zero, measured on April 28, 1988.

Species	n/m²	g/m²	mg/plant
Bromus rubens	324 ± 154	4 ± 2	9 ± 2
B. tectorum	2004 ± 424	26 ± 7	19 ± 6
B. unidentifiable	36 ± 24	.5 ± .3	18 ± 12
Chaenactis carphoclinia	4 ± 4	.004 ± .004	1
Cryptantha circumscissa	28 ± 12	.11 ± .05	4 ± 1
Erodium cicutarium	8 ± 8	.5 ± .5	66
Euphorbia albomarginata	8 ± 5	.13 ± .09	16 ± 4
Salsola sp.	60 ± 27	.12 ± .06	2 ± 0
Mean Quadrat Totals	2469 ± 493	31 ± 8	

Table 2.23 Ephemeral population characteristics on Plot YUF018, Sedan, 1524 meters from ground zero, measured May 2, 1988.

Species	n/m²	g/m²	mg/plant
Bromus rubens	142 ± 69	5 ± 3	33 ± 13
B. tectorum	2 ± 2	.02 ± .02	10
Chaenactis stevioides	10 ± 6	.2 ± .1	17 ± 2
Cryptantha circumscissa	2 ± 2	.002 ± .002	1
Descurainia pinnata	4 ± 4	.2 ± .2	36
Gilia sinuata	4 ± 3	.10 ± .07	24 ± 1
Ipomopsis polycladon	2 ± 2	.08 ± .08	40
Lepidium lasiocarpum	10 ± 5	.04 ± .02	4 ± 1
Oxytheca perfoliata	2 ± 2	.006 ± .006	3
Sisymbrium altissimum	2 ± 2	.05 ± .05	27
Mean Quadrat Totals	180 ± 71	5 ± 3	

Table 2.24 Ephemeral plant population characteristics on Plot PAM001, Pahute Mesa baseline plot, measured on May 23, 1988. (*Phlox stansburyi*, an herbaceous perennial, is excluded from the totals.)

Species	n/m²	g/m²	mg/plant
Astragalus calycosus	1.0 ± 0.7	.02 ± .02	23 ± 5
Cryptantha pterocarya	1.0 ± 0.7	.01 ± .01	10 ± 6
Descurainia pinnata	2 ± 1	.03 ± .02	14 ± 5
Gilia transmontana	28 ± 12	.5 ± .2	16 ± 3
Phacelia fremontii	.5 ± .5	.004 ± .004	9
(*Phlox stansburyi*)	(2 ± 1)	(.4 ± .2)	102 ± 30
Mean Quadrat Totals	32 ± 12	.5 ± .2	

Table 2.25 Ephemeral and herbaceous perennial population characteristics on Plot RAM001, Rainier Mesa baseline plot, measured May 25, 1988. (Herbaceous perennials are excluded from the totals.)

Species	n/m²	g/m²	mg/plant
(*Chaenactis douglassii*)	(.5 ± .5)	(.01 ± .01)	21
(*Eriogonum umbellatum*)	(.5 ± .5)	(.1 ± .1)	194
Gayophytum decipiens	.5 ± .5	.004 ± .004	9
(*Poa sandbergii*)	(.5 ± .5)	(.07 ± .07)	140
(*Streptanthus cordatus*)	(.5 ± .5)	(.08 ± .08)	152
Mean Quadrat Totals	.5 ± .5	.004 ± .004	

Table 2.26 Dead annuals on a site within a burned area in a valley within Yucca Mountain. The fire occurred June 21; dead grass was measured June 29, 1988.

Species	n/m²	g/m²	mg/plant
Bromus rubens	1460 ± 380	24 ± 6	14 ± 2
B. tectorum	700 ± 140	20 ± 5	26 ± 5
B. unidentifiable	60 + 60	3 + 3	49
Mean Quadrat Totals	2220 ± 434	47 ± 13	

Table 2.27 Species presence-absence on plots sampled in 1988 for ephemeral plants. (A = censused in quadrats (densities and biomasses are in Tables 2.1-2.26); B = present in 100 m^2; C = present in 1000 m^2; D = present only near the plot; - = not seen; * = introduced species of ephemerals encountered in 1988).

Location->	FRF	FRF	FRF	FRF	JAF	MER	MER
Plot ->	001	001	002	002	001	001	001
Replicate->	A	B		C		C	
Species							
Allium nevadense	-	-	-	-	-	-	-
Amsinckia tessellata	A	B	B	A	-	-	-
Anisocoma acaulis	B	C	-	C	-	-	-
Arabis pulchra	-	-	-	C	-	-	-
Arenaria congesta	-	-	-	-	-	-	-
Astragalus acutirostris	-	-	B	A	-	-	-
A. calycosus calycosus	-	-	-	-	-	-	-
A. didymocarpus	-	-	-	-	A	-	-
A. lentiginosus fremontii	-	-	-	-	-	-	-
A. purshii tinctus	-	-	-	-	-	-	-
A. tidestromii	-	-	-	-	-	-	C
Baileya multiradiata	-	-	-	-	-	-	C
*Bromus rubens**	A	A	A	A	A	A	A
*B. tectorum**	A	-	-	-	B	A	A
*B. trinii**	-	-	-	-	-	-	-
*B. unidentifiable**	-	-	-	-	-	-	-
Calochortus flexuosus	-	-	-	-	-	-	-
C. unidentified species	-	-	-	-	-	-	-
Calycoseris wrightii	-	-	-	-	-	-	-
Camissonia boothii ssp. condensata	-	-	-	-	-	-	-
C. claviformis integrior	B	-	-	-	-	C	C
C. kernensis var. gilmanii	-	C	B	-	-	-	-
C. pterosperma	-	-	-	A	-	-	-
Castilleja chromosa	-	-	-	-	-	-	-
Caulanthus cooperi	-	-	-	-	-	C	C
C. lasiophyllus	-	-	-	-	-	-	C
Chaenactis carphoclinia	-	-	-	-	-	-	-
C. douglassii	-	-	-	-	-	-	-
C. fremontii	A	A	-	-	-	-	-

Table 2.27 (Continued) Species presence-absence on plots sampled in 198[illegible] for ephemeral plants. (A = censused in quadrats (densities and biomasses are [illegible] Tables 2.1-2.26); B = present in 100 m^2; C = present in 1000 m^2; D = present only near the plot; - = not seen; * = introduced species of ephemerals encountered in 1988).

Location->	FRF	FRF	FRF	FRF	JAF	MER	MER
Plot ->	001	001	002	002	001	001	001
Replicate->	A	B	[illegible]	C	[illegible]	C	[illegible]
Species							
C. stevioides	C	-	B	A	-	-	A
C. xantiana	-	-	-	A	-	-	-
Chorizanthe brevicornu	-	-	-	-	-	-	-
C. rigida	-	-	A	B	-	A	A
C. thurberi	C	-	-	-	-	-	-
Crepis intermedia	-	-	-	-	-	-	-
Cryptantha angustifolia	-	-	-	-	A	-	-
C. circumscissa	A	A	-	A	C	-	A
C. dumetorum	B	-	-	-	-	-	-
C. flavoculata	-	-	-	-	-	-	-
C. gracilis	-	-	-	C	C	-	-
C. micrantha	B	-	-	-	-	A	-
C. nevadensis	A	A	A	B	A	-	-
C. pterocarya	B	A	C	A	B	-	-
C. recurvata	A	A	A	-	-	-	A
C. virginensis	-	-	-	-	-	-	C
Cuscuta spp.	-	-	-	-	-	-	-
Cymopteris ripleyi	-	-	-	-	-	-	-
Delphinium parishii	-	-	-	-	-	-	-
Descurainia pinnata	C	A	B	A	-	A	A
*D. sophia**	-	-	-	-	-	-	-
Eriastrum eremicum	C	-	-	-	-	-	A
Eriogonum brachypodum	-	-	-	-	-	A	A
E. glandulosum	-	-	-	-	-	-	-
E. inflatum	-	-	-	-	-	-	C
E. maculatum	-	A	-	A	A	-	-
E. nidularium	-	-	-	-	-	-	-
E. ovalifolium ovalifolium	-	-	-	-	-	-	-
E. sp. (unidentifiable)	B	-	A	-	-	-	-
E. umbellatum subardum	-	-	-	-	-	-	-
Eriophyllum pringlei	A	A	A	A	-	-	-

Table 2.27 (Continued) Species presence-absence on plots sampled in 1988 for ephemeral plants. (A = censused in quadrats (densities and biomasses are in Tables 2.1-2.26); B = present in 100 m^2; C = present in 1000 m^2; D = present only near the plot; - = not seen; * = introduced species of ephemerals encountered in 1988).

Location->	FRF	FRF	FRF	FRF	JAF	MER	MER
Plot ->	001	001	002	002	001	001	001
Replicate->	A	B		C		C	
Species							
*Erodium cicutarium**	C	-	A	-	-	A	A
Escholzia glyptosperma	B	B	B	-	-	-	-
Euphorbia albomarginata	C	-	C	-	-	-	-
Fritellaria atropurpurea	-	-	-	-	-	-	-
Gayophytum decipiens	-	-	-	-	-	-	-
Gilia cana	-	-	C	-	-	-	-
G. sinuata	A	A	-	A	-	-	-
G. transmontana	-	-	-	B	-	A	A
Glyptopleura marginata	-	-	-	-	-	-	-
*Halogeton glomeratus**	-	-	-	-	-	-	C
Ipomopsis congesta	-	-	-	-	-	-	-
I. polycladon	-	-	-	-	-	A	A
Langloisia schottii	-	-	-	-	-	-	-
L. setosissima	-	-	-	A	-	A	A
Lepidium lasiocarpum	-	-	-	A	-	-	A
Lesquerella kingii	-	-	-	-	-	-	-
Linanthus arenicola	-	-	A	A	-	-	-
L. demissus	-	-	-	-	-	-	-
L. dichotomus	-	-	-	-	-	-	-
L. jonesii	-	-	-	-	-	-	-
L. nuttallii	-	-	-	-	-	-	-
Lomatium nevadense	-	-	-	-	-	-	-
Lupinus flavoculatus	-	-	-	-	-	-	-
L. shockleyi	-	-	-	B	-	-	-
Machaeranthera canescens	C	C	-	-	-	C	D
Malacothrix glabrata	-	C	-	-	-	C	-
M. sonchoides	-	-	-	-	-	-	-
Mentzelia albicaulis	-	-	-	-	A	B	B
M. congesta	-	-	-	-	-	-	-
Microseris linearifolia	-	-	-	-	-	-	-
Monoptilon bellidiforme	-	-	-	-	-	-	-

Table 2.27 (Continued) Species presence-absence on plots sampled in 1988 for ephemeral plants. A = censused in quadrats (densities and biomasses are in Tables 2.1-2.26); B = present in 100 m^2; C = present in 1000 m^2; D = present only near the plot; - = not seen).

Location->	FRF	FRF	FRF	FRF	JAF	MER	MER
Plot ->	001	001	002	002	001	001	001
Replicate->	A	B		C		C	
Species							
Nama demissum	-	-	-	-	-	-	C
N. densum densum	-	-	-	-	-	-	-
Nemacladus glanduliferus var. orientalis	-	-	-	-	-	-	-
Oenothera caespitosa	-	-	-	-	C	-	-
O. primiveris	-	-	-	-	-	-	-
Oxytheca perfoliata	-	-	-	C	-	-	A
Pectocarya heterocarpa	-	-	-	-	-	-	-
P. platycarpa	-	-	-	-	-	-	-
P. setosa	-	-	-	-	-	-	-
Penstemon sp.	-	-	-	-	-	-	-
Phacelia crenulata	-	-	-	-	-	-	-
P. fremontii	-	-	-	C	-	-	B
P. vallis-mortae	-	B	-	-	-	-	-
Phlox stansburyi	-	-	-	-	-	-	-
Poa sandbergii	-	-	-	-	-	-	-
Rafinesquia neomexicana	-	-	-	-	-	-	-
Salsola spp.	A	A	A	A	A	A	-
Schismus sp.	-	-	-	-	-	-	A
Sisymbrium altissimum	C	-	B	A	B	B	A
Streptanthella longirostris	-	-	-	-	-	-	-
Streptanthus cordatus	-	-	-	-	-	-	-
Stylocline micropoides	-	-	-	-	-	-	-
Syntrichopappus fremontii	-	-	-	-	-	-	-
Viguiera multiflora var. nevadensis	-	-	-	-	-	-	-
Vulpia microstachys pauciflora	-	-	-	-	-	-	-
V. octoflora	-	-	-	-	-	-	-

Table 2.28 Species presence-absence on plots sampled in 1988 for ephemeral plants. (A = censused in quadrats (densities and biomasses are in Tables 2.1-2.26); B = present in 100 m²; C = present in 1000 m²; D = present only near the plot; - = not seen).

Location->	MER	ROV	ROV	YUF	YUF	YUF	YUF
Plot ->	002	005	006	001	001	011	012
Replicate->				A	B		
Species							
Allium nevadense	-	-	-	-	-	-	-
Amsinckia tessellata	A	B	B	C	B	-	-
Anisocoma acaulis	-	-	-	-	-	-	-
Arabis pulchra	-	-	-	-	C	-	-
Arenaria congesta	-	-	-	-	-	-	-
Astragalus acutirostris	-	-	-	-	-	-	-
A. calycosus calycosus	-	-	-	-	-	-	-
A. didymocarpus	-	-	B	-	-	-	-
A. lentiginosus fremontii	B	-	C	A	B	-	B
A. purshii tinctus	-	-	-	-	-	-	-
A. tidestromii	-	-	-	-	-	-	-
Baileya multiradiata	-	-	-	-	-	-	C
Bromus rubens	A	A	A	A	A	-	A
B. tectorum	-	D	-	A	A	-	B
B. trinii	-	A	-	-	-	-	-
B. unidentifiable	-	-	-	-	-	-	-
Calochortus flexuosus	-	-	-	-	-	-	-
C. unidentified species	-	-	C	-	-	-	-
Calycoseris wrightii	-	B	B	-	-	-	-
Camissonia boothii ssp. *condensata*	-	-	-	-	-	-	-
C. claviformis integrior	-	A	-	-	-	-	-
C. kernensis var. gilmanii	-	-	-	-	C	-	-
C. pterosperma	-	-	-	-	-	-	-
Castilleja chromosa	-	-	-	-	-	-	-
Caulanthus cooperi	-	-	B	-	-	-	-
C. lasiophyllus	-	-	C	-	-	-	-
Chaenactis carphoclinia	-	C	-	-	A	-	-
C. douglassii	-	-	-	-	-	-	-
C. fremontii	A	-	A	-	B	-	-
C. stevioides	B	A	-	A	A	-	B

Table 2.28 (Continued) Species presence-absence on plots sampled in 1988 for ephemeral plants. (A = censused in quadrats (densities and biomasses are in Tables 2.1-2.26); B = present in 100 m^2; C = present in 1000 m^2; D = present only near the plot; - = not seen).

Location->	MER	ROV	ROV	YUF	YUF	YUF	YUF
Plot ->	002	005	006	001	001	011	012
Replicate->				A	B		
<u>Species</u>							
C. xantiana	-	-	-	-	-	-	-
Chorizanthe brevicornu	-	C	-	-	-	-	-
C. rigida	-	B	B	-	-	-	-
C. thurberi	-	-	B	-	-	-	-
Crepis intermedia	-	-	-	-	-	-	-
Cryptantha angustifolia	-	-	-	-	-	-	-
C. circumscissa	-	B	A	B	A	-	-
C. dumetorum	-	-	-	-	-	-	-
C. flavoculata	-	-	-	-	-	-	-
C. gracilis	-	-	-	-	-	-	-
C. micrantha	-	C	A	-	-	-	B
C. nevadensis	-	B	-	C	-	-	D
C. pterocarya	-	B	B	A	-	-	A
C. recurvata	-	-	-	-	A	-	A
C. virginensis	-	-	-	-	-	-	-
Cuscuta spp.	-	C	-	-	-	-	-
Cymopteris ripleyi	-	-	-	-	-	-	D
Delphinium parishii	-	B	-	-	-	-	-
Descurainia pinnata	C	A	A	A	-	-	A
D. sophia	-	-	-	-	A	-	A
Eriastrum eremicum	-	B	-	-	-	-	A
Eriogonum brachypodum	-	-	-	-	-	-	-
E. glandulosum	-	A	-	-	-	-	D
E. inflatum	-	-	-	-	-	-	-
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table 2.28 (Continued) Species presence-absence on plots sampled in 1988 for ephemeral plants. (A = censused in quadrats (densities and biomasses are in Tables 2.1-2.26); B = present in 100 m^2; C = present in 1000 m^2; D = present only near the plot; - = not seen).

Location->	MER	ROV	ROV	YUF	YUF	YUF	YUF
Plot ->	002	005	006	001	001	011	012
Replicate->				A	B		
<u>Species</u>							
Escholzia glyptosperma	-	B	-	-	-	-	-
Euphorbia albomarginata	A	-	-	B	-	-	-
Fritellaria atropurpurea	-	-	-	-	-	-	-
Gayophytum decipiens	-	-	-	-	-	-	-
Gilia cana	-	-	-	-	-	-	-
G. sinuata	-	-	-	-	-	-	-
G. transmontana	A	B	A	A	A	-	B
Glyptopleura marginata	-	-	-	-	-	-	C
Halogeton glomeratus	-	-	-	-	-	-	-
Ipomopsis congesta	-	-	-	-	-	-	-
I. polycladon	-	B	-	C	B	-	C
Langloisia schottii	-	-	B	B	-	-	-
L. setosissima	-	-	-	-	-	-	-
Lepidium lasiocarpum	-	C	C	B	-	-	B
Lesquerella kingii	-	-	-	-	-	-	-
Linanthus arenicola	-	-	-	-	-	-	-
L. demissus	-	A	-	-	-	-	-
L. dichotomus	-	-	-	-	-	-	-
L. jonesii	-	-	-	-	-	-	-
L. nuttallii	-	-	-	-	-	-	-
Lomatium nevadense	-	-	-	-	-	-	-
Lupinus flavoculatus	-	-	-	A	A	-	-
L. shockleyi	-	-	B	-	-	-	C
Machaeranthera canescens	B	-	-	B	A	-	B
Malacothrix glabrata	-	C	A	A	-	-	C
M. sonchoides	-	-	-	-	-	-	-
Mentzelia albicaulis	-	-	B	-	-	-	B
M. congesta	-	-	-	-	-	-	-
Microseris linearifolia	-	-	-	-	-	-	-

Table 2.28 (Continued) Species presence-absence on plots sampled in 1988 for ephemeral plants. (A = censused in quadrats (densities and biomasses are in Tables 2.1-2.26); B = present in 100 m^2; C = present in 1000 m^2; D = present only near the plot; - = not seen).

Location->	MER	ROV	ROV	YUF	YUF	YUF	YUF
Plot ->	002	005	006	001	001	011	012
Replicate->				A	B		
Species							
Monoptilon bellidiforme	-	C	A	-	-	-	-
Nama demissum	-	-	A	-	-	-	-
N. densum densum	-	-	-	-	-	-	-
Nemacladus glanduliferus var. orientalis	-	C	-	-	-	-	-
Oenothera caespitosa	-	-	-	-	-	-	-
O. primiveris	-	-	-	-	-	-	-
Oxytheca perfoliata	-	C	-	-	-	-	B
Pectocarya heterocarpa	-	B	-	-	-	-	-
P. platycarpa	-	B	-	-	-	-	-
P. setosa	-	-	-	-	-	-	-
Penstemon sp.	-	-	-	-	-	-	-
Phacelia crenulata	-	C	-	-	-	-	-
P. fremontii	-	A	-	A	-	-	C
P. vallis-mortae	-	B	B	C	-	-	-
Phlox stansburyi	-	-	-	-	-	-	-
Poa sandbergii	-	-	-	-	-	-	-
Rafinesquia neomexicana	-	-	A	-	-	-	-
Salsola spp.	-	-	-	-	-	A	A
Schismus sp.	-	-	-	-	-	-	-
Sisymbrium altissimum	-	-	-	-	-	-	B
Streptanthella longirostris	-	A	-	-	-	-	B
Streptanthus cordatus	-	-	-	-	-	-	-
Stylocline micropoides	-	B	-	-	-	-	-
Syntrichopappus fremontii	-	-	-	-	-	-	
Viguiera multiflora var. nevadensis	-	-	-	-	-	-	-
Vulpia microstachys pauciflora	-	-	-	-	-	-	-
V. octoflora	A	A	A	-	-	-	-

Table 2.29 Species presence-absence on plots sampled in 1988 for ephemeral plants. (A = censused in quadrats (densities and biomasses are in Tables 2.1-2.26); B = present in 100 m^2; C = present in 1000 m^2; D = present only near the plot; - = not seen).

Location->	YUF	YUF	YUF	YUF	YUF	YUF	YUF
Plot ->	009	010	014	015	016	017	018
Replicate->							
<u>Species</u>							
Allium nevadense	-	-	-	-	-	-	-
Amsinckia tessellata	C	B	-	-	C	B	C
Anisocoma acaulis	-	-	-	-	-	-	-
Arabis pulchra	-	C	-	-	-	-	-
Arenaria congesta	-	-	-	-	-	-	-
Astragalus acutirostris	-	-	-	-	-	-	-
A. calycosus calycosus	-	-	-	-	-	-	-
A. didymocarpus	-	-	-	-	-	-	-
A. lentiginosus fremontii	B	B	-	B	A	C	-
A. purshii tinctus	-	-	-	-	-	-	-
A. tidestromii	-	-	-	-	-	-	-
Baileya multiradiata	-	-	-	-	-	-	-
Bromus rubens	A	A	A	A	A	A	A
B. tectorum	A	A	C	A	A	A	A
B. trinii	-	-	-	-	-	-	-
B. unidentifiable	A	-	-	-	A	A	-
Calochortus flexuosus	-	-	-	B	-	-	-
C. unidentified species	-	-	-	-	-	-	-
Calycoseris wrightii	-	-	-	-	-	-	-
Camissonia boothii ssp. *condensa*	-	-	-	C	-	-	-
C. claviformis integrior	-	-	-	-	-	-	-
C. kernensis var. gilmanii	-	-	-	-	-	-	B
C. pterosperma	-	-	-	-	-	-	-
Castilleja chromosa	-	-	-	-	-	-	-
Caulanthus cooperi	-	-	-	-	-	-	-
C. lasiophyllus	-	-	-	-	-	-	-
Chaenactis carphoclinia	-	-	-	-	-	A	C
C. douglassii	-	-	-	-	-	-	-
C. fremontii	-	-	-	B	-	-	-
C. stevioides	C	A	-	-	-	-	-

Table 2.29 (Continued) Species presence-absence on plots sampled in 1988 for ephemeral plants. (A = censused in quadrats (densities and biomasses are in Tables 2.1-2.26); B = present in 100 m^2; C = present in 1000 m^2; D = present only near the plot; - = not seen).

Location->	YUF	YUF	YUF	YUF	YUF	YUF	YUF
Plot ->	009	010	014	015	016	017	018
Replicate->							
Species							
C. xantiana	-	-	-	-	-	-	-
Chorizanthe brevicornu	-	-	-	-	-	-	-
C. rigida	-	-	-	A	-	-	-
C. thurberi	-	A	-	-	-	-	-
Crepis intermedia	-	-	-	-	-	-	-
Cryptantha angustifolia	-	-	-	-	-	C	-
C. circumscissa	-	A	A	-	A	A	A
C. dumetorum	-	-	-	-	-	-	-
C. flavoculata	-	-	-	-	-	-	-
C. gracilis	-	-	-	-	-	-	-
C. micrantha	-	-	-	A	-	B	-
C. nevadensis	-	-	-	C	-	-	C
C. pterocarya	C	-	-	-	C	B	C
C. recurvata	-	-	-	-	-	C	C
C. virginensis	-	-	-	-	-	-	-
Cuscuta spp.	-	-	-	-	-	-	-
Cymopteris ripleyi	-	D	-	-	-	B	D
Delphinium parishii	-	-	-	-	-	-	-
Descurainia pinnata	-	-	-	B	-	-	A
D. sophia	-	-	-	-	C	C	-
Eriastrum eremicum	-	-	-	-	-	-	-
Eriogonum brachypodum	-	-	-	-	-	-	-
E. glandulosum	-	-	-	-	-	-	-
E. inflatum	-	-	-	-	-	-	-
E. maculatum	-	-	-	-	-	-	-
E. nidularium	-	A	C	A	A	C	B
E. ovalifolium ovalifolium	-	-	-	-	-	-	-
E. sp. (unidentifiable)	-	-	-	-	-	-	-
E. umbellatum subardum	-	-	-	-	-	-	-
Eriophyllum pringlei	-	A	-	B	-	-	B
Erodium cicutarium	D	-	A	A	-	A	-

Table 2.29 (Continued) Species presence-absence on plots sampled in 1988 for ephemeral plants. (A = censused in quadrats (densities and biomasses are in Tables 2.1-2.26); B = present in 100 m^2; C = present in 1000 m^2; D = present only near the plot; - = not seen).

Location->	YUF	YUF	YUF	YUF	YUF	YUF	YUF
Plot ->	009	010	014	015	016	017	018
Replicate->							
Species							
Escholzia glyptosperma	-	-	-	-	-	-	-
Euphorbia albomarginata	A	A	C	-	-	A	-
Fritellaria atropurpurea	-	-	-	-	-	-	-
Gayophytum decipiens	-	-	-	-	-	-	-
Gilia cana	-	-	-	-	-	-	-
G. sinuata	-	-	-	-	A	A	A
G. transmontana	-	B	-	A	B	-	B
Glyptopleura marginata	-	-	-	-	-	-	C
Halogeton glomeratus	-	-	-	-	-	-	-
Ipomopsis congesta	-	-	-	-	-	-	-
I. polycladon	-	-	-	C	-	-	A
Langloisia schottii	-	A	-	-	-	-	-
L. setosissima	-	-	-	-	-	-	-
Lepidium lasiocarpum	-	-	-	-	-	-	A
Lesquerella kingii	-	-	-	-	-	-	-
Linanthus arenicola	-	-	-	-	-	-	-
L. demissus	-	-	-	-	-	-	-
L. dichotomus	-	-	-	-	-	-	-
L. jonesii	-	-	-	-	-	-	-
L. nuttallii	-	-	-	-	-	-	-
Lomatium nevadense	-	-	-	-	-	-	-
Lupinus flavoculatus	-	-	-	-	-	-	-
Machaeranthera canescens	C	C	-	-	-	C	D
Malacothrix glabrata	-	C	-	-	-	C	-
M. sonchoides	-	-	-	-	-	-	-
Mentzelia albicaulis	-	-	-	-	A	B	B
M. congesta	-	-	-	-	-	-	-
Microseris linearifolia	-	-	-	-	-	-	-

Table 2.29 (Continued) Species presence-absence on plots sampled in 1988 for ephemeral plants. (A = censused in quadrats (densities and biomasses are in Tables 2.1-2.26); B = present in 100 m^2; C = present in 1000 m^2; D = present only near the plot; - = not seen).

Location->	YUF	YUF	YUF	YUF	YUF	YUF	YUF
Plot ->	009	010	014	015	016	017	018
Replicate->							
Species							
Monoptilon bellidiforme	-	-	-	-	-	-	-
Nama demissum	-	-	-	-	-	-	C
N. densum densum	-	-	-	-	-	-	-
Nemacladus glanduliferus var. orientalis	-	-	-	-	-	-	-
Oenothera caespitosa	-	-	-	-	C	-	-
O. primiveris	-	-	-	-	-	-	-
Oxytheca perfoliata	-	-	-	C	-	-	A
Pectocarya heterocarpa	-	-	-	-	-	-	-
P. platycarpa	-	-	-	-	-	-	-
P. setosa	-	-	-	-	-	-	-
Penstemon sp.	-	-	-	-	-	-	-
Phacelia crenulata	-	-	-	-	-	-	-
P. fremontii	-	-	-	C	-	-	B
P. vallis-mortae	-	B	-	-	-	-	-
Phlox stansburyi	-	-	-	-	-	-	-
Rafinesquia neomexicana	-	-	-	-	-	-	-
Salsola spp.	A	A	A	A	A	A	-
Schismus sp.	-	-	-	-	-	-	-
Sisymbrium altissimum	C	-	B	A	B	B	A
Streptanthella longirostris	-	-	-	-	-	-	-
Streptanthus cordatus	-	-	-	-	-	-	-
Stylocline micropoides	-	-	-	-	-	-	-
Syntrichopappus fremontii	-	-	-	-	-	-	-
Viguiera multiflora var. nevadensis	-	-	-	-	-	-	-
Vulpia microstachys pauciflora	-	-	-	-	-	-	-
V. octoflora	-	-	-	-	-	-	-

Table 2.30 Species presence-absence on plots sampled in 1988 for ephemeral plants. (A = censused in quadrats (densities and biomasses are in Tables 2.1-2.26); B = present in 100 m^2; C = present in 1000 m^2; D = present only near the plot; - = not seen).

Location->	MID	MID	PAM	RAM
Plot ->	001	001	001	001
Replicate->	C			
<u>Species</u>				
Allium nevadense	-	A	-	-
Amsinckia tessellata	-	B	-	-
Anisocoma acaulis	-	-	-	-
Arabis pulchra	-	C	C	-
Arenaria congesta	-	-	-	B
Astragalus acutirostris	-	B	-	-
A. calycosus calycosus	-	-	A	-
A. didymocarpus	-	-	-	-
A. lentiginosus fremontii	C	B	C	-
A. purshii tinctus	A	B	-	-
A. tidestromii	-	-	C	-
Baileya multiradiata	-	-	-	-
Bromus rubens	A	A	C	-
B. tectorum	A	A	B	-
B. trinii	-	-	-	-
B. unidentifiable	A	-	-	-
Calochortus flexuosus	-	-	-	-
C. unidentified species	-	-	-	-
Calycoseris wrightii	-	-	-	-
Camissonia boothii ssp. condensa	-	-	-	-
C. claviformis integrior	-	-	-	-
C. kernensis var.	-	-	-	-
C. pterosperma	-	-	-	-
Castilleja chromosa	-	C	-	-
Caulanthus cooperi	-	-	-	-
C. lasiophyllus	-	-	-	-
C. douglassii	-	-	-	A
C. fremontii	-	-	-	-

Table 2.30 (Continued) Species presence-absence on plots sampled in 1988 for ephemeral plants. (A = censused in quadrats (densities and biomasses are in Tables 2.1-2.26); B = present in 100 m^2; C = present in 1000 m^2; D = present only near the plot; - = not seen).

Location->	MID	MID	PAM	RAM
Plot ->	001	001	001	001
Replicate->	C			
<u>Species</u>				
C. xantiana	-	-	-	-
Chorizanthe brevicornu	B	-	-	-
C. rigida	-	-	-	-
C. thurberi	A	-	-	-
Crepis intermedia	-	-	-	C
Cryptantha angustifolia	-	-	-	-
C. circumscissa	A	-	-	-
C. dumetorum	-	-	-	-
C. flavoculata	-	-	C	B
C. gracilis	-	-	-	-
C. micrantha	-	A	-	-
C. nevadensis	-	-	-	-
C. pterocarya	A	B	A	-
C. recurvata	-	-	-	-
C. virginensis	-	-	-	-
Cuscuta spp.	-	-	-	-
Cymopteris ripleyi	-	-	-	-
Delphinium parishii	-	-	-	-
Descurainia pinnata	A	A	A	-
D. sophia	-	-	C	-
Eriastrum eremicum	A	A	C	-
Eriogonum brachypodum	A	-	-	-
E. glandulosum	-	-	-	-
E. inflatum	-	-	-	-
E. maculatum	-	-	-	-
E. nidularium	-	-	-	-
E. ovalifolium ovalifolium	-	-	-	-
E. sp. (unidentifiable)	-	-	-	-
E. umbellatum subardum	-	-	-	A
Eriophyllum pringlei	-	B	-	-
Erodium cicutarium	-	-	-	-

Table 2.30 (Continued) Species presence-absence on plots sampled in 1988 for ephemeral plants. (A = censused in quadrats (densities and biomasses are in Tables 2.1-2.26); B = present in 100 m^2; C = present in 1000 m^2; D = present only near the plot; - = not seen).

Location->	MID	MID	PAM	RAM
Plot ->	001	001	001	001
Replicate->	C			
Species				
Escholzia glyptosperma	-	-	-	-
Euphorbia albomarginata	A	-	-	-
Fritellaria atropurpurea	-	-	-	B
Gayophytum decipiens	-	-	-	A
Gilia cana	-	-	-	-
G. sinuata	A	A	-	-
G. transmontana	A	A	A	-
Glyptopleura marginata	-	-	-	-
Halogeton glomeratus	-	-	-	-
Ipomopsis congesta	-	-	D	C
I. polycladon	-	-	C	-
Langloisia schottii	-	-	-	-
L. setosissima	-	-	-	-
Lepidium lasiocarpum	-	-	-	-
Lesquerella kingii	-	-	-	B
Linanthus arenicola	-	-	-	-
L. demissus	-	-	-	-
L. dichotomus	A	-	-	-
L. jonesii	-	-	-	-
L. nuttallii	-	-	-	B
Lomatium nevadense	-	C	-	-
Lupinus flavoculatus	C	-	-	-
L. shockleyi	-	-	-	-
Machaeranthera canescens	-	B	-	-
Malacothrix glabrata	-	-	-	-
M. sonchoides	-	-	-	-
Mentzelia albicaulis	-	-	-	-
M. congesta	-	-	-	B
Microseris linearifolia	A	-	-	-

Table 2.30 (Continued) Species presence-absence on plots sampled in 1988 for ephemeral plants. (A = censused in quadrats (densities and biomasses are in Tables 2.1-2.26); B = present in 100 m^2; C = present in 1000 m^2; D = present only near the plot; - = not seen).

Location->	MID	MID	PAM	RAM
Plot ->	001	001	001	001
Replicate->	C			
Species				
Monoptilon bellidiforme	-	-	-	-
Nama demissum	-	-	-	-
N. densum densum	-	-	D	-
Nemacladus glanduliferus var. orientalis	-	-	-	-
Oenothera caespitosa	-	-	-	-
O. primiveris	-	-	-	-
Oxytheca perfoliata	-	-	-	-
Pectocarya heterocarpa	-	-	-	-
P. platycarpa	-	-	-	-
P. setosa	B	B	-	-
Penstemon sp.	-	-	-	B
Phacelia crenulata	-	-	-	-
P. fremontii	A	-	A	-
P. vallis-mortae	-	-	-	-
Phlox stansburyi	A	A	-	C
Poa sandbergii	-	-	-	A
Rafinesquia neomexicana	-	-	-	-
Salsola spp.	-	A	-	-
Schismus sp.	-	-	-	-
Sisymbrium altissimum	-	-	-	-
Streptanthella longirostris	-	-	-	-
Streptanthus cordatus	-	-	-	A
Stylocline micropoides	-	-	-	-
Syntrichopappus fremontii	C	B	-	-
Viguiera multiflora var. nevadensis	-	B	-	-
Vulpia microstachys pauciflora	A	-	-	-
V. octoflora	A	-	-	-

Table 2.31 Estimated soil water (0-30 cm depth; total mm of water 1-15) and precipitation (mm) in Mercury, Nevada between July 1, 1987, and June 30, 1988.

Date	Rain	Soil Water	Date	Rain	Soil Water
1 JUL 87		-1.5	15 JAN 88	6.4	+12.1
10 JUL		-0.4	23 JAN	31.2	+27.1
17 JUL	1.8	-0.4	29 JAN		+16.9
24 JUL	10.2	+2.7	4 FEB	0.8	+12.7
31 JUL		+0.6	12 FEB		+9.2
11 AUG		-0.5	19 FEB		+6.6
20 AUG		-0.7	26 FEB		+0.7
28 AUG		-0.7	4 MAR	6.8	+8.0
4 SEP		-0.5	11 MAR		+8.6
21 SEP		-0.5	18 MAR		+6.3
25 SEP		-0.4	25 MAR		+4.7
2 OCT		-0.5	1 APR		+4.6
9 OCT		+0.1	8 APR		+3.4
16 OCT	6.9	+10.6	18 APR	34.3	+14.2
23 OCT	6.4	+7.4	22 APR	2.8	+11.5
04 NOV	25.4	+13.8	29 APR		+7.6
06 NOV	15.5	+15.2	6 MAY	2.0	+7.5
13 NOV		+14.0	13 MAY	2.0	+3.6
20 NOV	1.0	+11.6	20 MAY		+1.3
4 DEC		+11.8	27 MAY		+1.0
17 DEC	10.7	+17.6	8 JUN	2.5	+0.1
23 DEC	7.1	+19.3	17 JUN		-0.2
7 JAN 88	6.4	+15.8	24 JUN	3.0	-0.5

Table 2.32 Densities (number/m^2) of *Bromus rubens* on Beatley Plots 3 and 4 in Rock Valley (ROV005 and ROV006), 1963-1988. Errors are seen.

Year	Plot 3	Plot 4
1963	5.0	0.0
1964	6.2	0.6
1965	2.2	0.0
1966	3.2	0.0
1967	3.6	0.2
1968	7.6	0.2
1969	14.0	0.0
1970	19.8	1.0
1971	0.2	0.0
1972	0.0	0.0
~	~	~
1987	745 ± 298	-
1988	2034 ± 632	514 ± 158

Table 2.33 Average weights (mg) of *Bromus* plants when growing at the same location.

Plot	Bromus rubens	Bromus tectorum
(Disturbed)		
Mid Valley	26 ± 11	33 ± 7
Sedan 1000'	23 ± 9	47 ± 13
Sedan 3000'	9 ± 2	19 ± 6
T1 GZ	11 ± 3	17 ± 4
(Undisturbed)		
Mid Valley	11 ± 1	20 ± 2
Sedan 5000'	34 ± 13	10*
T1 Control	42 ± 21	5*
YUF001A	14 ± 2	23 ± 6
YUF001B	16 ± 2	38 ± 24
T2 Control	22 ± 5	20*

* Only one value is given; no error term is calculable.

Table 2.34 Numbers of ephemeral species and percent introduced biomass on sites where ephemerals were sampled in 1988.

Site	Location	Number of Species	Percent Introduced
Disturbed			
YUF009	T1 GZ	12	99.8
YUF014	T2 GZ	8	84.2
FRF002	Roadside	26	5.2
MER002	Gopher	12	97.6
YUF016	Sedan 1000′	15	77.0
YUF017	Sedan 3000′	22	98.8
YUF011	3B Scraped	2	100.
MID001b Burned		23	83.7
means		15.0	80.8
±sem		±2.9	±11.2
Undisturbed			
JAF001	Baseline	13	10.2
ROVOO5	Beatley 3	38	97.5
ROV006	Beatley 4	29	65.2
FRF001a Baseline		32	41.0
FRF001b Baseline		20	39.5
FRF002C Control		31	18.9
YUF001a Baseline		21	88.8
YUF001b Baseline		15	98.0
YUF010	T1 Control	16	87.5
YUF015	T2 Control	20	98.0
YUF018	Sedan 5000′	23	88.3
YUF012	3B Control	30	96.1
MID001a Burn Control		23	84.0
PAM001	Baseline	16	0.0
RAM001	Baseline	16	0.0
means		22.9	60.9
±sem		±1.9	±9.9

Table 2.35 Densities of *Bromus rubens* and native species censused in several close plots in Rock Valley, 1963-1988.

Year	Bromus	Native
1963[1]	5.0	10.0
1964	6.2	27.6
1965	2.2	2.4
1966	3.2	69.6
1967	3.6	7.0
1968	7.6	99.6
1969	14.0	109.8
1970	19.8	14.0
1971	0.2	2.0
1972	0.0	3.0
1973	0.4	118.
1974	11.2	101.
1975	13.0	216.
1976	90.9	327.
~	~	~
1983	89.	108.
1984	167.	19.
1985	156.	111.
1986		
1987	745.	98.
1988	2045.	106.

[1]Sources: 1963-1972, data of Janice Beatley (Plot 3) held by P. A. Medica; 1973-76 data of F. B. Turner, Rock Valley Validation Site Reports, U. S. IBP/Desert Biome; 1983-5 data of R. B. and K. B. Hunter, unpublished; 1987-88 BECAMP annual reports.

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SECTION 3
STATUS OF REPTILES IN 1988

by
Philip A. Medica

INTRODUCTION

Reptile studies under the Basic Environmental Compliance and Monitoring Program (BECAMP) were initiated in 1987 to document the relative number or density of the common lizards at various locations on the Nevada Test Site (NTS), and to document changes which may occur over time. Desert tortoise growth studies initiated in Rock Valley (NTS) are being continued, and free-ranging tortoises throughout NTS will be enumerated on an ongoing basis.

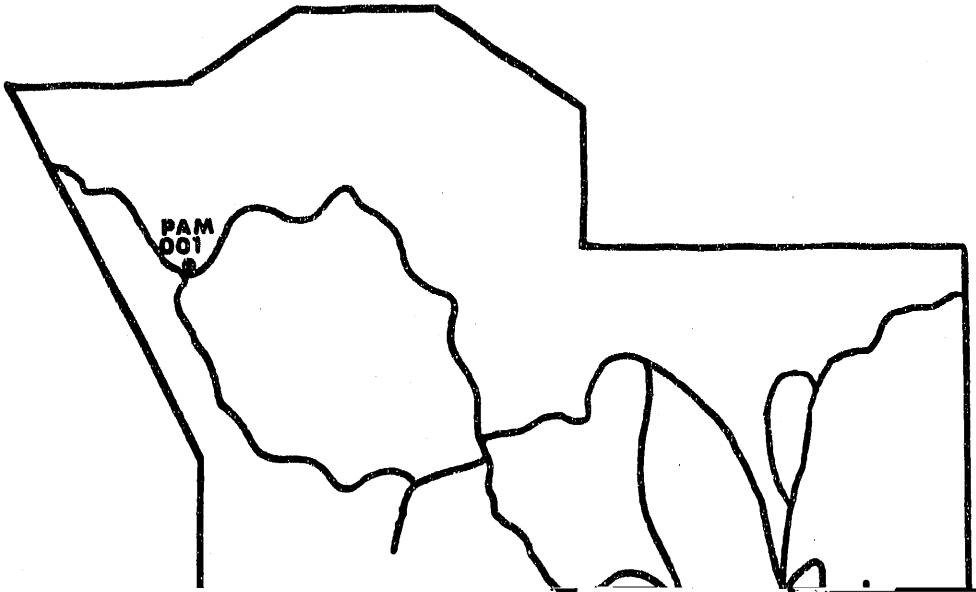
The BECAMP reptile sampling project in 1988 included surveys of natural populations of lizards in three major valleys (Jackass Flats, Frenchman Flat, and Yucca Flat) and on Pahute Mesa. The resident reptile species on the BECAMP baseline monitoring plots were sampled to provide data on species composition and relative density, which eventually will provide information on the stability and condition of the populations under baseline conditions. Uta sampling was conducted on seven subsidiary plots in Yucca Flat in 1988 (T1 Blast area and control; T3 Blast area, 3B Consolidation Site and control; and a natural burn area and nearby unburned area).

Desert tortoises (Gopherus agassizii) were recaptured in Rock Valley, maintaining records on animals first marked in the early 1960s (Medica et al. 1975; Turner et al. 1987). As part of the BECAMP studies at the NTS, the tortoises in the Rock Valley study area will be recaptured at least yearly. Tortoises were also searched for, marked and released in Frenchman Flat, northern Jackass Flats, Mercury Valley and Rock Valley.

METHODS

SAMPLING LOCATIONS AND DATES

Baseline monitoring plots 300 x 300 m, with an inner grid of 165 x 165 m (2.72 ha) for small mammal studies and a 105 x 105 m (1.10 ha) area within the small mammal grid for lizard studies, were established on Pahute Mesa (PAM001) and Rainier Mesa (RAM001) in 1988. Lizard transect lines 500 m long with stakes 50 m apart along each line were also established on the Pahute Mesa baseline monitoring plot. The geographic location of each plot sampled in 1988 is illustrated in Figure 3.1, and the design of the baseline monitoring plot is shown in Figure 3.2. Appendix 3A lists the plot designations and the Nevada State Grid Coordinates


PAM
001

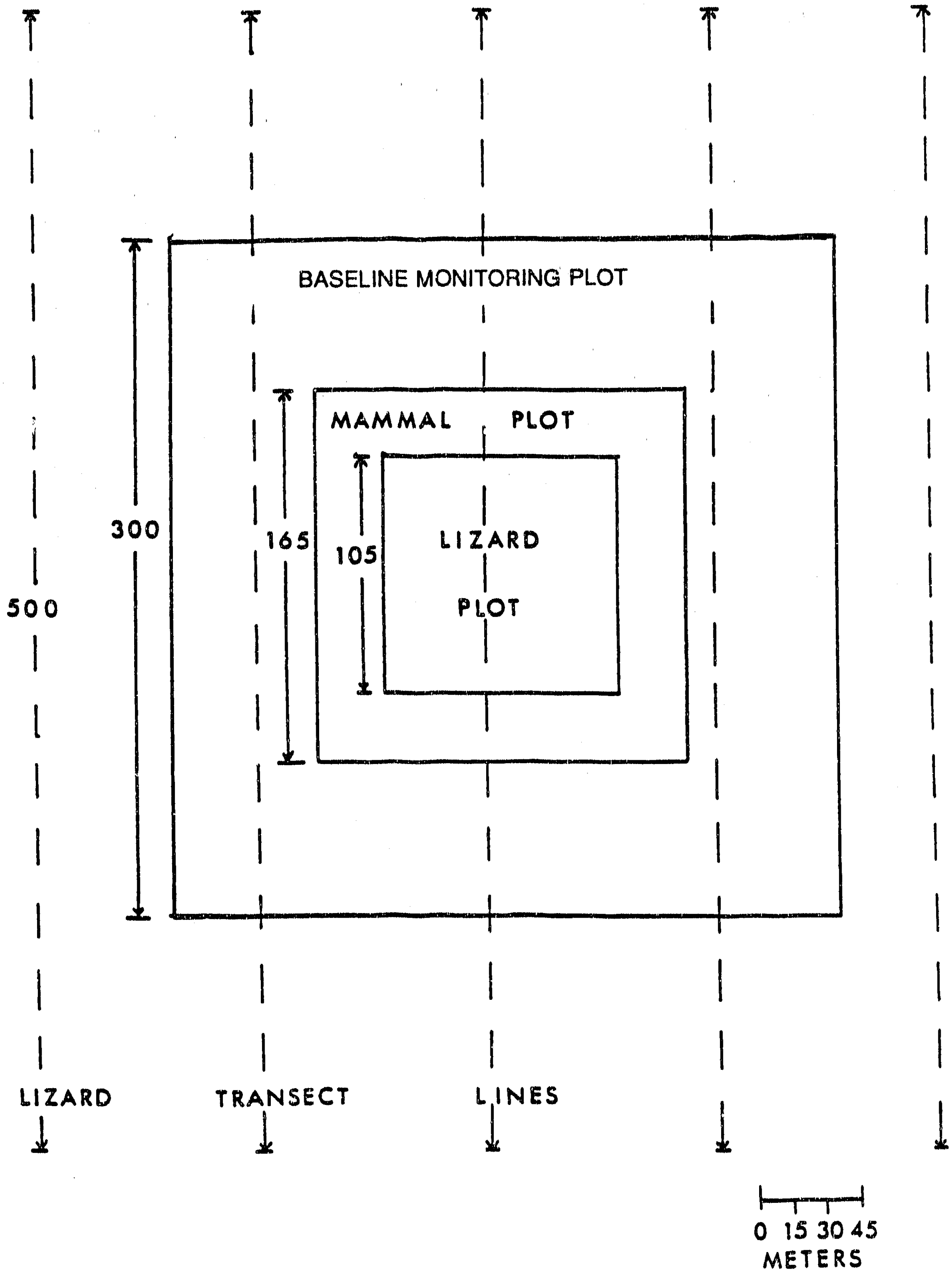


Figure 3.2 BECAMP pristine monitoring plot layout.

for all plots established in 1987 and 1988. The lizard plots established on seven subsidiary sites in Yucca Flat were 75 x 75 m (0.56 ha). Table 3.1 lists dates that the BECAMP lizard plots were sampled for Uta in 1988. The Pahute Mesa plot was not established soon enough to sample Uta in the spring. Uta sampling to estimate density was also conducted in the late summer (August 1-September 16) to obtain information on the number of hatchlings and surviving adults in eight study areas. Transect counts on four of the baseline monitoring plots for lizards other than Uta stansburiana were carried out between June 2 and June 30,

Table 3.1 Dates BECAMP study plots were sampled for *Uta stansburiana* in 1988.

	Spring		Summer	
Plot	Started	Completed	Started	Completed
JAFJ001	March 4	March 11	August 1	August 5
FRF001	March 14	March 18	August 22	September 8
YUF001	March 21	March 25	August 8	August 13
PAM001	---	---	September 12	September 16
YUF002	March 28	April 5	August 15	August 26
YUF003	March 28	April 5	August 15	August 26
YUF009	April 26	April 29	August 31	September 6
YUF010	April 26	April 29	August 29	September 6
YUF011	May 3	May 18	---	---
YUF012	May 3	May 18	---	---
YUF013	May 3	May 18	---	---

LIZARD SAMPLING TECHNIQUES

Adult Uta: Baseline Monitoring Plots

Uta stansburiana population densities were estimated during the spring (March) of 1988 on three baseline monitoring plots (JAF001, FRF001, and YUF001). Each plot was sampled during the early morning activity period for at least four days with two or three people capturing lizards by noosing. The density estimates used were from the final day of field sampling on which enough animals were recaptured to calculate an estimate (Appendix 3B).

All captured Uta were toe-clipped with a unique number so that individuals could be

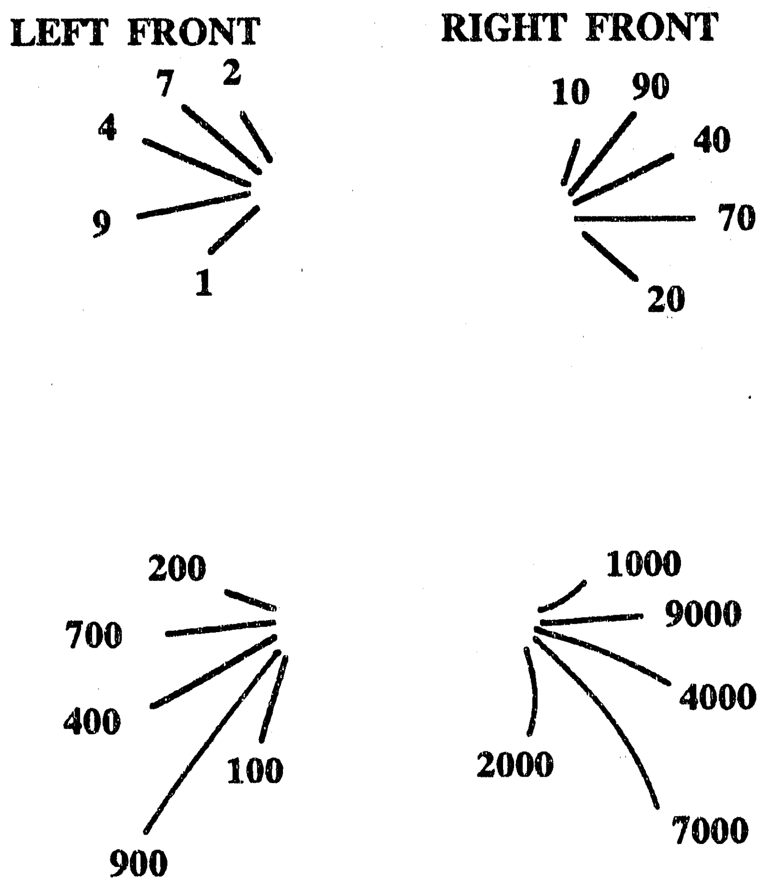


Figure 3.3 Dorsal view of lizard toes illustrating the toe numbering formula.

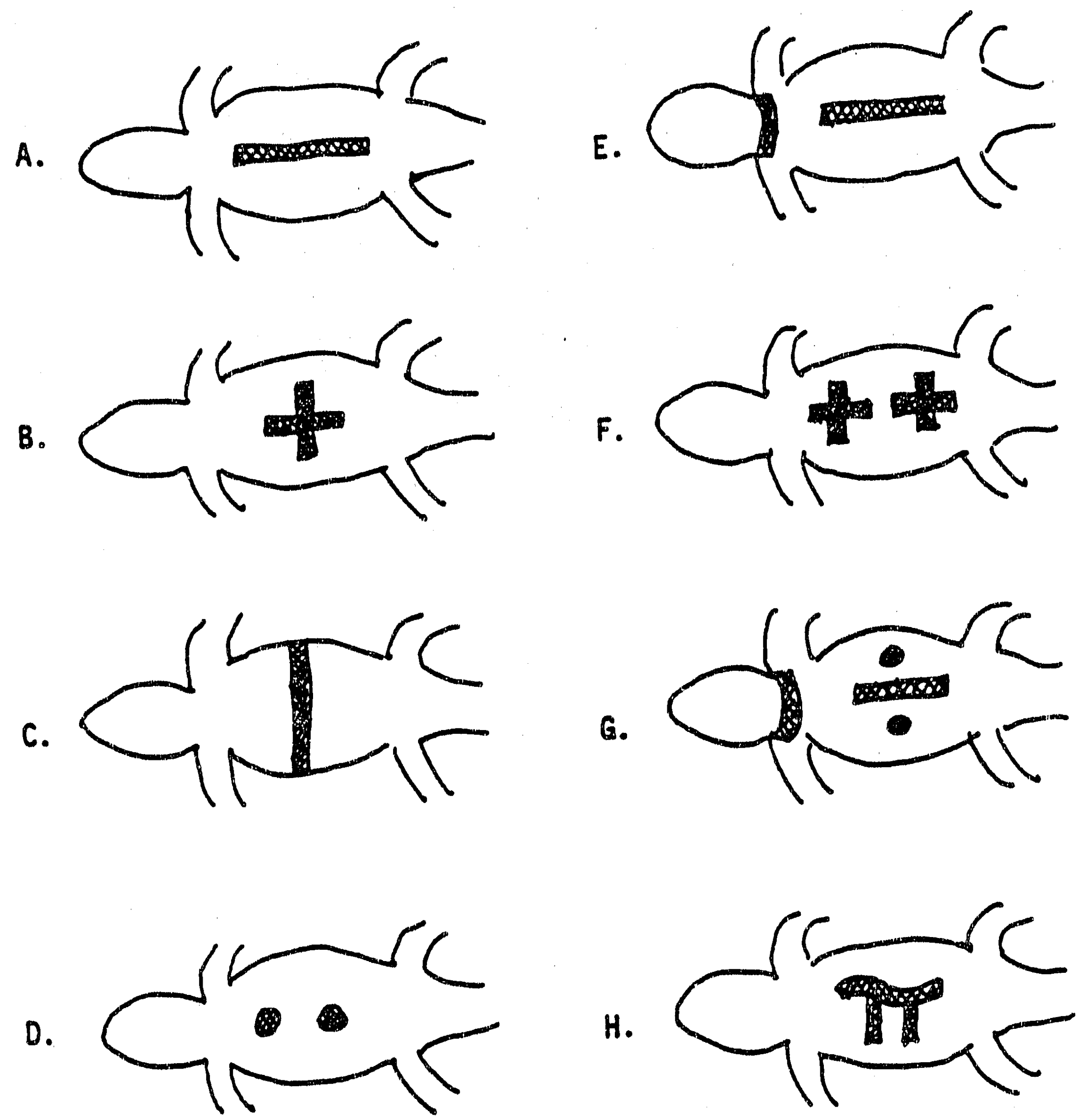
Year 1989

PloT YUF001 U Ta Medica
observer

Painted Symbols

		♂♂ Blue		♂♂ White		♀♀ Pink		♀♀ Yellow		♂ or ♀ Green	
N											
NM											
NS								1236			
N+											
NO											
N●											
N∧											
N‡											
N÷											
Nπ											
M		1137						1728			
S		1726						1193			
+		1727									
++		1437						1118			
+++											
O											
OO											
+O											
+∧											
●											
●●								1729			
+●											
∧●											
O●											
∧											
∧∧											
‡											
•/•											
π											

Figure 3.4 BECAMP lizard paint pattern form.



A. Is S = Stripe B. Is + = Plus C. Is M = Midbody
D. Is oo = Dot Dot E. Is NS = Neck Stripe F. Is ++ = Plus Plus
G. Is N = Neck Division H. Is = Pi

Figure 3.5 Symbols used to paint adult Uta.

(snout-vent length in mm) and released where captured. Details of the techniques used and sample data sheets appear in Hunter and Medica (1989).

The Pahute Mesa baseline monitoring plot (PAM001) was sampled only in September 1988 when hatchlings as well as adults were enumerated. Estimates of adults surviving from March to the end of the reproductive season are based upon those marked individuals surviving the 5-month interval (March-August 1988) on the three baseline monitoring plots in the valleys.

Hatchling Uta: Baseline Monitoring Plots

Juvenile Uta were marked and released within four baseline monitoring plots. At lower elevations, the first hatchlings usually appear in mid-June (Medica and Turner 1976) and at higher elevations in mid-July (Tanner and Hopkin 1972). We began our hatchling sampling

in Jackass Flats (JAF001) on August 1, 1988, and completed our Pahute Mesa plot (PAM001) on September 16, 1988.

Hatchling Uta were noosed within our study areas using the same techniques described for adult Uta (Hunter and Medica 1989). Hatchlings were toe-clipped, measured, sexed, weighed, and painted in the same manner as adult Uta.

Line Transects (Other Lizards on Baseline Monitoring Plots)

Other species of lizards, including Cnemidophorus tigris, Callisaurus draconoides, Phrynosoma platyrhinos, and Gambelia wislizenii, were inventoried using line transects. Measures of relative abundance can be used as an index of lizard species present and to provide a crude measurement of their density. Such line transect methods of counting lizards do not reflect true density, as has been shown by Degenhardt (1966) and Medica et al. (1971). It has also been determined that adult lizards are more readily observable than juveniles. However, the line transect technique provides information that can be used to indicate trends in relative abundance when comparing data from year to year. It is more labor-efficient to count these species rather than to attempt to mark-recapture them.

Five transect lines, each 500 m long, with numbered lath stakes every 50 m, were walked for five days in four baseline monitoring plots by three observers each day. Sampling normally began when soil surface temperatures averaged approximately 35° C (~0830 hrs.) and continued until lizard activity ceased. One pass of the entire plot usually was completed prior to cessation of lizard activity which occurred when soil temperatures approached 50° C (Medica, 1967).

DESERT TORTOISE SAMPLING

searched the same areas in northwest Frenchman Flat that were sampled in 1987. We also searched areas south of Kiwi Mesa in western Jackass Flats and Pluto Valley. The areas searched included washes, caliche overhangs and certain dirt roads where desert tortoises have been observed frequently.

RESULTS AND DISCUSSION

UTA SAMPLES

Baseline Monitoring Plots: Spring 1988

During sampling of Uta stansburiana adults, a total of 217 adult Uta were enumerated on all three baseline plots combined. The sex ratio was 95 males to 122 females, significantly different from 1:1 ratio (χ^2 test .05 level).

Spring Uta density estimates, based upon mark-recapture analysis (Seber 1973), indicate that Uta is most dense in Jackass Flats, slightly less dense in Yucca Flat and sparsest in Frenchman Flat (Table 3.2).

Table 3.2 Estimated densities (number of lizards per hectare ± two standard errors) of *Uta stansburiana* in the spring (March) of 1988 on three baseline monitoring plots (1.10 ha) on the Nevada Test Site. The number in parentheses is the total number of individuals enumerated.

	Jackass Flats (JAF001)	Frenchman Flat (FRF001)	Yucca Flat (YUF001)
Adult Lizards	96.6 ± 14.8	33.4 ± 2.2	91.1 ± 9.9
Male	(40)	(15)	(40)
Female	(51)	(21)	(50)
Total	(91)	(36)	(90)

Baseline Monitoring Plots: Summer 1988

Estimates of adult and hatchling density in late summer appear in Table 3.3. The Pahute Mesa plot had the highest estimated density of hatchlings. Yucca Flat possessed the highest density of adult Uta (Table 3.3).

Survivorship Of Adult Uta In 1988

Survivorship of marked adult Uta from spring (March 1988) to late summer (August-September 1988) was highest in Yucca Flat (34.4%) and lowest in Frenchman Flat (8.3%). Data comparing survivorship between the three valley baseline monitoring plots appear in Table 3.4.

Table 3.3 Estimated densities (number of lizards per hectare ± two standard errors) of *Uta stansburiana* in summer (August-September) 1988 on four baseline monitoring plots (1.10 ha) on the Nevada Test Site. Numbers in parentheses are the total numbers of individuals enumerated.

	Jackass Flats (JAF001)	Frenchman Flat (FRF001)	Yucca Flat (YUF001)	Pahute Mesa (PAM001)
Adult Lizards	21.3 ± 18.3	3.2 ± 1.6	41.5 ± 12.9	28.3 ± 11.3
Male	(7)	(2)	(17)	(8)
Female	(4)	(1)	(19)	(16)
Total	(11)	(3)	(36)	(24)
Hatchling Lizards	134.7 ± 81.1	54.0 ± 35.4	100.7 ± 33.6	142.0 ± 27.5
Male	(25)	(12)	(39)	(62)
Female	(30)	(16)	(29)	(55)
Total	(55)	(28)	(68)	(117)

Table 3.4 Number and percent survivorship of marked adult *Uta stansburiana* from spring (March 1988) to late summer (August - September 1988) on three baseline monitoring plots (1.10 ha) on the Nevada Test Site.

	JAF001		FRF001		YUF001	
	Spring	Summer	Spring	Summer	Spring	Summer
Adults Males	40	6	15	2	40	14
Females	51	4	21	1	50	17
Total	91	10	36	3	90	31
Percent Survivorship		11.0		8.3		34.4

Overwinter Survivorship of Uta

Overwinter survivorship of Uta marked as adults or hatchlings in 1987 and surviving to the spring of 1988 is listed by baseline monitoring plot in Table 3.5. Survivorship of adults was the highest in Jackass Flats (JAF001), intermediate in Yucca Flat (YUF001), and lowest in Frenchman Flat (FRF001). The same trends were exhibited in the survivorship of hatchling Uta. It is interesting to note that Uta survivorship between March and August and annual plant densities (numbers per meter^2) were highly correlated although annual biomass grams/m^2 was not (Table 3.6).

Table 3.5 Number and overwinter survivorship (%) of adult and juvenile *Uta stansburiana* on three baseline monitoring plots between August 1987 and March 1988.

	Jackass Flats		Frenchman Flats		Yucca Flat	
	August 1987	March 1988	August 1987	March 1988	August 1987	March 1988
Adult Lizards						
Male	7	4	5	2	16	8
Female	4	2	7	3	17	7
Total	11	6 (54.5%)	12	5 (51.7%)	33	15 (45.5%)
Juvenile Lizards						
Male	20	5	27	5	57	11
Female	26	13	34	9	56	23
Total	46	18 (39.1%)	61	14 (23.0%)	113	34 (30.1%)

Table 3.6 Survivorship of adult *Uta stansburiana* between March and August 1988 on the baseline monitoring plots compared to ephemeral biomass and numbers/meter^2.

Plot	Uta % survivorship	Ephemeral number/m^2	Ephemeral grams/m^2
JAF001	11.0	962 ± 109	10 ± 1
FRF001	8.3	293 ± 118	21 ± 11
YUF001	34.4	1713 ± 431.5	22 ± 5

Subsidiary Study Plots in Yucca Flat

Burned and Unburned Study Areas. The burned and unburned plots (YUF002, burned; YUF003, unburned) were sampled in the spring of 1988 to determine any effect of the lack of adults surviving the reproductive season, as seen in our August 1987 sampling (Hunter and Medica, 1989). The spring adult Uta density estimates on the two 0.56-ha plots in 1988 were not significantly different, YUF002 53.9 ± 7.4/ha and YUF003 59.1 ± 4.6/ha, indicating that the number of adults remaining on the plot in the summer of 1987 had little if any effect upon the number of animals ultimately recorded in the spring of 1988.

Summer adult density estimates in August (August 15-26) for YUF002 and YUF003 were 8.9 ± 4.1/ha and 30.6 ± 18.5/ha respectively, with survivorship being 14.3% in YUF002 and

22.6% in YUF003. Hatchling density estimates were high in YUF003 with large standard error (Table 3.7). The trend exhibited in 1987 in the burned study plot (Hunter and Medica, 1989) continued in 1988, with reduced survivorship of adults in summer, suggesting that predation might be the cause of the reduction of adults from spring to late summer.

Table 3.7 Estimated densities (number per hectare ± two standard errors) of *Uta stansburiana* on subsidiary (0.56 ha) study plots YUF002 (burned) and YUF003 (unburned) in spring and summer of 1988. Numbers in parentheses are actual numbers of individuals enumerated.

	Spring 1988		Summer 1988	
	(YUF002)	(YUF003)	(YUF002)	(YUF003)
Adult Lizards	53.7 ± 7.4	58.8 ± 9.1	8.9 ± 5.0	30.2 ± 18.5
Male	(10)	(9)	(0)	(2)
Female	(18)	(22)	(4)	(9)
Total	(28)	(31)	(4)	(11)
Hatchling Lizards			109.4 ± 14.8	215.5 ± 98.1
Male			(24)	(38)
Female			(32)	(21)
Total			(56)	(59)

In the fall of 1987, approximately equal amounts of effort were expended on each plot (13.7 man-hours on YUF002 and 13.3 man-hours on YUF003) with 4 Gambelia wislizenii enumerated on YUF002 and 2 G. wislizenii on YUF003. G. wislizenii is a predator on Uta.

In August 1988 a comparable number of man-hours were spent sampling these plots (12.8 in YUF002, and 13.3 in YUF003) with 2 G. wislizenii hatchlings being captured in each plot. Based upon the equal sampling effort (total man-hours on YUF002, 26.5; and YUF003, 26.6) and nearly equal numbers of leopard lizards (G. wislizenii) enumerated, it seems that the

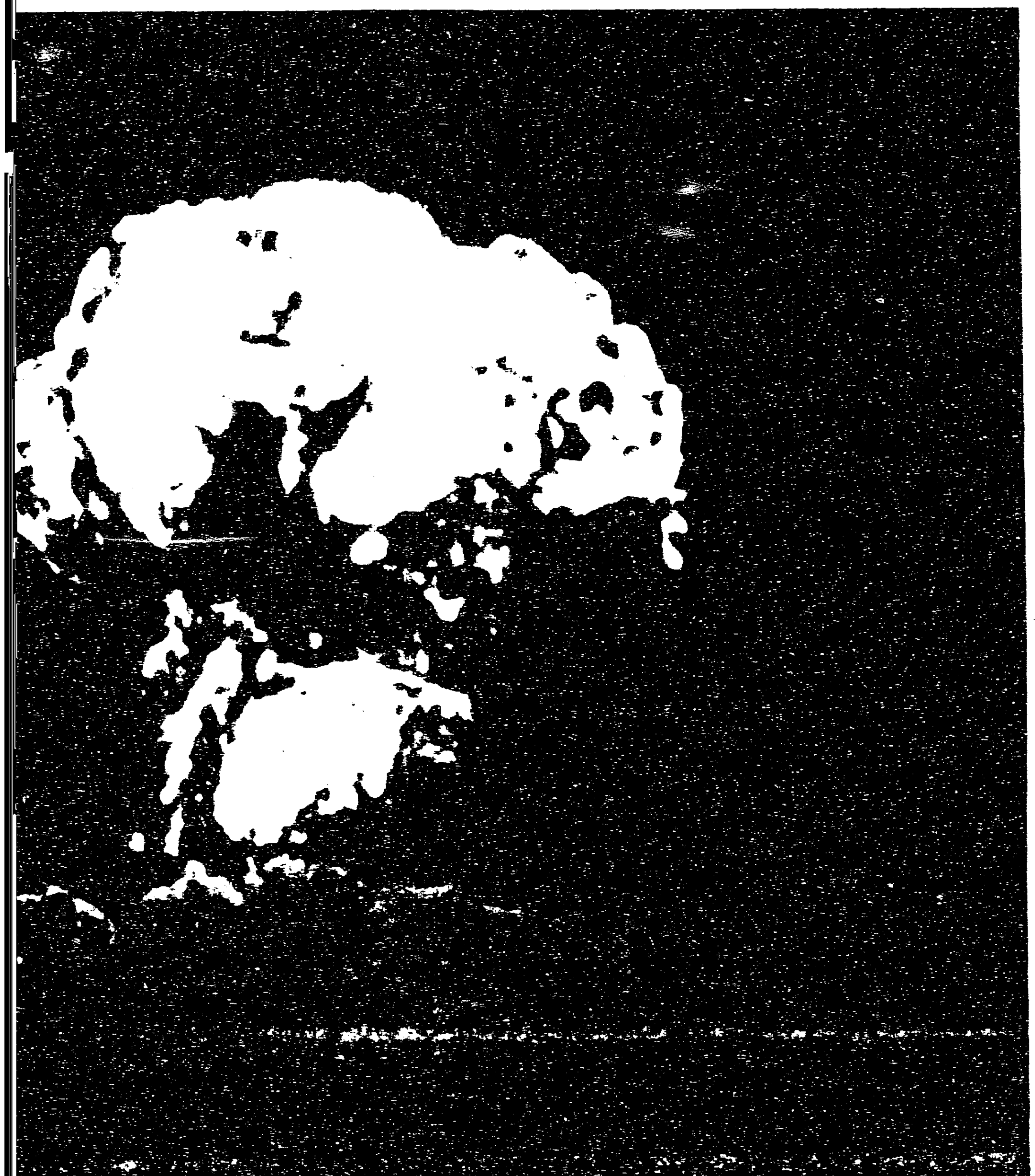
Blast Area Study at T1. Uta sampling was conducted at blast areas on sites of aboveground nuclear tests conducted between 1952 and 1957 (Figure 3.6). These areas were created by large fireballs enveloping the ground surface, denuding the vegetation, fusing portions of the sand and irradiating the area. Annual plant invasion took place rather rapidly (Shields and Wells, 1963). Our study plot (YUF009) was located within the old disturbed area described by Tanner and Jorgensen (1963:28-29) along the southeast transect line (3168 ft) from ground zero at T1. In 1988 this region was characterized by dense cover of introduced annuals in spring and the lack of much shrub cover except for an occasional Atriplex or Chrysothamnus shrub. The control plot was established along this same transect line (5808 ft) southeast of ground zero in the undisturbed vegetation in the Grayia-Lycium community. A region similar to that described by Tanner and Jorgensen (1963) is shown in Figure 2.2 this report.

A total of 61 adult Uta were enumerated on the T1 control area (YUF010) in the spring of 1988, compared to only 4 Uta adults on the T1 blast area plot (YUF009). There was 31% survivorship (19 of 61) of Uta adults from spring to summer on YUF010, compared to 0% survivorship on the blast area (YUF009). The estimated adult density on the blast area was 12.4 ± 12.3 compared to 121.7 ± 15.0 per hectare on the control plot. Correspondingly, the number of hatchling Uta enumerated on the blast area was 3 compared to 82 on the control site (Table 3.8).

Table 3.8 Estimated densities (number per hectare ± two standard errors) of *Uta stansburiana* in late April and August-September on subsidiary (0.56 ha) plots YUF009 (T1 Blast Area) and YUF010 (Control). Numbers in parentheses are actual numbers of individuals enumerated.

	Spring 1988		Summer 1988	
	(YUF009)	(YUF010)	(YUF009)	(YUF010)
Adult Lizards	12.4 ± 12.3	121.7 ± 15.0		24.3 ± 4.0
Male	(1)	(27)	(0)	(13)
Female	(3)	(34)	(0)	(12)
Total	(4)	(61)	(0)	(25)
Hatchling Lizards				219.1 ± 1.7
Male			(24)	(38)
Female			(32)	(21)
Total			(56)	(59)

ear test Apple II (May 5, 1955) which enveloped the study plot YUF009 sampled in



stansburiana indicated that the control area possessed more Uta adults. The 3B Consolidation Site (YUF011) which was bladed in the fall of 1987 was approximately 4.5 ha. No Uta was ever observed on the 3B Consolidation Site. The highest Uta density observed was on the undisturbed study plot (YUF012), which was approximately 150 m south of the 3B Consolidation Site (Table 3.9).

Table 3.9 Estimated densities (number per hectare ± two standard errors) of *Uta stansburiana* in spring (early May) on subsidiary (0.56 ha) plots YUF011 (3B consolidation site), YUF012 (Undisturbed), and YUF013 (T3a Blast Area). Numbers in parentheses are actual numbers of individuals enumerated.

	Spring 1988		
	YUF011	YUF012	YUF013
Adult Lizards	0	80.0 ± 53.9	38.2 ± 13.5
Male	(0)	(13)	(7)
Female	(0)	(12)	(10)
Total	(0)	(25)	(17)

LIZARD TRANSECTS (BASELINE MONITORING PLOTS)

Estimated densities of Cnemidophorus tigris in 1988 ranged from a low of .05/ha on Pahute Mesa, to a high of 4.7/ha in Jackass Flats (Table 3.10).

Table 3.10 Relative abundance of adult lizards observed on the BECAMP baseline monitoring plot transect lines surveyed in 1988. Estimated numbers/ha in parentheses.

Species	Jackass Flats (JAF001)	Frenchman Flat (FRF001)	Yucca Flat (YUF001)	Pahute Mesa (PAM001)
Cnemidophorus tigris	1.43 (4.71)	.65 (2.13)	.68 (2.25)	.014 (.05)
Callisaurus draconoides	.006 (.012)	.201 (.403)	.03 (.06)	0
Gambelia wislizenii	.13	.15	.052	.021
Phrynosoma platyrhinos	.024	.041	.030	.007
Crotaphytus collaris	0	0	0	.014
Sceloporus occidentalis	0	0	0	.021
Uta stansburiana	.089	.30	.36	.43

Comparing the transects sampled on the baseline monitoring plots in 1987 with the 1988 data

indicated that there was a slight increase in whiptails on Frenchman Flat from 1.65/ha in 1987 to 2.13 in 1988, and a decrease in Yucca Flat from 6.37/ha in 1987 to 2.25 in 1988. At this point it is difficult to explain what may account for the decline of whiptail lizards in Yucca Flat. The number of lizards of the other species recorded were too few to accurately estimate density. It is evident (Table 3.3) that the transect method of sampling is inadequate to provide reasonable adult Uta abundance estimates. Multiplication factors from 10 to 100 would be required to arrive at density estimates comparable to those derived by mark-recapture methods.

REPTILE SPECIES OBSERVED ON THE NEVADA TEST SITE

Tables 3.11 and 3.12 list the species of lizards, tortoise and snakes observed on the baseline monitoring plots in 1988. The above tables also indicate species which, although not observed in 1988, were likely to be present on the plots based on records in published literature (Tanner and Jorgensen, 1963) or observations by the author in previous years.

On September 13, 1988, a noteworthy record for the western red-tailed skink (Eumeces gilberti rubricaudatus) was recorded on Pahute Mesa off the southern end of our PAM001 plot. This was the third known record for this subspecies on the Nevada Test Site (Medica, Haworth and Kelly, 1990).

DESERT TORTOISE STUDY

Much of the southern portion of the NTS has been searched for the presence of the desert tortoise (Gopherus agassizii) by E.G.& G. (O'Farrell, unpublished maps). In over 300 miles of line transects surveyed between 1984 and 1986, only seven desert tortoises were observed. In 1987 we walked 15 (1.5 mi) transects mainly in northwest Frenchman Flat (one of the highest density tortoise locations on the NTS) and found only two tortoises. The above indicates that the use of the transect technique is not a very effective way to enumerate animals. The objective of our tortoise study was to enumerate as many animals as possible within the NTS and monitor their survivorship, growth, and movements, and to locate hibernacula.

A total of 48 different desert tortoises were captured on the NTS in 1988: 8 in Jackass Flats; 3 in Mercury Valley; 20 in Frenchman Flat; 17 in Rock Valley (14 within fenced plots, 3 free ranging) (Table 3.13).

Figure 3.7 illustrates the size relationships of the tortoises captured in 1987 and 1988, excluding those from fenced enclosures in Rock Valley.

Rock Valley (Fenced Study Areas)

In April 1988 a total of 14 desert tortoises were recaptured in the Rock Valley study area: 11 of these animals were of known age (± one year) (Turner, Medica and Bury, 1987). In September-October 1988 the Rock Valley study area was resampled and 9 tortoises were recaptured; all of these individuals had previously been captured in the spring except for No. 1211 which was last captured in October 1987.

Growth in 1988 was measured on 8 tortoises (5 males and 3 females) first captured in April 1988 and then recaptured in September - October 1988. The mean growth and range was 1.6 mm (0-4 mm) for male tortoises, and 2.7 mm (1-6 mm) for females, with the overall mean of 2.0 mm growth in 1988. The one tortoise of undetermined sex which is known to be 24 years old grew 4 mm in 1988 which falls within the ranges observed for both male and female tortoises.

Other Tortoises on the NTS

A total of 34 additional desert tortoises were marked and released between April and October 1988 on the NTS. Three were from Rock Valley outside of the fenced plots, 18 from Frenchman Flat (14 from the northwestern portion of the valley and 4 from the southern part of the valley), 10 from Jackass Flats (8 from the northern end of the valley along Saddle Mountain Road and two from eastern Pluto Valley), and 3 from Mercury Valley just south and west of Mercury. Tortoise capture locations are shown on the map (Figure 3.8).

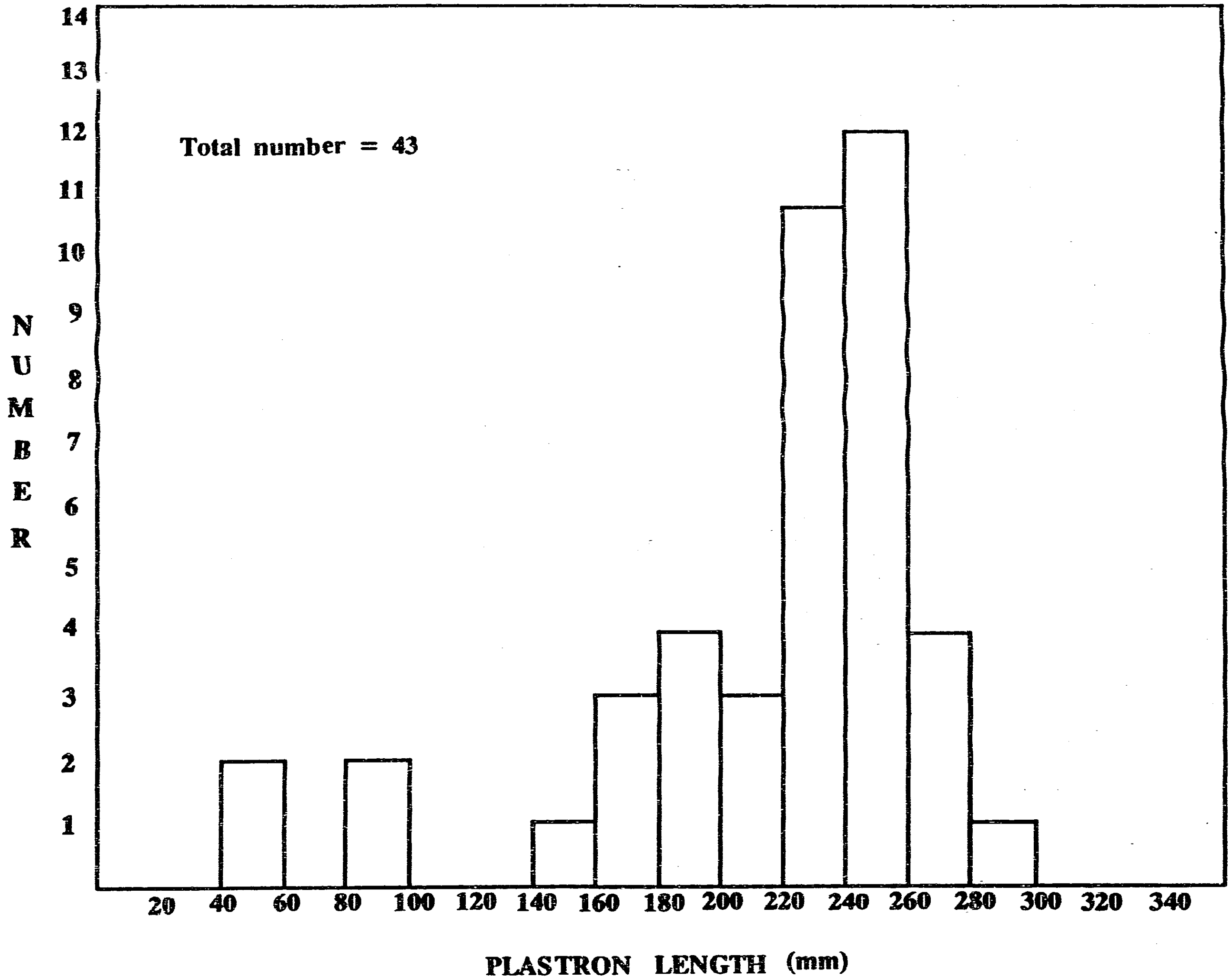


Figure 3.7 Size relationship (plastron length) of desert tortoises (<u>Gopherus agassizii</u>) enumerated on the NTS during 1987 and 1988.

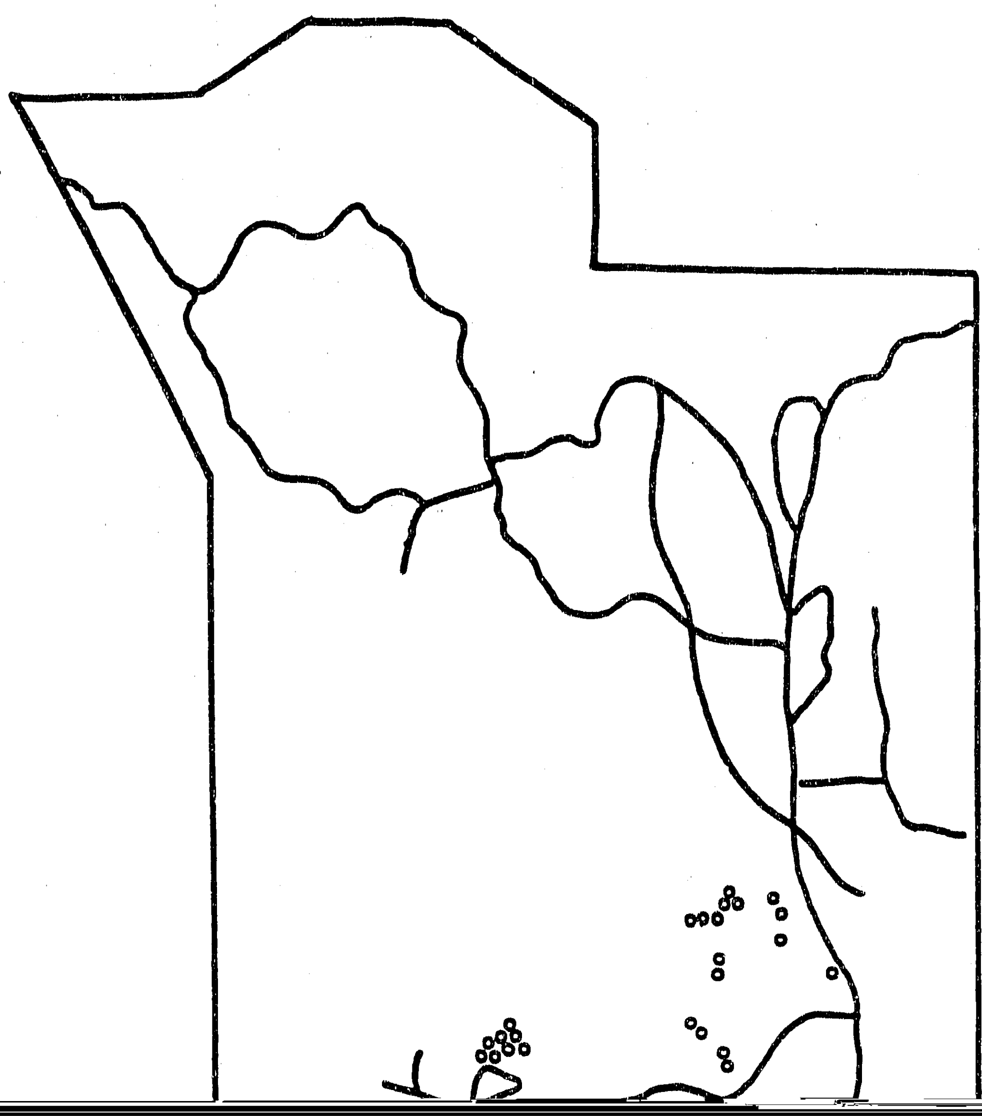


Table 3.11 Lizards that were observed on the BECAMP baseline monitoring plots in 1988 are indicated by (X); those which probably were present but were not observed (P). Blanks indicate that the species probably does not occur on the plot.

Species	Jackass Flats (JAF001)	Frenchman Flat (FRF001)	Yucca Flat (YUF001)	Pahute Mesa (PAM001)	Rainier Mesa (RAM001)
Coleonyx variegatus	P	P	X		
Callisaurus draconoides	X	X	X		
Crotaphytus collaris				X	P
Gambelia wislizenii	X	X	X	X	
Dipsosaurus dorsalis	P	X			
Phrynosoma platyrhinos	X	X	X	X	
Sauromalus obesus					
Sceloporus graciosus				P	P
Sceloporus magister	P	P	X		
Sceloporus occidentalis				X	X
Uta stansburiana	X	X	X	X	X
Eumeces gilberti				X	P
Eumeces skiltonianus					P
Cnemidophorus tigris	X	X	X	X	
Xantusia vigilis			P		

Table 3.12 Desert tortoise and snakes that were observed on the BECAMP baseline monitoring plots in 1988 (X); those which probably were present but were not observed (P), and species which probably did not occur (blank).

Species	Jackass Flats (JAF001)	Frenchman Flat (FRF001)	Yucca Flat (YUF001)	Pahute Mesa (PAM001)	Rainier Mesa (RAM001)
Gopherus agassizii	P	P			
Arizona elegans	P	P			
Chionactis occipitalis	X	P	P		
Diadophis punctatus				P	P
Hypsiglena torquata	P	P	P		
Lampropeltis getulus	P	P	P	P	P
Leptotyphlops humilis	P	P			
Masticophis flagellum	P	P	P	P	
Masticophis taeniatus				P	P
Phyllorhynchus decurtatus	P	P			
Pituophis melanoleucus	P	P	P	P	P
Rhinocheilus lecontei	P	P	P	P	
Salvadora hexalepis	P	P	P		
Sonora semiannulata	P	P	P		
Tantilla utahensis	P	P	P		
Trimorphodon lambda	P	P			
Crotalus cerastes	X	P	P		
Crotalus mitchelli	P	P	P	P	P

Table 3.13 Desert tortoises (*Gopherus agassizii*) captured on the Nevada Test Site in 1988.

	Animal #	Sex	Plastron length (mm)	Carapace length (mm)	Weight (g)
Jackass Flats	15	M	210	228	2350
	16	F	193	213	1850
	17	M	208	222	2100
	18	M	254	278	4175
	19	F	244	262	3375
	20	F	240	262	3425
	21	F	231	255	2925
	23	F	228	254	3100
Frenchman Flat	11	M	253	265	3900
	12	F	248	262	3575
	13	F	249	267	3700
	14	F	246	260	3550
	24	F	222	239	2725
	25	J	143	150	650
	26	F	265	270	3725
	27	M	228	237	2525
	28	F	218	231	2025
	29	F	236	253	2950
	32	M	198	202	1850
	33	M	195	212	1725
	34	M	195	206	1775
	35	H	45	48	20-25
	36	H	45	48	20-25
	37	M	263	286	4850
	38	M	236	245	2875
	41	M	272	282	4225
	42	J	100	110	300
	43	M	261	289	4000

Table 3.13 Desert tortoises *(Gopherus agassizii)* captured on the Nevada Test Site in 1988. (Continued)

	Animal #	Sex	Plastron length (mm)	Carapace length (mm)	Weight (g)
Mercury Valley	22	F	176	199	1925
	39	M	236	245	2875
	40	F	186	207	1575
Rock Valley (Fenced Plots)*					
Plot 1	4111	M	235	249	2750
	4415	M	236	269	3600
	2444	F	218	226	2250
Plot 2	1112	M	247	278	3650
	4444	M	234	254	3200
Plot 3	1222	F	211	222	2150
	1411	F	215	229	2425
	2111	M	221	236	2450
	4121	J	157	169	975
	4414	M	226	252	2700
	4811	F	218	234	2500
	5111	F	218	231	2275
	6111	F	237	242	2525
	8222	M	224	232	2250
Rock Valley (Unfenced)	10	M	245	261	3025
	30	M	240	261	3075

*Spring capture weights and measurements only.

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APPENDIX 3A
BECAMP/ECOLOGY PLOT LOCATIONS
(as of January 1989)

Plots	Nevada State Grid Coordinate	Area	Location
FRF001	N 751,745 E 699,304	5	Frenchman Flat
FRF002	N 749,465 E 693,519	5	Frenchman Flat Roadside
JAF001	N 735,274 E 585,114	25	Jackass Flats
MER001	N 698,283 E 696,420	23	Mercury Water Balance Plots
MER002	N 692,904 E 660,831	22	Gopher Denuded Area

Appendix 3A
(Continued)

Plots	Nevada State Grid Coordinate	Area	Location
ROV001	N 705,812 E 639,433	25	Fenced Plot A (UCLA)
ROV002	N 706,766 E 641,167	25	Fenced Plot B (UCLA)
ROV003	N 705,169 E 638,582	25	Fenced Plot C (UCLA)
ROV004	N 706,979 E 639,972	25	Unfenced Plot D (UCLA)
ROV005	N 704,975 E 640,393	25	Beatley Plot 3 (UCLA)
ROV006	N 710,093 E 644,831	25	Beatley Plot 4 (UCLA)
ROV007	N 707,038 E 639,531	25	IBP Plot 16
YUF001	N 822,135 E 670,729	1	Yucca Flat
YUF002	N 819,572 E 664,869	6	Burn (June 1985)
YUF003	N 818,445 E 664,450	6	Unburned Area
YUF004	N 838,631 E 664,089	1	T1 Plots Romney UCLA #1
YUF005	N 838,581 E 663,589	1	T1 Plots Romney UCLA #2
YUF006	N 838,531 E 663,089	1	T1 Plots Romney UCLA #3

Appendix 3A
(Continued)

Plots	Nevada State Grid Coordinate	Area	Location
YUF 007	N 838,481 E 662,489	1	T1 Plots Romney UCLA #4
YUF008	N 838,481 E 661,689	1	T1 Plots Romney UCLA #5
YUF009	N 836,736 E 666,833	1	T1 Blast Area 3168 ft. SE, GZ
YUF010	N 834,635 E 668,974	1	T1 Undisturbed 5808 ft. SE, GZ
YUF011	N 838,553 E 693,936	3	3B Consolidation Site
YUF012	N 837,648 E 694,079	3	3B Undisturbed Area
YUF013	N 838,003 E 692,355	3	T3 Blast Area ESE, GZ
YUF014	N 869,364 E 661,309	2	T2-1 Plot
YUF015	N 872,679 E 665,894	2	T2-5 Plot
YUF016	N 884,782 E 682,661	10	Sedan 1500 ft. NE, GZ 16 A Line
YUF017	N 885,787 E 684,214	10	Sedan 3500 ft. NE, GZ 16 A Line
YUF018	N 886,405 E 687,088	10	Sedan 5250 ft. NE, GZ 16 A Line

APPENDIX 3B

Density Estimates for Adult Uta stansburiana Sampled In Spring and Summer, and Hatchlings Sampled During the Summer of 1988 on the BECAMP Study Plots on the Nevada Test Site

The table heading JAF188ADUTASPRDEN stands for the following:

JAF	=	Jackass Flats.
1	=	Plot 001.
88	=	year 1988.
ADUTA	=	Adult Uta.
SPRDEN	=	Spring density.

Lines 1-7 of each table mean the following:

N1	=	Cumulative number of individuals recorded in previous days samples.
XB	=	Number of new individuals captured on day 2.
M2	=	Number in N2 which were recaptured (marked in a previous sample).
N2	=	Total number of individuals captured in the days sample.
N*/HA	=	Population density estimate in number per hectare.
V/HA 2	=	Variance estimate per hectare squared.
2SE/HA	=	two times the standard error per hectare.

Calculations are based on Seber (1982).

Appendix 3B
(Continued)

#JAF188ADUTASPRDEN

0 ANIMAL #	1 04-MAR-88	2 07-MAR-88	3 08-MAR-88	4 09-MAR-88	5 10-MAR-88	6 11-MAR-88
1 N1	19.00	42.00	64.00	72.00	85.00	
2 X8	23.00	22.00	8.00	13.00	6.00	
3 M2	3.00	7.00	23.00	31.00	23.00	
4 N2	26.00	29.00	31.00	44.00	29.00	
5 N*/HA	121.54	145.35	77.70	92.20	96.59	
6 V/HA^2	2043.59	1418.73	38.97	42.62	54.83	
7 2SE/HA	90.41	75.33	12.48	13.05	14.80	

#JAF188ADUTASUMDEN

0 ANIMAL #	1 01-AUG-88	2 02-AUG-88	3 03-AUG-88	4 04-AUG-88	5 05-AUG-88
1 N1	2.0C	2.00	3.00	6.00	
2 X8	0.00	1.00	3.00	5.00	
3 M2	1.00	0.00	0.00	1.00	
4 N2	1.00	1.00	3.00	6.00	
5 N*/HA	1.81	4.53	13.60	21.31	
6 V/HA^2	0.00	4.93	59.23	83.98	
7 2SE/HA	0.00	4.44	15.39	18.32	

#JAF188JUUTASUMDEN

0 ANIMAL #	1 01-AUG-88	2 02-AUG-88	3 03-AUG-88	4 04-AUG-88	5 05-AUG-88
1 N1	6.00	18.00	29.00	38.00	
2 X8	12.00	11.00	9.00	17.00	
3 M2	1.00	3.00	3.00	5.00	
4 N2	13.00	14.00	12.00	22.00	
5 N*/HA	43.53	63.71	87.52	134.69	
6 V/HA^2	403.12	483.59	938.49	1642.84	
7 2SE/HA	40 15	43.98	61.26	81.06	

Appendix 3B
(Continued)

#FRF188ADUTASPRDEN

0 ANIMAL #	1 14-MAR-88	2 15-MAR-88	3 16-MAR-88	4 17-MAR-88	5 18-MAR-88
1 N1		9.00	24.00	34.00	35.00
2 XB		15.00	10.00	1.00	1.00
3 M2		5.00	10.00	14.00	19.00
4 N2		20.00	20.00	15.00	20.00
5 N*/HA		30.83	42.38	32.95	33.37
6 V/HA^2		41.13	41.64	2.55	1.18
7 2SE/HA		12.82	12.90	3.19	2.17

#FRF188ADUTASUMDEN

0 ANIMAL #	1 22-AUG-88	2 24-AUG-88	3 25-AUG-88
1 N1		2.00	3.00
2 XB		1.00	0.00
3 M2		1.00	2.00
4 N2		2.00	2.00
5 N*/HA		3.17	2.72
6 V/HA^2		0.61	0.00
7 2SE/HA		1.57	0.00

#FRF188JUUTASUMDEN

0 ANIMAL #	1 22-AUG-88	2 24-AUG-88	3 25-AUG-88	4 07-SEP-88	5 08-SEP-88
1 N1		10.00	18.00	21.00	28.00
2 XB		8.00	3.00	7.00	0.00
3 M2		0.00	3.00	3.00	5.00
4 N2		8.00	6.00	10.00	5.00
5 N*/HA		88.88	29.25	53.96	25.39
6 V/HA^2		3257.90	61.54	313.57	0.00
7 2SE/HA		114.15	15.69	35.41	0.00

5-MAR-88	3-AUG-88	3-AUG-88
4.00	3.00	5.00
6.00	3.00	3.00
0.00	7.00	2.00
6.00	0.00	5.00
1.11	1.49	0.68
0.05	1.66	3.00
9.94	2.90	3.64

Appendix 3B
(Continued)

…MAR-88	3 30-MAR-88	4 31-MAR-88	5 [illegible]	…R-88	6 05-APR-88
…00	22.00	22.00	[illegible]	[illegible]	25.00
…00	0.00	2.00	[illegible]	[illegible]	3.00
…00	6.00	9.00	[illegible]	[illegible]	14.00
…00	6.00	11.00	[illegible]	[illegible]	17.00
…11	39.11	47.28	[illegible]	[illegible]	53.68
…70	0.00	20.61	[illegible]	[illegible]	13.55
…63	0.00	9.08	[illegible]	[illegible]	7.36

…AUG-88	3 19-AUG-88
…00	4.00
…00	0.00
…00	1.00
…00	1.00
…88	7.11
…62	0.00
…92	0.00

…AUG-88	3 18-AUG-88	4 19-AUG-88	5 [illegible]	…G-88
…00	46.00	51.00	[illegible]	[illegible]
…00	5.00	2.00	[illegible]	[illegible]
…00	19.00	17.00	[illegible]	[illegible]
…00	24.00	19.00	[illegible]	[illegible]
…22	102.66	100.93	1[illegible]	[illegible]
…07	59.68	36.30	[illegible]	[illegible]
…36	15.45	12.05	[illegible]	[illegible]

Appendix 3B
(Continued)

#YUF388ADUTASPRDEN

0 ANIMAL #	1 28-MAR-88	2 29-MAR-88	3 30-MAR-88	4 31-MAR-88	5 01-APR-88	6 05-APR-88
1 N1		8.00	22.0C	24.00	28.00	30.00
2 XB		14.00	2.00	4.00	2.00	1.00
3 M2		4.00	5.00	12.00	11.00	9.00
4 N2		18.00	7.00	16.00	13.00	10.00
5 N*/HA		59.02	52.74	56.34	58.37	58.84
6 V/HA^2		201.76	78.46	27.25	23.30	20.57
7 2SE/HA		28.40	17.71	10.44	9.65	9.07

#YUF388ADUTASUMDEN

0 ANIMAL #	1 15-AUG-88	2 16-AUG-88	3 18-AUG-88	4 19-AUG-88	5 26-AUG-88
1 N1		3.00	6.00	8.00	8.00
2 XB		3.00	2.00	0.00	3.00
3 M2		0.00	0.00	3.00	2.00
4 N2		3.00	2.00	3.00	5.00
5 N*/HA		26.66	35.55	14.22	30.22
6 V/HA^2		227.55	398.22	0.00	85.33
7 2SE/HA		30.16	39.91	0.00	18.47

#YUF388JUUTASUMDEN

0 ANIMAL #	1 15-AUG-88	2 16-AUG-88	3 18-AUG-88	4 19-AUG-88	5 26-AUG-88
1 N1		9.00	16.00	29.00	43.00
2 XB		7.00	13.00	14.00	16.00
3 M2		2.00	2.00	3.00	8.00
4 N2		9.00	15.00	17.00	24.00
5 N*/HA		57.48	159.40	238.22	215.50
6 V/HA^2		430.17	4346.03	7765.33	2403.53
7 2SE/HA		41.48	131.84	176.24	98.05

Appendix 3B
(Continued)

#YUF988ADUTASPRDEN

0 ANIMAL #	1 26-APR-88	2 27-APR-88	3 28-APR-88	4 29-APR-88
1 N1		2.00	3.00	3.00
2 XB		1.00	0.00	1.00
3 M2		0.00	1.00	0.00
4 N2		1.00	1.00	1.00
5 N*/HA		8.88	5.33	12.44
6 V/HA^2		18.96	0.00	37.92
7 2SE/HA		8.70	0.00	12.31

Appendix 3B
(Continued)

#YUF1088ADUTASPRDEN

0 ANIMAL #	1 26-APR-88	2 27-APR-88	3 28-APR-88	4 29-APR-88
1 N1		14.00	41.00	53.00
2 XB		27.00	12.00	8.00
3 M2		3.00	20.00	27.00
4 N2		30.00	32.00	35.00
5 N*/HA		204.88	115.55	121.65
6 V/HA^2		5456.00	113.77	56.20
7 2SE/HA		147.72	21.33	14.99

#YUF1088ADUTASUMDEN

0 ANIMAL #	1 29-AUG-88	2 31-AUG-88	3 01-SEP-88	4 02-SEP-88	5 06-SEP-88
1 N1		8.00	12.00	23.00	24.00
2 XB		4.00	11.00	1.00	1.00
3 M2		3.00	5.00	8.00	8.00
4 N2		7.00	16.00	9.00	9.00
5 N*/HA		15.41	32.50	23.28	24.28
6 V/HA^2		14.80	55.55	3.65	4.06
7 2SE/HA		7.69	14.90	3.82	4.03

#YUF1088JUUTASUMDEN

0 ANIMAL #	1 29-AUG-88	2 31-AUG-88	3 01-SEP-88	4 02-SEP-88	5 06-SEP-88
1 N1		17.00	53.00	63.00	70.00
2 XB		36.00	10.00	7.00	12.00
3 M2		2.00	13.00	21.00	15.00
4 N2		38.00	23.00	28.00	27.00
5 N*/HA		414.22	162.79	148.20	219.11
6 V/HA^2		33280.00	557.27	154.91	952.85
7 2SE/HA		364.85	47.21	24.89	61.73

Appendix 3B
(Continued)

YUF1168ADSPRSTATS

NO STATISTICS

#YUF1288ADUTASPRDEN

0 ANIMAL #	1 03-MAY-88	2 09-MAY-88	3 10-MAY-88	4 16-MAY-88	5 18-MAY-88
1 N1		13.00	14.00	18.00	22.00
2 XB		1.00	4.00	4.00	3.00
3 M2		0.00	1.00	3.00	2.00
4 N2		1.00	5.00	7.00	5.00
5 N*/HA		48.00	78.22	65.77	80.00
6 V/HA^2		575.20	1232.59	360.29	726.91
7 2SE/HA		47.96	70.21	37.96	53.92

#YUF1388ADUTASPRDEN

0 ANIMAL #	1 02-MAY-88	2 03-MAY-88	3 09-MAY-88	4 10-MAY-88	5 16-MAY-88	6 18-MAY-88
1 N1		4.00	11.00	13.00	14.00	14.00
2 XB		7.00	2.00	1.00	0.00	3.00
3 M2		1.00	3.00	3.00	2.00	5.00
4 N2		8.00	5.00	4.00	2.00	8.00
5 N*/HA		38.22	30.22	29.33	24.88	38.22
6 V/HA^2		248.88	45.51	27.65	0.00	45.71
7 2SE/HA		31.55	13.49	10.51	0.00	13.52

Appendix 3B
(Continued)

#PAM188ADUTASUMDEN

0 ANIMAL #	1 12-SEP-88	2 13-SEP-88	3 14-SEP-88	4 15-SEP-88	5 16-SEP-88
1 N1		7.00	14.00	18.00	22.00
2 XB		7.00	4.00	4.00	2.00
3 M2		3.00	4.00	3.00	4.00
4 N2		10.00	8.00	7.00	6.00
5 N*/HA		19.04	23.58	33.56	28.29
6 V/HA^2		25.33	29.61	93.78	31.78
7 2SE/HA		10.06	10.88	19.36	11.27

#PAM188JUUTASUMDEN

0 ANIMAL #	1 12-SEP-88	2 13-SEP-88	3 14-SEP-88	4 15-SEP-88	5 16-SEP-88
1 N1		47.00	77.00	87.00	104.00
2 XB		30.00	10.00	17.00	13.00
3 M2		15.00	18.00	31.00	25.00
4 N2		45.00	28.00	48.00	38.00
5 N*/HA		124.26	107.08	121.32	141.95
6 V/HA^2		400.70	152.07	99.94	189.56
7 2*SE/HA		40.04	24.66	19.99	27.54

SECTION 4
STATUS OF SMALL MAMMALS ON THE NTS IN 1988

by
M. B. Saethre and P. A. Medica

INTRODUCTION

Rodents are the most abundant mammals on the Nevada Test Site (NTS), and are common to all of the various habitats present on the NTS. Extensive studies on small mammal distribution, seasonal and daily activity patterns, home ranges and specific habitat preferences were undertaken by Brigham Young University (BYU) over a five year period from 1959 to 1965 (Allred et al. 1963; Jorgensen and Hayward 1965). A further review of the history of mammal sampling on the NTS is found in Hunter and Medica (1989).

There are three species of lagomorphs (rabbits and hares) and over twenty species of rodents present on the NTS. Several species of rodents are found throughout most of the biotic communities on the NTS. The majority of these species have patchy distributions at low densities, occupying specific plant communities and elevations, as well as the specific biotic communities characteristic of Mojave Desert and Great Basin Desert, which merge within the NTS, providing a unique ecotonal habitat. Two species of rodents found on NTS, *Perognathus* and *Dipodomys*, may be used as indicator species of different biotic communities (Jorgensen and Hayward 1965).

The sampling of small mammals by the Basic Environmental Compliance and Monitoring Program (BECAMP) in 1988 consisted of resurveys of natural populations in three major valleys, Jackass Flats (JAF001), Frenchman Flat (FRF001), and Yucca Flat (YUF001), and initial surveys on two mesas, Pahute Mesa (PAM001) and Rainier Mesa (RAM001). Resident mammals on the above monitoring plots were sampled to provide baseline data on species composition, estimated densities of the more common species, sex ratios, age distribution, and biomass, as well as to document stability of rodent populations over time in areas undisturbed by NTS activities.

In addition to the baseline monitoring plots, various types of disturbances and their impact on small mammal populations were studied on subsidiary plots. The following disturbed areas were investigated: an area denuded by gophers in Mercury Valley (MER002); two sites where fires denuded the study area, one in Mid Valley (MID002) and one in Redrock Valley (RED001), a fenced study plot (ROV008) previously exposed to a cesium-137 source (^{137}Cs)

site (YUF011) from which all radioactive waste and soil had recently been removed; and the area to the northeast of project Sedan in Yucca Flat (YUF016 and YUF017) which had been affected by the blast and throw-out from the 1962 underground nuclear test. Near each of the disturbed study plots, a control area was selected and sampled to document the resident species and population sizes in areas which were representative of undisturbed habitat. Locations for all of the plots sampled for mammals in 1988 are shown in Figure 4.1. Plot locations in Nevada State Grid Coordinates are listed in Appendix 3A of Section 3, "Status of Reptiles in 1988."

METHODS

SMALL MAMMAL SAMPLING TECHNIQUES

Baseline Monitoring Plots

Small mammals were trapped on the three existing BECAMP monitoring plots in 1988: JAF001, April 12-14 and August 11; FRF001, April 12-14 and August 5; and YUF001, April 26-28 and August 11. These three sites had been previously trapped during the summer of 1987 and results were reported in Hunter and Medica (1989). Two new baseline monitoring sites were established and sampled in 1988: PAM001, June 24, 28, 29 and August 19; and RAM001, August 2-4. Plots at JAF001, FRF001, YUF001, and PAM001 were sampled in August to determine summer species composition (Appendix 4A).

The sampling technique consisted of three consecutive trap nights, or as close to consecutive as possible. Small nocturnal mammals were captured in Sherman live traps measuring 8 x 9 x 30 centimeters which were set to capture animals which weighed approximately 5 grams (the average weight of a juvenile *Perognathus longimembris*). All mammal study plots on the baseline sites consisted of 12 x 12 staked grids (144 stations) with 15 meters between stakes [illegible]

A total of 288 traps were placed on each study site (2 per station). Two traps were used to provide more opportunities for animals to be captured during the trapping period of only three days. Traps were baited in the early evening (1630+ hours) with a mixture of rolled oats and birdseed and checked shortly after sunrise the following day. Traps were oriented north-south with the opening faced away from any wind. A metal (half-cylinder) trap cover

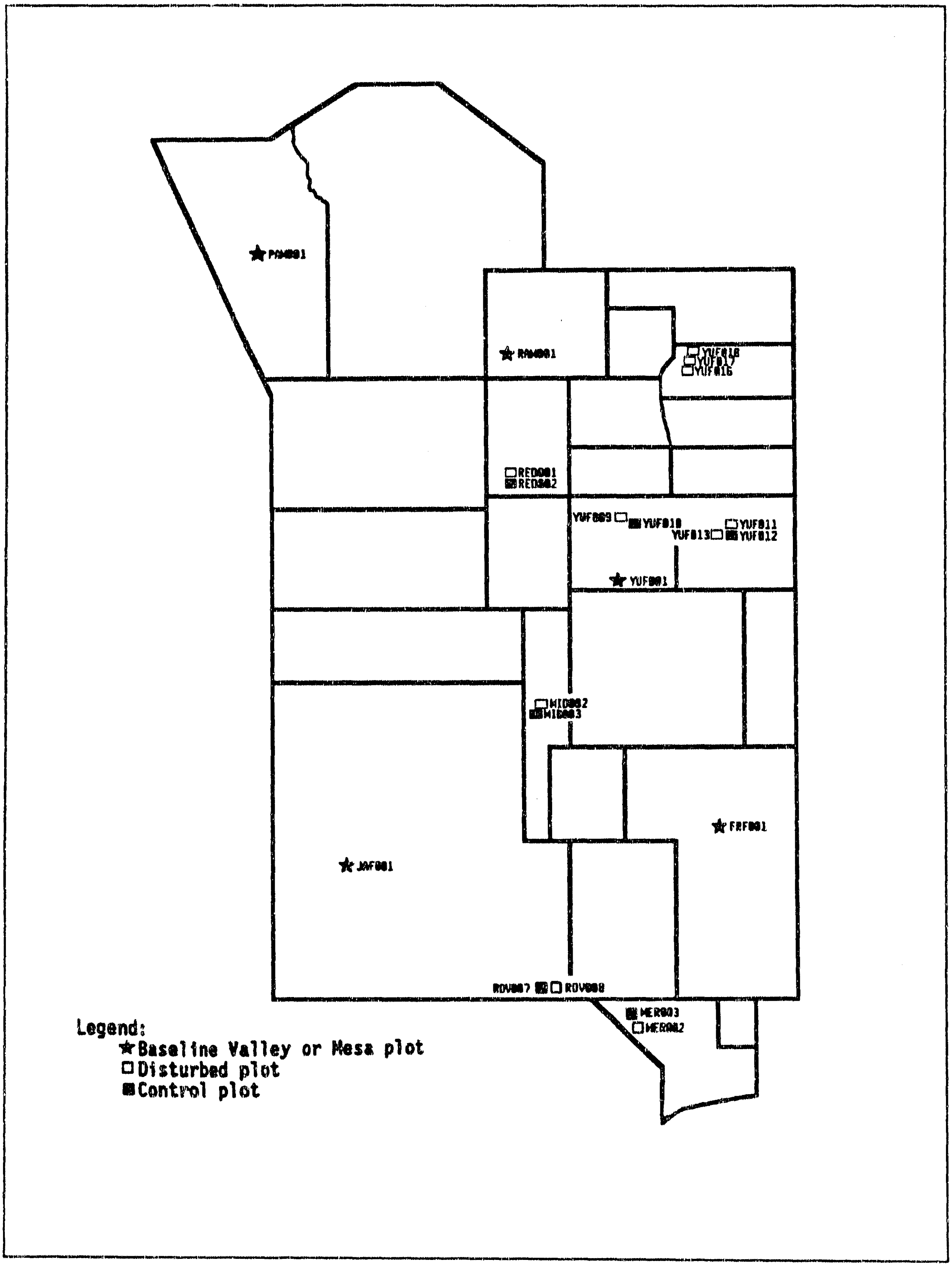

Figure 4.1 Locations of 1988 BECAMP small mammal study plots.

nearest gram using a spring scale and released at the point of capture. Mean weights were analyzed using ANOVA or Student's t-test where appropriate.

Subsidiary Plots

Procedures on the subsidiary plots did not differ significantly from those on the baseline monitoring sites. However, plot size was smaller and a disturbed and control site were sampled at the same time. Each subsidiary plot site was staked and gridded at 15-meter intervals with the size of grid adjusted to the size of habitat available to be sampled. In general, an 8 x 8 grid was used. The two burned areas were long and narrow, therefore a 15 x 5 grid in Mid Valley (MID002) and a 14 x 5 grid in Redrock Valley (RED001) were used on both the controls and disturbed areas. The T3 (YUF013), 3B consolidation site (YUF011), and control (YUF012) were also 14 x 5 grids.

Trap Density Experiment

Immediately after completion of trapping for small, nocturnal mammals on the baseline plots in Jackass Flats (JAF001) and Frenchman Flat (FRF001), traps were rearranged for a trap density experiment to determine whether or not the present number of traps per hectare at a distance of 15 meters between traps was adequate for sampling a population. Four smaller grids were established within the existing 12 x 12 grid as follows: a 10 x 10 grid (0.46 ha), 100 traps placed at 7.5-m intervals (51 traps/ha); a 7 x 7 grid (0.41 ha), 49 traps placed at 10.7-m intervals (69 traps/ha); a 5 x 5 grid (0.36 ha), 25 traps placed at 15-meter intervals (119 traps/ha); a 4 x 4 grid (0.32 ha), 16 traps placed at 18.75-m intervals (219 traps/ha). The placement of the smaller grids was chosen at random. However, the smaller grids were placed at the same relative location within both plots. A diagram of the placement of the traps in the larger grid is shown in Figure 4.2.

The traps were set for only one night, rather than three. Locations of animals captured during the three days of trapping the 12 x 12 grid were mapped out on the smaller grid. These animals and locations were considered to be the number of animals which could be captured on that respective grid. The 10 x 10 and 4 x 4 grid total number of animals possible included edge animals captured at traps less than 7.5 m away. The number of recaptured and newly captured animals were enumerated and percent success (recaptures/number possible) was calculated for each small grid. The densities of *Perognathus longimembris* and *Dipodomys merriami* (the most common species on both plots) were calculated for the one night of trapping by dividing the total number of animals captured by the smaller plot size in hectares and were compared to the density calculated during the three nights of trapping

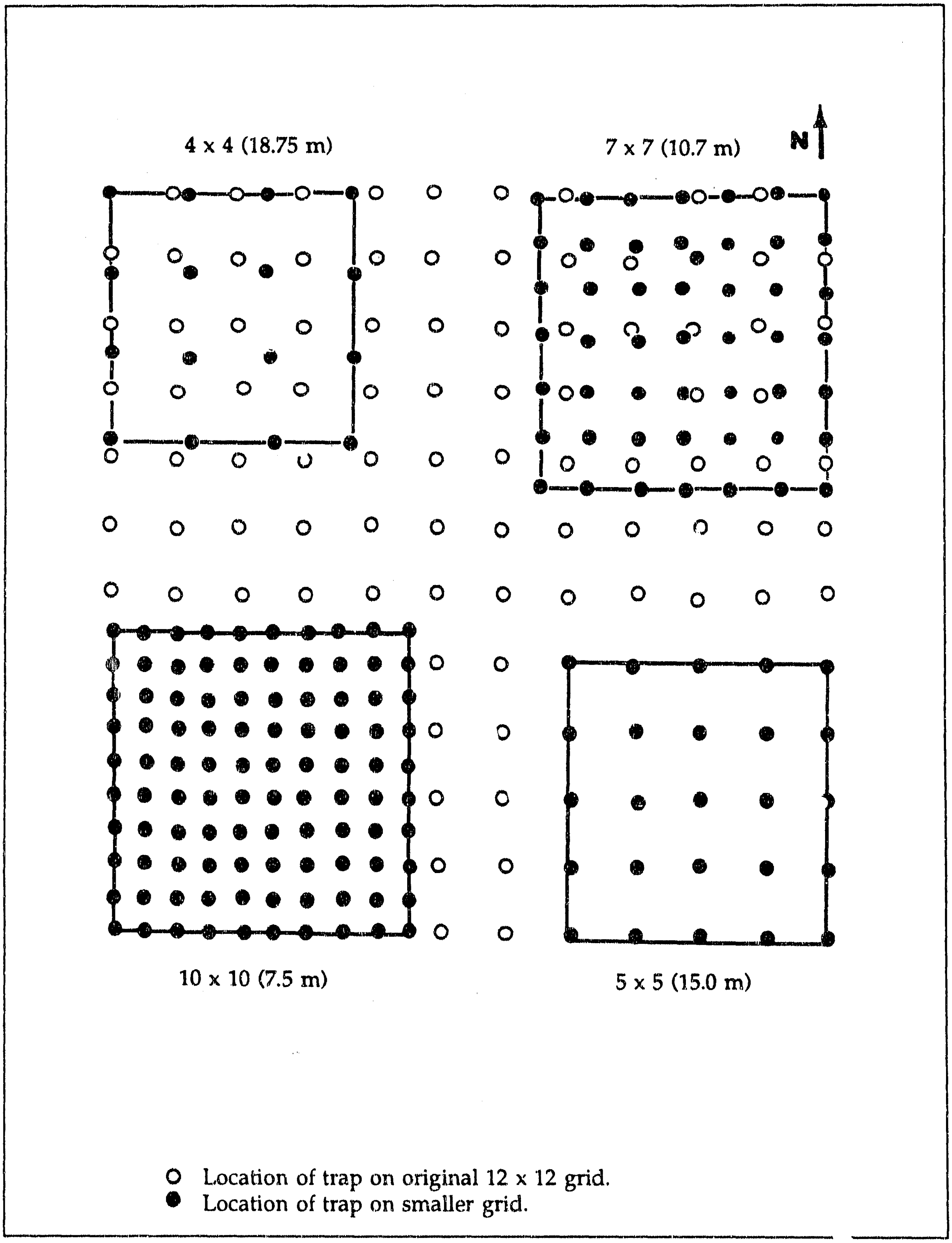

Figure 4.2 Placement of the 4 x 4, 5 x 5, 7 x 7, and 10 x 10 grids inside of the larger, 12 x 12, grids on the Jackass Flats and Frenchman Flat baseline monitoring plots.

Density Estimation

The first night of the three nights of trapping was considered a preliminary trap night. The population of small mammals was estimated by using the following capture/recapture formula (Seber 1982:138) and data from the second and third nights of trapping:

$$N* = \frac{(n_1 + 1)(n_2 + 1)}{(m_2 + 1)} - 1$$

N^* = Population estimate, number per plot.
n_1 = Total individuals marked before the present trap night.
n_2 = Total individuals captured during the present trap night.
m_2 = Number in n_2 which were recaptured (marked in a previous sample).

The standard error (SE) of the population estimate was calculated using the following formula (Seber 1982:138):

$$SE = \sqrt{\frac{(n_1 + 1)(n_2 + 1)(n_1 - m_2)(n_2 - m_2)}{(m_2 + 1)^2 (m_2 + 2)}}$$

Calculations using these two formulas give an estimate of population in number of animals per plot plus or minus the standard error. To estimate the density in number of animals per hectare $\pm$ the standard error, N^* and SE were divided by the plot size in hectares, which included a 7.5-m perimeter (half of the distance between trap stations) to account for effective trapping area. To get a suitable estimation of density and standard error from equations 1 and 2, m_2 (number of recaptures) should be greater than 7 (Seber, 1982). Therefore, densities for rare (i.e. infrequently captured) species were not calculated. Equation 1 assumes a closed population with a constant number of animals during the capture-recapture time period. For trapping times of short duration, immigration, emigration, reproduction and death may be ignored and these equations should be adequate to estimate population densities. A standard error of zero arose when all marked animals were recaptured on the last day (n_1 - m_2) or no new animals were captured on the last day and, therefore, all of the captures were recaptures (n_2 - m_2).

Diurnal Rodents (Ground Squirrels)

Trapping for ground squirrels was conducted during August 1988 for one day on the baseline study plots in Jackass Flats and Yucca Flat to determine size, age distribution, and activity pattern of the resident population. Squirrel live traps ('Tomahawk' live trap #102, 13 x 13 x 40 centimeters, set to close at a minimum weight of 30 grams) were placed at every-other grid stake on each of the 12 lines of the 12 x 12 trapping grid (72 total traps). Traps were opened in early morning (0800 hours) and were left open throughout the day until late afternoon (1600 hours). The traps were baited with rolled oats and bird seed and checked at two-hour intervals. Captured animals were toe-clipped, sex and age determined, weighed, and released at the capture location. Shades of 30.5 x 30.5 x 0.5-centimeter masonite were placed over the traps and continuously repositioned throughout the day to shade any trapped animals.

Rabbit and Hare Sampling (Transect Lines)

These censuses on the NTS were performed concurrently with line transects for lizard sampling. The design of the lizard transect lines is illustrated in Hunter and Medica (1989, Figure 2) and in Figure 3.2 of this report. Transect lines were simultaneously walked by three observers, 7.5 meters apart, in late spring and early summer of 1988. On the baseline sites, observers walked the 500-meter length of each of the five transect lines (total of 2500 m). Transects on subsidiary plots consisted generally of walking around the perimeter of the area in a square. When a rabbit or hare was observed, the flushing distance and direction when first observed were estimated and recorded on a 3 x 5-inch card or the bottom of the lizard transect data sheet.

To obtain density (D) in number per hectare, the following formula was used (Whitford, 1973):

$$D = \left(\frac{N}{2\,r\,L}\right) \times (10{,}000\ m^2/ha)$$

L = the total distance walked in the transect in meters
N = the number of flushes
r = the mean flushing distance estimated in meters

The estimated densities of a species were averaged for all of the days sampled (usually five days) and the standard error calculated for this average. Estimated densities and species observed were compared between different habitats which occur on the NTS.

RESULTS

Species' names appear in results tables as the abbreviations shown in Table 4.1. Estimates of rodent density (number per hectare $\pm$ two standard errors) for all five of the baseline monitoring sites appear in Table 4.2. Descriptions of the flora of each plot are found in the sections entitled Status of Perennial Vegetation and Status of Desert Ephemeral Plants in this report. Percent of total captured population for each species appears in Table 4.3.

Table 4.1 Abbreviations for scientific names of small mammals captured on the NTS and the common names.

	Scientific Name	Common Name
AMM LEU	*Ammospermophilus leucurus*	White-tailed antelope squirrel
DIP DES	*Dipodomys deserti*	Desert kangaroo rat
DIP MER	*Dipodomys merriami*	Merriam's kangaroo rat
DIP MIC	*Dipodomys microps*	Great Basin kangaroo rat
DIP ORD	*Dipodomys ordii*	Ord's kangaroo rat
LEP CAL	*Lepus californicus*	Black-tailed jackrabbit
MIC MEG	*Microdipodops megacephalus*	Dark kangaroo mouse
[redacted]		
ONY TOR	*Onychomys torridus*	Southern grasshopper mouse
PER FOR	*Perognathus formosus*	Long-tailed pocket mouse
PER LON	*Perognathus longimembris*	Little pocket mouse
PER PAR	*Perognathus parvus*	Great Basin pocket
PER CRI	*Peromyscus crinitus*	Canyon mouse
PER MAN	*Peromyscus maniculatus*	Deer mouse
PER SPP	**Peromyscus* spp.	
PER TRU	*Peromyscus truei*	Pinon mouse
REI MEG	*Reithrodontomys megalotis*	Western harvest mouse

Table 4.2 Estimated densities (number per hectare ± two standard errors) of small mammals on BECAMP baseline monitoring plots on NTS in 1988. Numbers in parentheses are individual animals captured.

Species	JAF001 12,13,14 April		FRF001 12,13,14 April		YUF001 26,27,28 April		PAM001 24,28,29 June		RAM001 2,3,4 August	
DIP MER	10.6 ± 0.8	(33)	4.9 ± 0	(16)	5.2 ± 0	(17)	---		---	
DIP MIC	---		---		5.2 ± 0.8	(16)	*	(2)	---	
DIP DES	*	(1)	---		---		---		---	
PER LON	34.5 ± 11.4	(67)	24.2 ± 4.0	(64)	19.0 ± 1.8	(57)	---		---	
PER PAR	---		---		---		10.3 ± 0.8	(33)	*	(1)
MIC MEG	---		---		---		*	(1)		
PER SPP	---		---		---		4.3 ± 0.8	(13)	5.2 ± 0.7	(16)
PER TRU	---		---		---		---		1.5 ± 0	(5)
REI MEG	---		---		---		---		*	(2)
ONY TOR	---		*	(1)	*	(2)	---		---	
NEO LEP	---		---		---		*	(2)	---	
SYL AUD	---		---		*	(1)	---		---	
SYL NUT	---		---		---		*	(1)	*	(4)
AMM LEU	---		*	(1)	*	(4)	*	(1)	---	
TAM DOR	---		---		---		---		6.2 ± 6.9	(8)
Total N/ha	31.2	(101)	25.3	(82)	29.9	(97)	16.4	(53)	11.1	(36)
Total species	3		4		6		7		6	

*Species present but data insufficient to calculate density.

Table 4.3 Percent of total captured population (%T) and sex ratio (M/F = male : female) of small mammals on the BECAMP baseline monitoring plots on NTS in 1988.

Species	JAF001		FRF001		YUF001		PAM001		RAM001	
	%T	M/F	%T	M/F	%T	M/F	%T	M/F	%T	M/F
DIP MER	32.7	1.8:1	19.5	1.3:1	17.5	1.8:1	—	—	—	—
DIP MIC	—	—	—	—	16.5	1.3:1	3.8	1:1	—	—
DIP DES	1.0	0:1	—	—	—	—	—	—	—	—
PER LON	66.3	1:1.2	78.1	1:1.4	58.7	1:1.1	—	—	—	—
PER PAR	—	—	—	—	—	—	62.2	1.5:1	2.8	0:1
MIC MEG	—	—	—	—	—	—	1.9	1:0	—	—
PER SPP	—	—	—	—	—	—	24.5	2.3:1	44.4	*1:4.3
PER TRU	—	—	—	—	—	—	—	—	13.9	1:1.5
REI MEG	—	—	—	—	—	—	—	—	5.6	1:1
ONY TOR	—	—	1.2	0:1	2.1	2:0	—	—	—	—
NEO LEP	—	—	—	—	—	—	3.8	2:0	—	—
SYL AUD	—	—	—	—	1.1	0:2	—	—	—	—
SYL NUT	—	—	—	—	—	—	1.9	indet	11.1	indet
AMM LEU	—	—	1.2	1:0	4.1	1:1	1.9	1:0	—	—
TAM DOR	—	—	—	—	—	—	—	—	22.2	3:1

*Sex ratio significantly different from 1:1 (chi-square, $0.010 < P < 0.025$).
In the case of *S. audubonii* and *S. nuttallii*, only juveniles of indeterminate sex were captured.

Species captured in 1987 but not in 1988 on the Jackass Flats baseline monitoring site were the diurnal squirrels *Spermophilus tereticaudus* and *Ammospermophilus leucurus*. However, while no *A. leucurus* were trapped during the 1988 nocturnal mammal trapping in Jackass Flats, they were captured during daytime squirrel trapping in August. In 1987 *S. tereticaudus* was also captured on the Frenchman Flat baseline site but not in 1988.

Peromyscus maniculatus was not captured during mammal trapping on the Yucca Flat site in 1988 but was present in 1987. One *Reithrodontomys megalotis* and a juvenile *Sylvilagus audubonii* were captured in August of 1988 but not in April 1988 nor in 1987. *Neotoma lepida* and *A. leucurus* were not captured during summer trapping in August on the Pahute Mesa plot. A complete list of species captured during spring and summer on the BECAMP baseline monitoring sites is shown in Appendix 4A.

A sum of 369 individual animals from 15 different species were marked and released during spring trapping for a total of 652 captures on the baseline monitoring sites. Trapping on each plot involved 864 trap nights (288 traps x 3 nights), with 101 different animals captured a total of 159 times on JAF001, 146 captures of 82 animals on FRF001, 192 captures of 97 animals on YUF001, 98 captures of 53 animals on PAM001, and 57 captures of 36 animals on RAM001. Percent trap success on the above plots (total captures divided by trap nights) were 18.4% (JAF001), 16.9% (FRF001), 22.2% (YUF001), 11.3% (PAM001), and 6.6% (RAM001). Overall trap success was 15.1%.

Individual animals were captured from an average low of 1.6 times on RAM001 to a high of 2.0 on YUF001, which was the same for Yucca Flat in 1987 (Hunter and Medica 1989). Average capture frequency in 1988 for JAF001 was 1.6 (1.6 also in 1987) and for FRF001, 1.8 (1.9 in 1987). Differences in trap success

Table 4.4 Adult spring mean weights (grams $\pm$ 2 SE) by sex of common rodent species on three BECAMP baseline monitoring plots in 1988.

		JAF001		FRF001		YUF001	
Species	Sex	N	Weight	N	Weight	N	Weight
PER LON	M	31	7.3 $\pm$ 0.3	25	7.8 $\pm$ 0.3	27	8.3 $\pm$ 0.3
	F	36	7.4 $\pm$ 0.3	39	7.5 $\pm$ 0.3	30	8.0 $\pm$ 0.2
DIP MER	M	21	40.9 $\pm$ 1.3	9	41.6 $\pm$ 1.0	11	42.5 $\pm$ 0.9
	F	12	41.6 $\pm$ 2.3	7	39.7 $\pm$ 2.9	6	39.6 $\pm$ 2.0
DIP MIC	M	0	---	0	---	9	63.2 $\pm$ 4.1
	F	0	---	0	---	7	58.8 $\pm$ 5.2

weight of *D. merriami* males did not differ significantly between Frenchman Flat and Jackass Flats, nor did females between the two plots. There was no significant difference between the combined mean adult weight (male and female) for *D. merriami* trapped at Yucca Flat and Frenchman Flat, nor between Frenchman Flat and Jackass Flats or Yucca Flat and Jackass Flats. The mean weight of adult male *D. merriami* was significantly greater than adult female *D. merriami* in Yucca Flat (ANOVA, $p = 0.0087$) but not in Frenchman Flat or Jackass Flats. This is likely due to the females in Yucca Flat being reproductively active later due to the cooler temperatures of the higher latitude and altitude - during reproduction, female weights differ the least from those of males (Kenagy 1973). Mean summer weights of *Dipodomys merriami* for both sexes were lower than spring mean weights on all three plots (Table 4B-1, Appendix 4B), most likely due to the addition of lower-weighted subadults.

The mean weights of *Perognathus longimembris* males in Yucca Flat were significantly greater than those in Frenchman Flat and Jackass Flats (ANOVA, $p<0.05$). The mean weights of adult female *P. longimembris* were also significantly heavier on the Yucca Flat baseline plot than on the Frenchman Flat plot ($0.001<p<0.05$) and the Jackass Flats plot ($p<0.001$), while the burned plot. This area in Mid Valley burned in June 1986 due to a lightning strike, and was sampled 3, 7, and 8 June 1988.

The plots in the burned and undisturbed areas of Redrock Valley were also set up as long and narrow grids. A paved road separated the control from the burned area in this valley. The probable cause for the fire in Redrock Valley was listed as a lit cigarette. The fire was started and extinguished on 20 July 1988, incinerating an estimated 160 to 200 ha (400 to 500 acres). A study plot was immediately constructed to monitor th[redacted]e species which might have survived and if recolonization might occur. These plots were trapped on 26-28 July (6 days after the fire), 24-25 August (1 month after the fire) and 26-28 October (3 months after the

fire).

Mid Valley

The estimated densities of the most commonly captured species on the burned and unburned plots in Mid Valley are given in Table 4.5. Most of the species which occurred on the control were also present on the burned plot with the exception of one adult *Reithrodontomys megalotis* and one juvenile *Lepus californicus* captured on the control plot, indicating a normally low frequency and incidental capture. The three most common species (*Dipodomys merriami*, *Dipodomys microps*, and *Perognathus longimembris*) accounted for 84.7% of the captured population on the burned site and only 54.9% on the unburned control (Table 4.6).

Table 4.6 Percent of total captured population (%T) and sex ratio (M/F = male : female) of [illegible]

Species	MID002 (Burn) %T	MID002 (Burn) M/F	MID003 (Control) %T	MID003 (Control) M/F
DIP MER	57.7	1:2.7	16.1	1.5:1
DIP MIC	3.8	1:0	19.4	1:2
PER LON	23.2	1:1	19.4	1:1
PER FOR	7.7	1:1	9.7	2:1
PER MAN	3.8	0:1	16.1	4:1
REI MEG	---	---	3.2	1:0
ONY TOR	3.8	0:1	12.9	1:3
LEP CAL	---	---	3.2	indet

In the case of *Lepus californicus*, only juveniles of indeterminate sex were captured.

A comparison of the densities and frequencies of species on these two plots indicated a greater species diversity on the unburned plot. On the burned plot, *D. merriami* and *Perognathus longimembris* accounted for 80.8% of the captured population, and most of these were captured on the edge of the plot nearest to the unburned vegetation; no more than two animals of the other species were captured.

The percentage of *Dipodomys merriami* was greater on the Mid Valley burned plot than on the unburned control plant (57.7% and 16.1%), while *Dipodomys microps* mostly disappeared (3.8% and 19.4%). Assuming that the unburned area was representative of the population on the burned area before the fire, the percent of the total estimated population of these two kangaroo rats (*D. merriami* at 16.1% and *D. microps* at 19.4%) were approximately equal before the fire. These results are consistent with earlier studies which showed that *D.*

animal, while 31 different animals were captured 48 times on the unburned plot, averaging 1.6.

The sex ratio of the most frequently captured species (Table 4.6) did not differ significantly from 1:1 on either plot. Adult *Dipodomys merriami* males on the burned area (43.6 $\pm$ 3.2 g) were heavier than adult males captured on the unburned control (41.0 $\pm$ 2.0 g), but not with

Table 4.7 Estimated densities (number per hectare ± 2 SE) of small mammals on the BECAMP plots (1.58 ha) at the Redrock Valley burn site during trapping in July, August, and October 1988. Numbers in parentheses are individual animals captured.

Species	RED001 (Burn) July	RED001 (Burn) August	RED001 (Burn) October	RED002 (Control) July	RED002 (Control) August	RED002 (Control) October
DIP MER	15.5 ± 1.0 (24)	21.6 ± 0.6 (34)	22.6 ± 2.0 (34)	20.7 ± 0 (31)	19.6 ± 2.3 (29)	20.8 ± 1.3 (32)
DIP MIC	* (3)	7.5 ± 1.6 (11)	6.3 ± 0 (10)	8.3 ± 6.1 (8)	5.9 ± 0.8 (9)	12.2 ± 0.6 (19)
DIP ORD	---	* (4)	* (2)	---	---	---
PER LON	4.1 ± 2.5 (5)	* (1)	---	3.8 ± 0 (6)	* (1)	---
PER FOR	* (2)	---	---	* (1)	---	* (1)
PER PAR	4.4 ± 0 (7)	6.8 ± 3.5 (8)	---	5.3 ± 2.2 (7)	* (3)	---
PER MAN	* (4)	* (2)	---	* (3)	* (2)	* (3)
REI MEG	---	---	---	---	---	* (1)
ONY TOR	* (1)	* (1)	---	---	* (1)	* (3)
SYL AUD	---	---	---	* (4)	---	* (1)
Total N/ha	29.2 (46)	38.7 (61)	29.2 (46)	38.1 (60)	28.6 (45)	38.1 (60)
Total species	7	7	3	7	6	7

*Species present but data insufficient to calculate density.

the fluctuating density of *D. microps* on the control plot (Allred and Beck 1963).

The most significant change in species composition occurred during August trapping when *Dipodomys ordii* appeared on the burned plot for the first time. *D. ordii* previously had been collected most frequently on the Nevada Test Site in areas disturbed by aboveground nuclear testing (Jorgensen and Hayward 1965). Where these animals emigrated from is unknown since they were not ever captured on the unburned control plot in 1988, nor were they trapped on the burned plot in July. It is possible that these animals were present in low numbers and relatively inactive at the trapping period due to temporal or seasonal activity patterns (Jorgensen et al. 1980; Whitford 1974). *D. ordii* was trapped in this valley during 1959-1965 sampling by BYU (Jorgensen & Hayward 1965). This species was not captured at any other BECAMP study location on the NTS during the 1987 and 1988 trapping seasons.

Heteromyid rodents (*Dipodomys* and *Perognathus*) accounted for 89.1% of the captured individuals in July on the Redrock Valley burn plot, 95.1% in August, and 100% in October (Table 4.8). These same rodents accounted for 88.4%, 93.4% and 86.6% of the captured population on the control plot in July, August, and October, respectively. By October, most of the *Perognathus* spp. had disappeared due to seasonal hibernation. The sex ratios for the most commonly captured species on both plots (Table 4.8) were not significantly different from a 1:1 ratio of males to females.

Percent trap successes on the Redrock Valley burned area for July and October (months with 3 trap nights) were 22.9% and 24.8%, respectively and 25.0% and 31.4% on the unburned control. Animals on the burned area were captured an average of 2.1 times (46 animals captured 96 times) in July, while on the unburned control plot in July the average capture was 1.8 times (60 captured 105 times). In October, average captures were over 2.0 for both plots (2.4 times in the burned area and 2.2 times on the control). Trapping effort in August was only 280 trap nights as opposed to 420 in July and October; therefore, the percent trap success (33.9% on the burned plot and 25.0% on the unburned control) and average capture numbers (1.6 times on both plots) for August are not readily comparable to the other two months in which trapping occurred.

Among *Dipodomys merriami* in July, ANOVA on mean weights (Table 4B-2, Appendix 4B) revealed that, while adult females on the control (43.1 $\pm$ 1.9 g, n = 11) were consistently heavier than adult females on the burned area (39.3 $\pm$ 2.6 g, n = 5), the difference was not statistically significant ($p>0.05$). The mean weight of males on the control (40.0 $\pm$ 3.2 g, n = 11) also did not differ significantly from that of males on the burned area in July (41.3 $\pm$ 3.3 g, n = 8). In July and August, there were no significant differences between male and female adult *D. merriami* on the control (42.2 $\pm$ 2.6 g, n = 10 and 43.7 $\pm$ 2.2 g, n = 11); however, in August, male adults were significantly heavier ($0.01<p<0.02$) than females on the burned area (43.4 $\pm$ 1.9 g, n = 13 and 39.4 $\pm$ 2.6 g, n = 12). Control adult females were also significantly heavier than adult females from the burned area in August ($p<0.05$). Males were consistently

Table 4.8 Percent of total captured population (%T) and sex ratios (M/F = male : female) of small mammals on the BECAMP plots in Redrock Valley on NTS in 1988.

	RED001 (Burn)						RED002 (Control)					
	July		August		October		July		August		October	
Species	%T	M/F	%T	M/F	%T	M/F	%T	M/F	%T	M/F	%T	M/F
DIP MER	52.2	1.4:1	55.8	1:1	73.9	1:1	51.7	1.4:1	64.5	1.1:1	53.3	1.3:1
DIP MIC	6.5	2:1	18.0	1:1.2	21.7	1.5:1	13.3	1.7:1	20.0	1:1.3	31.6	1.4:1
DIP ORD	---	---	6.6	1:1	4.6	0:2	---	---	---	---	---	---
PER LON	10.9	1.5:1	1.6	0:1	---	---	10.0	1:1	2.2	0:1	---	---
PER FOR	4.3	2:1	---	---	---	---	1.7	0:1	---	---	1.7	0:1
PER PAR	5.2	2:1	13.1	1:1.7	---	---	11.7	1:1.3	6.7	1:2	---	---
PER MAN	8.7	3:1	3.3	2:0	---	---	5.0	2:1	4.4	1:0	5.0	3:0
REI MEG	---	---	---	---	---	---	---	---	---	---	1.7	1:0
ONY TOR	2.2	1:0	1.6	1:0	---	---	---	---	2.2	1:0	5.0	1:2
SYL AUD	---	---	---	---	---	---	6.6	indet	---	---	1.7	indet

In the case of *Sylvilagus audubonii*, only juveniles of indeterminate sex were captured.

heavier than females on the burned area in all three months, while females on the control were heavier than males in July and August, but lighter in October. After trapping in October, adult male *D. merriami* captured on both areas were slightly heavier than adult females.

The mean weight of adult female *D. merriami* on the control decreased significantly (ANOVA, $p<0.05$) from August to October (43.7 $\pm$ 2.2 g, n = 11, to 37.1 $\pm$ 1.5 g, n = 12) after relatively no gain from July (43.1 $\pm$ 1.9 g, n = 10). While the mean weight of adult male *D. merriami* on the control also decreased from August to October (42.2 $\pm$ 2.6 g, n = 10, to 38.2 $\pm$ 1.7 g, n = 17), mean weight increased slightly after July (40.0 $\pm$ 3.2 g, n = 11), but without any statistical significance. Mean weights for adult males on the burned plot showed similar changes over the three trapping periods, with a significant decrease in mean weight from August to October (ANOVA, $p<0.05$). The mean weights of adult females on the burned plot remained relatively constant throughout the duration of trapping in 1988, with no significant changes in mean weight. ANOVA on the mean weights of *Dipodomys microps* and *Perognathus longimembris* revealed no significant changes in mean weight between the three trapping times (Tables 4B-2 and 4B-3, Appendix 4B). Changes in weight, along with morphological changes, can be indicators of reproduction in the population (Bradley & Mauer 1971; Kenagy 1973). No real conclusions can be made on whether or not these two plots had differing reproductive success, as not all BECAMP personnel indicated reproductive condition (including non-reproductive status) on the data sheets.

Rock Valley (Fenced, Previously Irradiated Plot and Control)

This area on the southern edge of the Nevada Test Site contains a 9-hectare fenced plot B (ROV002) that was continuously exposed to gamma-radiation from a ^{137}Cs source over a period of 17 years from 1964 to 1981, and an unfenced 9-ha control plot D (ROV004) approximately 200 meters to the west. BECAMP sampled 12 x 12 grids on the southwestern edge of both of these original plots (ROV007 on plot D and ROV008 on plot B) on 14-17 June 1988 in order to compare present populations to those sampled in earlier studies (e.g., French et al. 1974; Turner 1973, 1974). The southwestern portion of plot D, IBP plot 16, has historical data from the 1970's, so a comparison of present and past populations was possible.

The estimated densities of the most common species captured on these two plots during 1988

Table 4.9 Estimated densities (number/ha ± 2 SE) of small mammals inside the 3.24-ha Rock Valley fenced plot (3.24 ha) in June 1988 and on IBP plot 16 in July 1972, April and August 1973, and June 1988. Numbers in parentheses are individual animals captured.

	ROV008 (Fenced plot)		ROV007 (Control, IBP plot 16)							
Species	June 1988		July 1972**		April 1973**		August 1973**		June 1988	
DIP MER	1.9 ± 0	(6)	3.7	(12)	---		1.5	(5)	4.4 ± 0.4	(14)
DIP MIC	26.4 ± 0.5	(85)	4.6	(15)	7.4	(24)	5.6	(18)	11.8 ± 0.4	(38)
PER FOR	2.9 ± 0.4	(9)	12.0	(39)	1.5	(5)	25.6	(83)	*	(2)
PER LON	---		34.9	(113)	15.1	(49)	50.3	(163)	10.4 ± 0.7	(33)
PER CRI	---		0.6	(2)	0.3	(1)	0.3	(1)	---	
PER MAN	---		---		---		*		*	(2)
ONY TOR	1.9 ± 0	(6)	1.5	(5)	1.9	(6)	6.2	(20)	3.1 ± 0	(10)
MUS FRE	*	(1)	---		---		---		*	(1)
AMM LEU	*	(7)	0.9	(3)	---		0.9	(3)	*	(5)
THO UMB	---		---		1.9	(6)	2.5	(8)	---	
OTHER***	---		---		---		0.3	(1)	---	
Total N/ha	35.2	(114)	58.3	(189)	28.1	(91)	93.2	(302)	32.4	(105)
Total Species	6		7		7		9		8	

* Species present but data insufficient to calculate density.

** Original densities were recalculated using actual number of individuals captured and effective trapping area of 3.24 ha.

*** Possibly *Neotoma lepida* or *Spermophilus tereticaudus*.

in the enclosed plot, while the unfenced plot had a greater annual seed supply. While *P. longimembris* is a granivore, it mainly sifts through the soil for seeds from annual or perennial grasses and forbs (Zeveloff and Collett 1988).

Estimated densities of species in the unfenced control (IBP plot 16) in July of 1972 and April and August of 1973 were lower for *Dipodomys merriami* (1.5 - 3.7/ha) and *Dipodomys microps* (4.6 - 7.4/ha) than in 1988 and higher for *Perognathus longimembris* (15.1 - 50.3/ha) and *Perognathus formosus* (1.5 - 25.6) (Turner 1973, 1974). The two species of *Dipodomys* initially did not survive well in the irradiated enclosure. Both species were present in low numbers and were extirpated less than one year after initiation of radiation treatment. *D. microps* died out after five years in a fenced, unirradiated control plot of the same size while kangaroo rats in the remaining enclosures declined to only two animals but persisted in low numbers until at least 1970 (French et al. 1974). This indicated that the enclosure, more so than the gamma radiation, might have contributed to the decline in the kangaroo rat population. Less than optimum food supplies was also a contributing factor - a higher perennial leaf and seed production in 1966 to 1968 within plot B, which favors *D. microps* reproduction, and higher annual seed production on plot 16, which favors *D. merriami* reproduction, but low seasons of primary productivity in 1963, 1964, and 1967 showed corresponding declines in the populations of kangaroo rats (French et al. 1974). French et al. (1974) also concluded that chronic exposure to the gamma radiation was clearly detrimental to a desert rodent population in terms of a decrease in the probability of survival.

Trap success was higher inside of the fenced area (30.9% as compared to 24.5%) as was the average times captured (2.3 and 2.0). This might be due to a smaller home range of some of the animals in the fenced plot, which is inversely related to density (Maza et al. 1973).

The most significant find on both of these plots in 1988 was the presence of the long-tailed weasel, *Mustela frenata*. Rock Valley has the most continuous sampling history of any plot on NTS, and never before has this species been encountered in this valley (Medica 1990). *Peromyscus crinitus* was captured in 1972 on plot 16, but not in 1988. *Peromyscus maniculatus*, however, was captured in 1988 on plot 16, but not reported in 1972. Both species [illegible]

reported in this area by BYU (Jorgensen and Hayward 1965).

Table 4.10 Percent of total captured population (%T) and sex ration (M/F = male : female) of small mammals in the Rock Valley fenced plot (ROV008) in 1988 and on IBP plot 16 (ROV007) in 1972, 1973, and 1988.

	ROV008 (Fenced Plot) June 1988		ROV007 (Control, IBP plot 16) July 1972	April 1973	August 1973	June 1988	
Species	%T	M/F	%T	%T	%T	%T	M/F
DIP MER	5.3	1:1	6.3	---	1.7	13.3	1.8:1
DIP MIC	74.5	1:1.1	7.9	26.4	6.0	36.2	1.1:1
PER FOR	7.0	*1:1	20.6	5.5	27.5	1.9	0:2
PER LON	---	---	59.8	53.8	54.0	31.4	1.4:1
PER CRI	---	---	1.1	1.1	0.3	---	---
PER MAN	---	---	---	---	---	1.9	1:1
ONY TOR	5.3	*4:1	3.7	6.6	6.6	9.5	2.3:1
MUS FRE	0.9	0:1	---	---	---	1.0	0:1
AMM LEU	6.1	*1:4	1.6	---	1.0	4.8	1.5:1
THO UMB	---	---	---	6.6	2.6	---	---
OTHER	---	---	---	---	0.3	---	---

*One animal of undetermined sex not included.

was no significant difference between the mean weight of adult males in the enclosure and ~~the mean weight of adult males in the unfenced area. Adult male *Dipodomys microps* were~~ heavier than adult females on both plots (Table 4B-3, Appendix 4B), but only significantly so in the enclosed plot ($p<0.05$), while males and females from the unfenced area were heavier than males and females from the fenced plot, but not with any significance.

Disturbance From Aboveground Testing and Blading

Two sites in Yucca Flat were trapped in 1988 to estimate the current population densities and species compositions of areas that had been denuded by the heat, fire and radiation from repeated aboveground nuclear testing during the 1950's. Site T1, on the western side of Yucca Flat, was the location of four tower-supported tests between 1952 and 1957. A circular area of approximately 500 hectares was completely cleared of vegetation due to the testing, and has since been invaded by *Salsola* spp., *Stipa speciosa*, *Bromus rubens*, and *Bromus tectorum*. This area was sampled for small mammals and other animals by BYU during continuous studies from 1959 to 1965 (Jorgensen and Hayward 1965). BECAMP plots were placed on an existing BYU trap line to the southeast (SE) of ground zero (GZ). An 8 x 8 grid (YUF009) was set up on this line 960 m (3168 ft) SE of GZ to sample the disturbed area. Another 8 x 8 grid (YUF010) 1760 m (5808 ft) SE of GZ on this line was established as a control in an undisturbed *Grayia-Lycium* plant community (as defined by Beatley 1976a).

Trapping for nocturnal mammals took place on 4, 16, 17, and 18 May and 9, 10 August in 1988. August trapping was done to assess summer resident species and the results were not [illegible]

with the exception of *Dipodomys merriami*, (which was still abundant at both sites (Appendix 4C, p. 142. However, two additional species, *Ammospermophilus leucurus* and *Reithrodontomys megalotis*, were captured on the blast area in August while both had been captured only on the control during trapping in May.

control area during BYU sampling but were not captured during the two sampling periods in 1988 on either plot. *D. microps* was found on both areas in 1959 to 1965, and only on the control in 1988. *Reithrodontomys megalotis* was captured in both plots for the first time in 1988. The only species unique to the disturbed area during the history of sampling on this site was the gopher, *Thomomys umbrinus*. However, aboveground evidence suggests that this species was present on the undisturbed control in recent times, but was not captured in the Sherman traps or is no longer present. *Dipodomys ordii* was captured on the blast area by BYU (1959-1965) but was not captured in 1988 (Jorgensen and Hayward 1965).

Of the captured animals on the blast area, 65.9% were *Dipodomys merriami*, while *Perognathus longimembris* (at 54.3%) was the most frequently captured species on the control (Table 4.12). Average capture rate in the blast area (41 animals captured 101 times for an average of 2.5) was 1.3 times greater than that on the control area (70 animals captured 133 times for an average of 1.9). This, again, is probably due to differences in abundance of food resources, home ranges, and population densities between the two plots. Percent trap success on the T1 blast area, like that on the Redrock burn disturbed study area, was lower than that on the control (19.7 and 26.0% respectively).

Table 4.12 Percent of total captured population (%T) and sex ratio (M/F = male : female) of small mammals on the BECAMP plots at T1, Yucca Flat in 1988.

	YUF009 T1		YUF010 Control	
Species	%T	M/F	%T	M/F
DIP MER	65.9	1.7:1	24.3	1.8:1
DIP MIC	—	—	7.1	4:1
PER LON	17.1	1:1.7	54.3	1:1.2
PER FOR	2.4	1:0	—	—
PER MAN	9.8	1:3	—	—
REI MEG	—	—	5.7	1:1
ONY TOR	2.4	0:1	4.3	2:1
THO UMB	2.4	0:1	—	—
AMM LEU	—	—	4.3	3:0

Indeterminate values indicate that only one sex of a species was captured.

Sex ratios for the most commonly captured animals (Table 4.12) on the two plots did not differ significantly from 1:1. The mean weight of adult male *Dipodomys merriami* on the blast area (44.1 ± 1.5 g, n = 16) was slightly heavier than that of adult females (42.6 ± 1.9 g, n = 9) but not significantly different from adult males of the control (43.3 ± 1.6 g, n = 11). Female mean weights did not differ significantly between plots (Table 4B-2, Appendix 4B). Mean weights of adult males, however, were slightly heavier than females on YUF009 ($0.05<p<0.10$) and YUF010 ($0.02<p<0.05$) after summer trapping in August. The mean weights of adult male (7.7 ± 0.3 g, n = 17) and female (8.1 ± 0.4 g, n = 21) *Perognathus longimembris* were greater on the control than that of male (7.3 ± 0.5 g, n = 5) and female (7.6 ± 0.5 g, n = 2) *P. longimembris* on the blast area but not significantly heavier (Table 4B-4, Appendix 4B).

Another aboveground test area sampled by BECAMP in 1988 was the T3 area. This area was also used for tower-supported nuclear tests from 1952 to 1957 and is located on the eastern side of Yucca Flat. To study the long-term effects of aboveground testing in this area, a 14 x 5 grid was located approximately 1000 m (3300 ft) southeast of GZ (YUF013). A 14 x 5 grid control plot (YUF012) was set up approximately 300 m east of the disturbed area plot. The 3B waste consolidation site was located immediately to the north of the T3 control area and was surrounded by a barbed and chicken wire fence. This area was "cleaned up" in 1987, which involved removal of all radioactive scrap material previously stored on the site as well as blading and removal of several inches of surface soil, and hence all vegetation. A 14 x 5 grid was also established on this cleared site (YUF011). Mammals were censused on all three plots on 20, 25, and 26 May 1988.

The estimated densities for all three sites are shown in Table 4.13. *Dipodomys merriami* and

Table 4.13 Estimated densities (number/hectare ± 2 SE) of small mammals on the BECAMP plots (1.58 ha) in Yucca Flat, YUF011, YUF012, and YUF013, in May 1988. Numbers in parentheses are number of individual animals captured.

Species	YUF011 3B Consolidation Site (bladed area)		YUF012 Control		YUF013 T3 Blast Area (1000m SSE GZ)	
DIP MER	5.2 ± 0.5	(8)	10.8 ± 0	(17)	8.5 ± 1.0	(13)
DIP MIC	*	(1)	4.1 ± 1.1	(6)	---	
PER LON	*	(2)	12.6 ± 1.7	(19)	*	(1)
PER MAN	---		*	(2)	---	
ONY TOR	---		*	(1)	---	
AMM LEU	---		*	(7)	*	(2)
Total N/ha	7.0	(11)	33.1	(52)	10.2	(6)
Total species	3		6		3	

*Species present but data insufficient to calculate density.

Perognathus longimembris made up 90.9% and 87.5% of the animals captured on 3B and T3 respectively, while these two species comprised 69.2% of the captured animals on the control (Table 4.14). Both of the disturbed areas showed the typical decrease in numbers or absence of *Dipodomys microps* as compared to the control. Animals on the 3B site were never captured more than 30 m in from the north and east edges of the plot, which were closest to the undisturbed vegetation. Animals on the other two plots were captured throughout the

[illegible]

control were ever captured on the bladed area. However, one *Ammospermophilus leucurus* did move from the control to the T3 site.

Table 4.14 Percent of total captured population (%T) and sex ratio (M/F = male : female) on BECAMP plots YUF011, YUF012, and YUF013 on Yucca Flat in 1988.

	YUF011 (3B Consolidation)		YUF012 (Control)		YUF013 (T3 Blast Area)	
Species	%T	M/F	%T	M/F	%T	M/F
DIP MER	72.7	1:1	32.7	1.1:1	81.3	1.6:1
DIP MIC	9.1	1:0	11.5	1:2	---	---
PER LON	18.2	0:2	36.5	1:1.4	6.2	2:0
PER MAN	---	---	3.9	0:2	---	---
ONY TOR	---	---	1.9	1:0	---	---
AMM LEU	---	---	13.5	1:1.3	12.5	2:0

Continued Monitoring of Disturbance From the Sedan Cratering Test

The Sedan nuclear detonation, conducted at the NTS on July 6, 1962, was unique in that ecological studies were conducted by BYU, in cooperation with the University of California, Los Angeles (UCLA), before and after detonation to determine the immediate close-in effects on small mammals (Allred et al. 1964). In 1988, BECAMP set up three plots on the 16A, 57°30′ azimuth established by BYU for the 1962 study. BYU trapped mammals on grids of known size at the following distances in feet from GZ: 1000 (303 m), 2000 (606 m), 3000 (909 m), 4000 (1212 m), 5000 (1515 m), 7000 (2121 m) and 9000 (2727 m). BECAMP study plots (8 x 8 grids) were set up at the following distanced in feet from GZ: 1500 (455 m, YUF016), 3500 (1060 m, YUF017) and 5250 (1591 m, YUF018). Trapping occurred on 12, 13, and 14 July 1988, so that comparisons between the two data sets were possible. Differences in methods used to estimate population might, however, compromise the comparisons; BYU used a method described by Hayne (Allred, et al. 1964). This method is similar to Seber's, in that the population estimate, P, is directly proportional to the product of the total marked population (M) and the number of animals captured during the last trap period (C), and indirectly proportional to the number of recaptured animals in the last trap period (R) or: $P = \frac{C*M}{R}$. Studies in this area were also conducted by O'Farrell and Sauls (1987). The percent cover for 1988 at 303, 909, and 1515 m from GZ are found in the Status of Perennial Vegetation and Status of Desert Ephemeral Plants sections of this report. Percent vegetation before detonation is found in Allred et al. (1964); the blast damage extended to about 4500 feet (1363 m) from GZ, so the 1591-m plot can be considered an undisturbed control. The estimated density (Table 4.15) and percent of total captured population (Table 4.16) of

Table 4.15 Estimated densities (number/hectare ± 2 SE) of small mammals on the BECAMP plots (1.44 ha) at Sedan crater, YUF016, YUF017, and YUF018 during July 1988. Numbers in parentheses are number of individuals captured.

Species	YUF016 (455 m from GZ)		YUF017 (1060 m from GZ)		YUF018 (1591 m from GZ)	
DIP MER	23.7 ± 2.6	(32)	20.1 ± 0	(29)	10.8 ± 1.2	(15)
DIP MIC	---		---		5.8 ± 0.9	(8)
PER FOR	*	(1)	---		---	
PER LON	---		---		4.3 ± 0.7	(6)
AMM LEU	*	(1)	*	(2)	4.2 ± 0	(6)
ONY TOR	---		*	(1)	*	(4)
SYL AUD	---		*	(1)	*	(1)
Total N/ha	23.6	(34)	22.9	(33)	27.8	(40)
Total species	3		4		6	

*Species present but data insufficient to calculate density.

Table 4.16 Percent of total captured population (%T) and sex ratio (M/F = male : female) of small mammals on the BECAMP plots at Sedan crater in Yucca Flat in 1988.

	YUF016 (455 m from GZ)		YUF017 (1060 m from GZ)		YUF018 (1591 m from GZ)	
Species	%T	M/F	%T	M/F	%T	M/F
DIP MER	94.2	1.1:1	87.9	1.6:1	37.5	1.1:1
DIP MIC	---	---	---	---	20.0	1.7:1
PER FOR	2.9	1.0	---	---	---	---
PER LON	---	---	---	---	15.0	1:1
AMM LEU	2.9	0:1	6.1	*0:1	15.0	2:1
ONY TOR	---	---	3.0	1:0	10.0	1:3
SYL AUD	---	---	3.0	indet	2.5	indet

In the case of *S. audubonii* only one juvenile of indeterminate sex was captured.
*One animal of undetermined sex not included.

Dipodomys merriami in 1988 decreased as distance from GZ increased, while *Dipodomys microps* was present only at the farthest plot, 1591 m from GZ, where the species diversity was the greatest. The total number of individual captures on all three plots was fairly low (34 animals at 455 m, 33 at 1060 m, and 40 at 1591 m) and were not significantly different (chi-square, p>0.05). Animals were captured an average of 2.1 times at 455 m, 2.4 times at 1060 m, and 1.9 times at 1591 m; the percent trap successes on the three plots were similar (19.0%, 20.6%, and 19.3%, respectively).

The ratio of males to females of the most commonly captured species did not differ significantly from 1:1 (Table 4.16). Mean weights of adult male *Dipodomys merriami* (Table 4B-2, Appendix 4B) were significantly heavier than adult females at 455 m (ANOVA, p = 0.028) and 1060 m (p = 0.002) but not significantly heavier at 1591 m (p>0.05). There was no significant difference between the mean weights of adult females at the three distances or between the mean weights of adult males at the three sites (ANOVA, p>0.05). There was no significant difference between plots and combined weights of adult *D. merriami*. However, the combined mean weight of adult females from all three plots was significantly less than

Figure 4.17 Population estimate of small mammals (number per hectare) along line 16A before and after detonation of Sedan. Densities were calculated from number per plot data in Allred et al. 1964.

Feet from GZ (meters)	*Dipodomys microps* Pre-Test	*Dipodomys microps* Post Test	*Dipodomys merriami* Pre-Test	*Dipodomys merriami* Post Test	*Perognathus longimembris* Pre-Test	*Perognathus longimembris* Post Test	*Perognathus parvus* Pre-Test	*Perognathus parvus* Post Test
1000 (303)	0.3	***	1.5	***	7.9	***	1.6	***
2000 (606)	0.3	***	1.7	***	5.7	***	1.4	***
3000 (909)	0.9	0	1.2	0.8	10.3	0.9	3.1	0
4000 (1212)	0.9	0.9	3.0	0.3	9.9	0.6	0.6	0
5000 (1515)	2.3	8.5	0.9	0.6	29.7	29.5	0.6	0.3
7000 (2121)	7.5	8.2	0	0	11.0	27.6	0.6	0
9000 (2727)	6.9	9.2	0	0	19.4	15.5	0	0

***Not trapped post-test due to burial by overburden.

from GZ (*Dipodomys microps* and *Perognathus parvus*) have apparently not moved closer to GZ than post-test distances. In the case of *P. parvus*, one animal was captured 915 m from GZ in 1983 during intensive trapping (O'Farrell and Sauls 1987). Since then, this species has not been captured at the Sedan location.

Perognathus longimembris, present post-test at 909 m (3000 ft), was not captured in 1988 closer than 1591 m from GZ and in what appeared to be greatly reduced numbers (29.5/ha at 1515 m post-test versus 4.3/ha in 1988 at 1591 m). Prior to the Sedan detonation, this area was used for a number of aboveground tests, so that the area was already disturbed. What might be occurring is that pre-test and post-test data are showing the continued dispersal of rodents (e.g., *P. longimembris*) away from the disturbed areas, and into less disturbed habitat with a greater abundance of cover and food, with the exception of *Dipodomys merriami*, which does well in disturbed areas with minimal shrub cover.

Disturbances from Naturally Occurring Gopher Populations

One site in Mercury Valley was censused on 21, 22, and 26 July 1988 for small mammals to determine species composition and estimated densities on an area denuded by gophers, *Thomomys umbrinus*. The vegetation consisted of a sparse cover of *Stanleya pinnata* (see Hunter, Section 1, p 20 [subject to change] of this report). An 8 x 8 plot (MER002) was established in the middle of the gopher area, and another 8 x 8 plot (MER003) was set up in an undisturbed *Larrea-Ambrosia* community 450 m to the northwest. Estimated densities of the most commonly captured species and presence of other species are shown in Table 4.18.

Table 4.18 Estimated densities (number/ha ± 2 SE) of small mammals on the BECAMP plots (1.44 ha) at a gopher site in Mercury Valley in August 1988. Numbers in parentheses are individuals captured.

Species	MER002 (Gopher area)		MER003 (Control)	
DIP MER	6.9 ± 0	(10)	10.5 ± 0.6	(15)
DIP MIC	4.5 ± 1.2	(6)	6.4 ± 0.8	(9)
PER LON	---		8.0 ± 2.7	(10)
PER FOR	---		18.6 ± 6.8	(20)
ONY TOR	*	(2)	*	(3)
AMM LEU	*	(2)	*	(1)
Total N/ha	13.8	(20)	40.3	(58)
Total species	4		6	

*Species present but data insufficient to calculate density.

Note that not one gopher was trapped in the gopher area. This in itself is not a significant indication of the absence of gophers. It is most likely due to the fact that fossorial gophers are rarely captured in Sherman traps of the type used. More notable was the absence of *Perognathus* spp. in the disturbed area.

Nearly three times as many individual animals were caught on the control plot (58 animals) as compared to the disturbed area (20 animals). Total captures were also greater on the control (101 total captures as compared to 41 total captures), as was percent trap success (26.3 and 10.7%). Animals were captured an average of 2.1 times on the gopher area and 1.7 times on the control.

Table 4.19 Percent of total captured population (%T) and sex ratios (M/F = male : female) of small mammals on the BECAMP plots at a gopher disturbed site in Mercury Valley on NTS in 1988.

	MER002 (Gopher area)		MER003 (Control)	
Species	%T	M/F	%T	M/F
DIP MER	50.0	1:1	25.9	1.1:1
DIP MIC	30.0	1:2	15.5	1.3:1
PER LON	---	---	17.2	1:1
PER FOR	---	---	34.5	1:1.1
ONY TOR	10.0	1:1	5.2	2:1
AMM LEU	10.0	1:1	1.7	1:0

Of the animals captured on the gopher plot, 80.0% were kangaroo rats, compared to 41.4% on the control (Table 4.19). Approximately half, 51.7%, of the animals on the control plot were *Perognathus* spp. The ratio of males to females for the most commonly captured species did not differ significantly from 1:1 (Table 4.19). There were no significant differences between mean weights of *D. merriami* males and females on the same plot or between adult males and adult females on different plots (Appendix 4B).

TRAP DENSITY EXPERIMENT

Results from the trap density experiments conducted on the Jackass Flats and Frenchman Flat baseline plots are summarized in Table 4.20. In both plots, the greatest number of new captures of *Perognathus longimembris* was on the 10 x 10 grids, 10 in Jackass Flats and 4 in Frenchman Flat, where the traps were only 7.5 m apart. A total of 21 new animals were captured on the Jackass Flats plot and 11 new animals were captured on the Frenchman Flat plot. The 10 x 10 plots also had the best percent success rate for recapture of *P. longimembris* (44% on JAF001 and 57% on FRF001). No more than 2 new *Dipodomys merriami* were

Table 4.20 Number of animals per hectare and percent trap success during one day of trapping on 4 x 4, 5 x 5, 7 x 7, and 10 x 10 grids and three days of trapping on a 12 x 12 grid. Densities were calculated using actual grid size without any boundary.

Jackass Flats Density Experiment:

	Traps Per Hectare					
	4 x 4	5 x 5	7 x 7	10 x 10	12 x 12	
	50.6/ha	69.4/ha	118.9/ha	219.5/ha	105.9/ha	Seber
PER LON	6.3	11.1	12.0	30.6	24.6	41.1
DIP MER	9.5	11.1	21.8	17.6	12.1	12.6
Trap success	25%	28%	26%	23%	18%	

Frenchman Flat Density Experiment:

	Traps Per Hectare					
	4 x 4	5 x 5	7 x 7	10 x 10	12 x 12	
	50.6/ha	69.4/ha	118.9/ha	219.5/ha	105.9/ha	Seber
PER LON	12.6	5.6	12.1	26.3	23.5	28.8
DIP MER	0.0	11.1	7.3	8.8	5.9	6.0
Trap success	25%	28%	16%	16%	17%	

captured on any of the grids. The highest percent success recapture of *D. merriami* for Jackass Flats occurred on the 10 x 10 grid (6 of 9, or 67%), but the 7 x 7 grid percent success was only 3% lower (7 of 11, or 64%). 100% of the *D. merriami* on the Frenchman Flat 7 x 7 grid were recaptured (2 of 2) while 3 of 7, or 43%, were captured on the 10 x 10 grid.

These results seem to indicate that when sampling *Perognathus longimembris*, spacing between traps might be shorter, or the smaller home range should be considered when estimating their density; otherwise, relative abundance may be underestimated. These results suggest that any density comparisons between plots of differing trap distances should not be considered valid unless the trap difference is somehow accounted for in the estimation. However, using the original number of 67 *Perognathus longimembris* captured on the Jackass Flats plot (24.6/ha) and adding the number of new captures of 10 on the 10 x 10 plot (21.9/ha), the resultant 46.5 animals per hectare was in the range of the calculated Seber estimate (Table 4.2, without 7.5 m boundary) of 41.1 $\pm$ 13.6 animals per hectare on JAF001, assuming that the 10 x 10, 0.56-ha plot is representative of the total plot. *P. longimembris* captured on the FRF001 plot (32.3 animals per hectare) would also fall within the estimated density and 95% confidence interval given by the Seber estimate for that plot (28.8 $\pm$ 4.8). The Seber estimates of the standard errors for these two plots accurately predicted that over twice as many new *P. longimembris* remained uncaptured after the three trapping nights on the Jackass Flats plot (13.6/ha) as compared to the Frenchman Flat plot (4.8/ha).

Density of *Perognathus longimembris* did increase as trap density increased, but did not reach a plateau. Density of *Dipodomys merriami* on the Jackass Flats and Frenchman Flat plots also increased as trap density increased, but reached a plateau at the 7 x 7 plot in Jackass Flats and the 5 x 5 plot in Frenchman Flat. Further investigation is needed before any real conclusions can be made.

SQUIRREL TRAPPING

The only squirrels captured during day-time trapping were white-tailed antelope squirrels, *Ammospermophilus leucurus*. One female was trapped on the Jackass Flats plot between 0800 and 1000 hours. Two males were captured on Yucca Flat between 1000 and 1200 hours and one female was caught between 1400 and 1600 hours. All of the squirrels captured were new

During spring trapping, when the 8 x 9 x 30 cm Sherman traps were left open from late populations and were 2500 meters long. Desert cottontails were observed only on the Yucca Flat baseline plot, while Nuttall's cottontails were observed only on the Pahute Mesa plot. Jack rabbits were observed on all four of the baseline sites surveyed.

Densities and mean flushing distances are shown in Table 4.21. Fall jackrabbit density in

Table 4.21 Estimated densities (D = number/hectare ± 1 SE) and mean flushing distance (F = meters ± 1 SE) of rabbits and hares on BECAMP baseline sites on NTS in June 1988.

	SYL AUD		SYL NUT		LEP CAL	
Plot	D	F	D	F	D	F
JAF001	---	---	---	---	0.11 ± 0.19	13.1 ± 7.63
FRF001	---	---	---	---	0.11 ± 0.14	33.3 ± 19.4
YUF001	0.14 ± 0.38	10.6 ± 6.6	---	---	0.01 ± 0.03	27.3 ± 27.3
PAM001	---	---	1.00 ± 0.43	4.9 ± 3.7	0.52 ± 0.55	9.5 ± 10.1

northern Frenchman Flat in 1987 was estimated to be 0.10/ha with a mean flushing distance of 33.5 m. Similarly, desert cottontail density was estimated at 0.23/ha and mean flushing distance of 3.3 m (Hunter and Medica 1989).

Rabbits and hares were also surveyed on subsidiary plots in Yucca Flat (5, 6 July) and Mid Valley (7 June). Jackrabbit densities on the T1 blast site (YUF009) and control (YUF010) were estimated at 0.32/ha and 0.66/ha, respectively. Lengths of the transects were 1560 m each. Mean flushing distance on the denuded blast area was 16.7 ± 15.0 m as compared to 2.4 ± 2.4 m on the control. No cottontail rabbits were observed on either plot. No jackrabbits or cottontail rabbits were observed on the three plots on the eastern side of Yucca Flat (T3, 3B consolidation site, and control). This side of Yucca Flat has been used extensively for nuclear testing, which has left the area disturbed with little vegetative cover. Rabbits (*Sylvilagus*) are usually found in habitat that will provide shelter for concealing themselves from predators and a secluded nesting area or burrow for their altricial young. Hares (*Lepus*) will generally outrun a predator and therefore require less vegetation. Hares also do not construct burrows, and the precocial young do well in exposed and open habitats. (Zeveloff & Collett 1988:84). No rabbits were observed on the Mid Valley burn area (MID002) or the control (MID003) during transect surveys.

DISCUSSION AND RECOMMENDATIONS

RARE SPECIES

It is evident from the entire trapping record on the Nevada Test Site, as well as the differences between species captured during spring and summer trapping on the same plots in 1988, that intensive trapping, such as was done by BYU during 1959 to 1965 (Jorgensen and Hayward 1965), is necessary to adequately assess the complete species composition of a particular area. Many species that are recorded for an area could erroneously be assumed to have disappeared, when in fact they are only present in very low numbers or during different seasons. Therefore, the probability of capture during a trapping duration of only three days is low. For the purpose of assessing the population density of the dominant species, however, a short trapping duration appears to be adequate. To adequately determine whether or not a particular species has disappeared from a disturbed area, more intensive trapping should be undertaken.

TRAP SUCCESS

The average capture rates of animals on the BECAMP plots (total number of captures/ number of different animals) are listed in Table 4.22. Average captures consistently showed that the control animals were caught less frequently than the animals on the corresponding disturbed plot. That is, individual animals on the disturbed plots tended to be captured at least two out of the three nights, while individual animals on the control plots were captured less than two out of the three nights. The combined average capture of all disturbed plots (2.1) was significantly greater than the combined average capture rate of all control plots (1.8) (t-test, $p<0.001$).

The combined average percent trap success (number of total captures/trap nights), however, was greater on the controls (21.0) than on the disturbed sites (19.4) but not significantly greater. These two trapping parameters indicate that a greater number of individual animals and species of animals (Table 4.22) are being captured on the control areas. Since two traps were activated at each trapping station, and it was not common to capture animals in both traps, "trap happy" rodents probably did not decrease the chances of catching other unmarked animals on the disturbed areas. Therefore, it can be assumed that the number of animals that were likely to be trapped were captured, and that the density estimates adequately describe the animal population at a particular site.

TYPE OF DISTURBANCE RELATED DIFFERENCES

In all of the BECAMP paired plots sampled in 1988, with the exception of the Rock Valley plots, disturbed areas had either no *Dipodomys microps* present or present at numbers much lower than the control plots. Areas disturbed by blast effects from nuclear detonation had no *D. microps* while areas disturbed by burning, blading and gophers still showed the presence of *D. microps* but at lower numbers. The Rock Valley enclosed plot had a *D. microps*

Table 4.22 Number of species, average capture rates, and percent trap success on baseline, disturbed, and control monitoring plots in 1988 on NTS.

Plot		Type of Disturbance	Number of Species	Average Capture	Percent Success
FRF001		Baseline	4	1.8	16.9
JAF001		Baseline	3	1.6	18.4
YUF001		Baseline	6	2.0	22.2
PAM001		Baseline	7	1.8	11.3
RAM001		Baseline	6	1.6	6.6
MID002		Burn	6	1.9	10.9
MID003		Control	8	1.6	10.7
RED001	(July)	Burn	7	2.1	22.9
	(August)		7	1.6	33.9
	(October)		3	2.4	24.8
RED002	(July)	Control	7	1.8	25.0
	(August)		6	1.6	25.0
	(October)		7	2.2	31.4
ROV008		Fenced	6	2.3	30.9
ROV007		Control	8	2.0	24.5
YUF009		Aboveground blast	6	2.5	19.4
YUF010		Control	6	1.9	26.0
YUF011		Blading	3	2.3	6.0
YUF012		Control	6	1.8	22.1
YUF013		Aboveground blast	3	2.3	8.6
YUF016		Sedan throw-out, 455 m GZ	3	2.1	19.0
YUF017		Sedan throw-out, 1060 m GZ	4	2.4	26.6
YUF018		Sedan control, 1591 m GZ	6	1.9	19.3
MER002		Gopher denuded	4	2.1	10.7
MER003		Control	6	1.7	26.3

population of over twice that of the unfenced plot. The enclosed area has an abundant shrub cover available for food supply and cover. The absence of perennial shrub cover on the other disturbed sites may be limiting the *D. microps* populations.

Dipodomys merriami was generally the dominant species on the disturbed plots (again, with the exception of Rock Valley) while on the control, *D. merriami* was usually co-dominant with

Perognathus longimembris. Bladed, blasted, and gopher denuded areas had two to three fewer species than the corresponding control, except for the T1 blast area, while the areas disturbed due to burning had one to two fewer species than the control (Table 4.22).

Each of the Yucca Flat control plots, as well as the baseline site, had six different species trapped. Five of the six were the same: *Dipodomys merriami, Dipodomys microps, Perognathus longimembris, Onychomys torridus*, and *Ammospermophilus leucurus*. The sixth species was either *Sylvilagus audubonii, Peromyscus maniculatus* or *Reithrodontomys megalotis*, of which only one or two animals were trapped.

FUTURE MONITORING PLAN

Fluctuations in population sizes are a normal occurrence in some small mammals (*Dipodomys* spp. and *Perognathus* spp.), while other small rodents (e.g. *Peromyscus* spp. and *Onychomys* spp.) occur at low densities that are relatively stable from year to year (Brown and Heske 1990; Swihart and Slade 1990; Drost and Fellers 1991). Annual cycles in natural communities have been attributed to both abiotic (climate, rainfall) and biotic (food abundance, density [illegible]

interaction with other rodent species (Brown and Heske 1990; Swihart and Slade 1990) and breeding suppression in peak periods (Terman 1965; Van Horne 1981; Drost and Fellers 1991) are density-related changes in the reproductive effort and success in several rodent species. Monitoring on the Yucca Flat baseline site will continue on a yearly basis in order to document any natural changes in the small mammal community at this site. Other baseline sites will be monitored on a three to four year cycle, while subsidiary sites will be trapped at

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Appendix 4A

Species and Number Captured During Three Days of Spring Sampling and One Day of Summer Sampling on Five Baseline Monitoring Plots on the NTS in 1988

	Plot								
	JAF001		FRF001		YUF001		PAM001		RAM001
Species	SP	SU	SP	SU	SP	SU	SP	SU	SU
AMM LEU	-	-	1	1	4	-	1	-	-
DIP DES	1	-	-	-	-	-	-	-	-
DIP MER	33	31	16	18	17	14	-	-	-
DIP MIC	-	-	-	-	16	11	2	-	-
MIC MEG	-	-	-	-	-	-	1	2	-
NEO LEP	-	-	-	-	-	-	2	-	-
ONY TOR	-	-	1	-	2	4	-	-	-
PER LON	67	23	64	29	57	6	-	-	-
PER PAR	-	-	-	-	-	-	34	20	1
PER SPP	-	-	-	-	-	-	13	6	16
PER TRU	-	-	-	-	-	-	-	-	5
REI MEG	-	-	-	-	-	1	-	-	2
SYL AUD	-	-	-	-	1	-	-	-	-
SYL NUT	-	-	-	-	-	-	1	-	4
TAM DOR	-	-	-	-	-	-	-	-	9

SP indicates a spring trapping.
SU indicates a summer trapping.

Appendix 4B

Mean Weights of the Most Commonly Captured Species Found on BECAMP Monitoring Plots on the NTS in 1988

Table 4B-1 Adult summer mean weights (grams ± 2 SE) by sex of common rodent species on three BECAMP baseline monitoring plots in 1988.

		JAF001		FRF001		YUF001	
Species	Sex	N	Weight	N	Weight	N	Weight
PER LON	M	11	8.7 ± 0.7	13	7.7 ± 0.6	2	8.5 ± 3.0
	F	11	8.8 ± 0.8	12	8.3 ± 0.9	4	8.0 ± 0.8
DIP MER	M	18	38.9 ± 2.2	5	38.6 ± 5.3	4	39.5 ± 2.4
	F	8	35.1 ± 3.2	5	37.0 ± 2.8	6	39.0 ± 2.9
DIP MIC	M	0	---	0	---	3	54.7 ± 3.3
	F	0	---	0	---	5	54.6 ± 5.5

Appendix 4B (Continued)

Table 4B-2 Mean weights (grams ± 2 SE) by sex and age of *Dipodomys merriami* captured on BECAMP subsidiary plots on NTS in 1988. Numbers in parentheses are individuals weighed.

Plot	Male Adult		Female Adult		Male Juvenile		Female Juvenile	
YUF009 (May)	44.1 ± 1.5	(16)	42.6 ± 1.9	(9)	18.0	(1)	26.0	(1)
YUF009 (August)	42.6 ± 3.2	(5)	37.3 ± 2.6	(4)	30.0	(1)	8.5 ± 1.0	(2)
YUF010 (May)	43.3 ± 1.6	(11)	42.1 ± 2.4	(4)			23.5 ± 1.0	(2)
YUF010 (August)	42.6 ± 3.2	(5)	37.3 ± 2.6	(4)	30.0	(1)	28.5 ± 1.0	(2)
YUF011	45.7 ± 0.7	(4)	42.8 ± 2.6	(4)				
YUF012	45.0 ± 2.3	(8)	48.2 ± 6.0	(3)	22.0	(1)	21.6 ± 1.6	(5)
YUF013	41.3 ± 1.3	(8)	41.8 ± 4.9	(4)			32.0	(1)
YUF016	43.3 ± 2.0	(14)	39.6 ± 2.3	(9)	25.7 ± 2.7	(3)	29.3 ± 4.9	(6)
YUF017	43.6 ± 2.2	(12)	37.8 ± 1.3	(7)	30.9 ± 2.2	(6)	28.7 ± 0.2	(4)
YUF018	42.8 ± 1.8	(5)	38.9 ± 3.3	(5)	29.5 ± 1.1	(3)	27.5 ± 7.0	(2)
MID002	43.6 ± 3.2	(8)	44.1 ± 3.7	(4)	27.1 ± 2.3	(3)		
MID003	41.0 ± 2.0	(3)	38.7 ± 6.7	(2)				
RED001 (July)	41.3 ± 3.3	(8)	39.3 ± 3.2	(5)	29.2 ± 3.0	(6)	26.3 ± 3.3	(5)
RED001 (August)	43.4 ± 1.9	(13)	39.4 ± 2.6	(12)	34.4 ± 2.3	(4)	32.3 ± 3.2	(5)
(October)	39.1 ± 1.2	(18)	36.6 ± 1.0	(13)			31.9 ± 1.0	(3)
RED002 (July)	40.0 ± 3.2	(11)	43.1 ± 1.9	(10)	27.3 ± 1.7	(7)	26.9 ± 3.0	(3)
RED002 (August)	42.2 ± 2.6	(10)	43.7 ± 2.2	(11)	31.4 ± 4.2	(4)	34.0 ± 2.0	(2)
RED002 (October)	38.2 ± 1.7	(17)	37.1 ± 1.5	(12)	34.0	(1)	32.9 ± 3.2	(2)
ROV002	42.2 ± 3.8	(3)	46.8 ± 1.5	(2)			29.5	(1)
ROV007	41.0 ± 1.4	(8)	37.3 ± 1.9	(5)	25.0	(1)		
MER002	40.9 ± 7.8	(4)	40.5 ± 5.4	(4)	30.5	(1)	[illegible]	(1)

Appendix 4B (Continued)

Table 4B-3 Mean weight (grams $\pm$ 2 SE) of *Dipodomys microps* on BECAMP subsidiary plots on NTS in 1988. Numbers in parentheses are individuals weighed.

Plot	Male Adult		Female Adult		Male Juvenile		Female Juvenile	
YUF010 (May)	69.7 ± 6.6	(3)	47.7	(1)	36.3	(1)		
YUF010 (August)	54.7 ± 3.3	(4)	54.6 ± 5.5	(5)	48.0	(1)	49.0	(1)
YUF011	58.0	(1)						
YUF012	67.3 ± 11.5	(2)	52.0 ± 7.2	(3)			37.0	(1)
YUF018	58.0 ± 9.4	(3)	64.0 ± 0.0	(2)	44.0 ± 2.0	(2)	45.0	(1)
MID002					44.5	(1)		
MID003	67.5	(1)	64.0	(1)	28.5	(1)	37.2 ± 8.4	(3)
RED001 (July)	52.2 ± 5.0	(2)	51.3	(1)				
RED001 (August)	56.5 ± 11.2	(5)	51.3 ± 8.7	(6)				
RED001 (October)	61.9 ± 4.9	(6)	54.6 ± 7.4	(3)			48.0	(1)
RED002 (July)	58.4 ± 8.2	(5)	54.3 ± 9.3	(3)				
RED002 (August)	61.4 ± 3.9	(4)	59.0 ± 8.4	(5)				
RED002 (October)	60.7 ± 3.9	(11)	55.3 ± 3.6	(8)				
ROV002	57.3 ± 1.9	(30)	53.4 ± 1.5	(28)	41.1 ± 3.6	(11)	41.4 ± 2.1	(16)
ROV007	59.0 ± 3.7	(12)	55.2 ± 3.6	(11)	44.0 ± 3.6	(7)	43.3 ± 4.0	(8)
MER002	54.8 ± 3.7	(2)	61.2 ± 9.7	(3)	46.0	(1)		
MER003	55.8 ± 5.4	(4)	56.2 ± 4.6	(3)	47.0	(1)	40.5	(1)

Appendix 4B (Continued)

Table 4B-4 Mean weight (grams ± 2 SE) of *Perognathus longimembris* on BECAMP subsidiary plots on NTS in 1988. Numbers in parentheses are individuals weighed.

Plot	Male Adult		Female Adult		Male Juvenile		Female Juvenile	
YUF009	7.3 ± 0.5	(5)	7.6 ± 0.5	(2)				
YUF010 (May)	7.7 ± 0.3	(17)	8.1 ± 0.4	(21)				
YUF010 (August)	8.0	(1)	7.1 ± 1.0	(4)				
YUF011			8.0 ± 0.0	(2)				
YUF012	8.3 ± 0.4	(7)	9.5 ± 0.9	(11)	7.0	(1)		
YUF018	8.2 ± 0.9	(3)	7.8 ± 1.7	(2)			7.0	(1)
MID002	8.2 ± 2.0	(3)	10.0 ± 3.1	(3)				
MID003	8.3 ± 0.7	(3)	9.5 ± 1.0	(2)			6.0	(1)
RED001 (July)	8.0 ± 1.2	(3)	6.5 ± 1.0	(2)				
RED001 (August)			8.0	(1)				
RED002 (July)	7.0	(1)	8.0 ± 1.2	(3)	6.5 ± 1.0	(2)		
RED002 (August)			8.0	(1)				
ROV007	8.0 ± 0.3	(18)	8.3 ± 0.5	(12)	5.0	(1)	5.5 ± 1.0	(2)
MER003	6.7 ± 0.7	(3)	7.4 ± 1.0	(5)	5.5 ± 1.0	(2)		

Appendix 4C

Results of Density and Standard Error Calculations Using Seber (1982:138)

N1 = Total individuals marked before present trap night.

XB = New individuals captured during present trap night.

M2 = Number in N2 which were recaptured during present trap night.

N2 = Total of individuals captured during present trap night.

N*/hectare = Estimated number of animals per hectare.

V/Ha^2 = Estimated variance per hectare squared for N*/Ha.

2 SE/ha = two times the estimated standard error per hectare for N*/ha.

#FRF188SPRDEN

0		1 12-APR-88	2 13-APR-88	3 14-APR-88
1	DIP MER			
2	N1		14	16
3	XB		2	0
4	M2		12	14
5	N2		14	14
6	N*/HECTARE		5	4.94
7	V/HA^2		0.04	0
8	2 SE/HA		0.38	0
9				
10	PER LON			
11	N1		26	48
12	XB		22	16
13	M2		10	26
14	N2		32	42
15	N*/HECTARE		24.69	23.78
16	V/HA^2		20.58	3.46
17	2 SE/HA		9.07	3.72

#JAF188SPRDEN

0	1 12-APR-88	2 13-APR-88	3 14-APR-88
1 DIP MER			
2 N1		22	29
3 XB		7	4
4 M2		16	22
5 N2		23	26
6 N*/HECTARE		9.71	10.56
7 V/HA^2		0.42	0.17
8 2 SE/HA		1.30	0.83
9			
10 PER LON			
11 N1		20	50
12 XB		30	17
13 M2		6	13
14 N2		36	30
15 N*/HECTARE		33.95	34.55
16 V/HA^2		79.30	32.22
17 2 SE/HA		17.81	11.35

#MER288SUMDEN

0	1 21-AUG-88	2 22-AUG-88	3 26-AUG-88
1 DIP MER			
2 N1		8	8
3 XB		0	2
4 M2		8	8
5 N2		8	10
6 N*/HECTARE		5.56	6.94
7 V/HA^2		0	0
8 2 SE/HA		0	0.
9			
10 DIP MIC			
11 N1		3	4
12 XB		1	2
13 M2		1	3
14 N2		2	5
15 N*/HECTARE		3.47	4.51
16 V/HA^2		0.96	0.36
17 2 SE/HA		1.96	1.20

#MER388SUMDEN

0	1 21-JUL-88	2 22-JUL-88	3 26-JUL-88
1 DIP MER			
2 N1		12	14
3 XB		2	1
4 M2		6	12
5 N2		8	13
6 N*/HECTARE		10.91	10.52
7 V/HA^2		1.73	0.09
8 2 SE/HA		2.63	0.59
9			
10 DIP MIC			
11 N1		6	8
12 XB		2	1
13 M2		4	6
14 N2		6	7
15 N*/HECTARE		6.11	6.45
16 V/HA^2		0.63	0.18
17 2 SE/HA		1.59	0.84

#MID288SPRDEN

0	1 03-JUN-88	2 07-JUN-88	3 08-JUN-88
1 DIP MER			
2 N1		7	15
3 XB		8	0
4 M2		7	12
5 N2		15	12
6 N*/HECTARE		8.89	8.89
7 V/HA^2		0	0
8 2 SE/HA		0	0
9			
10 PER LON			
11 N1		3	6
12 XB		3	0
13 M2		1	2
14 N2		4	2
15 N*/HECTARE		5.33	3.56
16 V/HA^2		3.51	0
17 2 SE/HA		3.75	0

Appendix 4C (Continued)

#MID388SPRDEN

0		1 03-JUN-88	2 07-JUN-88	3 08-JUN-88
1	DIP MER			
2	N1		3	4
3	XB		1	1
4	M2		1	2
5	N2		2	3
6	N*/HECTARE		2.96	3.36
7	V/HA^2		0.70	0.39
8	2 SE/HA		1.68	1.25
9				
10	DIP MIC			
11	N1		3	4
12	XB		1	2
13	M2		3	4
14	N2		4	6
15	N*/HECTARE		2.37	3.56
16	[illegible]		[illegible]	[illegible]
17	2 SE/HA		0	0
18				
19	PER LON			
20	N1		2	2
21	XB		0	4
22	M2		1	2
23	N2		1	6
24	N*/HECTARE		1.19	3.56
25	V/HA^2		0	0
26	2 SE/HA		0	0
27				
28	PER MAN			
29	N1			3
30	XB			2
31	M2			1
32	N2			3
33	N*/HECTARE			4.14
34	V/HA^2			1.87
35	2 SE/HA			2.73

#PAM188SPRDEN

0	1 24-JUN-88	2 28-JUN-88	3 29-JUN-88
1 PER PAR			
2 N1		10	25
3 XB		15	8
4 M2		8	22
5 N2		23	30
6 N*/HECTARE		8.74	10.51
7 V/HA^2		0.93	0.15
8 2 SE/HA		1.93	0.76
9			
10 PER SPP			
11 N1		6	12
12 XB		6	1
13 M2		5	6
14 N2		11	7
15 N*/HECTARE		4.01	4.28
16 V/HA^2		0.19	0.15
17 2 SE/HA		0.87	0.78

#RAM188SUMDEN

	0	1 02-AUG-88	2 03-AUG-88	3 04-AUG-88
1	PER SPP			
2	N1		11	15
3	XB		4	1
4	M2		9	8
5	N2		13	9
6	N*/HECTARE		4.88	5.18
7	V/HA^2		0.12	0.13
8	2 SE/HA		0.68	0.73
9				
10	PER TRU			
11	N1		3	5
12	XB		2	0
13	M2		2	1
14	N2		4	1
15	N*/HECTARE		1.75	1.54
16	V/HA^2		0.11	0
17	2 SE/HA		0.65	0
18				
19	TAM DOR			
20	N1			6
21	XB			2
22	M2			0
23	N2			2
24	N*/HECTARE			6.17
25	V/HA^2			12.00
26	2 SE/HA			6.93

#RED188JULDEN

0	1 26-JUL-88	2 27-JUL-88	3 28-JUL-88
1 DIP MER			
2 N1		20	23
3 XB		3	1
4 M2		16	16
5 N2		19	17
6 N*/HECTARE		15.05	15.50
7 V/HA^2		0.39	0.23
8 2 SE/HA		1.25	0.97
9			
10 PER LON			
11 N1		2	4
12 XB		2	1
13 M2		0	1
14 N2		2	2
15 N*/HECTARE		5.08	4.13
16 V/HA^2		7.26	1.51
17 2 SE/HA		5.39	2.46
18			
19 PER PAR			
20 N1		2	6
21 XB		4	1
22 M2		1	6
23 N2		5	7
24 N*/HECTARE		5.08	4.44
25 V/HA^2		2.42	0
26 2 SE/HA		3.11	0

#RED188AUGDEN

0		1 24-AUG-88	2 25-AUG-88
1	DIP MER		
2	N1		28
3	XB		6
4	M2		27
5	N2		33
6	N*/HECTARE		21.72
7	V/HA^2		0.10
8	2 SE/HA		0.65
9			
10	DIP MIC		
11	N1		10
12	XB		1
13	M2		5
14	N2		6
15	N*/HECTARE		7.51
16	V/HA^2		0.62
17	2 SE/HA		1.57
18			
19	PER PAR		
20	N1		4
21	XB		4
22	M2		2
23	N2		6
24	N*/HECTARE		6.77
25	V/HA^2		3.14
26	2 SE/HA		3.54

Appendix 4C (Continued)

#RED188OCTDEN

0	1 25-OCT-88	2 26-OCT-88	3 27-OCT-88
1 DIP MER			
2 N1		23	28
3 XB		5	6
4 M2		20	22
5 N2		25	28
6 N*/HECTARE		18.23	22.58
7 V/HA^2		0.39	0.96
8 2 SE/HA		1.25	1.96
9			
10 DIP MIC			
11 N1		8	8
12 XB		0	2
13 M2		8	8
14 N2		8	10
15 N*/HECTARE		5.08	6.35
16 V/HA^2		0	0
17 2 SE/HA		0	0

#RED288JULDEN

0	1 26-JUL-88	2 27-JUL-88	3 28-JUL-88
1 DIP MER			
2 N1		21	27
3 XB		6	4
4 M2		17	19
5 N2		23	23
6 N*/HECTARE		17.99	20.70
7 V/HA^2		0.83	1.03
8 2 SE/HA		1.82	2.03
9			
10 DIP MIC			
11 N1		3	6
12 XB		3	2
13 M2		1	1
14 N2		4	3
15 N*/HECTARE		5.71	8.25
16 V/HA^2		4.03	9.41
17 2 SE/HA		4.02	6.13
18			
19 PER LON			
20 N1		3	6
21 XB		3	0
22 M2		1	1
23 N2		4	1
24 N*/HECTARE		5.71	3.81
25 V/HA^2		4.03	0
26 2 SE/HA		4.02	0
27			
28 PER PAR			
29 N1		2	6
30 XB		4	1
31 M2		1	2
33 N*/HECTARE		5.08	5.29
34 V/HA^2		2.42	1.25
35 2 SE/HA		3.11	2.24

Appendix 4C (Continued)

#RED288AUGDEN

0	1 24-AUG-88	2 25-AUG-88
1 DIP MER		
2 N1		22
3 XB		7
4 M2		17
5 N2		24
6 N*/HECTARE		19.65
7 V/HA^2		1.32
8 2 SE/HA		2.30
9		
10 DIP MIC		
11 N1		7
12 XB		2
13 M2		6
14 N2		8
15 N*/HECTARE		5.90
16 V/HA^2		0.15
17 2 SE/HA		0.77

#RED288OCTDEN

0	1 25-OCT-88	2 26-OCT-88	3 27-OCT-88
1 DIP MER			
2 N1		24	30
3 XB		6	2
4 M2		19	22
5 N2		25	24
6 N*/HECTARE		20.00	20.76
7 V/HA^2		0.94	0.39
8 2 SE/HA		1.93	1.25
9			
10 DIP MIC			
11 N1		13	16
12 XB		3	3
13 M2		12	15
14 N2		15	18
15 N*/HECTARE		10.31	12.18
16 V/HA^2		0.11	0.09
17 2 SE/HA		0.68	0.60

#ROV788SPRDEN

0	1 14-JUN-88	2 15-JUN-88	3 16-JUN-88
1 DIP MER			
2 N1		9	11
3 XB		2	3
4 M2		7	10
5 N2		9	13
6 N*/HECTARE		3.55	4.41
7 V/HA^2		0.07	0.03
8 2 SE/HA		0.51	0.36
9			
10 DIP MIC			
11 N1		23	33
12 XB		10	5
13 M2		19	31
14 N2		29	36
15 N*/HECTARE		10.80	11.82
16 V/HA^2		0.33	0.04
17 2 SE/HA		1.14	0.38
18			
19 PER LON			
20 N1		15	31
21 XB		16	2
22 M2		11	22
23 N2		27	24
24 N*/HECTARE		11.21	10.43
25 V/HA^2		1.46	0.11
26 2 SE/HA		2.42	0.66
27			
28 ONY TOR			
29 N1		2	10
30 XB		8	0
31 M2		1	2
32 N2		9	2
33 N*/HECTARE		4.32	3.09
34 V/HA^2		1.91	0
35 2 SE/HA		2.76	0

#ROV888SPRDEN

0	1 14-JUN-88	2 15-JUN-88	3 16-JUN-88
1 DIP MER			
2 N1		6	6
3 XB		0	0
5 N2		4	4
6 N*/HECTARE		1.85	1.85
7 V/HA^2		0	0
8 2 SE/HA		0	0
9			
10 DIP MIC			
11 N1		67	80
12 XB		13	5
13 M2		55	73
14 N2		68	78
15 N*/HECTARE		25.55	26.38
16 V/HA^2		0.39	0.05
17 2 SE/HA		1.25	0.46
18			
19 PER FOR			
20 N1		6	8
21 XB		2	1
22 M2		6	6
23 N2		8	7
24 N*/HECTARE		2.47	2.87
25 V/HA^2		0	0.03
26 2 SE/HA		0	0.37
27			
28 ONY TOR			
29 N1		3	6
30 XB		3	0
31 M2		2	1
32 N2		5	1
33 N*/HECTARE		2.16	1.85
34 V/HA^2		0.19	0
35 2 SE/HA		0.87	0

Appendix 4C (Continued)

#YUF188SPRDEN

0		1 26-APR-88	2 27-APR-88	3 28-APR-88
1	DIP MER			
2	N1		15	16
3	XB		1	1
4	M2		13	16
5	N2		14	17
6	N*/HECTARE		4.98	5.25
7	V/HA^2		0.02	0
8	2 SE/HA		0.25	0
9				
10	DIP MIC			
11	N1		10	11
12	XB		1	5
13	M2		7	9
14	N2		8	14
15	N*/HECTARE		3.51	5.25
16	V/HA^2		0.05	0.16
17	2 SE/HA		0.44	0.79
18				
19	PER LON			
20	N1		29	51
21	XB		22	6
22	M2		20	29
23	N2		42	35
24	N*/HECTARE		18.65	18.95
25	V/HA^2		2.51	0.84
26	2 SE/HA		3.17	1.84

Appendix 4C (Continued)

#YUF988SPRDEN

0	1 04-MAY-88	2 16-MAY-88	3 17-MAY-88	4 18-MAY-88
1 DIP MER				
2 N1		14	22	25
3 XB		8	3	2
4 M2		13	19	15
5 N2		21	22	17
6 N*/HECTARE		15.67	17.67	19.62
7 V/HA^2		0.43	0.27	1.04
8 2 SE/HA		1.32	1.05	2.04
9				
10 PER LON				
11 N1		1	5	6
12 XB		4	1	1
13 M2		1	4	5
14 N2		5	5	6
15 N*/HECTARE		3.47	4.31	4.98
16 V/HA^2		0	0.12	0.09
17 2 SE/HA		0	0.68	0.61

#YUF988DIPMERSUMDEN

0	1 09-AUG-88	2 10-AUG-88
1 N1		26
2 XB		8
3 M2		20
[illegible]		[illegible]
5 N*/HECTARE		25.20
6 V/HA^2		1.87
7 2 SE/HA		2.73

#YUF1388DIPMERSPRDEN

0	1 20-MAY-88	2 25-MAY-88	3 26-MAY-88
1 N1		11	12
2 XB		1	1
3 M2		11	8
4 N2		12	9
5 N*/HECTARE		7.62	8.54
6 V/HA^2		0	0.26
7 2 SE/HA		0	1.02

#YUF1688DIPMERSUMDEN

0	1 12-JUL-88	2 13-JUL-88	3 14-JUL-88
1 N1		21	25
2 XB		4	7
3 M2		18	19
4 N2		22	26
5 N*/HECTARE		17.80	23.68
6 V/HA^2		0.41	1.69
7 2 SE/HA		1.27	2.60

#YUF1788DIPMERSUMDEN

0	1 12-JUL-88	2 13-JUL-88	3 14-JUL-88
1 N1		23	29
2 XB		6	0
3 M2		22	24
4 N2		28	24
5 N*/HECTARE		20.32	20.14
6 V/HA^2		0.16	0
7 2 SE/HA		0.80	0

Appendix 4C (Continued)

#YUF1888SUMDEN

0	1 12-JUL-88	2 13-JUL-88	3 14-JUL-88
1 DIP MER			
2 N1		10	14
3 XB		4	1
4 M2		7	9
5 N2		11	10
6 N*/HECTARE		10.76	10.76
7 V/HA^2		1.33	0.36
8 2 SE/HA		2.30	1.20
9			
10 DIP MIC			
11 N1		4	6
12 XB		2	2
13 M2		1	5
14 N2		3	7
15 N*/HECTARE		6.25	5.79
16 V/HA^2		4.82	0.21
17 2 SE/HA		4.39	0.93
18			
19 PER LON			
20 N1		3	5
21 XB		2	1
22 M2		2	4
23 N2		4	5
24 N*/HECTARE		3.94	4.31
25 V/HA^2		0.54	0.12
26 2 SE/HA		1.46	0.68
27			
28 AMM LEU			
29 N1		4	6
30 XB		2	0
31 M2		0	3
32 N2		2	3
33 N*/HECTARE		9.72	4.17
34 V/HA^2		28.94	0
35 2 SE/HA		10.76	0

SECTION 5

WILDLIFE UTILIZATION OF NATURAL SPRINGS AND MAN-MADE WATER SOURCES AT THE NEVADA TEST SITE

by
Evan M. Romney and Paul D. Greger

INTRODUCTION

Wildlife utilization of water sources on the Nevada Test Site (NTS) had not been studied in any detail. Wildlife usage of permanent or temporary water sources was only mentioned briefly in existing studies (Hayward et al. 1963, Allred et al. 1963, Jorgensen and Hayward 1965, Giles 1976, Giles and Cooper 1985). Studies at natural springs were limited to Giles (1976), who examined the availability of water for wildlife usage; and Taylor and Giles (1979), who investigated algae living in those waters. The Giles study (1976) was the most relevant to our study, but it did not contain any detailed information on wildlife utilization over time. The long-term objectives of this study were to describe the kinds of wildlife that

utilize the available water sources on the NTS, determine the extent of such utilization, and assess any changes and unusual disturbances in the natural spring habitats.

METHODS

Monitoring of both permanent and temporary water sources involved site visits on a seasonal basis to determine the qualitative usage of natural springs and man-made ponds by wildlife

Samples of riparian and aquatic vegetation growing at natural springs were collected, identified, and deposited with the BECAMP herbarium collection. Water quality (twenty-five elements) of the natural springs and man-made ponds was monitored for mineral content, determined by ICP-spectrometry (Alexander and McAnulty 1981).

Long term photographic documentation around natural springs was begun in 1988 to assess the impact of feral horses on the riparian habitat and adjacent areas from grazing and trampling. Field notes from observations were combined with the photographic record to document any change in habitat. Photographic benchmarks were used to ensure reproducibility of the subject landscape. These benchmarks were 5-foot posts of two types: one post marked the position from which each photograph was taken; the other post near the spring supported a white PVC pipe sleeve that is focused to appear at the same position in the frame of each successive photograph. Several photographic shots were necessary at certain places to adequately document the riparian habitat. Figure 5.1 is an example of the field note sheet used for each water source visit.

RESULTS

Figure 5.2 shows the relative distribution of natural springs monitored on the NTS that provide a supply of water for wildlife. Table 5.1 lists the elevations and Nevada grid coordinate locations for those springs. A few seepage sites also supply water during the winter and spring months but dry up during summer and fall. Such sites were not routinely monitored.

Figure 5.3 shows the distribution of man-made water sources that presently are available to wildlife; Table 5.2 lists their elevations and Nevada grid coordinate locations. Some well water sources used for intermittent engineering activity have been and will be short-lived, but some of them have existed for many years and have developed dependent wildlife populations. All of the well ponds and reservoirs host intermittent populations of migrating waterfowl.

Table 5.3 indicates the wildlife utilization of natural springs on the NTS during the period of November 1987 through December 1988 as determined by sightings and the presence of animal signs such as scats and tracks. Table 5.4 lists the wildlife utilization at man-made water sources during the same period. It should be noted, however, that those totals may include counting the same individual on repeated visits as certainly was the case for feral horses observed at the Camp 17 water source.

Figure 5.4 shows the relative locations of raptor sightings (n = 87) during the 1988 dominant species observed during 1988, however other species such as golden eagles, prairie falcons and northern harriers were also observed.

Data for the mineral element concentrations determined in water samples collected from natural springs are listed in Appendix 5.

Figure 5.5 illustrates the utilization of both natural springs and man-made water sources by mule deer as determined by the presence of tracks and scats. Frequency of use was rare to low at water sources located in lower elevations of the NTS and moderate to heavy at water sources located in higher elevations.

The feral horse population made heavy utilization of several natural springs and man-made water sources located within their preferred grazing area (Figure 5.6). Individual and group sightings of feral horses were made primarily within the higher elevation areas of the NTS as illustrated in Figure 5.7. However, a few horses also were seen grazing on the grassland in Area 2.

WILDLIFE SURVEY NTS

LOCATION: ______________________ TIME: ______________________

DATE: ______________________ WIND SPEED: ______________________

TECH: ______________________ AIR TEMPERATURE: ______________________

WATER SAMPLES: ______________________ BENCHMARK PHOTOS: ______________________

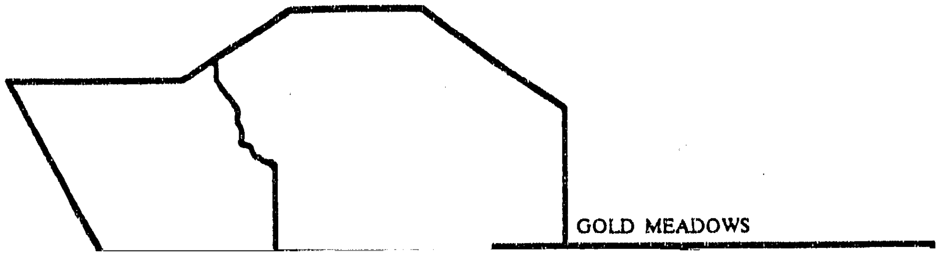
SPECIES CODE	GEN SPE	COMMON NAME	NUMBER OBSERVED TOTAL	M	F	J	A	TRACKS	SCATS	BRIEF NOTES

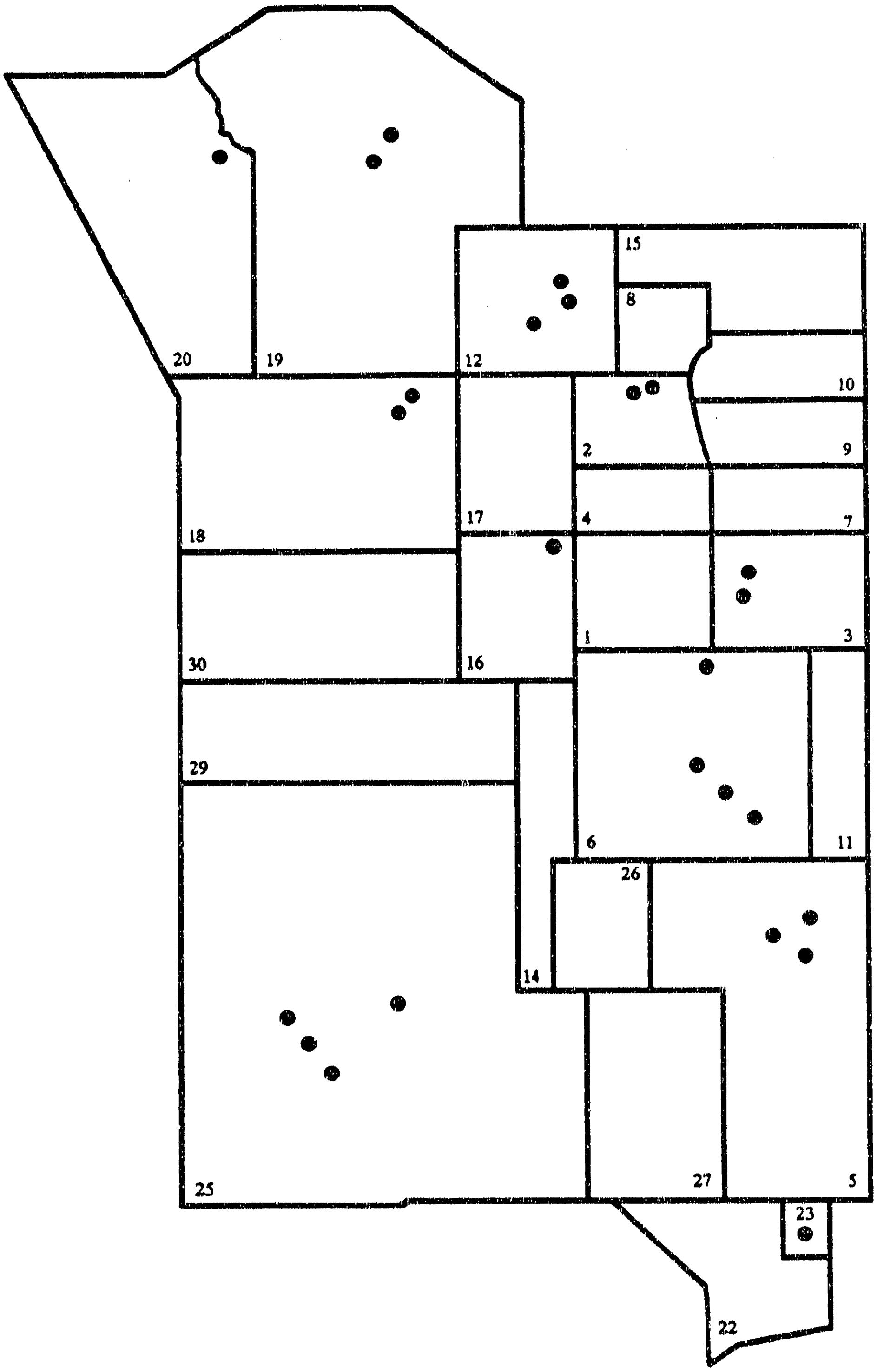
DEER UTILIZATION: LOW MODERATE HIGH

HORSE UTILIZATION: LOW MODERATE HIGH

NOTES:

Figure 5.1. Field Data Sheet


GOLD MEADOWS


15
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27
5
23
22

Table 5.1 Approximate elevation and location of natural springs on the Nevada Test Site monitored for wildlife utilization.

Spring	Elevation (ft).	Area	Nevada Grid Coordinates	
Cane	4060	5	N 746,300	E 667,400
Tippipah	5200	16	N 835,000	E 635,100
Topopah	5820	29	N 797,000	E 616,300
Reitman	4600	7	N 853,900	E 702,300
White Rock	5050	12	N 892,800	E 655,700
Captain Jack	5880	12	N 880,700	E 645,050
Oak	5850	15	N 909,000	E 672,800
Tub	5230	15	N 907,300	E 681,700
Gold Meadows	6720	12	N 902,900	E 634,100
Yucca Airstrip	3900	6	N 803,900	E 681,000

Table 5.2 Approximate elevation and location of well reservoirs on the Nevada Test Site monitored for wildlife utilization.

Reservoir	Elevation (ft)	Area	Nevada Grid Coordinates	
Mercury Sewage	3620	23	N 694,400	E 691,840
Well J11	3440	25	N 740,880	E 611,700
Well J12	3130	25	N 733,440	E 580,800
Well J13	3280	25	N 750,800	E 579,000
NUW AX	3060	25	N 725,000	E 581,250
Well 5B	3095	5	N 747,440	E 704,560
Well UE5C	3210	5	N 760,080	E 701,000
Stream	3130	5	N 755,000	E 704,600
Well C1	3920	6	N 790,400	E 692,000
CP Sewage	4030	6	N 794,800	E 680,260
Well 3	3970	6	N 818,000	E 677,680
Well A	4005	3	N 833,360	E 684,320
Mud Plant	4025	3	N 836,880	E 686,000
Well 16D	4680	16	N 844,720	E 646,800
Well 2	4480	2	N 880,000	E 669,040
Mud Plant	4500	2	N 878,800	E 666,640
Sewage	5100	12	N 892,500	E 651,300
N Tunnel	5750	12	N 891,000	E 641,000
Camp 17	5760	18	N 878,750	E 618,750
Well 8	5700	18	N 878,875	E 609,200
Well U19C-Lower	6680	19	N 916,250	E 600,000
Well U19C-Upper	6900	19	N 918,750	E 602,500
Well 20 A	6500	20	N 920,100	E 570,000

Table 5.3 Total numbers of wildlife observed at natural springs at the Nevada Test Site during 1988. P indicates utilization by a species inferred from animal sign.
*Approximate estimate only

[illegible]	[illegible]	...ing	...ng	...ng	...pring	...Spring	[illegible]	[illegible]	...v Spring	...p Pond	[illegible]	[illegible]
[illegible]												

Table 5.4 Total numbers of wildlife observed at well reservoirs on the Nevada Test Site during 1988. P indicates utilization by a species inferred from animal sign.

	Area 23 Sewage	Area 25 Well J11	Area 25 Well J12	Area 25 Well J13	Area 25 Nuwax	Area 5 Well 5B	Area 5 Well Ue5c	Area 5 Stream - Cambric	Area 6 Well C1	Area 6 CP Sewage	Area 6 Well 3	Area 3 Well A	Area 3 Mud Plant	Area 16 Well 16D	Area 2 Well 2	Area 2 Mud Plant	Area 12 Sewage	Area 12 N Tunnel	Area 18 Camp 17	Area 18 Well 8	Area 19 Well U19C-Lower	Area 19 Well U19C-Upper	Area 20 Well 20A	Totals
Number of Visits	6	3	3	3	3	9	8	5	4	3	6	2	4	6	3	3	1	1	7	3	5	2	3	93
Mule Deer				P		P	P	P						P			P	P	P	P	P	1	P	1
Feral Horse														P				P	65		P		P	65
Mountain Lion																	1							1
Bobcat		P				P								P										
Cattle			P	P	P														P	P				
Coyote	P	P	P	P	P	P	P	P	P	P	1		P	P	P	1	P							2
Kit Fox							P	P			P													
Cottontail Rabbit			3			1		1	2							1								8
Jack Rabbit	P	P	4	P	P	P	P	P			P		P											4
Chukar										6				10							6			22
Gambels Quail	15		12	90				1	90								50		6					318
Mourning Dove	15			1	6	1		1				1	7		3				1	1	1			38
Golden Eagle							1							1										2
Northern Harrier					2			5																7
Buzzard Hawk	7	1	1			3	2	2			1													17
Great Blue Heron	2		1		1	1	2		1		2								1					11
White Faced Ibis	1																							1
Belted Kingfisher											1								1					2
Common Raven	64		1			1	1	1		29			3	4	2	1								110
Killdeer	26						1				2						3					1		32
Unidentified Ducks	68				3	11	50			2									2					136

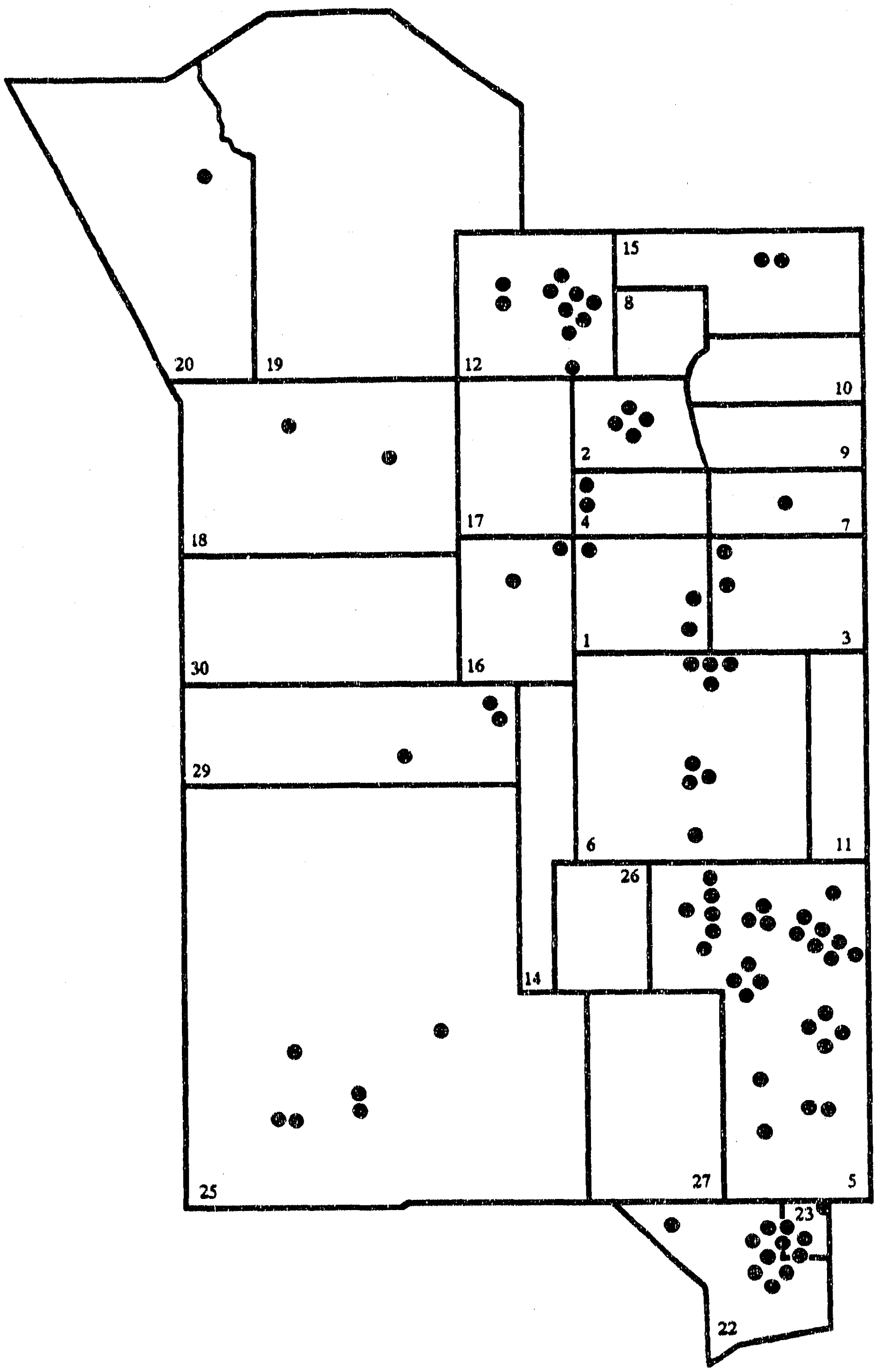

Figure 5.4 Sightings of individual raptors during 1988 (n = 87).

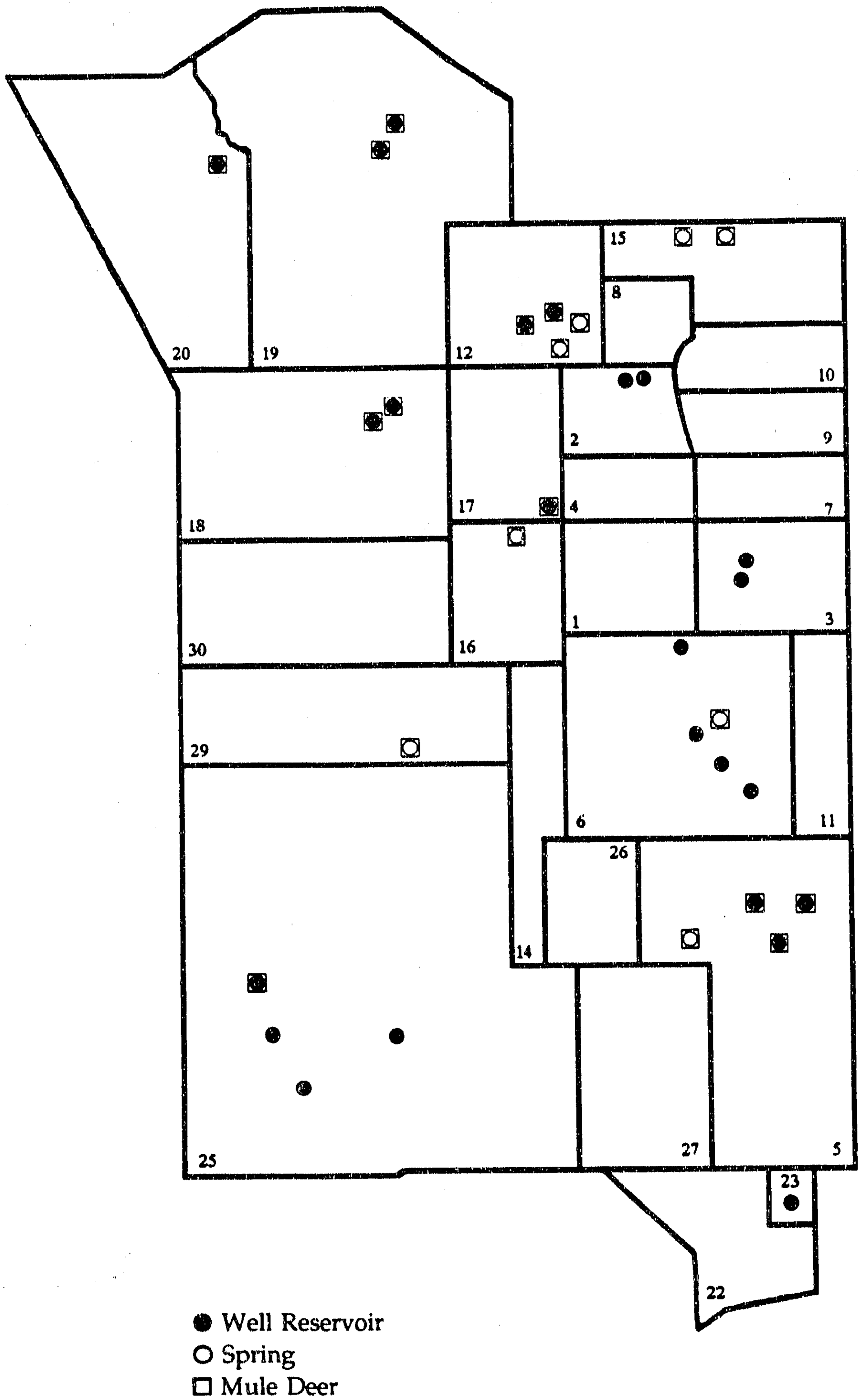

Figure 5.5 Mule deer utilization of water sources at the Nevada Test Site.

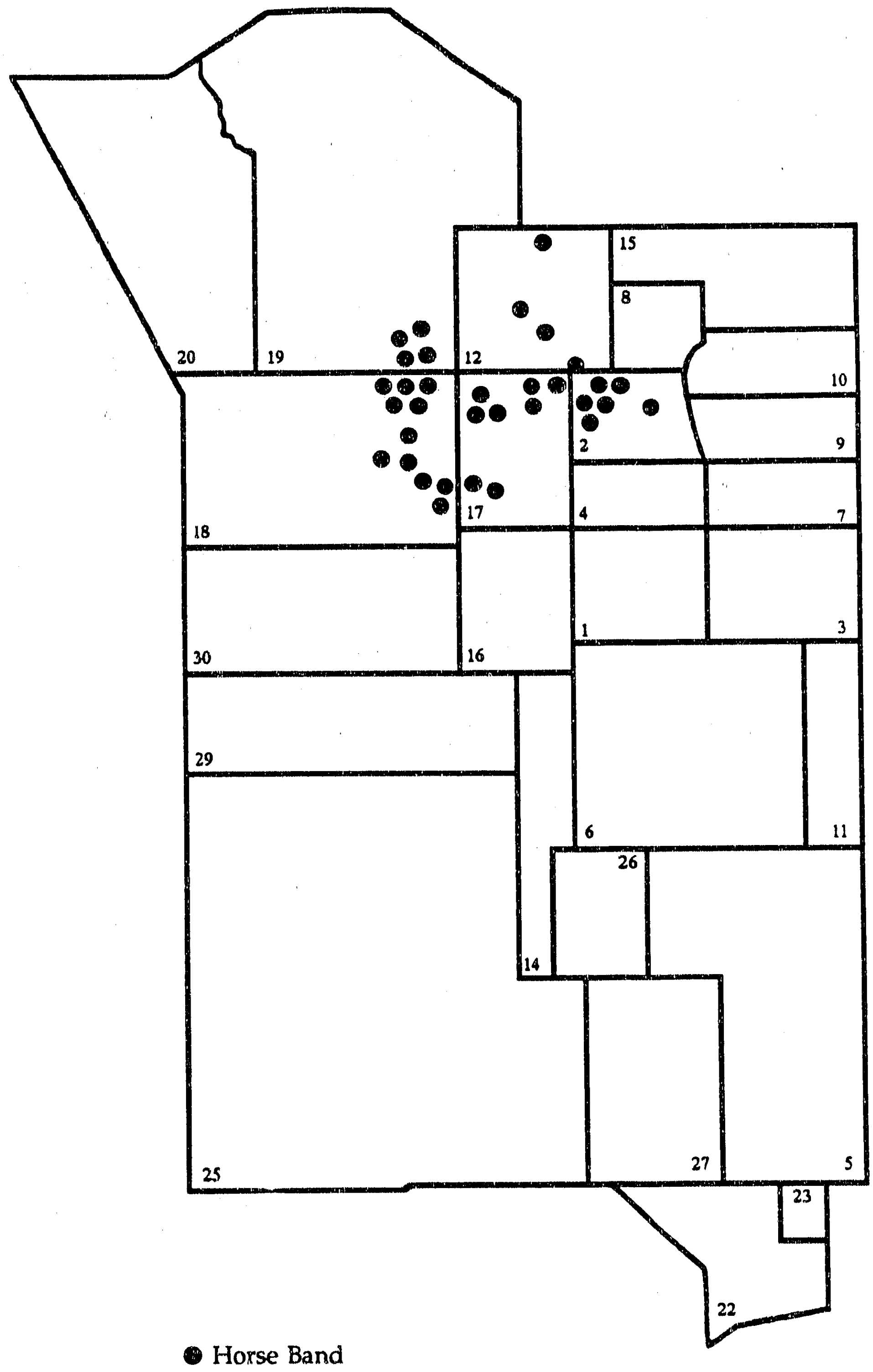

Figure 5.7 Feral horse sightings at the Nevada Test Site (n = 33).

tap water supplied to Mercury. The present treatment system for softening water for Mercury results in sodium levels in drinking water inappropriate for personnel on sodium-restricted diet.

The present population of feral horses is estimated to be approximately fifty to sixty animals for the total NTS property, and they are restricted to a relatively small area as indicated from sighting data given in Figure 5.7. The present population appears to have sufficient forage, shelter and water to supply their needs. However, if their population increases, we may expect to see a broader foraging range. One group of nine feral horses was observed foraging in grassland on sites where earlier aboveground nuclear events were conducted in Area 2. Those grassland sites and others in northern Yucca Flat that have developed on disturbed land through natural succession of vegetation can be expected to be utilized by feral horses in the future should the herd size increase.

The most serious threat from feral horses in the future is the possibility that herds presently confined to the TTR property might move south onto the NTS property. We have considered at length why they have not already done so, and concluded that it is most likely because no water sources are located within the forty-mile-wide stretch of land across the northern boundary of the NTS. Southern movement of TTR herds is further discouraged by the lack of good forage within that forty mile expanse of impoverished land. Nevertheless, the NTS management should take great care in permitting water sources to be developed across the northern and northwest boundary of the NTS and beyond. Otherwise, the gateway may be opened for intrusion of the TTR feral horses onto the NTS. Should it become necessary to extend water sources further north, adequate steps must be taken to make those sources unavailable to feral horses.

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Appendix 5
NTS NATURAL SPRINGS SAMPLES 1988
(Arranged by site and date, mg/liter)

SAMPLE	Na	K	Ca	Mg	P	Fe
Budweiser 3-17	45.5	113	23.7	6.73	14.1	.110
Cane Sp 8-9	37.3	9.31	31.1	9.24	1.62	.011
Cane Sp 10-31	39.3	11.6	33.3	9.40	1.05	.003
Capt Jack 3-10	32.1	2.36	2.82	.882	.242	2.90
Capt Jack 8-1	38.8	4.83	2.20	.771	.540	2.59
Rock Val SP 1-25	2.18	0	17.0	.554	.749	.011
Gold Med 6-21	6.10	12.3	18.8	1.72	.723	.023
Gold Med 10-28	7.18	26.2	24.5	25.80	.807	.011
Mercury Tap	102	7.20	4.75	1.21	1.46	.007
Oak Sp 11-17	74.2	41.6	111	17.7	3.80	.113
Reitman 8-18	201	18.7	17.5	6.98	2.57	18.9
Reitman 11-16	153	20.4	11.8	1.27	1.48	.529
Tippipah 3-4	37.6	3.12	4.22	.747	.258	1.69
Tippipah 11-01	42.3	7.05	11.3	1.10	.923	.456
Topopah 2-8	13.2	5.16	6.29	1.42	.211	.471
Topopah 7-27	12.5	11.1	7.98	1.84	1.39	.346
Topopah 11-07	12.2	13.9	5.56	1.26	.426	.247
Tub Sp 4-2	30.5	3.44	15.7	2.70	.875	.006
Tub Sp 8-19	29.8	4.66	13.1	2.42	1.01	.006
Tub, Cave 11-10	29.9	13.0	15.0	2.53	.527	.019
Tub, Out 11-10	30.9	13.7	15.7	2.60	.664	.232
White Rk 1-29	37.7	6.29	4.70	1.33	1.00	4.85
White Rk 3-4	38.9	6.75	4.87	1.10	.725	4.11
White Rk 8-18	43.9	5.50	4.81	.852	.585	2.94
White Rk 11-10	43.1	18.4	9.22	2.76	1.34	9.86

Appendix 5 (Continued)
NTS NATURAL SPRINGS SAMPLES 1988
(Arranged by site and date, mg/liter)

SAMPLE	Cr	Cu	Mn	Al	Cd	Pb
Budweiser 3-17	0	.145	.002	.236	0	0
Cane Sp 8-9	.006	0	.001	.379	.005	.025
Cane Sp 10-31	0	0	0	.161	.019	.006
Capt Jack 3-10	.002	.011	.023	7.37	0	0
Capt Jack 8-1	.012	.004	.024	7.45	.052	.048
Rock Val Sp 1-25	.001	.003	.000	.118	.010	.015
Gold Med 6-21	.007	.009	.002	.285	.022	.042
Gold Med 10-28	0	.001	.000	.182	.025	.027
Mercury Tap	.004	.036	0	.090	.217	0
Oak Sp 11-17	0	0	3.21	.368	.057	.113
Reitman 8-18	.009	.010	.186	35.9	.019	.065
Reitman 11-16	.002	.004	.090	.412	.060	.053
Tippipah 3-4	.002	.003	.022	4.00	0	.007
Tippipah 11-01	.003	.000	.006	1.04	.012	.017
Topopah 2-8	.004	0	.005	1.53	0	0
Topopah 7-27	.009	.011	.007	1.46	.078	.015
Topopah 11-07	0	.003	.002	.732	.021	0
Tub Sp 4-2	.008	.005	.001	.304	.021	0
Tub Sp 8-19	.006	.001	.000	.275	.013	.009
Tub, Cave 11-10	.002	0	0	.121	.025	0
Tub, Out 11-10	.000	.000	.001	.133	.052	0
White Rk 1-29	.005	.002	.073	10.8	0	0
White Rk 3-4	0	0	.057	9.47	0	0
White Rk 8-18	.006	.004	.033	7.20	.009	.019
White Rk 11-10	.005	.007	.128	20.7	.019	.015

Appendix 5 (Continued)
NTS NATURAL SPRINGS SAMPLES 1988

(Averaged by site and date, mg/liter)

SAMPLE	Ni	Be	V	Ti	Zn	Ag
Budweiser 3-17	.024	0	.012	.005	.238	0
Cane Sp 8-9	.012	.001	.021	0	.031	.107
Cane Sp 10-31	.009	.000	.015	.000	.031	.117
Capt Jack 3-10	0	.004	.012	.167	.024	.004
Capt Jack 8-1	.022	.001	.018	.158	.037	.006
Rock Val Sp 1-25	0	.001	.004	.001	.000	.031
Gold Med 6-21	.021	.003	.015	.001	.008	.154
Gold Med 10-28	0	.002	.006	0	.007	.246
Mercury Tap	.001	.001	.021	0	.030	.025
Oak Sp 11-17	.026	.000	.005	0	.054	.077
Reitman 8-18	.008	.003	.036	1.02	.106	.025
Reitman 11-16	0	0	.015	.030	.040	.012
Tippipah 3-4	0	.000	.007	.082	.017	.006
Tippipah 11-01	0	0	.007	.021	.022	.025
Topopah 2-8	.003	0	.007	.021	.007	.007
Topopah 7-27	.017	.003	.015	.016	.010	.014
Topopah 11-07	.008	0	.005	.011	.006	.008
Tub Sp 4-2	0	.001	.014	.000	.022	.011
Tub Sp 8-19	.011	.000	.009	.000	.016	.009
Tub, Cave 11-10	0	0	.005	.001	.017	.010
Tub, Out 11-10	0	0	.003	.001	.018	.012

Appendix 5 (Continued)
NTS NATURAL SPRINGS SAMPLES 1988
(Arranged by site and oate, mg/liter)

SAMPLE	Mo	Ba	Li	Sr	As	Se	Sn
Budweiser 3-17	.082	.307	.051	.141	.058	.019	.090
Cane Sp 8-9	.089	0	.227	.003	0	.219	.009
Cane Sp 10-31	.058	0	.106	.009	0	.030	.023
Capt Jack 3-10	.048	0	.185	.033	0	.049	.011
Capt Jack 8-1	.031	.096	.246	.028	.004	.218	.000
Rock Val Sp 1-25	.033	0	.070	.002	0	.056	.002
Gold Med 6-21	.100	.048	.186	.006	.001	.214	.007
Gold Med 10-28	.097	.029	.097	.007	0	.037	.007
Mercury Tap	.044	.026	0	.010	0	.151	.001
Oak Sp 11-17	.080	0	.108	15.9	0	.068	.008
Reitman 8-18	.093	0	.175	.172	.003	.012	.025
Reitman 11-16	.113	0	.068	.004	0	.047	.003
Tippipah 3-4	0	0	.130	.021	.000	.053	.001
Tippipah 11-01	.097	.010	.052	.005	.001	.037	.001
Topopah 2-8	.037	0	.216	.007	0	.042	0
Topopah 7-27	.035	.023	.212	.012	.002	.233	0
Topopah 11-07	.055	.002	.026	.015	.002	.020	.002
Tub Sp 4-2	.090	0	.163	.003	.001	.194	.005
Tub Sp 8-19	.103	.023	0	.001	.002	.049	.004
Tub, Cave 11-10	.036	.032	.049	0	0	.038	.002
Tub, Out 11-10	.085	0	.044	0	.001	.057	.002
White Rk 1-29	0	.048	.211	.041	0	.047	.008
White Rk 3-4	.032	0	.144	.039	0	.050	.008
White Rk 8-18	.039	.008	.072	.027	.004	.038	.007
White Rk 11-10	.122	.045	.131	.081	.001	.021	.011

record the spatial distributions of the flora and fauna and their changes with time on the NTS. The purpose of the perennial plant measurements is to determine population densities and plant sizes at particular locations, and to monitor changes in those variables by repeated measurements at intervals of one to five years. Because the perennial populations change slowly, monitoring changes is considered a long-term undertaking, requiring the maintenance of permanently marked sample populations and extended maintenance of records on individual plants for long periods. Nineteen-eighty-eight was the second year of sampling of perennial plants for the BECAMP program, and thus the first year for comparison of data between years. The resulting change in analytical procedures was still in experimental stages, but allowed an enhanced assessment of the changes occurring in the desert shrub communities sampled.

Table 6.1 Dominant species of perennial plants found on the Nevada Test Site.

Species	Common Name
Ambrosia dumosa	bursage
Artemisia tridentata	big sagebrush
Atriplex canescens	fourwing saltbush
Atriplex confertifolia	shadscale
Coleogyne ramosissima	blackbrush
Ephedra nevadensis	Mormon tea
Grayia spinosa	spiny hopsage
Juniperus osteosperma	Utah juniper
Larrea tridentata	creosotebush
Lycium andersonii	wolfberry
Pinus monophylla	singleleaf pinyon pine
Yucca brevifolia	Joshua tree
Yucca schidigera	Mohave yucca

Areas sampled in 1988 included five baseline sites, three ground zeros from 1950s bomb tests, the scraped edge (verge) of an abandoned road, and a newly scraped site.

METHODS

Methods of shrub measurement changed slightly from those used in 1987 (Hunter and Medica 1989). The techniques used involved selecting a site, laying out a 50-m steel surveyor's tape, and measuring all the perennial plants within one meter on both sides of the tape. In 1988 dead shrubs were measured as well as live ones, and the data sheets were modified slightly (Figure 6.1). (Dead grasses were recorded only when those measuring felt they were sparse enough to relocate individuals at a later time. Recorded locations were inadequate to distinguish among several close individuals of a given species.) In addition, the dead parts of live shrubs were estimated and given a code (0 = no dead parts, 1 = <25%, 2 = 25-75%, 3 = 75-99%, 4 = 100% dead), whereas in 1987 the absolute percent dead was

NO	DAY	YEAR	OBSERVERS	LOCATION		TRANSECT NO			TRANSCECT DIMENSIONS			REPRODUCTION STATE CODES 0 - Veg., 1 = flr. buds, 2 = flowering 3 - fruiting, 4 - dormant		SECTOR
GUAD	QUAD SECTOR	SPECIES NO.	SPECIES	HEIGHT (cm)	WIDTH	WIDTH	NO of INDIV	CRWS	WEIGHT	NO WEIGHED	% DEAD	REPRO ST	% GRAZED	REMARKS

Figure 1.

5 10 15 20 25

Figure 6.1 Perennial Vegetation Data Sheet estimated (0-100%). The system of recording distances of shrub bases from the tape was standardized, after experimenting with several techniques in 1987. In 1988 a "sector" was recorded, in which the two-meter width of the transect was divided into eight 0.25-m sections, the first one being to the left as the person measuring faced the end (50 m) of the transect from any location along the transect (see diagram in Figure 6.1). Cover was calculated from width measurements on the shrubs, as in 1987. Note that the cover calculations were not corrected for overlapping canopies.

The locations of study sites are shown on the map (Figure 6.2), and their coordinates are given in Appendix 3A (page 83). Plant species names and their abbreviations are in Table 6.2, with nomenclature following Kartesz and Kartesz, 1980, with the exception of *Haplopappus nanus*, which follows Welsh et al. 1987.

Analyses of the data involved calculating a "live volume" for each plant measured, and using linear regression of size versus weight to estimate biomass of individual plants (Hunter and Medica 1989). In the absence of a volume/biomass regression line for *Pinus monophylla* for NTS populations (Hunter and Medica 1989), the biomass of that species was estimated from a published relationship for northern Nevada (Tausch and Tueller 1990). Only live portions of living plants were measured, but the whole extent of a dead individual was measured. Transects which were measured a second time in 1988 had the data from individual plants matched for the two years, and growth or shrinkage was calculated on the matched plants. Unmatched plants on the borders (sectors 1 and 8) of the 1988 transect which were large enough to have been easily seen in 1987 (>20 cm in one dimension, and not under another shrub) were deleted from the 1988 data, as they were considered to be outside the transect. A dead plant was considered to have a live volume, cover, and biomass of zero. Summary data were calculated both for populations and for individuals for those transects measured at two different times.

On several transects in Jackass Flats and Frenchmen Flat *Larrea tridentata* and *Mendora spinescens* were measured when they occurred within 2 m of the tape, instead of within 1 m. The goal was to increase the numbers being monitored for those lower-density species. All other species on those transects were measured within 1 m of the tape.

Other parameters (height, maximum and perpendicular widths, reproductive states, etc.) were measured as in 1987 (Hunter and Medica 1989). Statistics were performed with the "RS1" program, Release 4 (BBN Software Products Corporation, Cambridge, MA).

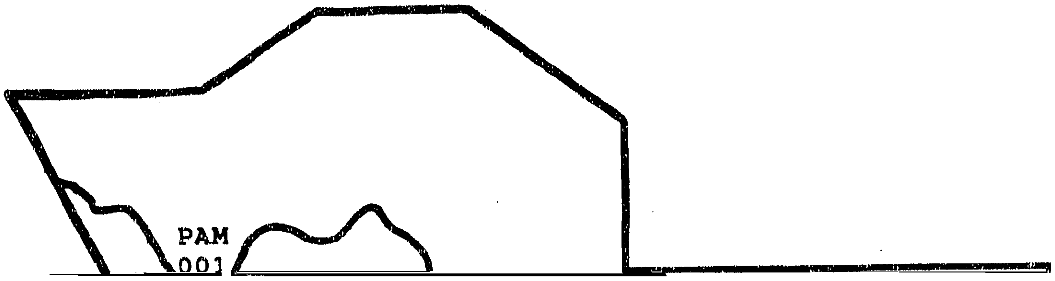
PAM
001

Table 6.2 Perennial plant species names, authorities, and the abbreviations used in this report.

Species and Authority	Abbreviation
Acamptopappus shockleyi Gray	ACA SHO

RESULTS

MEASUREMENTS AT PREVIOUSLY SAMPLED LOCATIONS

The baseline plots in Jackass Flats, Frenchman Flat, and Yucca Flat each had five transects measured in both 1987 and 1988, to give 15 transects measured both years. The task of matching plants between years was found to be both difficult and time consuming, and the quality of the 1987 data was found to be variable, depending on the person measuring the plants. For these reasons only a subset was analyzed as paired 1987-1988 data sets. This included five of the fifteen transects, and one censused in 1986 for another project.

The new technique of matching plants between censuses made it possible to analyze sources of error in the plant transect data to a greater degree than previously possible. Table 6.3 shows the results of looking at the plants on transect JAF001 which were not matchable at the two censuses. The most common cause of failure to match individual plants appeared to be a difference in criteria for including or excluding borderline plants between the two people doing the transect, and this was partially corrected by deleting selected 1988 plants as described in the Methods section. It appeared that in 1988 borderline plants were included which were excluded in 1987. In addition, the person measuring in 1988 appears to have searched more carefully in clumps to measure the small hidden plants within them. The "ambiguous" plants were probably the same individuals each year. Ambiguities resulted sometimes from a subjective determination of whether a plant had two crowns or was two individuals, and sometimes from when two or more similar plants were near enough that their locations could not be distinguished with the data collected. On the whole, within the 100 square meters measured in 1987, 24 more plants were found in 1988 than in 1987. That was an increase of 9%, which could be explained by the borderline changes and the better inclusion of small plants in clumps. (Inclusion of *Larrea tridentata* and *Menodora spinescens* in the extra 100 square meters sampled in 1988 also increased the total number sampled. Those plants were not included in Table 6.3.)

Adding 100 m^2 to the area measured for *Larrea tridentata* and *Menodora spinescens* did not

…ıt 954 m sampled

…verage Biomass g	Total Biomass kg
…91 ± 7	11.96
…03 ± 9	13.73
…)0 ± 14	6.39
…)4 ± 14	6.45
…29 ± 45	0.65
…37 ± 69	0.55
…47 ± 609	17.36
…29 ± 955	22.76
…54 ± 195	10.46
…50 ± 220	13.50
…2.0 ± 0.6	0.08
…1.1 ± 0.4	0.04
-	-
-	-
-	-
-	-
	48.95
	57.03

Table 6.5 Perennial plant population characteristics on a 100 m^2 transect (JAF001 V4), a baseline plot at an elevation of 954 m, sampled July 23, 1987 (first line), and July 11, 1988 (second line). Totals exclude dead plants.

Species	N	Average Height cm	Average Maximum Width cm	Average Perpend Width cm	Average Cover m^2	Total Cover m^2	Average Volume $m^3 \times 10^{-3}$	Total Volume $m^3 \times 10^{-3}$	Average Biomass g	Total Biomass kg
ACA SHO	87	25 ± 1	37 ± 2	28 ± 1	.09 ± .01	7.94	26 ± 2	2232	80 ± 7	6.92
	97	25 ± 1	34 ± 1	28 ± 1	.08 ± .01	8.20	24 ± 2	2337	75 ± 7	7.24
AMB DUM	54	31 ± 2	48 ± 4	39 ± 3	.19 ± .03	10.00	72 ± 12	3876	179 ± 31	9.69
	59	31 ± 2	48 ± 4	40 ± 3	.21 ± .04	12.55	91 ± 21	5378	228 ± 53	13.45
CER LAN	12	34 ± 3	29 ± 3	27 ± 4	.07 ± .01	0.82	25 ± 6	298	79 ± 18	0.95
	13	30 ± 3	28 ± 3	25 ± 3	.06 ± .01	0.82	21 ± 5	275	68 ± 16	0.88
LAR TRI	8	91 ± 6	135 ± 8	101 ± 11	1.10 ± .17	8.83	1054 ± 214	8432	1370 ± 278	10.96
	3	91 ± 10	174 ± 35	177 ± 70	2.78 ± 1.47	8.83	2586 ± 1308	7759	3362 ± 1701	10.09
MEN SPI	3	19 ± 8	61 ± 37	54 ± 34	.45 ± .41	1.36	148 ± 142	445	1232 ± 1181	3.70
	5	9 ± 5	56 ± 24	51 ± 24	.41 ± .28	2.04	132 ± 103	662	1098 ± 857	5.49
ORY HYM	42	26 ± 1	7 ± 1	6 ± 1	.00 ± .00	0.20	1.4 ± 0.4	60	1.6 ± 0.4	0.07
	42	13 ± 1	6 ± 1	4 ± 1	.00 ± .00	0.11	0.4 ± 0.2	17	0.4 ± 0.2	0.02
DEAD GS	-	-	-	-	-	-	-	-	-	-
	5	22 ± 3	7 ± 2	6 ± 2	.00 ± .00	0.02	1 ± 0	4	-	-
DEAD SH	-	-	-	-	-	-	-	-	-	-
	27	15 ± 1	27 ± 3	24 ± 3	.06 ± .01	1.78	13 ± 3	353	-	-
Totals	206					29.16		15343		32.29
	219					32.03		16428		37.17

numbers and decreased average sizes. We concluded that at this site in Jackass Flats there was an approximate stasis in the plant population between 1987 and 1988.

The baseline plot in Frenchman Flat (FRF001) is situated on a sandy, shallow-sloped bajada at 965 meters. It is near Beatley's plot 23 (Beatley 1979), and the vegetation was dominated by *Larrea tridentata*. Plant population characteristics were very similar in 1988 and 1987, except for the loss of some *Hymenoclea salsola* and *Oryzopsis hymenoides* plants (Table 6.6). In this case the losses were probably due to death of plants rather than failure to measure them. *Hymenoclea salsola* is a shrub which invades and grows well on disturbed areas and in washes

1980s, following presumed germination events between 1978 and May 1983 (see Hunter et al. 1987). The largest *H. salsola* on plot FRF001 was 0.57 m^3 in size, while the majority were generally small and young, the average being 0.034 in 1987 and 0.059 m^3 in 1988. Beatley (1979) reported average heights of 38 cm in 1963 and 45 cm in 1975 for the *H. salsola* on the set of plots which included plot 23, while our average heights were 23 and 27 cm. The death m, sampled

verage omass g	Total Biomass kg
7 ± 11	0.85
6 ± 11	0.82
5 ± 32	3.76
5 ± 35	3.74
7 ± 36	0.97
3 ± 35	1.08
200	0.20
284	0.28
6 ± 23	0.99
3 ± 24	1.17
3 ± 41	7.21
9 ± 70	9.45
± 986	18.51
± 953	15.07
± 325	2.33
± 338	3.15

Table 6.6 Continued.

Species	N	Average Height cm	Average Maximum Width cm	Average Perpend Width cm	Average Cover m^2	Total Cover m^2	Average Volume $m^3 \times 10^{-3}$	Total Volume $m^3 \times 10^{-3}$	Average Biomass g	Total Biomass kg
ORY HYM	12	15 ± 2	4 ± 1	4 ± 1	.00 ± .00	0.03	0.50±.2	6	0.5 ± 0.2	0.01
	7	15 ± 2	-	-	-	-	0.50±.2	-	-	-
PSO FRE	1	26	38	26	0.08	0.08	20	20	50	0.05
	1	26	37	27	0.08	0.08	20	20	51	0.05
SPH AMB	1	14	19	12	0.02	0.02	2.5	3	1	0.00
	0	-	-	-	-	-	-	-	-	-
TET AXI	1	36	31	12	0.03	0.03	11	11	28	0.03
	1	54	24	16	0.03	0.03	16	16	44	0.04
AMBxHYM	1	7	5	5	0.00	0.00	0.1	0	0.3	0.00
	-	-	-	-	-	-	-	-	-	-
DEAD SH	-	-	-	-	-	-	-	-	-	-
	16	20 ± 4	38 ± 6	33 ± 6	.13 ± .03	2.17	44 ± 17	709	-	-
Totals	178					25.42		20246		34.91
	154					24.71		18827		35.27

tion of 1237 m on a Yucca Flat
Totals exclude dead plants.

tal ume x 10^-3	Average Biomass g	Total Biomass kg
92	42 ± 8	1.84
44	31 ± 5	1.07
-	-	-
1	0.5	0.00
32	61 ± 8	3.00
27	46 ± 6	2.16
85	151 ± 48	5.42
35	105 ± 33	3.99
98	39 ± 5	2.55
61	25 ± 4	1.48
07	319 ± 97	7.01
20	414 ± 120	7.45
1	0.1 ± 0.0	0.00
2	0.1 ± 0.0	0.00
48	170 ± 26	6.78
95	210 ± 47	7.35
20	122 ± 26	1.34
96	70 ± 18	0.63
73	448 ± 105	8.95
11	515 ± 123	7.72

Total biomass kg
0.01
0.01
0.00
0.00
0.05
0.01
0.01
0.00
0.01
0.01
0.00
0.00
4.68
4.27
-
-
-
-
41.65
36.15

Table 6.8 Perennial plant population characteristics on a 100-m^2 transect (YUF001 V3), at 1237 m elevation, sampled on August 7, 1987 (top line) and July 22, 1988 (second line). Totals exclude dead plants.

Species	N	Average Height cm	Average Maximum Width cm	Average Perpend Width cm	Average Cover m^2	Total Cover m^2	Average Volume $m^3 \times 10^{-3}$	Total Volume $m^3 \times 10^{-3}$	Average Biomass g	Total Biomass kg
ACA SHO	44	22 ± 1	30 ± 2	26 ± 2	.07 ± .01	3.10	18 ± 3	791	56 ± 9	2.45
	45	20 ± 1	23 ± 2	21 ± 2	.05 ± .01	2.07	11 ± 2	486	34 ± 7	1.51
ART SPI	26	22 ± 1	29 ± 2	27 ± 2	.07 ± .01	1.75	18 ± 4	456	72 ± 15	1.87
	27	21 ± 1	27 ± 2	24 ± 2	.06 ± .01	1.57	14 ± 3	368	56 ± 13	1.51
ATR CAN	40	38 ± 3	30 ± 4	26 ± 3	.09 ± .02	3.52	49 ± 13	1942	126 ± 34	5.05
	38	38 ± 3	27 ± 3	26 ± 3	.08 ± .02	3.06	45 ± 14	1722	118 ± 37	4.48
CER LAN	97	26 ± 1	19 ± 1	16 ± 1	.03 ± .00	2.85	9 ± 1	864	28 ± 4	2.76
	90	24 ± 1	18 ± 1	15 ± 1	.02 ± .00	2.21	7 ± 1	618	22 ± 2	1.98
EPH NEV	13	56 ± 6	77 ± 12	63 ± 9	.47 ± .12	6.13	325 ± 100	4227	455 ± 140	5.92
	16	47 ± 5	64 ± 12	56 ± 11	.42 ± .12	6.79	272 ± 94	4356	381 ± 131	6.10
ERI PUL	10	5 ± 1	4 ± 1	4 ± 1	.00 ± .00	0.01	0 ± 0	1	0 ± 0	0.00
	3	4 ± 1	6 ± 2	6 ± 1	.00 ± .00	0.01	0 ± 0	0	0 ± 0	0.00
GRA SPI	41	40 ± 3	45 ± 5	40 ± 4	.20 ± .04	7.76	103 ± 24	4033	238 ± 56	9.27
	39	41 ± 2	44 ± 5	37 ± 4	.18 ± .04	7.20	85 ± 19	3313	195 ± 43	7.62
HYM SAL	31	32 ± 3	30 ± 4	27 ± 5	.11 ± .04	3.45	62 ± 26	1933	200 ± 85	6.19
	30	27 ± 3	25 ± 5	22 ± 4	.09 ± .04	2.72	53 ± 26	1576	168 ± 84	5.04
LYC AND	2	44 ± 6	70 ± 30	60 ± 2	.34 ± .15	0.67	154 ± 84	309	340 ± 185	0.68
	6	43 ± 5	62 ± 10	68 ± 5	.31 ± .04	1.86	137 ± 31	819	300 ± 68	1.80

Table 6.8 Continued.

Species	N	Average Height cm	Average Maximum Width cm	Average Perpend Width cm	Average Cover m^2	Total Cover m^2	Average Volume $m^3 \times 10^{-3}$	Total Volume $m^3 \times 10^{-3}$	Average Biomass g	Total Biomass kg
MIR PUD	4	16 ± 4	8 ± 3	5 ± 2	.00 ± .00	0.01	1 ± 0	3	0 ± 0	0.00
	3	11 ± 2	5 ± 3	5 ± 3	.00 ± .00	0.01	0 ± 0	1	0 ± 0	0.00
ORY HYM	11	36 ± 2	9 ± 2	8 ± 1	.01 ± .00	0.06	2 ± 0	22	2 ± 0	0.02
	8	18 ± 2	9 ± 1	9 ± 1	.01 ± .01	0.05	1.2 ± 0.2	9	1 ± 0	0.01
SIT JUB	9	22 ± 4	4 ± 1	4 ± 1	.00 ± .00	0.01	0 ± 0	3	0 ± 0	0.00
	2	20 ± 4	3 ± 0	3 ± 0	.00 ± .00	0.00	0 ± 0	0	0 ± 0	0.00
SPH AMB	3	11 ± 3	7 ± 2	6 ± 1	.00 ± .00	0.01	1 ± 0	2	0 ± 0	0.00
	8	12 ± 2	9 ± 1	7 ± 1	.01 ± .00	0.04	1 ± 0	6	0 ± 0	0.00
STI SPE	15	34 ± 4	8 ± 1	7 ± 1	.01 ± .00	0.09	3 ± 1	42	3 ± 1	0.05
	19	21 ± 2	5 ± 1	6 ± 1	.00 ± .00	0.07	1 ± 0	20	1 ± 0	0.02
TET AXI	1	68	105	107	0.88	0.88	600	600	1620	1.62
	1	62	114	106	0.95	0.95	588	588	1589	1.59
DEAD GS	-	-	-	-	-	-	-	-	-	-
	9	16 ± 2	7 ± 1	9 ± 2	.01 ± .00	0.05	0.9 ± 0.3	8	-	-
DEAD SH	-	-	-	-	-	-	-	-	-	-
	38	21 ± 2	35 ± 5	33 ± 4	.15 ± .05	5.51	64 ± 29	2428	-	-
Totals	366					30.32		15228		35.89
	335					28.63		13882		31.66

Table 6.9 Perennial plant population characteristics on a 200-m^2 transect, YUF012, at an elevation of 1239 m, sampled May 14, 1986 (top line) and August 8, 1988 (second line). Totals are not adjusted to 100 m^2 area, and exclude dead plants.

Species	N	Average Height cm	Average Maximum Width cm	Average Perpend Width cm	Average Cover m^2	Total Cover m^2	Average Volume $m^3 \times 10^{-3}$	Total Volume $m^3 \times 10^{-3}$	Average Biomass g	Total Biomass kg
ACA SHO	109	18 ± 1	21 ± 1	16 ± 1	.04 ± .01	4.14	10 ± 1	1075	31 ± 4	3.33
	72	19 ± 1	25 ± 2	24 ± 2	.06 ± .01	4.30	15 ± 2	1080	47 ± 6	3.35
ATR CAN	68	39 ± 2	38 ± 3	29 ± 3	.13 ± .02	8.84	73 ± 15	4994	191 ± 38	12.98
	65	35 ± 2	33 ± 3	29 ± 3	.11 ± .02	7.23	50 ± 9	3257	130 ± 24	8.45
ATR CON	1	28	42	36	0.12	0.12	33	33	156	0.16
	0	-	-	-	-	-	-	-	-	-
CER LAN	95	31 ± 1	27 ± 2	20 ± 1	.06 ± .01	5.38	23 ± 3	2144	72 ± 10	6.86
	72	29 ± 1	28 ± 2	24 ± 1	.06 ± .01	4.58	22 ± 3	1611	72 ± 10	5.16
CHR VIS	20	34 ± 3	50 ± 7	42 ± 6	.22 ± .05	4.49	96 ± 25	1911	239 ± 63	4.78
	18	37 ± 4	46 ± 7	43 ± 6	.21 ± .05	3.72	93 ± 27	1675	233 ± 68	4.19
EPH NEV	6	61 ± 12	104 ± 23	83 ± 18	.83 ± .22	4.99	620 ± 178	3721	868 ± 249	5.21
	10	51 ± 8	56 ± 14	63 ± 16	.39 ± .15	3.89	277 ± 116	2772	388 ± 162	3.88
GRA SPI	2	43 ± 8	19 ± 13	10 ± 6	.02 ± .02	0.04	11 ± 10	21	24 ± 23	0.05
	0	-	-	-	-	-	-	-	-	-
HYM SAL	3	14 ± 4	13 ± 2	9 ± 1	.01 ± .00	0.02	1 ± 0	4	4 ± 1	0.01
	2	18 ± 8	15 ± 5	14 ± 5	.02 ± .01	0.04	4 ± 4	8	13 ± 11	0.03
LYC AND	3	47 ± 7	41 ± 7	40 ± 9	.14 ± .05	0.41	60 ± 18	181	133 ± 40	0.40
	3	49 ± 11	44 ± 8	47 ± 10	.18 ± .07	0.53	77 ± 20	230	169 ± 44	0.51
MEN SPI	16	16 ± 3	41 ± 9	35 ± 8	.19 ± .06	3.05	53 ± 18	855	444 ± 150	7.10
	14	15 + 2	47 + 11	43 + 9	.26 + .08	3.62	62 + 20	863	512 + 170	7.17

…)$^{-3}$	Total Volume $m^3 \times 10^{-3}$	Average Biomass g	Total Biomass kg
.4	18	0. ± 0.2	0.01
.8	15	0. ± 0.3	0.01
.3	257	2. ± 0.3	0.28
.2	116	1. ± 0.2	0.13
.6	156	-	-
.8	149	-	-
.4	61	0. ± 0.1	0.07
.8	9	0. ± 0.1	0.01
.4	4	0. ± 0.2	0.43
.0	5	0. ± 0.4	0.00
5	8684	809 ± 94	23.45
6	8925	1004 ± 97	24.10
	-	-	-
.3	6	-	-
	-	-	-
	780	-	-
	24119		64.69
	20715		56.98

plants counted declined from 720 to 464 between 1986 and 1988, with the major declines again occurring in the herbaceous species (the bunchgrasses *Oryzopsis hymenoides, Sitanion jubatum, Stipa speciosa*, and *Sphaeralcea ambigua, Mirabilis pudica*, and *Polygala subspinosa)*. One bunchgrass species, *Sitanion jubatum*, declined precipitously from 161 to 39 plants.

Another way of looking at these plots was to consider only the matchable plants and estimate growth and dieback of those individuals. This is somewhat different from looking at population means. It was statistically more powerful to look at individual data, but the sample populations differed because some plants were not matchable. The several reasons for failure to match could possibly create some bias in results. First, dead plants were not matched with live predecessors because the species determination is often ambiguous on dead plants, and the live size of zero for dead plants gives a growth coefficient of negative infinity. Therefore, the matched population may have been selected for healthier, surviving individuals rather than average plants. Second, small plants were harder to see, and often hidden under larger shrubs, so they may have been less frequently matched, again selecting larger, presumably healthier plants for matching. Third, plants with several individuals in a small area could not be readily distinguished from one another with the collected data, and were therefore excluded from the matched populations. Finally, plants well separated from others were easier to match, selecting individuals in what may be more open, favorable microhabitats. In spite of those factors, however, the median 1987 volume of matched plants was the same as the median volume of the whole 1987 population of plants with a probability of > 90% on plot JAF001 (t-test as proposed by Iglewicz in Hoaglin et al. 1988), indicating biases due to matching difficulties were more potential than real. (The percentages of shrubs matched, by plot, are included in Table 6.10.)

With those factors in mind, the measurements for matched plants were used to calculate average growth rates. In many cases, growth coefficients (defined as [ln(V2/V1)]/time in years, where V = live volume) can be significant indicators of the vigor of a plant population. The logarithmic growth coefficients resulted from a model of plant growth which was considered more realistic than linear models, as in most plants absolute growth is proportional to initial size. The model used here is appropriate for those plants which have not attained their full potential size (Erickson 1976). This is appropriate in desert situations, where water, rather than genetics, generally limits size, and plants shrink and grow with changes in rainfall. A rough idea of the meaning of the growth coefficients can be obtained from the calculated times required for a plant to double in size (Table 6.11). Shrinkage rates (negative k) are at analogous halving times.

The results of analyses of the two Jackass Flats transects (Table 6.10) show that, overall, there was no change in size from 1987 to 1988. It appeared that between 1987 and 1988 one species (*Oryzopsis hymenoides*) decreased in size, while the other five were static (growth not significantly different from 0). These results are consistent with the population data (Tables

/time in years; mean ± sem) of species inhabiting the six resampled transects, uses. Plot YUF012 was sampled 1986 and 1988, and all others 1987 and 1988.

)1	FRF001 V1	YUF001 V2	YUF001 V3	YUF012
)	75	74	83	44
).10	-0.22 ± 0.16	-0.37 ± 0.30	-0.56 ± 0.18*	+0.33 ± 0.05*
).08*	+0.20 ± 0.10*			
		-0.05 ± 0.09	-0.25 ± 0.12	
		0.00 ± 0.11	-0.17 ± 0.19	-0.11 ± 0.06
).15	+0.11 ± 0.06	-0.40 ± 0.13	-0.20 ± 0.14	+0.03 ± 0.04
				+0.11 ± 0.06
		+0.06 ± 0.15	+0.14 ± 0.13	+0.05 ± 0.07
		-0.93 ± 0.35		
	+0.14 ± 0.16	-0.10 ± 0.16	-0.19 ± 0.26	
	+0.26 ± 0.09*	-0.70 ± 0.25	-0.91 ± 0.17*	+0.74
).00	+0.22 ± 0.19			
	+0.42 ± 0.33	-0.09 ± 0.57	+0.48 ± 0.31	+0.12 ± 0.02
).34		+0.09		+0.20 ± 0.08
			-0.57	-0.12 ± 0.70
).24*		-0.84 ± 0.66	-0.86 ± 0.42	-
		-0.74 ± 0.40		
		+0.43 ± 0.43	+2.10 ± 0.40	+0.13 ± 0.13
		-2.24 ± 1.13	-0.52 ± 0.33	
	+0.43	-0.04 ± 0.07	-0.02	
				+0.04 ± 0.03
0.08	+0.16 ± 0.03	-0.16 ± 0.08	-0.31 ± 0.08	+0.10 ± 0.01

0.05, using Bonferoni simultaneous confidence intervals for 1987-88, data
cies with n > 20.

Table 6.11 Times to double in size associated with different growth coefficients (k = [ln(V2/V1)]/time in years).

k	time,years
0.1	6.93 years
0.2	3.46 years
0.4	1.73 years
0.7	361 days
1.0	253 days
2.0	126 days
3.0	84 days
4.0	63 days
5.0	51 days
7.0	36 days
9.0	28 days

6.4 and 6.5), but the ability to use statistical tests on the numerous individuals allowed a better interpretation of changes in size. It should be noted that to show that plants neither grew nor shrank over a one-year period may be a significant observation, rather than an indication of measurement error.

For comparison, a population of *Ambrosia dumosa* seedlings growing on a disturbed area in Jackass Flats grew at rates up to k = 8.6 for a thirteen month period (1983-4; Hunter 1989).

Values of growth coefficients from the other plots with matched plants were similar (Table 6.10). They showed a general stasis in plant sizes from 1987 to 1988, with only a few species either growing or shrinking significantly. The median growth coefficient for 1986 to 1988 (YUF012, Table 6.10) showed a positive but small growth (k = +0.06, n = 203), which was significantly different at $p < 0.01$ by t-test on the difference in medians (Iglewicz, see Hoaglin et al. 1983) from the 1987-88 growth coefficient on the nearest plot YUF001 (median k = -0.20, n = 513). These data suggest plants in Yucca Flat grew slightly from 1986 to 1987, then shrank in 1987-1988.

MEASUREMENTS AT NEW LOCATIONS

Results of censuses on new plots do not show the changes occurring, but provide a one-time picture of vegetative conditions of sites during summer of 1988. They are presented here in order of altitude.

A roadside in Frenchman Flat (5-03 Road: 977 meters) and an adjacent control area were

censused (Tables 6.12 and 6.13). The road has been abandoned and barricaded for approximately 20 years and the shoulders have not been maintained. The area measured was the two meters adjacent to the asphalt covering. Perennial shrubs growing on the verge were long-lived dominant species. They were generally small and young. There were no

dead plants. The control area had 9 dead plants and 61 live ones. The distribution of dead categories (see Methods) was significantly different at $p < 0.001$ (Chi-square), as 70% of the

roadside plants had no dead parts (category 0), compared to only 18% of those on the control. Seventy-six percent of control plants were 1-25% dead (category 1). Unusually healthy plant populations near the roadbed are a common phenomenon in the desert, probably resulting from several factors, including reduced competition (note the lower cover and total live volume values), runoff water received at the road edge, and storage of water under the asphalt.

An area in Mercury Valley denuded of perennial shrubs (MER002, 1076 meters) by gophers and other small animals (Hunter et al. 1980) had a very reduced perennial plant cover (Table 6.14). The only shrub inhabiting the area was *Stanleya pinnata* a species which is not grazed significantly, apparently because of bad flavor (Hunter 1987). It sometimes occurs on seleniferous soils (Munz 1974) and is therefore sometimes toxic to wildlife from selenium accumulation. A few other herbaceous perennials made up the sparse population. Dead shrubs were largely *S. pinnata*. The two *Sitanion jubatum* were unusual for Mercury Valley, but did not constitute a significant population. In contrast, the control area (MER003; ~525m to the NE, 3618 feet) had total cover of about 44% (Table 6.16) by a mixed shrub community dominated by *Larrea tridentata*. There were no *Stanleya pinnata* on the control transect. *S. pinnata* is normally restricted to areas where the dominant, drought-tolerant vegetation is absent, probably due to an inability to compete for water with the dominant shrub species.

n transect FRF002 (Roadside), 100 m^2 measured on the pavement of 977 m, sampled August 11, 1988.

Average Cover m^2	Total Cover m^2	Average Volume $m^3 \times 10^{-3}$	Total Volume $m^3 \times 10^{-3}$	Average Biomass g	Total Biomass kg
.12 ± .02	4.11	33 ± 7	1112	82 ± 17	2.78
1.7 ± 0.2	3.32	1141 ± 75	2282	1597 ± 105	3.19
.00	0.01	0.2	0	0.2	0.00
.55 ± .35	7.14	711 ± 544	9237	924 ± 707	12.01
.01 ± .01	0.03	0.9 ± 0.4	4	1.0 ± 0.4	0.00
.53 ± .34	1.07	161 ± 126	322	322 ± 252	0.64
	15.68		12956		18.63

elevation

	Total Biomass kg
	2.21
	2.56
7	1.16
12	29.53
	0.30
	0.07
	-
	35.78

ct in a rodent-denuded area (MER002) at an
ead shrubs.

Total Cover m^2	Average Volume $m^3 \times 10^{-3}$	Total Volume $m^3 \times 10^{-3}$	Average Biomass g	Total Biomass kg
0.02	0.3 ± 0.2	2	0.1 ± 0.1	0.00
0.00	0.2 ± 0.0	0	0.2 ± 0.	00.00
0.00	0.6	1	0.3	0.00
3.27	152 ± 42	2892	65 ± 18	1.24
1.78	150 ± 32	6744	-	-
3.29		2895		1.24

1
ss
18
43
08
61
75
23
13
20
-
.00
.01
-
.41

Total omass kg
0.00
0.49
-
-
0.49

n characteristics on a transect at T1 blast area (YUF009), at an elevation of about 1279
88. This transect covered 200 m^2. Totals exclude dead plants, and were not adjusted

rage mum dth m	Average Perpend Width cm	Average Cover m^2	Total Cover m^2	Average Volume m^3 x 10^{-3}	Total Volume m^3 x 10^{-3}	Average Biomass g	Total Biomass kg
112	100	0.88	0.88	545	545	1363	1.36
± 1	13 ± 1	.02 ± .00	1.12	4.6 ± 0.6	316	5.1 ± 0.7	0.35
± 3	13 ± 2	.02 ± .01	0.28	6.7 ± 1.8	94	7.4 ± 2.0	0.10
± 3	18 ± 4	.03 ± .01	0.13	5.3 ± 2.3	26	-	-
± 2	10 ± 2	.01 ± .00	0.07	0.7 ± 0.2	6	-	-
			2.28			955	1.81

Table 6.18 Perennial plant population characteristics on a 100-m^2 transect in undisturbed vegetation east of T1 ground zero. The plot (YUF010) is at an elevation of about 1267 m, and was sampled August 9, 1988. Totals exclude dead plants.

Species	N	Average Height cm	Average Maximum Width cm	Average Perpend Width cm	Average Cover m^2	Total Cover m^2	Average Volume $m^3 \times 10^{-3}$	Total Volume $m^3 \times 10^{-3}$	Average Biomass g	Total Biomass kg
ATR CAN	67	32 ± 1	21 ± 2	17 ± 1	.04 ± .01	2.48	14 ± 3	971	38 ± 8	2.52
CER LAN	20	31 ± 3	26 ± 4	22 ± 3	.06 ± .02	1.21	24 ± 8	484	77 ± 26	1.55
CHR VIS	58	32 ± 2	39 ± 3	34 ± 3	.14 ± .02	7.99	58 ± 14	3377	146 ± 35	8.44
EPH NEV	19	42 ± 5	55 ± 12	52 ± 11	.39 ± .12	7.49	247 ± 89	4687	345 ± 124	6.56
GRA SPI	17	44 ± 3	41 ± 7	35 ± 6	.16 ± .14	2.74	88 ± 29	1496	202 ± 66	3.44
LYC AND	5	32 ± 3	52 ± 17	32 ± 12	.20 ± .09	0.98	59 ± 30	297	131 ± 67	0.65
ORY HYM	21	23 ± 2	11 ± 1	10 ± 1	.01 ± .00	0.21	2.6 ± 0.5	54	2.8 ± 0.6	0.06
SIT JUB	167	25 ± 1	6 ± 0	6 ± 0	.00 ± .00	0.70	1.1 ± 0.1	183	1.2 ± 0.1	0.20
STI SPE	69	26 ± 1	9 ± 1	9 ± 1	.01 ± .00	0.84	4.1 ± 1.1	281	4.5 ± 1.2	0.31
UNKNOWN	65	15 ± 1	4 ± 0	5 ± 1	.00 ± .00	0.16	0.3 ± 0.0	20	-	-
DEAD GS	21	19 ± 2	10 ± 1	8 ± 1	.01 ± .00	0.18	1.8 ± 0.5	39	-	-
DEAD SH	37	33 ± 3	44 ± 5	46 ± 5	.22 ± .04	8.06	103 ± 23	3822	-	-
TOTALS	508					24.53		11850		23.73

The blast area at T1 sampled in 1988 (Table 6.17; YUF009, 1279 meters) was similarly dominated by *Oryzopsis hymenoides*, with the addition of some *Stipa speciosa*, another bunchgrass. One *Hymenoclea salsola* was present in 200 m^2. The dead shrubs were old dead stumps which could not be identified. They were possibly remains of shrubs present before the blasts occurred from 1952 to 1957. Its control area, around 600 m east, was a well-mixed shrub community dominated by *Ephedra nevadensis* and *Chrysothamnus viscidiflorus* (Table 6.18; YUF010, 1267 m).

Table 6.19 Grass seedlings marked following three germination events and censused the two succeeding years on T1 ground zero (E. M. Romney, personal communication).

	Number Per 100 m^2	
Year	Site A	Site B
1971	11 ± 2	23 ± 4
1972	8 ± 1	21 ± 4
1973	7 ± 1	18 ± 4
1978	29 ± 2	28 ± 9
1979	8 ± 1	7 ± 1
1980	1 ± 1	1 ± 1
1983	35 ± 5	22 ± 3
1984	33 ± 4	20 ± 3
1985	30 ± 4	18 ± 3

Dr. E. M. Romney monitored grass seedlings at two sites within the blast area at T1 from 1959 through 1987. The seedlings were marked after germination events with small wooden stakes, and those plants were followed for two years after marking (E. M. Romney, personal communication). New seedlings were apparent in 1971, 1978, and 1983; Table 6.19 shows the results of those studies. It should be noted that the numbers are not densities of grass on a site, but numbers of seedlings only; established plants were not followed. These data illustrate the nature of the influx of grasses to the blast area, i.e., germination in response to particular rainfall patterns, followed by erratic establishment depending on the weather.

In addition to the grass seedling data, in 1986 and 1987 Romney and Hunter measured plant cover in five plots established by Romney and Rhoads in 1959, when there were no perennial plants. Table 6.21 summarizes the results of those measurements. They demonstrate the presence of the bunchgrasses and *Hymenoclea salsola* as in the BECAMP plots measured in 1988 (YUF013 and YUF009).

Another blast area sampled was that around the peaceful nuclear excavation test which produced Sedan crater. The sites sampled were described earlier by UCLA (Martin 1963), Allred et al. (1963), and by Hunter et al. (1987). As at the other blast areas, the area near the crater (YUF016, 305 m from GZ) was populated solely by the bunchgrasses *Oryzopsis*

Table 6.20 Perennial plant numbers and percent cover on five 100-m^2 plots on the T1 blast area, west of ground zero, sampled in 1986 (A-C) and 1987 (D, E) by E. M. Romney and R. B. Hunter.

Species	Site A		Site B		Site C		Site D		Site E	
	#	%	#	%	#	%	#	%	#	%
Hymenoclea salsola	53	4.62	23	2.20	46	7.25	2	0.19	1	0.44
Sphaeralcea ambigua	0	0	4	0.03	0	0	0	0	0	0
Stipa speciosa	18	0.67	24	0.37	60	0.48	79	0.13	123	1.01
Totals	71	5.29	51	2.60	106	7.73	81	0.32	124	1.45

Table 6.21 Perennial plant population characteristics on a 100-m^2 transect (YUF016) 305 meters northeast of Sedan ground zero, at an elevation of about 1318 m, sampled July 6, 1988.

Species	N	Average Height cm	Average Maximum Width cm	Average Perpend Width cm	Average Cover m^2	Total Cover m^2	Average Volume $m^3 \times 10^{-3}$	Total Volume $m^3 \times 10^{-3}$	Average Biomass g	Total Biomass kg
ORY HYM	80	21 ± 1	6 ± 1	5 ± 1	.01 ± .00	0.56	3.2 ± 1.6	256	3.6 ± 1.7	0.28
STI SPE	27	17 ± 2	6 ± 1	6 ± 1	.00 ± .00	0.10	1.1 ± 0.4	30	1.2 ± 0.4	0.03
Unknown	1	3	7	10	0.01	0.01	0.2	0	-	-
Dead GS	11	33 ± 4	38 ± 5	34 ± 4	.11 ± .03	1.24	43 ± 12	467	-	-
Totals	108					0.67		286		0.31

almost 8% cover (Table 6.23). *H. salsola* increased from 3/100 m^2 in 1983 to 58/100 m^2 in 1988, while the other shrub present, *Lycium andersonii*, declined from three to two individuals (there was one in 1976, none in 1964; Hunter et al. 1987). At 1524 m from GZ, just past the edge of the area of blast removal of shrubs (Martin 1963), the vegetation was dominated by *Coleogyne ramosissima* (YUF018, Table 6.23), whose population remained intact after the blast. Total shrub numbers declined from 99/100 m^2 in 1963 (Martin 1963) to 82/100 m^2 in 1988 (Table 6.23, excluding grasses). Data from 1962-1964 (H. O. Hill, unpublished data) showed cover at this approximate location to be dominated by *Coleogyne ramosissima*(14%) and *Grayia spinosa* (7%), but the *G. spinosa* was absent in 1988. In 1975 one *G. spinosa* was seen in a 29-m^2 area sampled (Hunter, R. B. and H. O. Hill, unpublished data). This location was not sampled in 1983.

These data on the vegetation in the blast area of the Sedan event show a succession of the *Salsola*-dominated vegetation to perennial bunchgrasses during the 1970s and invasion by the shrub *H. salsola* to the edge of the throw-out zone (i.e., to 762 m from GZ) during the 1980s.

Two new baseline sites were sampled in 1988, one on Pahute Mesa and one on Rainier Mesa, to make more complete the number of vegetative communities sampled. The plot on Pahute Mesa (PAM001, 6310 feet) was in an *Artemisia nova* community with a few small scattered *Juniperus osteosperma* (junipers) and a rare *Artemisia tridentata*. The almost total dominance of cover by *A. nova* is seen in Table 6.24. *Ephedra nevadensis* and the bunchgrasses *Orysopsis hymenoides* and *Sitanion jubatum* contributed significantly to the numbers of plants. The plot is on a very rocky soil on a knoll. The *Ephedra nevadensis* plants were small in comparison to lower-altitude sites, and they appeared to have reproduced mostly vegetatively, with rhizomes. It was not possible to determine which of the small *Ephedra* shoots were individual plants and which parts of a clone, so the numbers are dependent on an arbitrary classification.

The baseline plot on Rainier Mesa (RAM001, 2283 meters) was chosen where lizard and small

Table 6.22 Perennial plant characteristics on a 100-m^2 transect (YUF017) 914 meters northeast of Sedan ground zero at an elevation of about 1327 m, sampled July 6, 1988.

Species	N	Average Height cm	Average Maximum Width cm	Average Perpend Width cm	Average Cover m^2	Total Cover m^2	Average Volume $m^3 \times 10^{-3}$	Total Volume $m^3 \times 10^{-3}$	Average Biomass g	Total Biomass kg
HYM SAL	58	29 ± 2	33 ± 4	31 ± 3	.13 ± .03	7.81	62 ± 20	3603	199 ± 62	11.53
LYC AND	2	50 ± 2	68 ± 6	72 ± 2	.38 ± .02	0.76	189 ± 16	378	227 ± 19	0.45
ORY HYM	101	29 ± 1	12 ± 1	12 ± 1	.01 ± .00	1.37	4.3 ± 0.5	438	4.8 ± 0.5	0.48
SPH AMB	2	31 ± 3	8 ± 1	9 ± 2	.01 ± .00	0.01	1.6 ± 0.5	3	0.7 ± 0.2	0.00
STI SPE	6	27 ± 3	9 ± 1	9 ± 2	.01 ± .00	0.04	2.2 ± 0.7	13	2.4 ± 0.8	0.01
DEAD GS	71	12 ± 1	8 ± 1	8 ± 1	.01 ± .00	0.47	1.0 ± 0.2	72	-	-
DEAD SH	2	17 ± 11	67 ± 34	65 ± 37	.44 ± .36	0.87	114 ± 110	229	-	-
Totals	169					9.99		4435		12.47

northeast of Sedan ground
ts.

otal ume x 10^-3	Average Biomass g	Total Biomass kg
93	759 ± 98	49.37
55	278 ± 130	3.06
91	693 ± 130	4.16
49	7.4 ± 2.8	0.16
0	0.2	0.00
3	-	-
31	-	-
62	-	-
491		56.75

Table 6.24 Perennial plant population characteristics on a 100-m^2 transect on plot PAM001, a Pahute Mesa baseline area at an elevation of 1923 m, sampled August 16, 1988. Totals exclude dead plants.

Species	N	Average Height cm	Average Maximum Width cm	Average Perpend Width cm	Average Cover m^2	Total Cover m^2	Average Volume $m^3 \times 10^{-3}$	Total Volume $m^3 \times 10^{-3}$	Average Biomass g	Total Biomass kg
ART NOV	332	24 ± 1	41 ± 1	34 ± 1	.13 ± .01	43.77	40 ± 3	13167	99 ± 7	32.92
CHR VIS	6	23 ± 2	28 ± 5	26 ± 4	.06 ± .02	0.38	15 ± 5	93	39 ± 12	0.23
EPH NEV	44	20 ± 1	10 ± 1	10 ± 1	.01 ± .00	0.41	2.2 ± 0.4	97	3 ± 1	0.14
GRA SPI	1	5	6	5	0.00	0.00	0.12	0	0.27	0.00
ORY HYM	28	19 ± 1	5 ± 1	5 ± 1	.00 ± .00	0.07	0.5 ± 0.1	15	0.6 ± 0.1	0.02
SIT JUB	212	18 ± 0	2 ± 0	2 ± 0	.00 ± .00	0.16	0.1 ± 0.0	30	0.2 ± 0.0	0.03
UNKNOWN	5	11 ± 2	10 ± 7	9 ± 6	.02 ± .02	0.09	3.2 ± 3.0	16	-	-
DEAD GR	14	7 ± 1	6 ± 1	6 ± 1	.00 ± .00	0.04	0.2 ± 0.0	3	-	-
DEAD SH	40	16 ± 1	33 ± 4	31 ± 4	.12 ± .03	4.97	22 ± 6	883	-	-
Totals	682					49.89		13417		33.34

plant population characteristics on a Rainier Mesa baseline plot (RAM001), at an elevation of 2283 m, ugust 19, 1988. This transect covered only 54 m². The *Penstemon* were not flowering and were ot identified. Totals are adjusted to 100 m² area.

verage Height cm	Average Maximum Width cm	Average Perpend Width cm	Average Cover m^2	Total Cover m^2	Average Volume $m^3 \times 10^{-3}$	Total Volume $m^3 \times 10^{-3}$	Average Biomass g	Total Biomass kg
4 ± 1	8 ± 1	5 ± 1	.00 ± .00	0.02	0.2 ± 0.1	1	.08 ± .05	0.00
± 16	30 ± 8	30 ± 14	8 ± 5	0.16	30 ± 27	61	76 ± 68	0.15
± 2	30 ± 2	35 ± 3	.11 ± .02	6.39	39 ± 10	2230	70 ± 17	4.01
1	4	4	0.00	0.00	0.0	0	0.01	0.01
± 4	31 ± 7	28 ± 6	.11 ± .04	1.47	48 ± 22	670	120 ± 55	1.68
± 8	106 ± 17	95 ± 16	1.09 ± .28	17.50	930 ± 259	14889	2325 ± 647	37.21
± 1	7 ± 1	7 ± 1	0.00	0.03	0.3 ± 0.1	2	.11 ± .04	0.00
± 1	9 ± 1	8 ± 1	.01 ± .00	0.20	0.7 ± 0.2	18	.28 ± .09	0.01
20	14	9	0.01	0.01	2.0	2	4.95	0.00
± 6	17 ± 5	11 ± 2	.02 ± .01	0.15	7.3 ± 4.0	58	18 ± 10	0.15
± 1	12 ± 1	10 ± 1	.02 ± .00	1.10	2.7 ± 0.5	196	6.81 ± 1.26	0.49
27	4	2	.00 ± .00	0.00	0.2	0	0.07	0.00

ss 01 00 57 03 06 00 01 00 00 37 .30

Table 6.26 Numbers of live plants, live cover (%), total live volume ($m^3/100\ m^2$), and estimated biomass ($kg/100\ m^2$) and altitudes (meters) for sites sampled in 1988.

Site		Altitude	$n/100\ m^2$	Cover	Volume	Biomass
JAF001	V1	954	263	46	26	57
	V4	954	219	32	16	37
FRF001	V1	965	154	25	19	35
FRF002	ROADSIDE	977	56	16	13	19
	CONTROL	977	61	27	26	36
MER002	GOPHER	1076	28	3	3	1
MER003	CONTROL	1103	198	44	49	75
YUF013	3B GZ	1236	154	2	0	0
YUF001	V2	1237	375	39	17	36
	V3	1237	335	29	14	32
YUF012	3B CONTROL	1239	232	22	11	28
YUF011	3B SCRAPED	1239	0	0	0	0
YUF010	T1 CONTROL	1267	508	25	12	24
YUF009	T1 GZ	1279	42	1	0	1
YUF016	SEDAN 1000′	1318	108	1	0	0
YUF017	SEDAN 3000′	1327	169	10	4	12
YUF018	SEDAN 5000′	1335	109	22	12	57
PAM001	V1	1923	682	50	13	33
RAM001	V1	2283	928	68	69	241

DISCUSSION

Overall these data suggest the year 1988 was one of stasis for the established perennial plants on the NTS. The dominant shrub species neither grew significantly nor shrank significantly. Herbaceous perennials and bunchgrasses declined somewhat in numbers and sizes, and a young population of *Hymenoclea salsola* decreased in numbers and sizes except on disturbed areas.

Data from disturbed areas showed some patterns. The three sampled areas affected by blasts from nuclear tests (T1, T3, and Sedan) had sparse populations of bunchgrasses (*Oryzopsis hymenoides, Sitanion jubatum,* and *Stipa speciosa*), with some invasion of *Hymenoclea salsola* at Sedan and T1. The reduced cover on these locations after several decades was not a reflection of an inability of plants to grow, but rather an indication of the desert habitat, in which episodes of germination and establishment are rare. At Sedan, the more advanced

suggested an inhibition of seedling establishment by those deposits. The area of deposits was invaded shortly after the blast by *Salsola paulsenii* (Russian thistle) (Martin 1963; Hill

Johnson et al. apparently adjusted the width of their transects to cover the observably larger plants adjacent to the scraped area. A proper assessment of the roadside effect would require a different sampling design repeated at more locations, which was beyond the scope of the present study.

Some of the rather simple changes in field technique used for the BECAMP studies resulted in significant changes in analytical procedures. In the past a representative area was sampled (100 m^2) and several replicates could be used to indicate reliability of the measurements (Hunter and Medica 1989). An analysis of 1987 data (R. O. Gilbert, personal communication) showed that for the most common species five transects would allow measurement of densities to within about 35% of the true value. For intermediate and rare species the densities could be estimated within roughly ± 50% and ± 110%, respectively. To get reliable estimates within ± 10% of density, cover, or biomass for any given species would not be possible with fewer than 70 transects. (However, total plant density could be estimated within 10%, cover within about ± 20%, and biomass within about ± 25% using five transects.) The amount of work involved in accurately determining these parameters for individual species is therefore not practical, and statistical comparisons between different sites and times cannot be practically made. This is largely a result of a high natural variability in these [illegible] vegetative parameters, rather than inaccuracies in the technique.

Repeated sampling of the same transect, however, allowed remeasurement of individual shrubs to determine growth rates (Tables 6.10 and 6.12), establishment and survivorship. The data apply only to the measured sites, and therefore it is necessary to carefully mark the transects used so that they may be repeatedly sampled. Analyses of the 1987-1988 data (Tables 6.4-6.8) showed deficiencies occurred in the matching of plants from year to year, and particular, *Larrea tridentata* dominance was better estimated, because it was generally the tallest species in its communities (Tables 6.4-6.6, 6.13 and 6.15).

The ratios of live to dead shrubs were generally greater than 6. This suggests either that shrub life spans are much longer than the decades required for their wood to decay, or that their populations were young and not at equilibrium. Lifespans and decay rates are currently unknown, but future monitoring at these locations should provide estimates of both those factors.

In the future these sites will be monitored at three to five-year intervals. Techniques will be refined to improve the ability to match plants from year to year, and new sites will be established. They will be permanently marked to allow repeat sampling over long intervals.

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1.4 and 1.5), but the ability to use statistical tests on the numerous individuals allowed a better interpretation of changes in size. It should be noted that to show that plants neither grew nor shrank over a one-year period may be a significant observation, rather than an indication of measurement error.

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