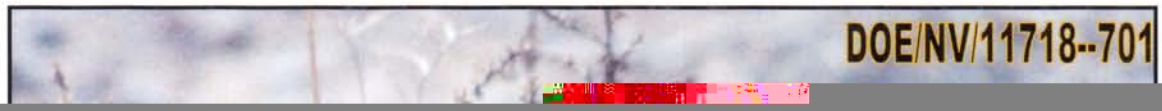

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Ecological Services

DOE/NV/11718—701

ECOLOGY OF THE WESTERN BURROWING OWL ON THE NEVADA TEST SITE

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Appendices

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ACRONYMS AND ABBREVIATIONS

BURS	Burrow use rate by burrow site
BURM	Burrow use rate by month and ecoregion
BRR	Burrow reuse rate
°C	degrees Celsius
cm	centimeter
DOE	U.S. Department of Energy
DOE/NV	U.S. Department of Energy, Nevada Operations Office
EMAC	Ecological and Monitoring Compliance Program
ESRI	Environmental Systems Research Institute
GIS	Geographic Information System
km	kilometer
m	meter
MBTA	Migratory Bird Treaty Act
n	sample size
NNSA/NSO	U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office
NTS	Nevada Test Site
s.d.	standard deviation
TM1500	TrailMaster® camera system, Model TM1500
USFWS	U.S. Fish and Wildlife Service
UTM	Universal Transverse Mercator

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EXECUTIVE SUMMARY

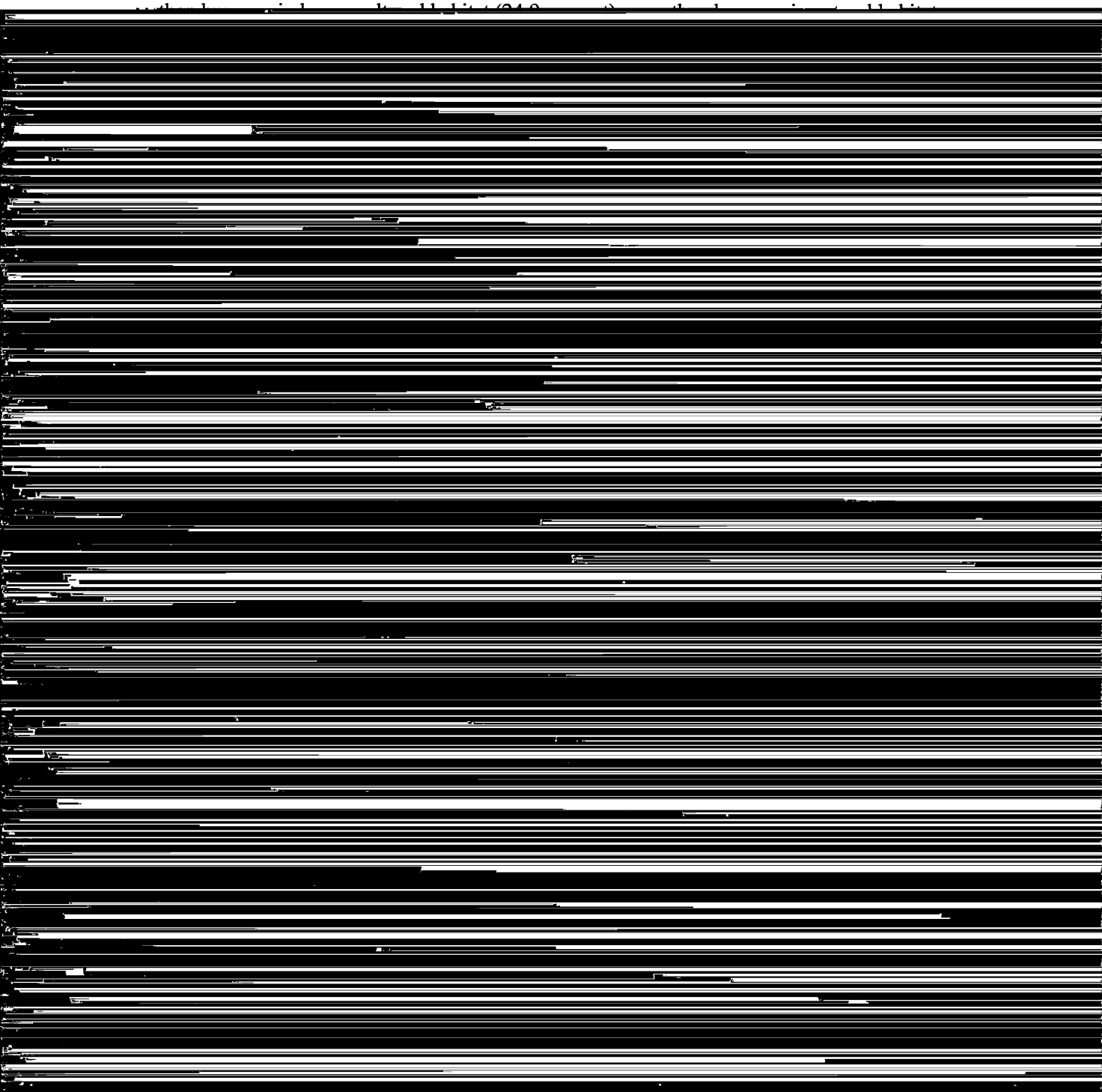
The western burrowing owl (*Athene cunicularia hypugaea*), hereafter referred to as owl, is one of many animal species of concern that occur on the Nevada Test Site (NTS). It is a relatively small, long-legged, ground-dwelling owl found in flat, open grasslands, steppes, deserts, prairies, and agricultural lands throughout the Central and Western United States, south-central Canada, Mexico, and Central America. Because of declines in the abundance of this species, owls were listed by the U.S. Fish and Wildlife Service as a candidate for classification as threatened or endangered under the Endangered Species Act. Although removed from that list in 1996 when the listing process for candidate species was revised, the owls are still regarded as a National Bird of Conservation Concern by the U.S. Fish and Wildlife Service, and they are protected under the Migratory Bird Treaty Act. In Nevada, owls are classified as Protected by the state and as a proposed Sensitive species by the U.S. Bureau of Land Management. Although data is sparse and perhaps insufficient, population trends for the owl in Nevada appear to be stable. However, localized population decreases have been noted, especially in southern Nevada (Clark County), and in the Lahontan Valley. The statewide population was roughly estimated at 1,000 to 10,000 pairs in 1992.

Compared to most other special status animal species on the NTS, the owl requires greater management attention because it occupies the flat, open valley bottoms where most ongoing activities are occurring and where most future activities are likely to occur. In addition, because owls occur near NTS activities, listing of this species as threatened or endangered may result in restrictions being placed on NTS activities in order to protect owls. Therefore, owls were monitored to: (1) obtain data on the ecology and natural history of this species on the NTS, (2) determine what impacts, if any, the U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) activities have on this species, and (3) develop mitigation recommendations in the event the owl is ever listed under the Endangered Species Act. This report summarizes the results of these monitoring efforts.

Owls occur in each of the three ecoregions (i.e., Great Basin Desert, Mojave Desert, and transition) found on the NTS, primarily in the large, open areas of Yucca Flat, Frenchman Flat, Jackass Flats, and near Buckboard Mesa. A total of 119 owl locations including 89 burrow sites and 30 sighting locations have been documented on the NTS. Of these 119 locations, 64 occur in the transition ecoregion, 38 occur in the Mojave Desert ecoregion, 11 occur in the Great Basin

habitat so it is more suitable for owls (e.g., increased opportunities for predators to dig burrows in altered soil because owls use abandoned predator burrows, more open habitat).

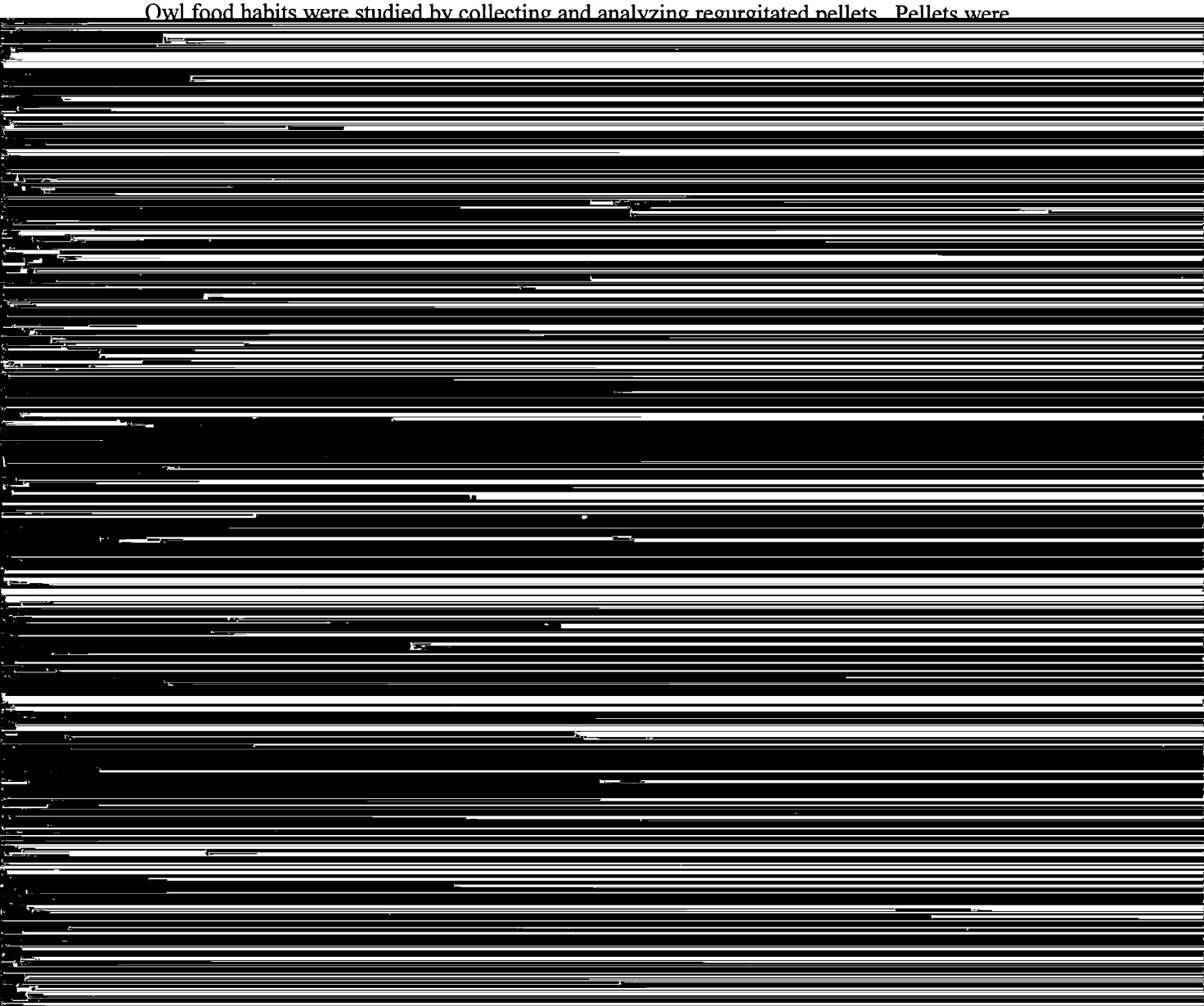
Active owl use (owls present or fresh sign) was detected at over 80 percent of the sites monitored. Overall, owl use at each burrow site averaged about 30 percent with no significant differences in use among ecoregions. In contrast, significant differences in use were detected among burrow types. Burrow sites containing both culvert and pipe burrows had significantly higher use rates (51.5 percent) than burrow sites having only culvert burrows (27.8 percent),



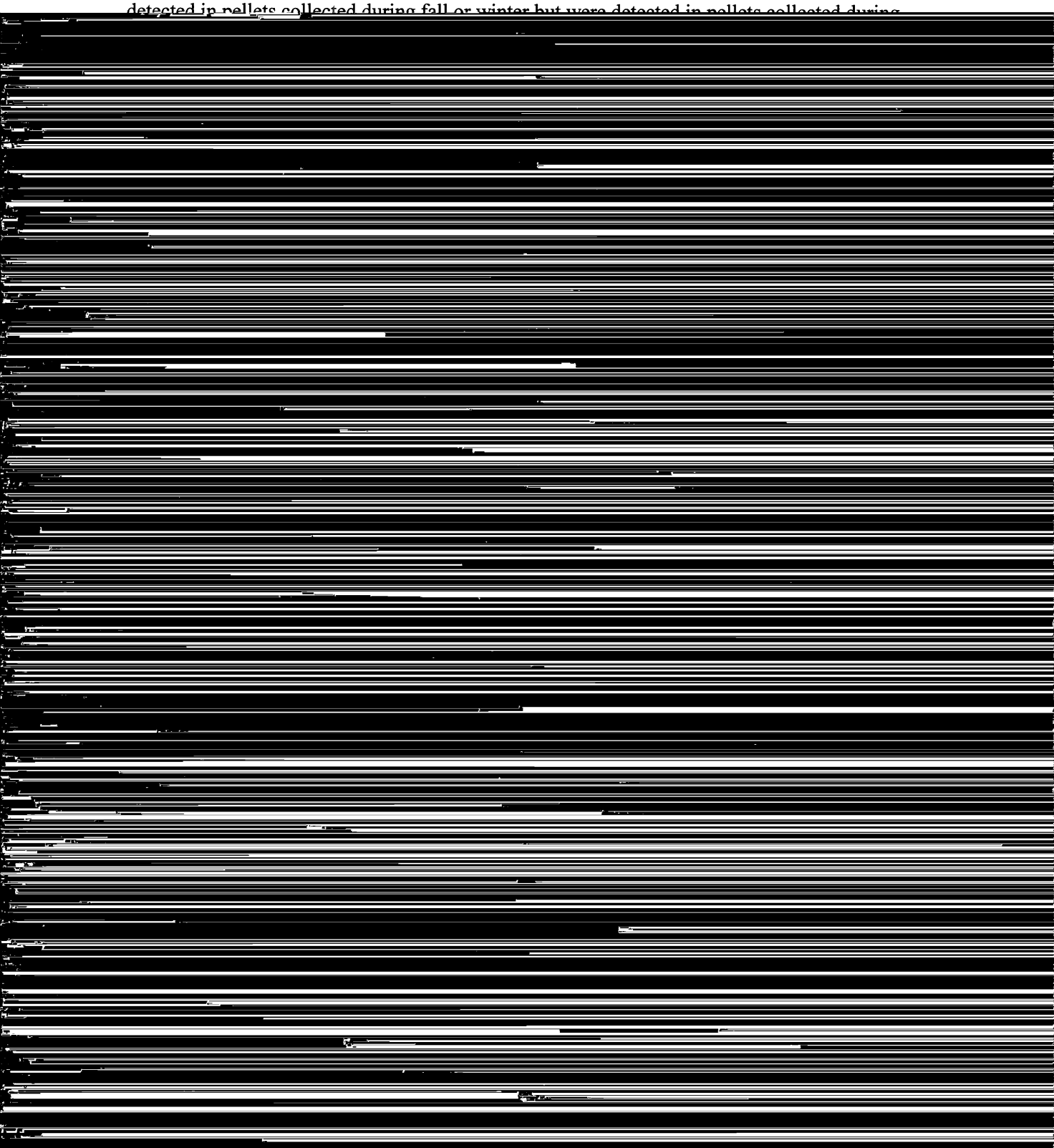
ecoregions; respectively. The TrailMaster® camera system is a cost-effective technique for documenting the number of owl breeding pairs and young.

Results from the photographs reveal that the maximum number of young owls per nest burrow were most frequently detected between 0500-1000 and 1800-2200 with peaks at 0700-0800 and 1900-2000. The highest frequency of prey delivery and feeding occurred between 2000-0100 and 0300-0500. No prey delivery or feeding was detected between 0600-0800, 1100-1200, nor 1300-1900. Young and adult owls were detected at the burrow entrance at all times throughout the day and night. However, they exhibited different activity patterns with adult owls being detected more frequently at the burrow apron during afternoon/early evening than young owls. Results from the full set of event data (n=45,188) show almost identical patterns of owl activity as do the photographs (n=2,225). Owls were active during all hours of the day and night with peaks of activity right around dawn, during the mid-morning hours, and in late afternoon and evening; thus exhibiting a trimodal activity distribution.

Owl food habits were studied by collecting and analyzing regurgitated pellets. Pellets were

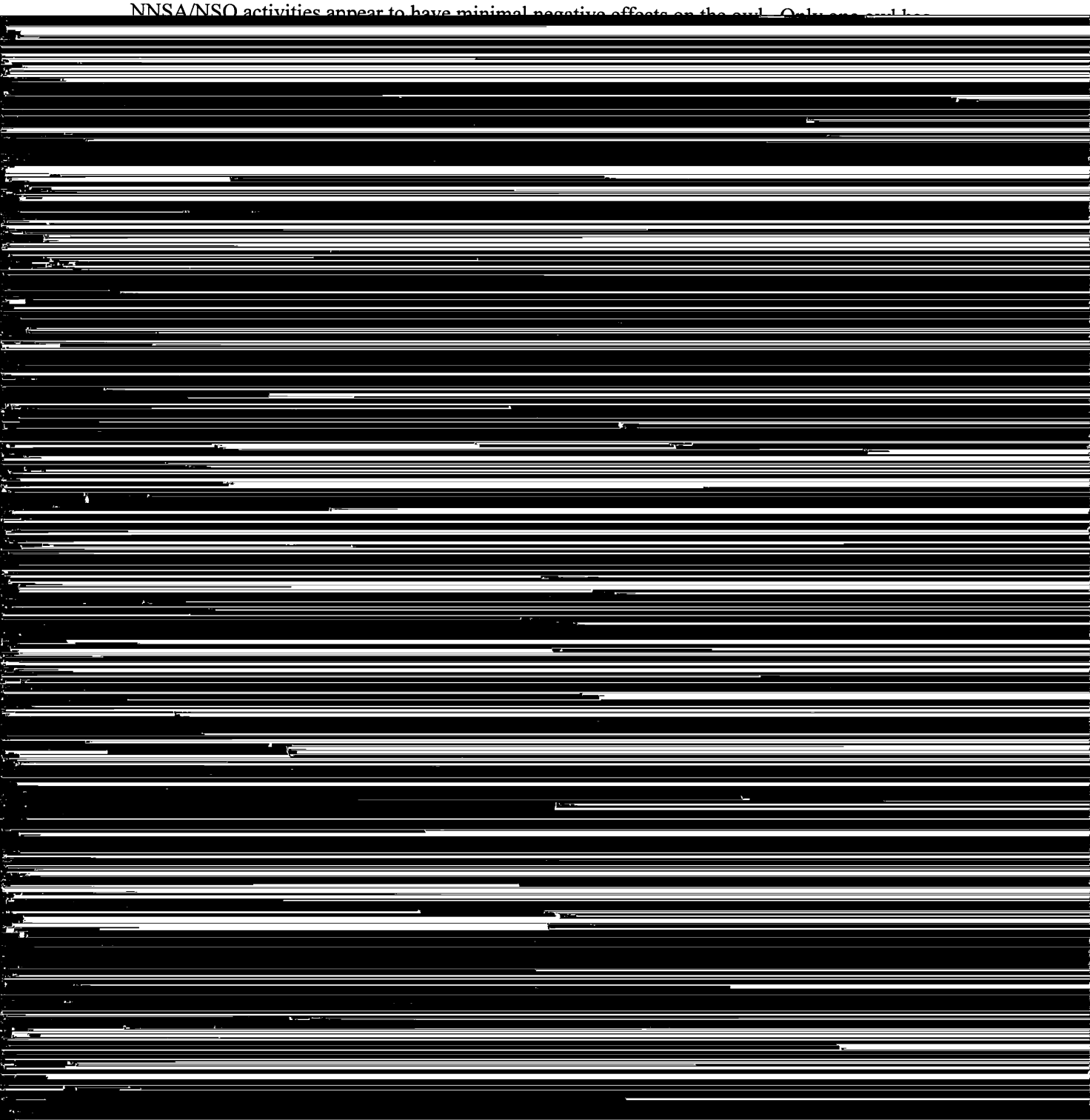


pellets was lowest during winter, although invertebrates still occurred in more than 80 percent of the pellet samples collected during this season. Among vertebrates, kangaroo rats and Perognathinae varied significantly in frequency of occurrence in owl pellets across seasons. Remains of reptiles, pocket gophers (*Thomomys* spp.), sagebrush voles, and shrews were not detected in pellets collected during fall or winter but were detected in pellets collected during



Burrows provide a warmer and more thermally stable environment through the winter with the average internal temperature of all burrows measured being 3.3 degrees Celsius (°C) warmer than the ambient air temperature. The biggest difference between average burrow and ambient air temperature occurred in December (5.1 °C) and was least in March (0.2 °C). Data from this study was limited and it was difficult to determine if owls preferentially selected winter burrows that were warmer than other available burrows.

NNSA/NSO activities appear to have minimal negative effects on the owl. Only one owl has



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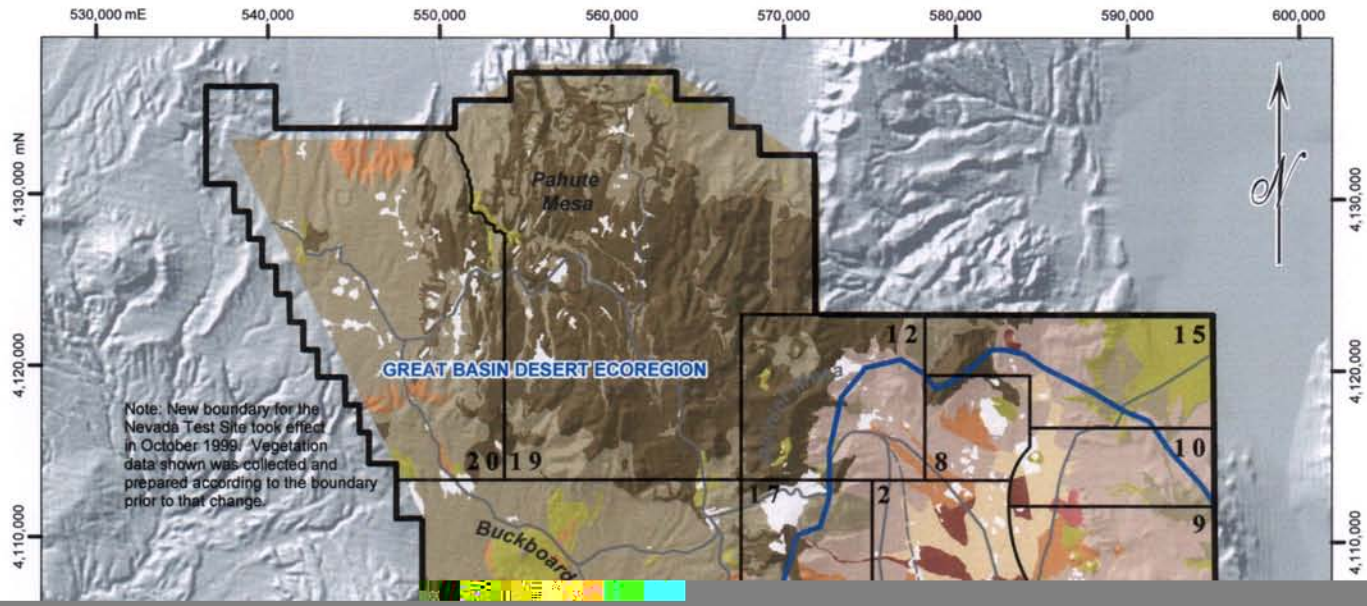
1.0 INTRODUCTION

The western burrowing owl (*Athene cunicularia hypugaea*), hereafter referred to as owl, is one of seven subspecies of owls that occur in North and Central America (Ridgway, 1914; Peters, 1940; Haug et al., 1993). It is a relatively small, long-legged, ground-dwelling owl (Figure 1-1) found in flat, open grasslands, steppes, deserts, prairies, and agricultural lands throughout the Central and Western United States, south-central Canada, Mexico, and Central America.

Because of declines in the abundance of this species, owls were listed by the U.S. Fish and Wildlife Service (USFWS) as a candidate for classification as threatened or endangered under the Endangered Species Act. Although removed from that list in 1996 when the listing process for candidate species was revised, owls are still regarded as a National Bird of Conservation Concern by the USFWS (USFWS, 2002), and is protected under the Migratory Bird Treaty Act.

In Nevada, owls are classified as Protected by the state, and as a

(NNSA/NSO) operates the Nevada Test Site (NTS), and is committed to managing lands in a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Pahute Mesa
GREAT BASIN DESERT ECOREGION
Note: New boundary for the Nevada Test Site took effect in October 1999. Vegetation data shown was collected and prepared according to the boundary prior to that change.
20
19
12
15
8
10
17
2
9
Buckboard

The NTS lies between the Great Basin Desert and the Mojave Desert as defined by Jaeger (1957). Within the site boundaries are found both of these desert types. Transitional areas between the two deserts are also present having been created by gradients in precipitation, elevation, temperature, and soils. Unique combinations of physical site conditions have resulted in several different vegetation alliances and associations (Ostler et al., 2000) (Figure 1-2). Based on these vegetation alliances, three distinct ecoregions occur on the NTS; namely, the Great Basin Desert, Mojave Desert, and transition ecoregions. The Great Basin Desert ecoregion is a cold desert with dominant plant species consisting of sagebrush species (*Artemisia* spp.), singleleaf pinyon (*Pinus monophylla*), and Utah juniper (*Juniperus osteosperma*). The Mojave Desert ecoregion is a hot desert with dominant plant species being creosote bush (*Larrea tridentata*) and white bursage (*Ambrosia dumosa*). The transition ecoregion is transitional between the Great Basin and Mojave Desert ecoregions with dominant plant species consisting of blackbrush (*Coleogyne ramosissima*), Nevada jointfir (*Epehdra nevadensis*), and burrobrush (*Hymenoclea salsola*). These three distinct ecoregions make the NTS a unique site and allow for comparisons of owl monitoring data among the three ecoregions.

2.0 SPECIES DISTRIBUTION

2.1 Introduction

Up until 1996, no studies on owls had been conducted on the NTS. However, numerous opportunistic sightings were recorded by biologists from 1961-1996 (Hayward et al., 1963; Hill, 1972, Hill and Burr, 1973; Castetter, 1975-1977 [unpublished field notes]; Greger, 1994; Greger and Romney, 1994a; Greger and Romney, 1994b; EG&G Energy Measurements, Inc. [EG&G/EM], 1995a; EG&G/EM, 1995b; EG&G/EM, 1995c; Greger, 1995; Woodward et al., 1995; DOE/NV, 1984-1996 [unpublished wildlife data]; Boone and Lederle, 1998). These data identified 41 unique owl locations. Owl locations include burrow sites (i.e., burrows with owl sign [e.g., owls, pellets]) and sighting locations (i.e., owl was seen but no burrow found). Burrow sites were documented at 18 of the 41 owl locations. All owl locations occurred within major flats and valleys in the eastern and southern portions of the NTS.

During the spring and summer of 1996, a study was initiated to determine the distribution of the owl on the NTS using a method adapted from Haug and Didiuk (1993) (Steen et al., 1997). This method entailed broadcasting a territorial call from a public address system at 250 call stops along roads throughout much of the NTS while listening for a response and visually searching for owls during the breeding season. Owls were detected at 12 call stop locations. Of these 12, 10 were new locations, making a total of 51 unique owl locations. Seven new burrow sites were located, making a total of 25 known burrow sites on the NTS through 1996.

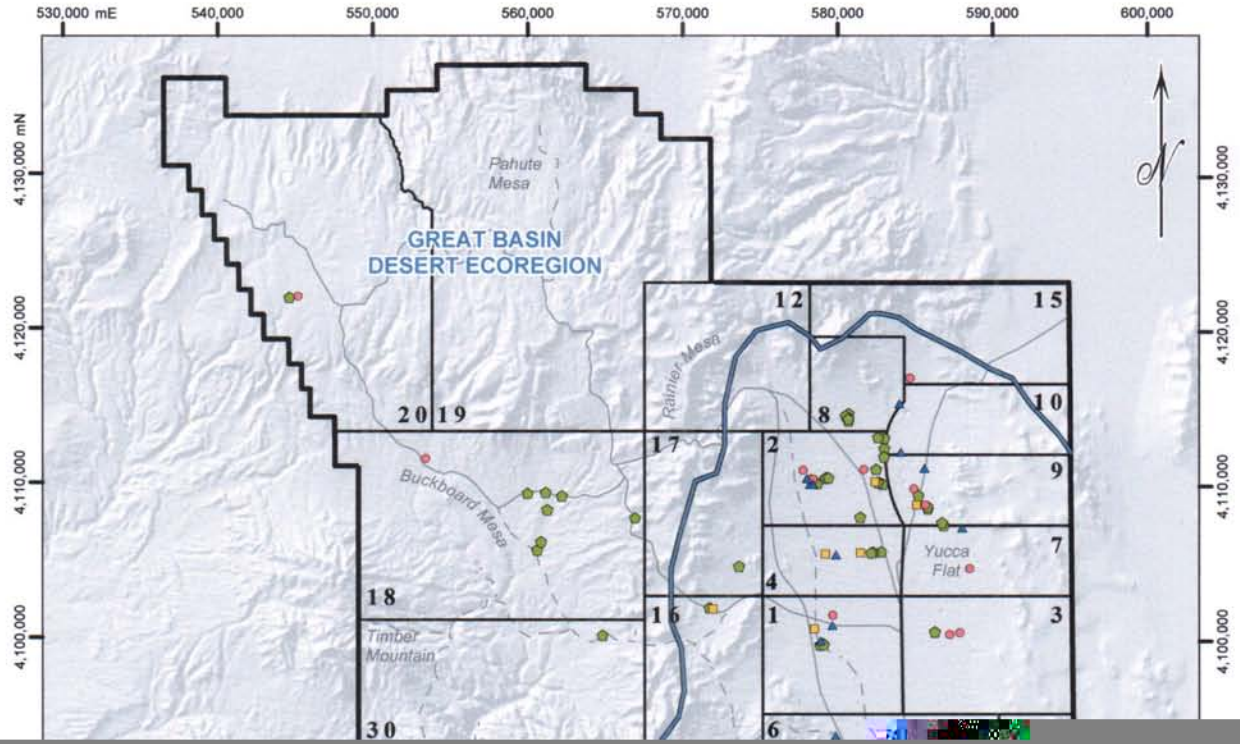
Walking surveys and road surveys were initiated after 1996 to find additional owl locations and to determine if owls occurred on the NTS year-round. All new owl locations found after 1996 as a result of walking surveys, road surveys, burrow monitoring, and other activities are presented along with the historical locations in this section.

approximately 128 km in length, and a northern route, located in Yucca Flat in the transition ecoregion, was approximately 70 km in length.

Universal Transverse Mercator (UTM) coordinates were taken at most owl burrows and sighting locations using a hand-held global positioning system unit. Some of the historic sites were identified only by written descriptions. For most of these locations, UTM coordinates were estimated from U.S. Geological Survey topographic maps (Scale 1:24,000). In some cases, written descriptions were too general to estimate UTM coordinates. All coordinates were entered into a Microsoft® Access database and exported as a text file, from which a geographic information system (GIS) coverage was created using Environmental Systems Research Institute® Data Automation Kit software. This coverage was then loaded into Environmental Systems Research Institute® ArcGIS software and displayed to spatially depict owl distribution on the NTS.

It is important to note that we define a burrow site as one or more burrow openings occurring in the same microhabitat type (e.g., drill pad). A burrow opening or burrow is defined as a structure that contains an opening leading underground. Burrow openings were in soil (earthen), caliche, a metal culvert, or metal or plastic pipe. In some cases, the same pipe or culvert had two openings, and it was not determined if the pipe or culvert was open all the way through or not. Therefore, each burrow opening within a burrow site was documented and monitored.

The following data were recorded for each burrow site: number of burrow openings; burrow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4,110,000
4,100,000
Pahute Mesa
GREAT BASIN DESERT ECOREGION
Rainier Mesa
Buckboard Mesa
Yucca Flat
Timber Mountain
12
15
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Table 2-1. Number of owl locations in each vegetation association and the areal extent (i.e., percent of total area) of each vegetation association occurring on the Nevada Test Site.

Vegetation Association	Number of owl locations	Areal extent (% of total area)
Hymenoclea salsola-Ephedra nevadensis Shrubland	26	2.0
Larrea tridentata/Ambrosia dumosa Shrubland	24	18.0
Other (Miscellaneous vegetation, playas, mapped disturbances)	14	1.5
Coleogyne ramosissima-Ephedra nevadensis Shrubland	13	21.6
Ephedra nevadensis-Grayia spinosa Shrubland	14	5.9
Artemisia tridentata-Chrysothamnus viscidiflorus Shrubland	7	7.3
Atriplex confertifolia-Ambrosia dumosa Shrubland	6	3.4
Menodora spinescens-Ephedra nevadensis Shrubland	3	2.5
Atriplex confertifolia-Kochia americana Shrubland	2	0.9
Atriplex canescens-Krascheninnikovia lanata Shrubland	2	2.2
Krascheninnikovia lanata-Ephedra nevadensis Shrubland	1	1.2
Lycium shockleyi-Lycium pallidum Shrubland	1	0.4
Ericameria nauseosa-Ephedra nevadensis Shrubland	0	0.8
Lycium andersonii-Hymenoclea salsola Shrubland	0	0.4
Eriogonum fasciculatum-Ephedra nevadensis Shrubland	0	3.0
Chrysothamnus viscidiflorus-Ephedra nevadensis Shrubland	0	4.8
Ephedra viridis-Artemisia tridentata Shrubland	0	2.5
Artemisia nova-Chrysothamnus viscidiflorus Shrubland	0	6.9
Artemisia nova-Artemisia tridentata Shrubland	0	1.4
Pinus monophylla/Artemisia nova Woodland	0	7.4
Pinus monophylla/Artemisia tridentata Woodland	0	5.9
TOTAL	113*	100.0

*=six are at unspecified locations

Thirteen new burrow sites were found during 36 walking surveys. Ten new burrow sites were found in the Mojave Desert ecoregion, three were found in the transition ecoregion, and none were found in the Great Basin Desert ecoregion. Approximately 1.3 burrow sites/10 km were found, and areas were sampled at a rate of approximately 1.9 km/hour. Fifty-one new burrow sites and two new owl locations were recorded while conducting other field work (e.g., burrow monitoring (Section 3.0), habitat mapping, preactivity surveys).

During the road surveys only two owl sightings were recorded on the northern route, one on November 25 around dusk and one on December 15 one hour before dusk. This is important because it showed that owls occur on the NTS year-round. No owls were seen on the southern route.

2.4 Discussion

The known distribution of owls on the NTS (Figure 2-1) is based on historical data and new data which include opportunistic sightings, road surveys with and without the territorial call playback, and walking surveys in areas considered to be good owl habitat. It is not based on a uniform sampling of all vegetation associations on the NTS, although some sampling has occurred in each of the vegetation associations.

The greatest number of owl locations occurs within the *Hymenoclea salsola-Ephedra nevadensis* Shrubland Association (Table 2-1). This vegetation association only occupies 2.0 percent of the NTS area and is associated with disturbed areas where much of the historic nuclear testing

occurred. Owls appear to be selecting for this disturbed habitat where there are open areas with numerous culverts and pipes with scattered perennial and abundant annual vegetation. Several

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3.0 BURROW USE

3.1 Introduction

Numerous studies have been conducted on burrow use by owls in the Western United States and Western Canada (Thomsen, 1971; Coulombe, 1971; Martin, 1973; Wedgwood, 1976; Henny and Blus, 1981; Rich, 1984; MacCracken et al., 1985a; Rich, 1986; Green and Anthony, 1989; Plumpton and Lutz, 1993; Belthoff and King, 1994; Belthoff et al., 1995; Botelho and Arrowood, 1998; Belthoff and Smith, 2000; Belthoff and Smith, 2003). Some of these studies have documented the use and reuse of individual burrows over multi-year periods (Martin, 1973; Wedgwood, 1976; Rich, 1984; Plumpton and Lutz, 1993; Belthoff and King, 1994; Belthoff and Smith, 2000; Belthoff and Smith, 2003). These studies have shown that burrow use varies greatly among studies and between locations and years. Since some burrows may be used more frequently or consistently than others, their loss might have a greater local impact on the species than the loss of infrequently used burrows in the same region. Additionally, little information is available on burrow use during the winter (Coulombe, 1971; Butts, 1976). Historically on the NTS, owls were reported to be year-round residents (Hayward et al., 1963; Hill and Burr, 1973; O'Farrell and Emery, 1976), but there was no data to support this conclusion (Steen et al., 1997). Specifically, there was no documentation of owls occurring on the NTS during the months of November and December. In order to determine which burrow sites were used the most and seasonal patterns of use (e.g., year-round residency status and timing of immigration and emigration), burrows were monitored on the NTS from 1997-2001 in each of the three ecoregions.

3.2 Methods

Monitoring was conducted at known owl burrows approximately every two weeks from November 1997 through March 1998 to determine if owls were found on the NTS during winter. Monitoring of some burrows continued infrequently through July. Monthly monitoring of known burrows began in November 1998 and continued through December 2001 except for the period February through April 1999 when monitoring was again done approximately every two weeks to better determine the timing of owl immigration to the NTS. When monitoring was initiated, burrows were selected from opportunistic sighting data from 1961-1996 (see references in 2.1 Introduction) and from primary call stop surveys from 1996 (Steen et al. 1997). As monitoring progressed, new burrows were found and added to the monitoring schedule. Also, the number of sites sampled did not remain constant for the following reasons: new burrows were found, some burrows were filled in, and some burrows were not visited when there were time or access constraints.

During each visit to a burrow site, the presence of any owls was recorded. In addition, the burrow apron of each burrow and the first 30 cm inside the burrow were searched for the

burrow was categorized as to occurring in natural (e.g., wash) or human-altered (e.g., roadcut, mound) habitat and then classified what type of burrow it was (e.g., earthen, culvert). Also recorded was the aspect (degrees), height and width of each burrow entrance (cm), microhabitat type (e.g., wash, drill-pad, roadside), and the number of burrow openings. Culverts were metal, semi-circular structures that had been inserted into the ground, usually at road crossings, to protect buried cables at old NTS project sites. Pipes were circular, metal or plastic structures at old project sites that were inserted into the ground usually with at least one opening exposed to the surface. Each burrow was also photographed (see Appendix A).

For each active burrow site monitored for at least seven months, a burrow use rate (BURS) was calculated as:

$$BURS = M_D / M_M \times 100,$$

where M_D is the number of months when owls or fresh sign were detected at the burrow site (including the original visit when sign was found) and M_M is the total number of

December 2001 (Table 3-1). The number of burrows monitored increased over the monitoring period as new burrows were found.

3.3.1 Burrow Characteristics

A total of 120 burrows in human-altered habitat and 44 burrows in natural habitat were monitored for owl use. Of the 120 burrows in human-altered habitat, 75 were culverts, 22 were pipes, and 23 were earthen (Table 3-1). Earthen burrows in human-altered habitat are mostly found in road-cuts and the rest are in mounds, ditches, or an open pit. Of the 44 burrows in natural habitat, 24 are wash burrows and 20 are non-wash burrows. The largest number of culvert and pipe burrows (94 of 97) is located in the transition ecoregion (Table 3-1) with all of these occurring in Yucca Flat. Most of the natural burrows (33 of 44) are located in the Mojave Desert ecoregion, while most road-cut burrows (11 of 15) are in the Great Basin Desert ecoregion (Table 3-1).

Table 3-1. Types of owl burrows by habitat and ecoregion monitored for owl use on the Nevada Test Site (November 1997 to December 2001).

Burrow Types		Ecoregion				
		Great Basin	Mojave	Transition	Total	%
NATURAL HABITAT						
Non-Wash Earthen Burrows		0	15	5	20	12.2
Wash Earthen Burrows						
Caliche		0	5	4	9	5.5
Alluvial		1	13	1	15	9.1
Total		**1**	**33**	**10**	**44**	**26.8**
HUMAN-ALTERED HABITAT						
Culvert Burrows						
Culvert Near Roads		0	0	52	52	31.7
Culvert on Pad		2	0	21	23	14.0
	Total	2	0	73	75	45.7
Pipe Burrows						
Pipe Near Roads		0	1	8	9	5.5
Pipe on Pad		0	0	13	13	7.9
	Total	0	1	21	22	13.4
Earthen Burrows						
Road-cut		11	0	4	15	9.1
Mound		0	1	3	4	2.4
Ditch		0	0	3	3	1.8
Open Pit		0	1	0	1	0.6
	Total	11	2	10	23	14.0
Total		**13**	**3**	**104**	**120**	**73.2**
TOTAL ALL BURROWS		**14**	**36**	**114**	**164**	

Twenty burrows monitored over 4 years were filled in with sediment and became unusable by owls. Eighteen (90 percent) of these were earthen burrows: 12 of these were in natural habitat and 6 were in human-altered habitat. Two earthen burrows out of 20 that became unusable by owls were filled in with vegetation by packrats. One additional earthen burrow was filled in with soil by an animal (for 5 months) and was later reopened; owls reproduced there after it was reopened. During this same period, only two (10 percent) culvert burrows became filled in. Sixteen burrows that were monitored were tortoise burrows that at some time during the study were used intermittently by owls.

The frequency distribution of the number of burrow openings at burrow sites is shown in

3.3.2 Burrow Use Rate by Burrow Site

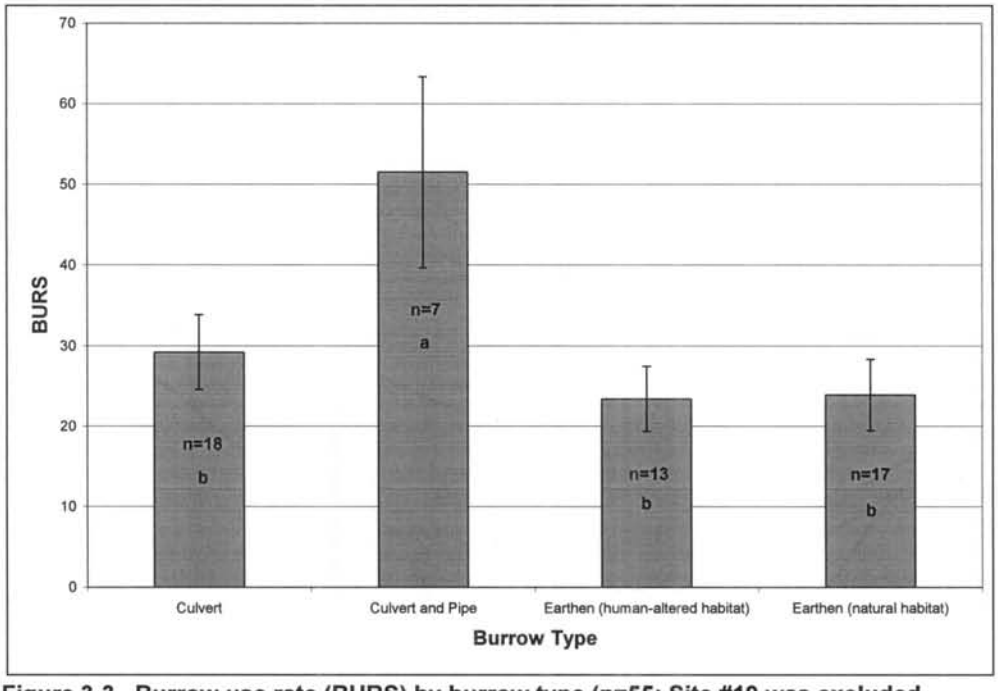


Figure 3-3. Burrow use rate (BURS) by burrow type (n=55; Site #19 was excluded due to a sample size of one; different letters indicate significant differences at α=0.05).

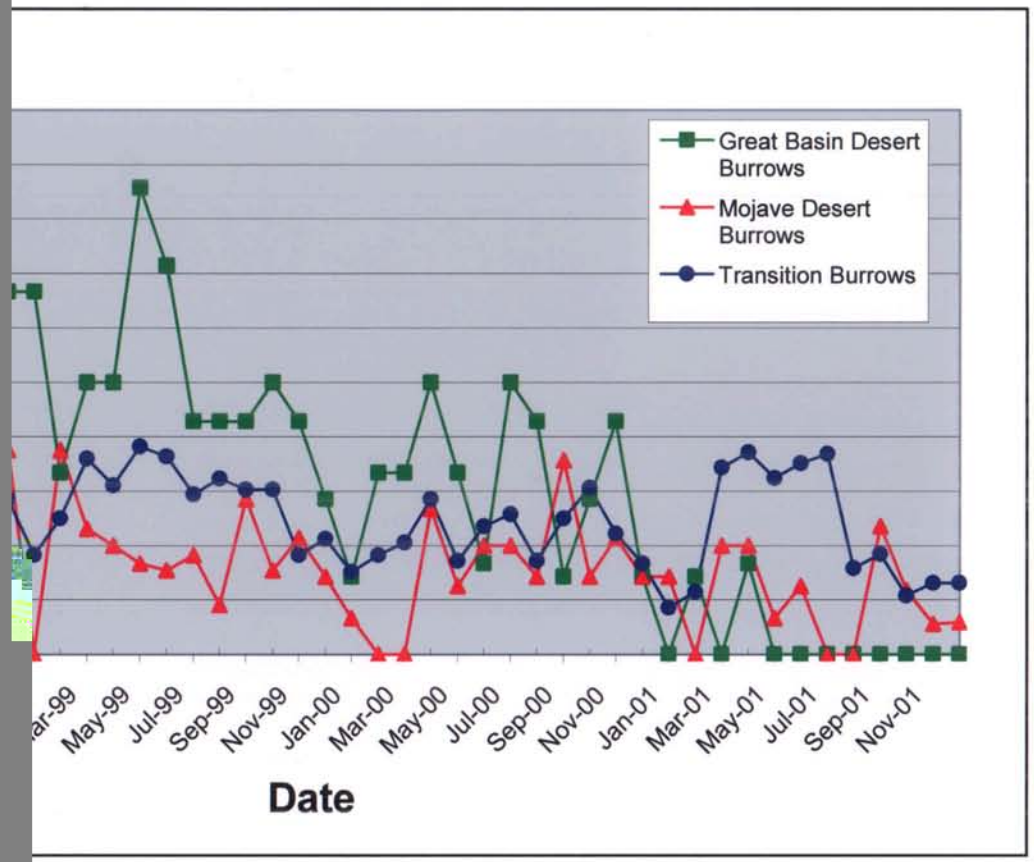
3.3.3 Burrow Use Rate by Month and Ecoregion

BURM values are shown for the duration of the monitoring period in Figure 3-4 with corresponding raw data presented in Appendix D. Results indicate that owls occur on the NTS year-round. The Great Basin Desert ecoregion had highest overall BURM values during 1998-2000, although only one to seven sites were sampled. The use rate in this ecoregion dropped to zero in the spring of 2001 and remained at zero through the end of the monitoring period. BURM values in the transition ecoregion were generally higher than in the Mojave Desert ecoregion.

Each ecoregion shows a similar pattern each year: BURM values decline during December to February followed by an increase during March to May. BURM values in the Mojave Desert ecoregion also increase each year in September. Owls were present on the NTS during winter (December-February) and BURM values were generally at their lowest point during this time. Overall, owls used 33 burrow sites during winter (December-February) at the NTS for at least one or more month's duration. Winter rates of burrow occupancy varied greatly (0-67 percent), between regions, months, and years and often dropped to below 15 percent or lower in each ecoregion during January or February (Figure 3-4, Appendix D).

3.3.4 Burrow Reuse Rate

The BRR value steadily declined each year over the monitoring period. Of the original 29 burrows active in 1998; 23 of 29 (79.3 percent) were reused during 1999, 18 of 27


Great Basin Desert Burrows
Mojave Desert Burrows
Transition Burrows
May-99
Jul-99
Sep-99
Nov-99
Jan-00
Mar-00
May-00
Jul-00
Sep-00
Nov-00
Jan-01
Mar-01
May-01
Jul-01
Sep-01
Nov-01
Date

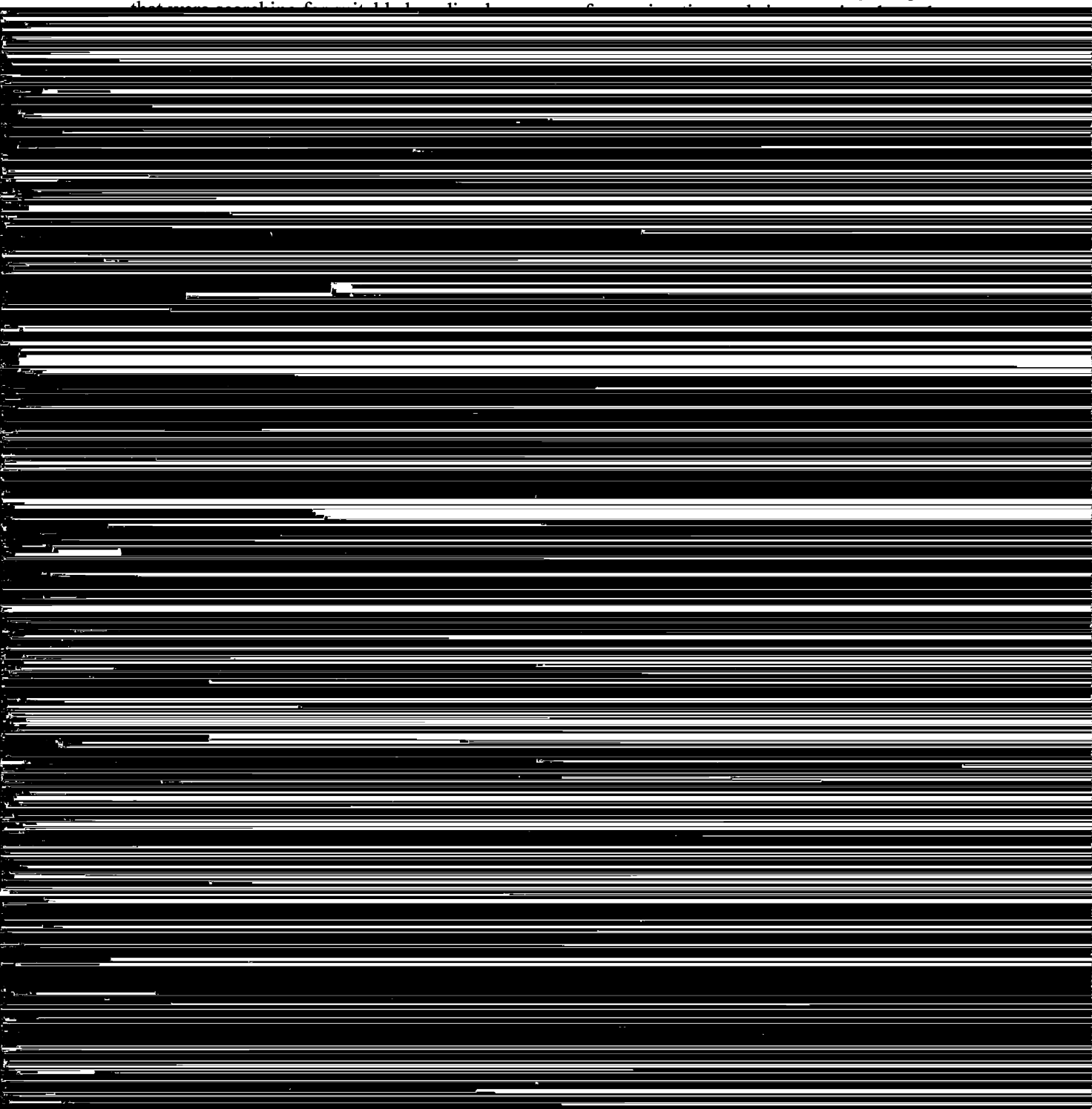
(66.7 percent) (two of the original burrows were filled in) were reused during 2000, and 14 of 27 (51.9 percent) were reused during 2001.

3.4 Discussion

3.4.1 Burrow Characteristics

Burrow monitoring on the NTS shows that burrows in human-altered habitat account for nearly three-fourths of all known burrows on the NTS while burrows in natural habitat account for

indicate increased use from March to May which suggests that owls were immigrating to the NTS during this time period. BURM values then generally decreased at various rates to their lowest point during December to February. An exception to this general use pattern occurred in the Mojave Desert ecoregion. During September, BURM values increased sharply and dropped again in October. This spike in use may have been due to dispersing juveniles searching for their own burrows or from migrating owls that used burrows in this ecoregion as stopover points as they headed south. The peak of use in the spring may have been from resident or migrating owls



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4.0 REPRODUCTION AND ACTIVITY PATTERNS

4.1 Introduction

Owl reproduction on the NTS was first documented in June 1990, when a biologist observed a family group of four individuals at a burrow in north Yucca Flat (Greger and Romney, 1994b). Ten additional opportunistic sightings of groups numbering more than two individuals were seen between June 1990 and June 1999, when reproductive monitoring began. For this study, it was assumed that a family group consisted of three or more individual owls observed at a burrow site during the breeding season, unless the number of juvenile owls was specifically noted. The objectives of reproduction monitoring were to (1) describe nest burrow location, type, and use over time, (2) quantify the number of owl breeding pairs and young and timing of reproduction on the NTS, (3) evaluate the use of remote monitoring of occupied burrows for identifying owl population trends on the NTS, and (4) describe the activity patterns of owls based on photographs and event data.

Remote reproduction monitoring was conducted using active infrared beam and camera technology, specifically the TrailMaster® camera system (Goodson and Associates, Inc., Lenexa, Kansas), to document the number of breeding pairs and young. Other researchers have documented numbers of owl breeding pairs and young by direct visual counts outside burrows (Butts, 1971; Thomsen, 1971; Smith and Murphy, 1973a; Martin, 1973; Wedgwood, 1976; Gleason and Johnson, 1985; Ratcliff, 1986; Green and Anthony, 1989; Plumpton and Lutz, 1994; Belthoff and King, 1994; Botelho and Arrowood, 1998; Lutz and Plumpton, 1999; Millsap and Bear, 2000; Belthoff and Smith, 2000; Conway and Simon, 2003; Gorman et al., 2003), direct capture (Plumpton and Lutz, 1994), or observing them inside artificial nest burrows (Henny and Blus, 1981; Botelho and Arrowood, 1998; Belthoff and Smith, 2000; Todd et al., 2003). The TrailMaster® technique was selected over visual observations because numerous (five to seven) visits are needed to maximize the probability of detecting all young present at a given burrow (Henny and Blus, 1981; Gleason and Johnson, 1985; Gorman et al., 2003). The TrailMaster® technique only requires one to three visits and records owls at burrows over a longer time period than direct observations (e.g., up to 35 observations over an 18-hour period if photographs are taken every half hour). Use of the TrailMaster® camera systems to count owl breeding pairs and young has not been documented. TrailMaster® systems have been used by other researchers to identify ground-nest predators (Hernandez et al., 1997) and to inventory a wide variety of animals in many different habitats in California (Kucera and Barrett 1993).

The photographs and event data were examined to investigate daily activity patterns defined as presence on the burrow apron, prey delivery or feeding at burrow apron, and entry into or exiting from the burrow entrance. This was not an attempt to develop activity budgets for owls because of the technique limitations. The main reasons for analyzing activity patterns were to answer the following questions: (1) when are the best times to count the maximum number of young per nest burrow, (2) when do owls deliver prey to or feed themselves or others, (3) are there differences in activity patterns between young and adults, and (4) when are owls most active at their burrows.

Activity patterns of owls at their burrows have been previously reported (Grant, 1965; Coulombe, 1971; Thomsen, 1971; Marti, 1974; Zarn, 1974; Haug and Oliphant, 1990; Haug et al., 1993). Activity patterns in these studies were determined mainly by visual observations. In addition to visual observations, Marti (1974) used event recorders and Haug and Oliphant (1990) used radiotelemetry.

4.2 Methods

Known owl burrow sites were monitored monthly from February to August in 1999, 2000, and 2001 to determine active use by owls (see Section 3.2). TrailMaster® camera systems

Figure 4-1. Trailmaster® (TM1500) camera system set up at Burrow Site #32 (A=transmitter, B=receiver, C=camera and protective shelter, and D=cable).

at each burrow. The maximum number of events that could be recorded was about 1,100 due to the memory storage limitations of the receiver.

Activity patterns were determined by analyzing photographs and the event data by time of day. All TM1500 event data (date, time, event number, photograph number) were uploaded to a desktop personal computer using StatPack® computer software (Goodson and Associates, Inc., Lenexa, Kansas). Each event having a corresponding photograph was also given a description of the content of the photograph. Content categories included: adult owl(s), young owl(s) young and adult owl(s) together, prey delivery or feeding, and whether the photograph contained the maximum number of young owls photographed at a burrow during a given year. These data were then imported into a Microsoft® Excel spreadsheet. Histograms were then constructed of the number of photographs containing the various contents listed above for each hour of the day. A photograph was assigned a whole hour value based on when it was taken. For example, if a photograph was taken between 0200 and 0259 it was assigned a whole hour value of 0200.

4.3 Results

Owl reproduction was monitored at 18 to 24 active burrow sites per year over a 3-year period (Table 4-1). A total of 39 unique, active sites were monitored with 23 sites occurring in the transition ecoregion, 10 in the Mojave Desert ecoregion, and 6 in the Great Basin Desert

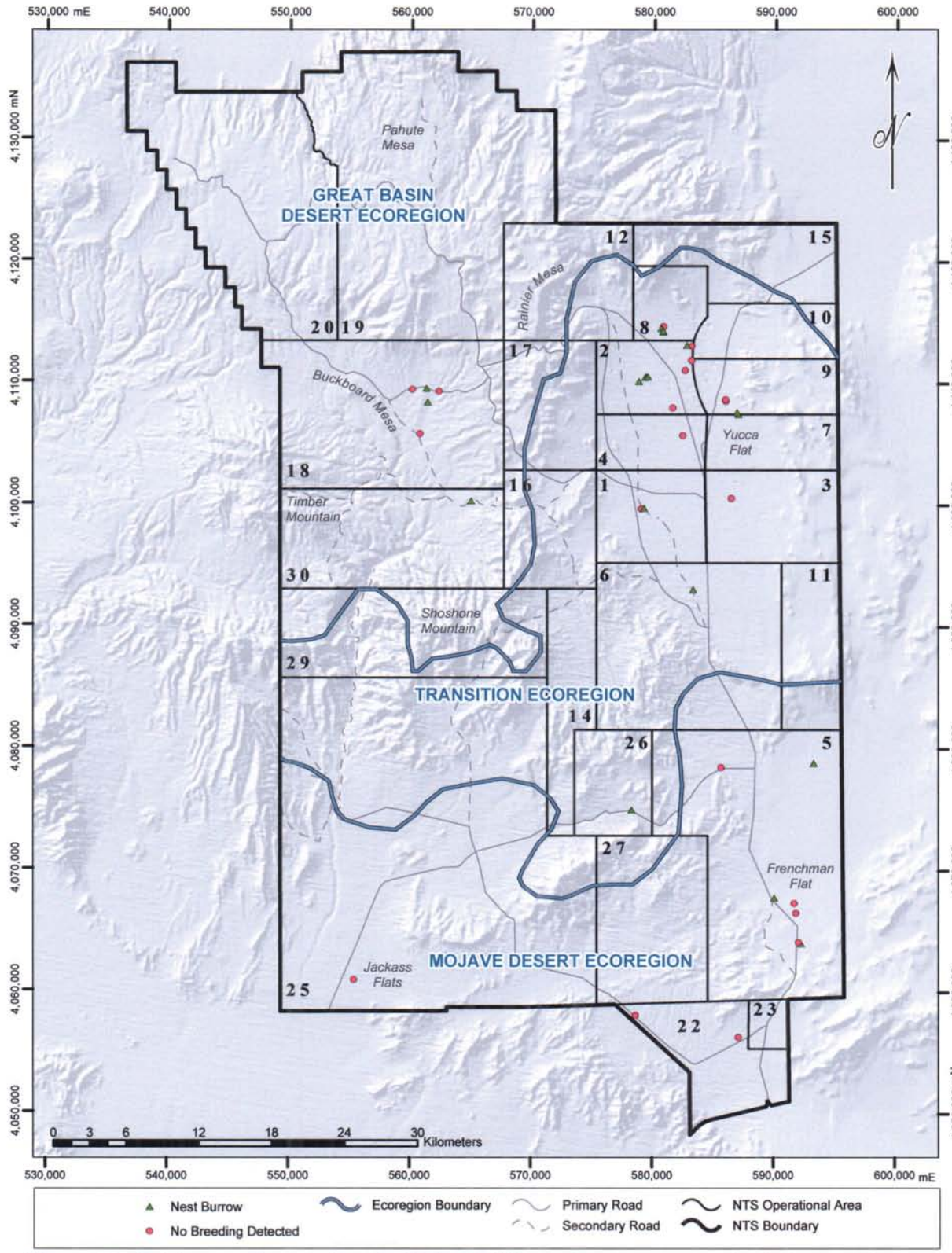


Figure 4-2. Owl burrow sites monitored with the TrailMaster® camera system, including nest burrows where breeding was detected.

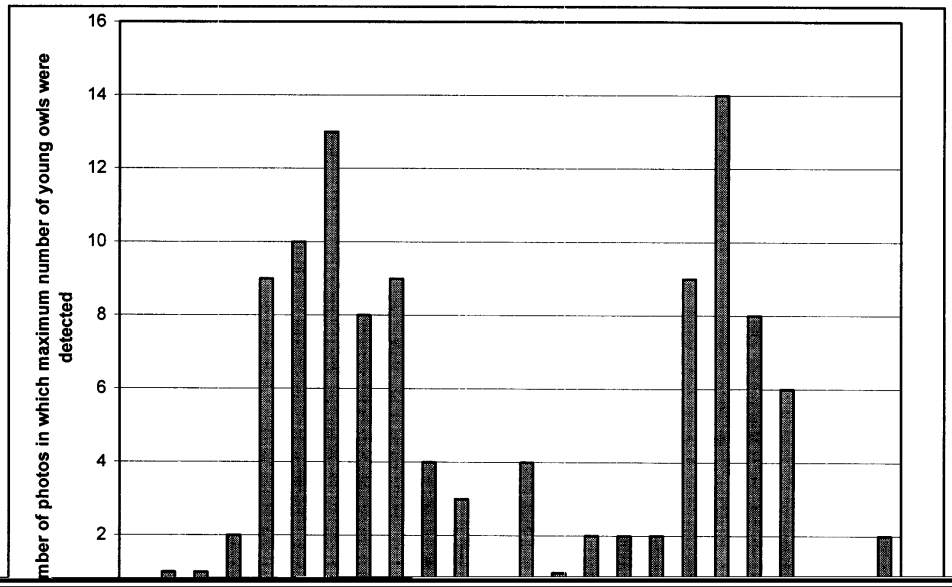
Table 4-2. Average number of young per breeding pair by year and ecoregion on the Nevada Test Site (1999-2001).

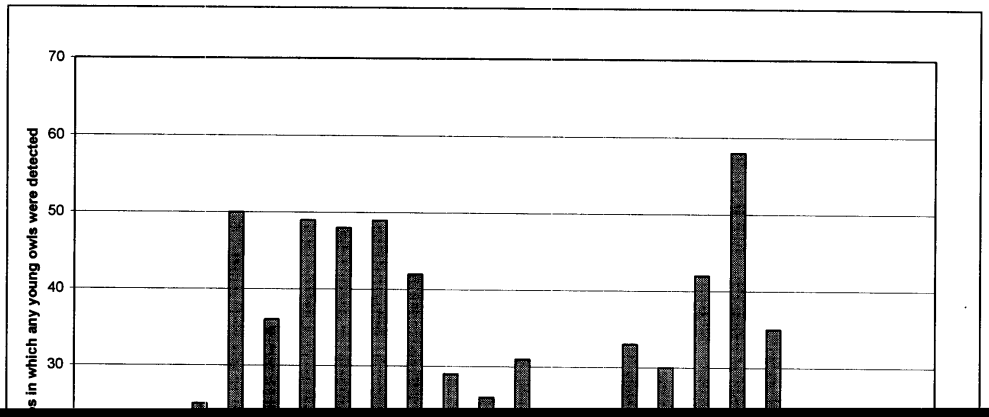
Ecoregion	1999				2000				2001				1999-2001			
	Young/Pair	n	range	s.d.	Young/Pair	n	range	s.d.	Young/Pair	n	range	s.d.	Young/Pair	n	range	s.d.
Great Basin Desert	3.3	3	1-6	2.5	8.0	1	8	0.0	0.0	0	0.0	0.0	4.5	4	1-8	3.1
Mojave Desert	0.0	0.0	0.0	0.0	3.0	1	3	0.0	3.0	2	3	0.0	3.0	3	3	0.0
Transition	3.5	4	3-5	1.0	5.3	6	4-7	1.0	5.4	9	1-8	2.1	5.0	19	1-8	1.8
NTS Total	3.4	7	1-6	1.6	5.6	8	3-8	1.6	5.0	11	1-8	2.1	4.7	26	1-8	2.0

The earliest date that young were detected during each year was June 26, 1999; May 18, 2000; and May 31, 2001. The vast majority of young were detected during the months of June and July (Appendix E).

Results from the photographs reveal that the maximum number of young owls per nest burrow were most frequently detected between 0500-1000 and 1800-2200 with peaks at 0700-0800 and 1900-2000 (Figure 4-3). Prey delivery and feeding were most frequently detected in photographs between 0300-0500 and 2000-0100 (Figure 4-4). No prey delivery or feeding were detected between 0600-0800, 1100-1200, and 1300-1900 (Figure 4-4). Young owls were detected on the burrow apron during all hours of the day and night with three peaks of activity: 0500-0600, 0700-1000, and 1900-2000 (Figure 4-5). Adult owls were also detected on the burrow apron during all hours of the day and night with three peaks of activity between 0500-0600, 0800-1000, and 1500-2000 (Figure 4-6). The presence of young and adult owls on the burrow apron together was detected during all hours of the day and night with three peaks: 0500-1000, 1300-1400, and 1900-2000 (Figure 4-7). The presence of any owl on the burrow apron was also detected during all hours of the day and night with three peaks of activity: 0500-0600, 0800-1100, and 1600-2000 (Figure 4-8). Events (times when the infrared light beam was broken regardless if a photograph was taken) were recorded during all hours of the day and night with three peaks of activity: 0500-0600, 0900-1000, and 1600-2000 (Figure 4-9).

Approximately 2,828 photographs were taken during the monitoring period. Of these 2,225 (79 percent) contained pictures of owls, 406 (14 percent) contained pictures of animals other than owls, and 197 (7 percent) showed nothing. Other animals detected at burrow entrances in the photographs include badger (*Taxidea taxus*), coyote (*Canis latrans*), kit fox (*Vulpes macrotis*), bobcat (*Felis rufus*), desert cottontail rabbit (*Sylvilagus audubonii*), black-tailed jackrabbit (*Lepus californicus*), antelope ground squirrel (*Ammospermophilus leucurus*), kangaroo rat (*Dipodomys* spp.), woodrat (*Neotoma* spp.), greater roadrunner (*Geococcyx californianus*), unidentified passerines, and raven (*Corvus corax*).


mber of photos in which maximum number of young owls were detected
16
14
12
10
8
6
4
2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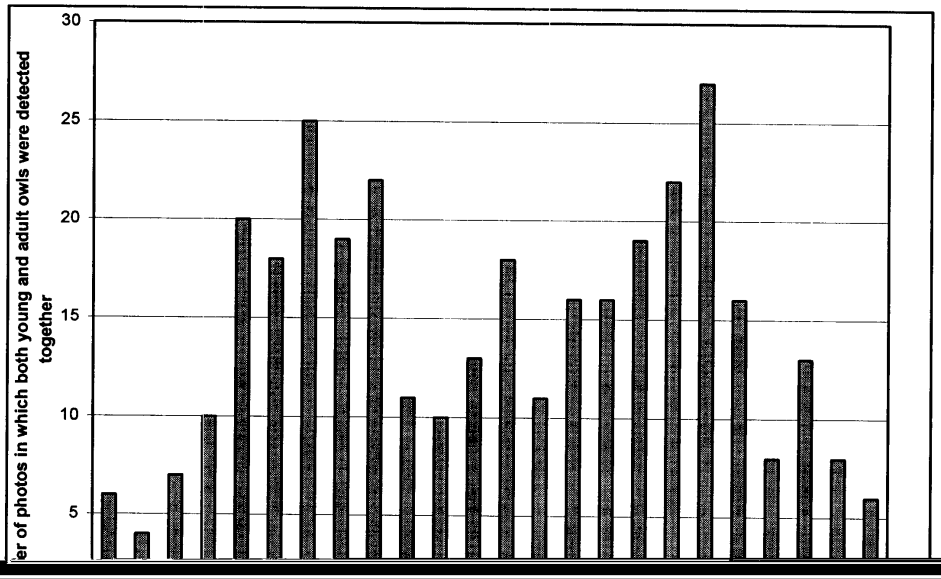
30
s in which any young owls were detected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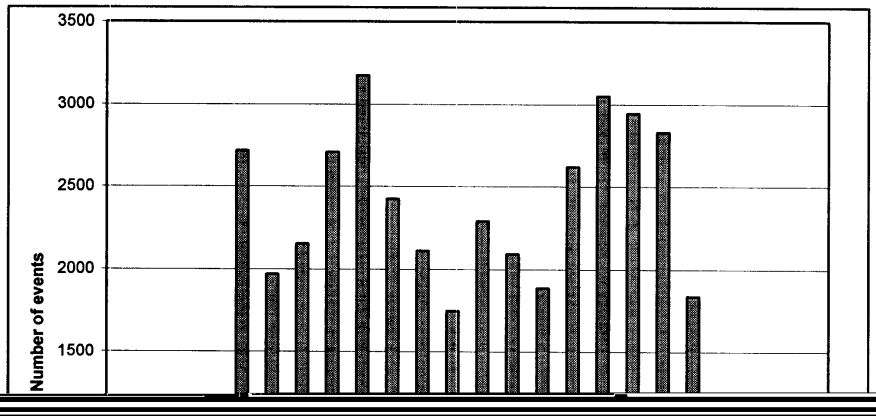
er of photos in which both young and adult owls were detected together


3500
3000
2500
2000
1500
Number of events

Forty percent of nest burrows on the NTS appeared to have been dug by other animals, including desert tortoise. Zarn (1974) also documented owl nests in tortoise burrows. Haug et al. (1993) report that nest burrows used by owls are most often dug by other animals (e.g., badgers, rodents, skunks), and that the close association owls have with burrowing mammals suggests dependence on these mammals to excavate burrows for owls to use. Thomsen (1971) reports that owls can excavate holes where burrowing mammals are absent but Haug et al. (1993) add that they rarely do so. On the NTS, our data suggest that while owls use nest burrows dug by other animals, they do not use them exclusively, and the addition of partially buried culverts and pipes has significantly increased the number of suitable burrows available to nesting owls. Thus, owls on the NTS may not be as dependent on burrowing animals as much as they are in other areas. Also, nine nest burrow entrances on the NTS were lined with horse and cow dung. This practice has been documented by other researchers and is believed to mask the owl's scent (Bent, 1938;

between the number of young per breeding pair in the transition ecoregion and October to March precipitation (as measured from a recording station in central Yucca Flat). More years of data are needed to verify this correlation. If it holds true, it may be a useful tool to predict owl reproductive output. Nagy (1988) and Sowell and Boone (1996) determined that abundance of desert vertebrates was highly correlated with precipitation during the previous winter and spring, which they defined as October to March. Saethre (1994) also found a strong correlation between small mammal density in the spring and the amount of precipitation the previous September through March. Beatley (1969) and Munger et al. (1983) showed that successful desert rodent reproduction (based on summer densities) was dependent on the presence of winter annuals that germinated from critical precipitation received the previous fall, winter, or spring. Since rodents are a major prey item of the owl, it is logical to assume that owl reproduction is strongly influenced by rodent abundance, which is driven by critical precipitation received the previous fall, winter, or spring.

4.4.4 Timing of Reproduction

The earliest date that young were detected on the NTS was May 18, 2000. The vast majority of young were detected during the months of June and July (Appendix E). Similarly, Belthoff et al. (1995) documented that the first young owls appeared above ground on May 20, 1994, in their study area in southwestern Idaho and concluded that most young were hatched between mid-May and early-June. Rich (1986) observed young near natal burrows as early as June 10 and as late as September 17 in south central Idaho.

Based on the size and plumage of the young in the photographs, it appears that reproduction was delayed during 1999 compared with 2000 and 2001. The delayed reproduction was possibly caused by the late arrival (April) of precipitation which is necessary for stimulating plant growth and rodent reproduction (Beatley, 1969). Based on our data, it is recommended that researchers using the TrailMaster® technique in similar habitat set up cameras from mid-May through mid-

problem was owls and other birds perching on the camera shelter and tipping the camera so it was not focused on the burrow entrance. This problem was fixed by using two pieces of duct tape to attach the camera shelter to the fence post. Another problem was rodents or other animals chewing through the cable that connected the camera to the receiver. This was remedied by burying the cable 2.5 to 5 cm and using duct tape to cover the cable the first 30-60 cm up the fence post. It is advisable to have two or three extra cables on hand. The C-cell alkaline batteries in the transmitter and receiver lasted approximately two months and the camera battery three months with continuous use. Appendix F details the costs and time involved with this technique.

4.4.6 Activity Patterns of Young and Adult Owls

The best times to detect the maximum number of young owls at NTS nest burrows were during

late July or August as the young owls developed their adult plumage. Wedgwood (1976) and Bent (1938) experienced similar identification problems. Figure 4-10 shows the contrast between the plumage of an adult and young owl.

4.4.7 Non-nest Burrows and Predation

Only about half of the active burrow sites sampled with the Trailmaster® system contained nest burrows. At some sites, photographs documented the presence of an adult pair, but no young were ever detected. These pairs were considered nonbreeding and one to thr

5.0 FOOD HABITS

5.1 Introduction

The objective of this study was to describe owl food habits on the NTS by ecoregion and by season by collecting and analyzing regurgitated owl pellets. Several studies have investigated the food habits of the owl (Errington and Bennett, 1935; Bent, 1938; Hamilton, 1941; Bond, 1942; Longhurst, 1942; Glover, 1953; Grant, 1965; Maser and Brodie, 1966; Ross, 1970; Coulombe, 1971; Maser et al., 1971; Thomsen, 1971; Smith and Murphy, 1973b; Marti, 1974; Gleason and Craig, 1979; Tyler, 1983; Haug, 1985; MacCracken et al., 1985b; Brown et al., 1986; Barrows, 1989; Green et al., 1993; Haug et al., 1993; Plumpton and Lutz, 1993; Rosenberg and Haley, 2003; York et al., 2002). Only one of these was conducted in Nevada, near Yerrington (western portion of the state) (Bond, 1942). Also, none of these investigated food habits of owls in the Mojave Desert.

Longhurst (1942), Coulombe (1971), Thomsen (1971), Haug (1985), MacCracken et al. (1985b), Plumpton and Lutz (1993), and York et al. (2002) point out that pellet analysis does not always

Data were analyzed statistically using Minitab® software (Minitab, 1997). Binomial logistic regression was used on the raw presence/absence data to determine if significant differences ($P \leq 0.05$) occurred among ecoregions and seasons for each taxon.

5.3 Results

A total of 292 samples (1,631 pellets) from 48 burrow sites (30 from transition, 7 from Great Basin Desert, and 11 from Mojave Desert) were analyzed (Figure 5-1). The average number of pellets per sample was 5.6 (s.d=5.8; range 1 to 38). There were no statistically significant interactions between ecoregion and season.

A total of 20 taxa were identified in the pellet analyses, including 7 taxa of invertebrates and 13 taxa of vertebrates. Some of the taxon categories encompass others (e.g., western harvest mouse [*Reithrodontomys megalotis*] is in the Muridae family). However, each category was broken out to the lowest level possible as opposed to lumping the data up into the highest level. Pellet weathering was not a problem in our study because of our frequent (at least monthly) collections.

Table 5-1 contains the results of the food habits analysis by ecoregion and for all ecoregions combined. Values with different letters are significantly different from each other at ($P<0.05$)

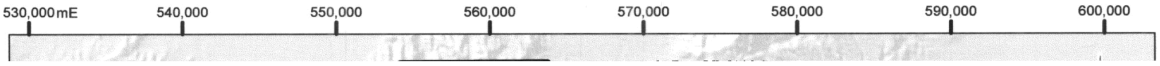

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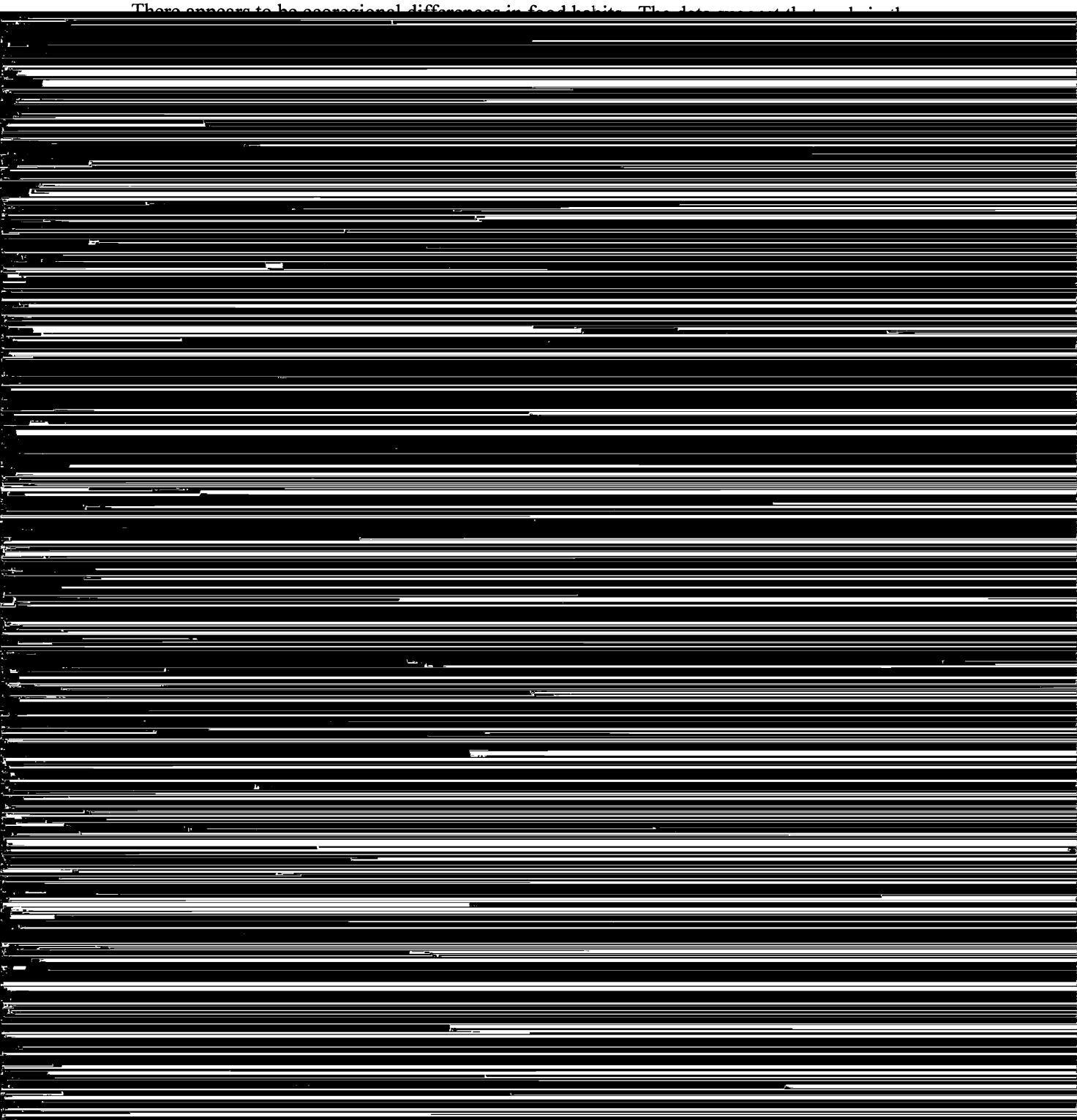
Table 5-1. Percent frequency of prey item remains in owl pellets on the Nevada Test Site by ecoregion and all ecoregions combined. Values with different letters are significantly different from each other at P≤0.05.

Taxon	Great Basin	Mojave	Transition	TOTAL
	n=58 (339)	n=43 (162)	n=191 (1,130)	n=292 (1,631)
Invertebrates				
Orthoptera	79.3a	95.3a	85.9a	86.0
Coleoptera	86.2a	72.1a	82.7a	81.8
Solpugida	75.9a	76.7ab	60.7b	66.1
Scorpiones	77.6a	58.1b	46.1b	54.1
Araneae	20.7a	16.3a	25.7a	23.3
Hemiptera	29.3a	0.0b	3.7b	8.2
Chilopoda	1.7a	0.0a	0.5a	0.7
Fragment of any invertebrate	93.1a	95.3a	95.8a	95.2

Table 5-2. Percent frequency of prey item remains in owl pellets on the Nevada Test Site by season. Values with different letters are significantly different from each other at P<0.05

western Nevada and found spadefoot toad (*Scaphiopus* spp.) remains as the dominant prey item. No spadefoot toad remains were found in pellets on the NTS since toads are not known to occur onsite (Wills and Ostler, 2001). Our results from the Mojave Desert are similar to what Barrows (1989) found in the Colorado Desert as far as major prey items detected in the pellets; however, the proportions of major prey items detected are quite different.

There appears to be ecoregional differences in food habits. The data suggest that [redacted]



Vertebrates occur less frequently in owl pellets than invertebrates but are still a significant part of the diet, especially given their larger body size. Vertebrate prey items occur least frequently in pellets collected during the fall and of equal frequency in pellets collected during winter, spring, and summer (Table 5-2, Figure 5-2). Reasons for this pattern may include prey availability, different seasonal energetic demands of owls, or most likely a combination of both.

Declines in the percentage of vertebrate prey and increases in invertebrate prey were not found during the breeding season in our study, unlike other studies (Errington and Bennett, 1935 [Iowa]; Green, 1983 [Oregon]; Haug, 1985 [Saskatchewan]; MacCracken et al., 1985b [South Dakota]). Our results more closely resembled the results of Butts (1973) and Tyler (1983) in Oklahoma who showed that invertebrates were found in lowest occurrence during winter and vertebrates in highest occurrence during winter and spring.

Our data, like most other studies, suggest that both invertebrate and vertebrate prey are important components of the owl's diet. Furthermore, our results support the general premise of other researchers that owls are opportunistic feeders and have a generalist feeding strategy, rather than focusing on only one or a few food types.

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6.0 DISTURBANCE EFFECTS

6.1 Introduction

Only a couple of studies have been conducted on human disturbance effects on the western burrowing owl (Plumpton and Lutz, 1993; Botelho and Arrowood, 1996) and a few additional studies on the Florida burrowing owl (*Athene cunicularia floridana*) (Wesemann and Rowe, 1987; Mealey, 1997; Millsap and Bear, 2000). Plumpton and Lutz (1993) measured time budgets of owls (i.e., how much time owls engaged in predefined behaviors) in response to vehicular traffic, and found no significant effects of vehicular traffic on productivity. Millsap and Bear (2000) found that high disturbance levels (>60 percent occupancy in subdivisions) due to homebuilding caused nest failures and decreased productivity of the Florida burrowing owl in Florida. They reported that Florida burrowing owls fledged more young if buffer zones greater than 10 m were established around active nests. Buffer zones are areas of a certain distance around active burrows in which human activity is limited or denied so as to avoid disturbing owls at their burrows. Buffer zones are normally of two types: spatial (i.e., defined area around burrow is protected) and temporal (i.e., only apply at certain times of the year). Recommended buffer zones for the western burrowing owl include prohibiting Carbofuran insecticide use within 250 m of occupied nest burrows in Canada (Haug, 1993), pesticide-and herbicide-free zones of 600-m radius around burrows in Idaho, and prohibiting human activities within 200 m of nest burrows in Oregon and Washington (Klute et al., 2003). For other species of raptors, recommended buffer zones have been summarized by Richardson and Miller (1997) and Holmes et al. (1993).

Our primary objectives were to determine the size of buffer zones that would protect owls and their burrows and determine their tolerance to different disturbance types (e.g., traffic, human activity near burrow). To accomplish these goals we examined: (1) the flushing distance of owls in response to biologists approaching the burrow site on foot and in a vehicle, (2) the relationship between the number of young per nest and vehicle traffic rates at various distances from nest burrows, and (3) the distance from burrows to existing disturbances.

6.2 Methods

We measured the flushing distance of owls in response to biologists approaching a burrow on foot (walking) and in a vehicle during reproductive and monthly burrow monitoring from 1999-2001. The flushing distance is the distance between the observer and the owl at the time the owl flies away from or moves into the burrow in response to the human disturbance. In each instance, the biologist drove up to a site, stopped the vehicle, exited the vehicle, and approached

sites. Many of the burrow sites monitored were active nest burrows. A distance was also

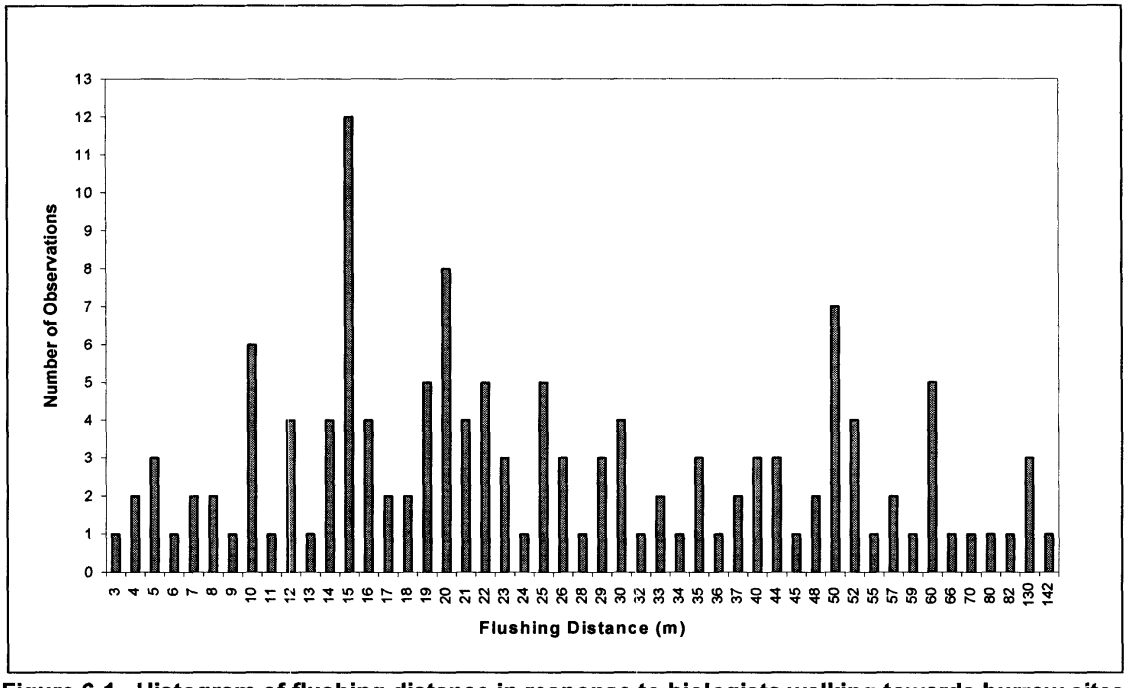


Figure 6-1. Histogram of flushing distance in response to biologists walking towards burrow sites on the Nevada Test Site (n=137).

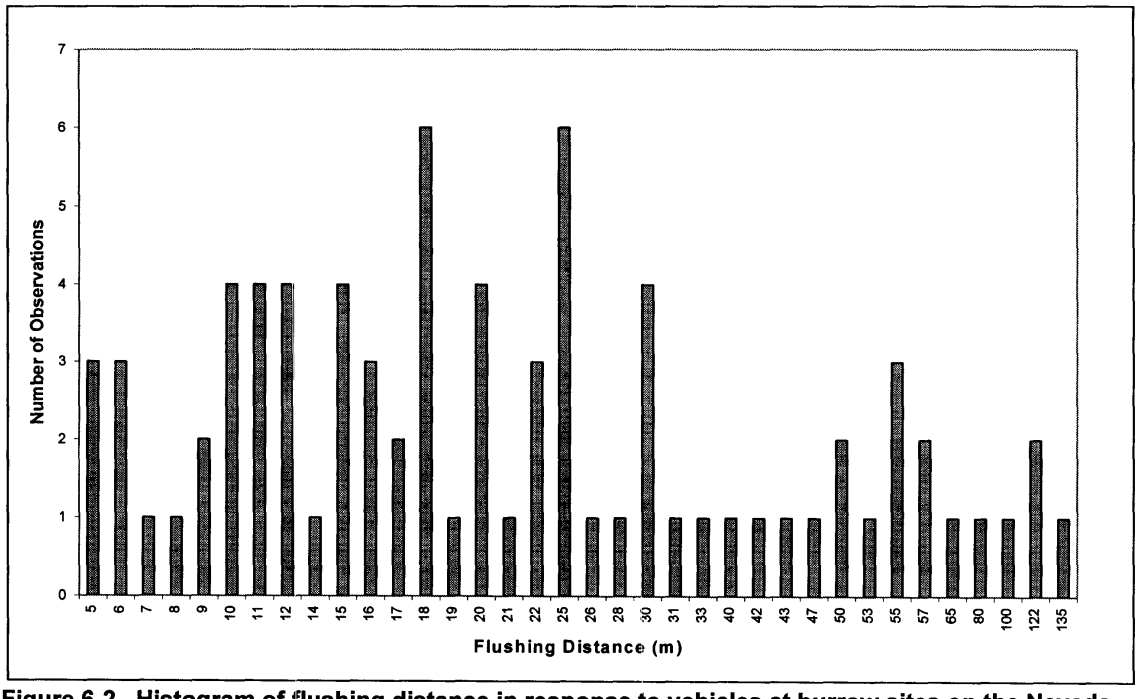
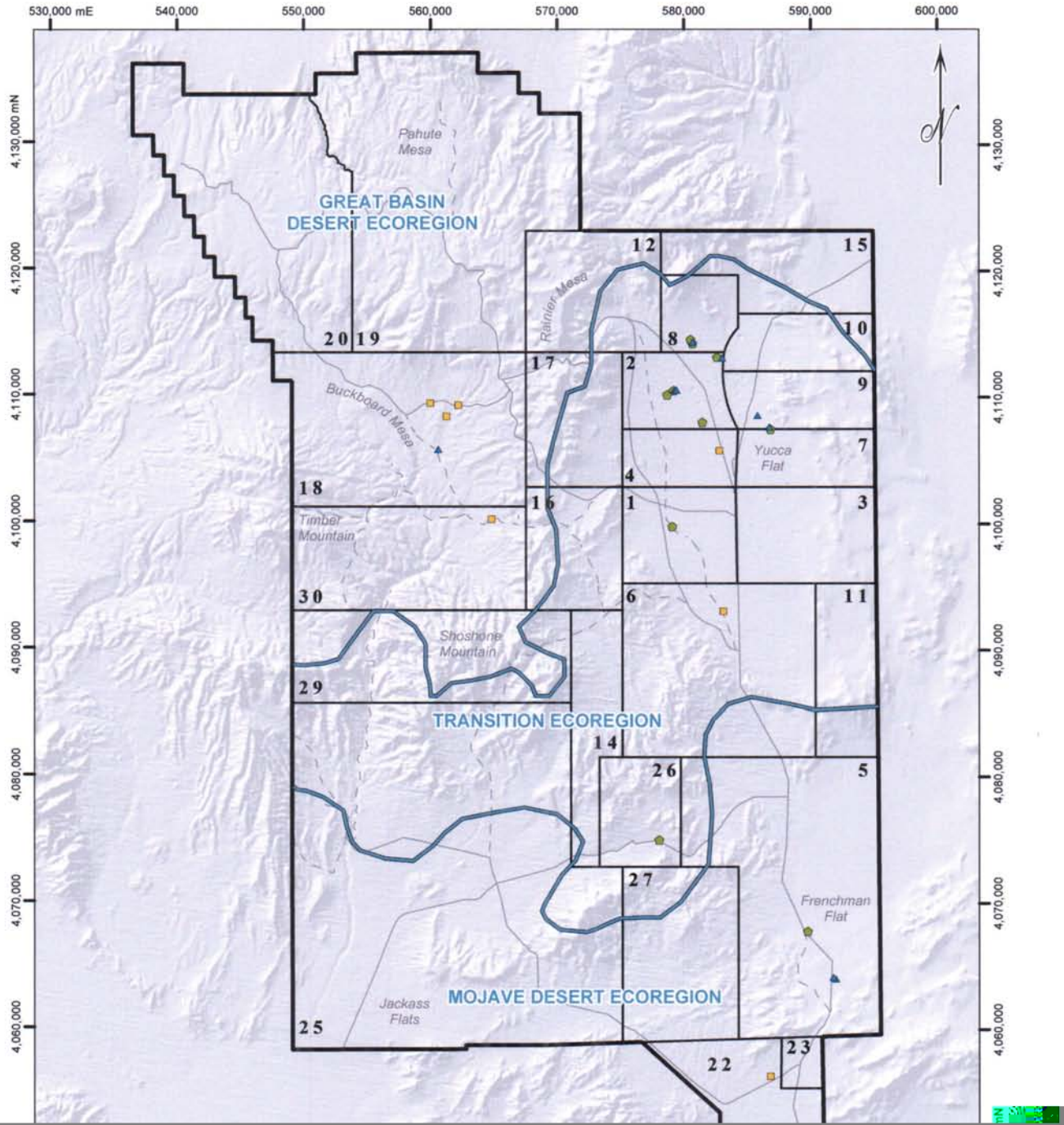


Figure 6-2. Histogram of flushing distance in response to vehicles at burrow sites on the Nevada Test Site (n=79).

Table 6-1. Average flushing distances in response to walking and driving vehicles towards burrow sites.

Owl Response	Flushing Distance (m)							
	Walking				Vehicle			
	Mean	SD	Range	n	Mean	SD	Range	n
Flush from burrow	28.3	20.4	3-142	117	31.4	29.0	5-135	62
Flush into burrow	45.0	39.1	7-130	20	18.6	11.2	5-53	17
All Responses	30.7	24.8	3-142	137	28.7	26.7	5-135	79

flushing distances are shown in Table 6-1. The average flushing distance of owls away from the burrow in response to walking and vehicles was similar, approximately 28 and 31 m, respectively. In contrast, there were differences in the average flushing distances of owls into the burrow in response to walking and vehicles, 45 and 19 m respectively. Owls flushed into burrows less often (37) than they flew away (179). The mean flushing distance for all responses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4,060,000
Pahute Mesa
GREAT BASIN DESERT ECOREGION
Rainier Mesa
Buckboard Mesa
Yucca Flat
Timber Mountain
Shoshone Mountain
TRANSITION ECOREGION
Frenchman Flat
Jackass Flats
MOJAVE DESERT ECOREGION
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Table 6-2. Vehicle traffic rates, distance to nest burrow, and number of young detected at burrow sites on the Nevada Test Site during 2000 and 2001 .

Burrow Site	Vehicles/ Day	Distance to Nest (m) from Road	Young Detected
2000			
Area 26, Cane Spring Road, Wash (#30)	40.2	165	6
Area 2, 2-07 Road, 2L-18 Pad (#67)	10.2	45	7
Area 18, Airport Road #2 (#38)	5.7	14	8
Area 8, 8D Road, Pad (Nest E) (#64)	0.4	196	7
Area 8, 8D Road, Pad (Nest B) (#64)	0.4	269	4
Area 9, Powerline Road, Pad (#15)	0.4	145	5
Area 1, Orange Road, O-30 #2, Wash (#43)	0.3	48	5
2001			
Area 5, Mercury Highway, M-27	487.8	65	3
Area 2, 2-04 Road, East (#4)	1.9	78	4
Area 2, 2-04 Road, West (#3)	1.8	11	4
Area 2, 2-04 and 2L Roads Intersection (#2)	1.2	10	1
Area 9, Powerline Road, Pad (#15)	0.9	172	6
Area 9, 9-01 Road, 9G-11 (#73)	0.9	75	7
Area 8, 8D Road, Pad (Nest E) (#64)	0.4	196	6
Area 8, 8D Road, Pad (Nest B) (#64)	0.4	269	6
Area 8, 8D Road, 8D-2 #2 (#76)	0.4	120	8
Area 2, 2L Road, 2L-5 (#8)	0.2	11	7

between humans walking and vehicles driving near burrows, our data indicate that over 90 percent of owl flushing responses will be prevented. Researchers setting buffer zones around nests of other raptor species have also used distances that would prevent 90 percent of flushing responses from occurring (White and Thurow, 1985; Holmes et al., 1993). The buffer distance of >10 m recommended by Millsap and Bear (2000) would only have avoided 16 percent of flushing responses based on our findings. The Florida burrowing owls they studied were probably more habituated to humans than owls in our study and thus tolerated human presence closer to their burrows.

Traffic rates measured during this study were low in most cases. There was no statistically significant effect of traffic on owl productivity. It appears that owls are very tolerant of traffic even up to levels approaching nearly 500 vehicles a day if their burrows are far enough away from the road (Table 6.3). Our results are consistent with those of Plumpton and Lutz (1993) who found no impact of traffic on owl productivity near owl nesting colonies in Colorado, where daytime traffic levels varied from 0-64 vehicles per hour. In addition, we recorded only three active projects on the NTS during this study in close enough proximity to any burrow site that could have potentially affected owls. Only one of these projects occurred during the breeding season.

We found no significant correlations between BURS and any type of disturbance within 400 m of the burrow sites (all $r^2 < 0.20$ for eight types of disturbances analyzed separately, Appendix I). Other factors such as prey availability, predation pressure, and microhabitat preferences (e.g., percent bare ground, percent vegetative cover, and vegetation height around burrows) influence burrow use rates.

7.0 WINTER BURROW TEMPERATURE PROFILES

7.1 Introduction

Owls spend much of their time underground in burrows. Few studies have been conducted to describe the microclimate of these burrows. Coulombe (1971) in southern California took

15 cm above the ground in the shade of the structure. Depth of emplacement was measured directly by digging down to the top of the culvert and measuring the distance between the soil surface and the top of the culvert and adding the height of the culvert or calculated by measuring the angle of the slope (A) into the burrow with a clinometer and the length of the slope (c). Depth (a) was then calculated using the formula a=c*sine(A). Owl occupancy was determined by checking each burrow approximately every two weeks. On each visit, any sign (e.g., pellets, scat, feathers) on or around the burrow apron was documented and cleared away. If new sign was found on the next visit, it was assumed that the burrow was occupied by an owl.

After data loggers were retrieved, they were taken back to the office and the data was uploaded onto personal computers using HOBO® software. The data were brought into a Microsoft®


530,000 mE
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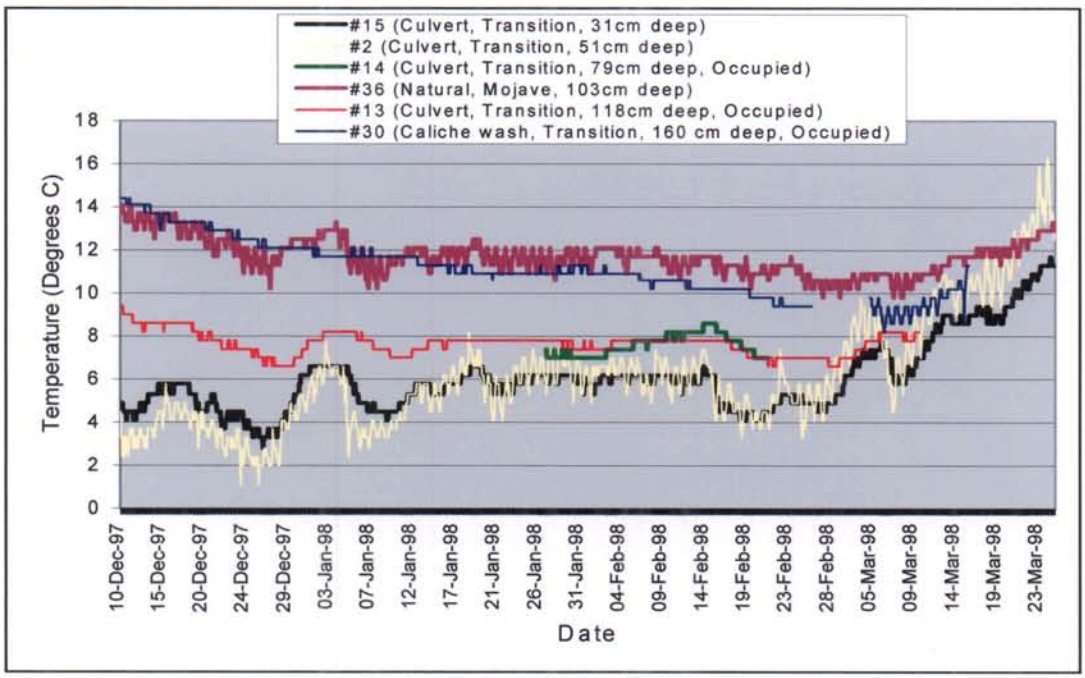
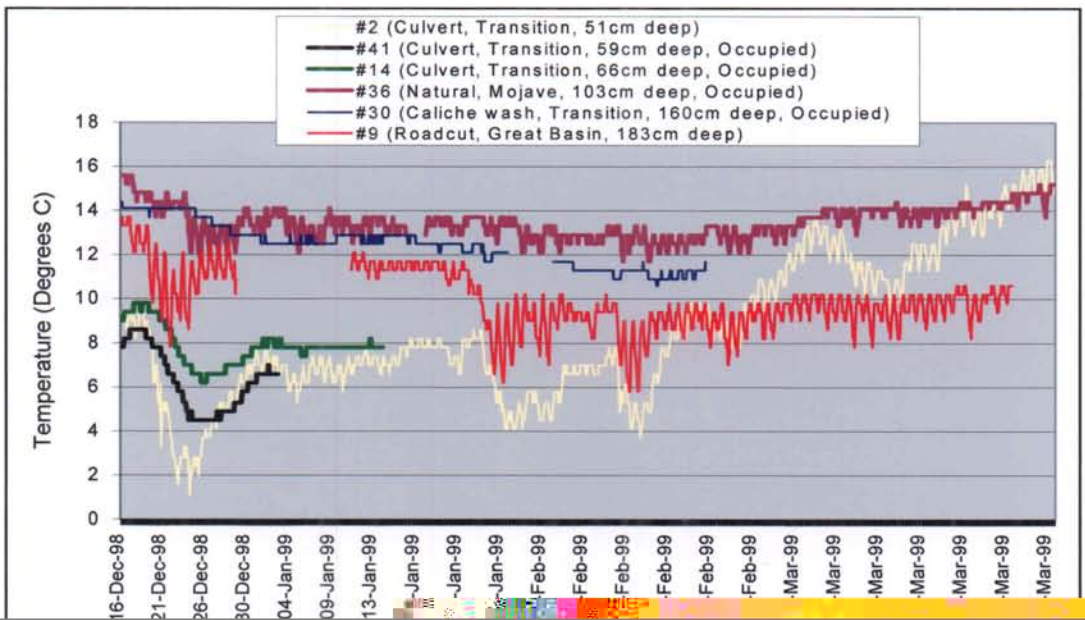


Figure 7-2. Internal burrow temperature profiles for six burrow sites monitored from December 1997 to March 1998.



ch 1999.

lax	Min	Stdev
6.3	1.1	3.2
.4	1.1	2.3
.6	4.1	1.0
2.1	3.7	1.9
6.3	9.4	1.6

lax	Min	Stdev
.6	4.5	1.4
6	4.5	1.5
0	6.6	0.1

ax	Min	Stdev
8	6.2	0.9
8	6.2	1.2
2	7.4	0.1

ax	Min	Stdev
.6	11.7	0.7
.6	11.7	0.9
.1	12.1	0.4
.3	11.7	0.4
.2	12.9	0.4

ax	Min	Stdev
.4	10.6	1.0
.4	12.9	0.5
.9	11.7	0.3
.7	10.6	0.3

ax	Min	Stdev
.7	5.8	1.3
.7	7.8	1.3
.1	6.2	1.4
.2	5.8	0.8
.6	7.8	0.6

sites, #36 and #30, had the warmest average burrow temperatures and the two shallow

Table 7-3. Burrow site characteristics, owl occupancy information, and temperature data (°C) from December to March, 1997-1998 and 1998-1999.

Burrow Site	1997-98	1997-98		Ave. Burrow Temp.	Ave. Ambient Temp.	Burrow-
(Type, Ecoregion)	Depth* (cm)	Length** (m)	Owl occupancy	(dates of data averaged)	(dates of data averaged)	Ambient
#15 (Culvert, transition)	31	6.1	No owls	**5.7** (1/27-2/21/98)***	N/A	N/A
#2 (Culvert, transition)	51	6.1	No owls	**5.9** (1/27-2/21/98)***	N/A	N/A
#14 (Culvert, transition)	79	6.1	Owl (1/27-3/25/98)	**7.6** (1/27-2/21/98)	**4.6** (1/27-2/21/98)	**3.0**
#36 (Natural, Mojave Desert)	103	2.4	No owls	**11.5** (1/27-2/21/98)***	N/A	N/A
#13 (Culvert, transition)	118	6.1	Owl (12/10-12/22/97)	**8.4** (12/10-12/22/97)	**2.5** (12/10-12/22/97)	**5.9**
#30 (Caliche wash, transition)	160	2.1	Owl (2/17-3/25/98)	**9.6** (2/17-2/26;3/4-3/15/98)	**7.9** (2/17-2/26;3/4-3/15/98)	**1.7**
	1998-99	**1998-99**				
	Depth* (cm)	**Length** (m)**				
#2 (Culvert, transition)	51	6.1	No owls	**6.2** (12/16/98-1/14/99)***	N/A	N/A
#41 (Culvert, transition)	59	3.0	Owl (12/16-12/22/98)	**7.9** (12/16-12/22/98)	**3.4** (12/16-12/22/98)	**4.5**
#41 (Culvert, transition)	59	3.0	Owl (3/3-3/30/99)	No data	N/A	N/A
#14 (Culvert, transition)	66	3.5	Owl (12/16/98-3/30/99)	**7.9** (12/16/98-1/14/99)	**4.5** (12/16/98-1/14/99)	**3.4**
#36 (Natural, Mojave Desert)	103	2.4	Owl 12/16-12/22/98	**14.7** (12/16-12/22/98)	**6.5** (12/16-12/22/98)	**8.2**
#36 (Natural, Mojave Desert)	103	2.4	Owl 3/17-3/30/99	**14.4** (3/17-3/30/99)	**14.9** (3/17-3/30/99)	**-0.5**
#30 (Caliche wash, transition)	160	3.0	Owl (1/6-3/30/99)	**12.0** (1/6-1/28; 2/2-2/19/99)	**7.8** (1/6-1/28; 2/2-2/19/99)	**4.2**
#9 (Roadcut, Great Basin Desert)	183	1.8	No owls	No data	N/A	N/A

*=Depth from the ground surface to the emplaced data logger

**=Distance the data logger was emplaced inside the burrow

***=Dates subjectively chosen for best comparison of temperatures with burrows occupied by owls

N/A=Not applicable due to lack of owl occupancy or temperature data for comparing with burrow temperature

5.0 °C and ranged from 2.5 °C at Pumpout Site #13 to 7.0 °C at Pumpout Site #20. The differences

From December 1998 to March 1999 owls occupied four of the six Burrow Sites (#41, #14, #36, and #30) for at least a portion of the time (Table 7-3). Duration and timing of owl occupancy varied greatly. Average burrow temperature during all or a portion of time when owls occupied a burrow was 11.4 °C and ranged from 7.9 °C at Burrow Sites #41 and #14 to 14.7 °C at Burrow Site #36. For corresponding time periods, the average ambient air temperature was 7.4 °C and ranged from 3.4 °C at Burrow Site #41 to 14.9°C at Burrow Site #36. The average difference between average burrow temperature and ambient air temperature was 4.0 °C and ranged from –0.5 °C at Burrow Site #36 (March 17-30, 1999) to 8.2 °C at Burrow Site #36 (December 16-22, 1998). Therefore, the average temperature inside a burrow was generally warmer than average ambient air temperature. Average burrow temperature was again 1.7 °C warmer in Burrow #14 (owl present) than in Burrow #2 (no owl present).

7.4 Discussion

Because of unequal time periods (missing data) and small sample size, it is not possible to statistically analyze these data (e.g., correlate burrow depth with burrow temperature). Also, direct comparisons among burrows should be made cautiously for the same reasons. However, some important and meaningful points can be made based on these data.

Burrow depth does influence burrow temperature with deeper burrows having warmer average

October/November, at which point burrow temperature would again become warmer than ambient air temperature.

The duration and timing of owl occupancy varied greatly during both study periods (Table 7-3). Also, due to data loggers being pulled out of burrows and data logger malfunctions, there is some missing data. For these two reasons, it is difficult to determine if owls preferentially selected winter burrows that were warmer than other available burrows. A slight trend for warmer temperatures (1.7 °C) and owl occupation at Burrow Site #14 versus Burrow Site #2 (no owls) during both years may suggest a preference for a deeper, warmer burrow at least within Yucca Flat. However, it is not known if this small difference is biologically significant enough to influence behavior. Owls were not detected in burrows where the recorded minimum burrow

malfunction. It is important to put a new battery in the data logger at the beginning of each use. Also, it may get rather humid inside the burrow so it may be helpful to put the data logger inside a waterproof container before emplacement. Another idea to ensure good data would be to use two data loggers instead of just one at each sampling spot.

8.0 SPECIES MANAGEMENT

8.1 Introduction

Bechtel Nevada biologists, under the direction and funding of NNSA/NSO, conduct a variety of wildlife management tasks on the NTS as part of the NTS Ecological Monitoring and Compliance (EMAC) Program. The overall objective of the EMAC Program is to protect the biological resources of the NTS while supporting the mission of DOE to operate a national test site. Meeting this objective involves developing procedures that ensure that NTS activities comply with state and federal wildlife and environmental protection regulations, and at the same time, allow operation of the NTS.

Over the past four years, owl monitoring tasks have been identified and supported through the EMAC program. Data gathered on the owl's distribution, abundance, and life history on the NTS have been incorporated into management procedures that enhance wildlife protection and environmental compliance goals of the EMAC Program.

The objectives of this section are to: (1) present the current legal status of the owl and NNSA/NSO's directives that influence owl management on the NTS, (2) describe owl management actions developed from data presented in this report, (3) discuss the effects of NTS

recontoured, or compacted. These surveys are called preactivity surveys and they have been routinely conducted for all new projects sited in previously undisturbed areas of the NTS. If sensitive species (including owls) or important resources (such as nest burrows) are found during a preactivity survey, recommendations are provided to mitigate potential impacts.

As a result of owl monitoring under the EMAC Program, the scope of preactivity surveys has expanded to include lands which have been previously disturbed. Owls inhabit disturbed areas and use partially buried culverts and pipes and predator burrows dug into human-made soil

equipment and materials. Even off-road driving of light vehicles to and from the project site may threaten harm to owls in their burrows.

Since 1979, over 1,400 sites have been surveyed for land-disturbing projects throughout all ecoregions of the NTS. At about 200 sites, active and inactive animal burrows have been found, including burrows of tortoises, predators (badger, coyote, kit fox), and owls, as determined by their size, shape, and presence of animals or their sign, such as scat or pellets. Owl burrows were only found at 8 of these 200 project sites. They included nine burrows: four occupied burrows and one unoccupied earthen burrow and one occupied and three unoccupied pipe burrows. Two unoccupied burrows found could not be avoided and were destroyed. Based on the results of preactivity surveys, land-disturbing activities on the NTS since 1979 have not negatively impacted owls. This is because very few owls and owl burrows occur on the NTS, or at least

8.5 EMAC Owl Monitoring Program

Owl reproduction should be monitored once every three to five years using a remote camera system. The number of breeding pairs and young will be recorded. Attempts will be made to periodically search ecoregions for new burrow sites and to sample known burrows to assess population trends over time. Due to the small number of owls on the NTS, population trend data are not statistically robust, however they are the best available and may be useful in future impact assessments. Preactivity surveys will continue to be performed year-round for proposed land-disturbing activities on both undisturbed and previously disturbed areas. New locations of owl sightings and owl burrows will be recorded.

If the western burrowing owl becomes listed under the Endangered Species Act, a biological assessment of the effects of NNSA/NSO activities on the owl will be prepared and consultation with the USFWS will be initiated. The biological assessment will include data collected under the EMAC Owl Monitoring Program.

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Appendix A

Physical Burrow Attributes and Photos of Owl Burrows Monitored on the Nevada Test Site from November 1997 through May 2002.

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Burrow Site 1: Burrows A-E

Location: Area 2, 2-07 Road, 2L-20 Pad
Ecoregion: Transition
Elevation: 1323 m
Topography: Basin floor
Vegetation: *Hymenoclea salsola-Ephedra nevadensis* Shrubland Association

Burrow A
Culvert
Aspect: 270° (W)
Height: 19 cm
Width: 35 cm

Burrow B
Culvert
Aspect: 10° (N)
Height: 13 cm
Width: 25 cm

Burrow C
Culvert
Aspect: 90° (E)
Height: 25 cm
Width: 40 cm

Burrow D
Pipe
Aspect: 120° (SE)
Height: 15 cm
Width: 16 cm

Burrow E
Culvert (Filled In)
Aspect: 190° (S)
Height: 8 cm
Width: 16 cm

Burrow Site 2: Burrows A and B

Location: Area 2, 2-04 and 2L Roads Intersection
Ecoregion: Transition
Elevation: 1341 m
Topography: Piedmont Slope
Vegetation: *Hymenoclea salsola-Ephedra nevadensis* Shrubland Association

Burrow A
Culvert
Aspect: 270° (W)
Height: 15 cm
Width: 35 cm

Burrow B
Culvert
Aspect: 90° (E)
Height: 14 cm
Width: 34 cm

Burrow Site 3: Burrows A-C

Location: Area 2, 2-04 Road, West
Ecoregion: Transition
Elevation: 1344 m
Topography: Piedmont Slope
Vegetation: *Hymenoclea salsola-Ephedra nevadensis* Shrubland Association

Burrow A
Culvert
Aspect: 20° (N)
Height: 20 cm
Width: 38 cm

Burrow B
Culvert
Aspect: 200° (S)
Height: 19 cm
Width: 38 cm

Burrow C
Culvert
Aspect: 20° (N)
Height: 12 cm
Width: 35 cm

Burrow Site 4: Burrows A-E

Location: Area 2, 2-04 Road, East
Ecoregion: Transition
Elevation: 1338 m
Topography: Piedmont Slope
Vegetation: *Hymenoclea salsola-Ephedra nevadensis* Shrubland Association

Burrow Site 8: Burrows A-C

Location: Area 2, 2L Road, 2L-5
Ecoregion: Transition
Elevation: 1372 m
Topography: Piedmont Slope
Vegetation: *Hymenoclea salsola-Ephedra nevadensis* Shrubland Association

Burrow A
Culvert
Aspect: 20° (N)
Height: 18 cm
Width: 34 cm

Burrow B
Earthen (Filled In)
Aspect: 300° (NW)
Height: 12 cm
Width: 18 cm

Burrow C
Culvert
Aspect: 200° (S)
Height: 23 cm
Width: 35 cm

Burrow Site 9: Burrows A-C

Location: Area 18, 18-03 Road #1
Ec

Burrow Site 12: Burrow A

Location: Area 9, 9-01 Road, North of 9G-15 #1
Ecoregion: Transition
Elevation: 1286 m
Topography: Piedmont Slope
Vegetation: *Ephedra nevadensis-Grayia spinosa* Shrubland Association

Burrow A
Culvert (Inaccessible Area)
Aspect: 270° (W)
Height: 13 cm
Width: 33 cm

Burrow Site 13: Burrow A

Location: Area 9, 9-01 Road, 9G-15
Ecoregion: Transition
Elevation: 1286 m
Topography: Piedmont Slope
Vegetation: *Ephedra nevadensis-Grayia spinosa* Shrubland Association

Burrow A
Culvert
Aspect: 210° (SW)
Height: 16 cm
Width: 36 cm

Burrow Site 17:

Burrow Site 28: Burrow A

Location: Area 5, Pre-Buggy Pit
Ecoregion: Mojave Desert
Elevation: 969 m

Burrow Site 29: Burrow A

Location: Area 5, Cane Spring Road, CS-7 #3
Ecoregion: Mojave
Elevation: 1078 m

Burrow Site 34: Burrows A-E

Location: Area 25, Lathrop Wells Road #1
Ecoregion: Mojave Desert
Elevation: 866 m
Topography: Piedmont Slope
Vegetation: *Larrea tridentata/Ambrosia dumosa* Shrubland Association





Burrow Site 39: Burrow A

Location: Area 18, Pahute Mesa Road #1
Ecoregion: Great Basin Desert
Elevation: 1731 m
Topography: Piedmont Slope
Vegetation: *Ephedra nevadensis-Grayia spinosa* Shrubland Association

Burrow A
Roadcut Earthen (Filled In)
Aspect: 130° (SE)
Height: 15 cm
Width: 30 cm

Burrow Site 40: Burrows A and B

Location: Area 16, Pahute Mesa Road #1
Ecoregion: Transition
Elevation: 1511 m
Topography: Piedmont Slope
Vegetation: *Coleogyne ramosissima-Ephedra nevadensis* Shrubland Association

Burrow A
Roadcut Earthen
Aspect: 40° (NE)
Height: 18 cm
Width: 60 cm

Burrow B
Roadcut Earthen
Aspect: 65° (NE)
Height: 10 cm
Width: 27 cm

Burrow Site 41: Burrows A-F

Location: Area 9, 9-01 Road, North of 9G-15 #2, Pad
Ecoregion: Transition
Elevation: 1286 m
Topography: Piedmont Slope
Vegetation: *Ephedra nevadensis-Grayia spinosa* Shrubland Association

Burrows A and B
Culverts
Aspect: 360° (N)
Height: 16 (A), 17 (B) cm
Width: 36 (A, B) cm

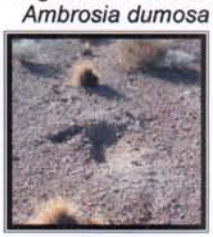
Burrow C
Pipe
Aspect: 330° (NW)
Height: 14 cm
Width: 14 cm

Burrows D and E
Culverts
Aspect: 180° (S)
Height: 25 (D), 23 (E) cm
Width: 38 (D), 37 (E) cm

Burrow F
Pipe
Aspect: 150° (SE)
Height: 13 cm
Width: 18 cm

Burrow Site 42: Burrow A

Location: Area 25, Jackass Flats Road #1
Ecoregion: Mojave Desert
Elevation: 1138 m
Topography: Piedmont Slope
Vegetation: *Larrea tridentata/ Ambrosia dumosa* Shrubland Association



Burrow A
Earthen (Filled In)
Aspect: 10° (N)
Height: 15 cm
Width: 18 cm

Burrow Site 43: Burrow A

Location: Area 1, Orange Road, O-30 #2, Wash
Ecoregion: Transition
Elevation: 1300 m
Topography: Wash
Vegetation: *Coleogyne ramosissima-Ephedra nevadensis* Shrubland Association

Burrow A
Earthen
Aspect: 220° (SW)
Height: 14 cm
Width: 30 cm

Burrow Site 44: Burrows

Burrow Site 48: Burrows A-C

Location: Area 5, 5-01 Road, Booster Station #2
Ecoregion: Mojave Desert
Elevation: 1018 m
Topography: Wash
Vegetation: *Atriplex confertifolia-Ambrosia dumosa* Shrubland Association

Burrow A
Earthen
Aspect: 60° (NE)
Height: 15 cm
Width: 35 cm

Burrow B
Earthen
Aspect: 90° (E)
Height: 14 cm
Width: 30 cm

Burrow C
Earthen
Aspect: 70° (E)
Height: 15 cm
Width: 30 cm

Burrow Site 49: Burrows A and B

Location: Area 9, 9-01 Road, 2G-24 #4
Ecoregion: Transition
Elevation: 1305 m
Topography: Basin Floor
Vegetation: *Hymenoclea salsola-Ephedra nevadensis* Shrubland Association

Burrow Site 50: Burrows A and B

Location: Area 5, 5-01 Road, 5A-28
Ecoregion: Mojave Desert
Elevation: 1000 m
Topography: Wash
Vegetation: *Atriplex confertifolia-Ambrosia dumosa* Shrubland Association

Burrow Site 51: Burrows A-I (Continued)
Location: Area 2, U-2gg Sump, Pad
Ecoregion: Transition
Elevation: 1317 m
Topography: Basin Floor
Vegetation: Disturbance

Burrow F
Pipe
Aspect: 80° (E)
Height: 16 cm
Width: 15 cm

Burrow G
Pipe
Aspect: 270° (W)
Height: 15 cm
Width: 15 cm

Burrow H
Pipe
Aspect: 0° (N)
Height: 10 cm
Width: 16 cm

Burrow I
Pipe
Aspect: 180° (S)
Height: 15 cm
Width: 15 cm

Burrow Site 52: Burrows A-F
Location: Area 4, 4-04 Road #2, Pad
Ecoregion: Transition
Elevation: 1274 m
Topography: Basin Floor
Vegetation: *Ephedra nevadensis-Grayia spinosa* Shrubland Association

Burrows A & B
Pipes
Aspect: 112° (E)
Height: 14 (A), 15 (B) cm
Width: 14 (A), 17 (B) cm

Burrow C
Culvert
Aspect: 100° (E)
Height: 11 cm
Width: 14 cm

Burrows D & E
Pipes
Aspect: 295° (NW)
Height: 15 (D), 11 (E) cm
Width: 17 (D), 16 (E) cm

Burrow F
Culvert
Aspect: 270° (W)
Height: 23 cm
Width: 37 cm

Burrow Site 53: Burrows A and B
Location: Area 4, 4-04 Road #3
Ecoregion: Transition
Elevation: 1274 m
Topography: Basin Floor
Vegetation: *Ephedra nevadensis-Grayia spinosa* Shrubland Association

Burrow Site 54: Burrow A
Location: Area 17, Red Canyon Wash
Ecoregion: Transition
Elevation: 1494 m
Topography: Piedmont Slope
Vegetation: *Hymenoclea salsola-Ephedra nevadensis* Shrubland Association

Burrow Site 55: Burrows A-C

Location: Area 5, Cane Spring Road, CS-7 #2
Ecoregion: Mojave Desert
Elevation: 1085 m
Topography: Wash
Vegetation: *Larrea tridentata/Ambrosia dumosa* Shrubland Association

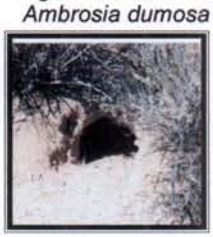
Burrow A
Earthen
Aspect: 120° (SE)
Height: 32 cm
Width: 45 cm

Burrow B
Earthen (Filled In)
Aspect: 320° (NW)
Height: 30 cm
Width: 45 cm

Burrow C
Earthen (Filled In)
Aspect: 230° (SW)
Height: 12 cm
Width: 22 cm

Burrow Site 56: Burrow A

Location: Area 5, Coyote Spring
Ecoregion: Mojave Desert
Elevation: 1109 m
Topography: Piedmont Slope
Vegetation: *Larrea tridentata/ Ambrosia dumosa* Shrubland Association



Burrow A
Earthen
Aspect: 70° (E)
Height: 16 cm
Width: 19 cm

Burrow Site 57: Burrow A

Location: Area 25, Jackass Flats Road #2
Ecoregion: Mojave Desert
Elevation: 1115 m
Topography: Piedmont Slope
Vegetation: *Larrea tridentata/ Ambrosia dumosa* Shrubland Association

Burrow A
Earthen (Filled In)
Aspect: 225° (SW)
Height: Unknown
Width: Unknown

Burrow Site 58: Burrows A and B

Location: Area 8, 8D Road, North of 8D-2

Burrow Site 59: Burrows A and B

Location: Area 8, 8D Road, 8D-2 #1

Burrow Site 60: Burrows A and B

Location: Area 4, 4-04 Road #4
Ecoregion: Transition
Elevation: 1281 m
Topography: Basin Floor
Vegetation:

Burrow Site 61: Burrow A

Location: Area 18, Old Buckboard Mesa Road
Ecoregion: Great Basin Desert
Elevation: 1518 m
Topography: Wash

Burrow Site 64: Burrows A-K (Continued)
Location: Area 8, 8D Road, Pad
Ecoregion: Transition
Elevation: 1384 m
Topography: Piedmont Slope
Vegetation: Disturbance

Burrow F
Culvert
Aspect: 200° (S)
Height: 31 cm
Width: 48 cm

Burrow G
Culvert
Aspect: 340° (NE)
Height: 15 cm
Width: 43 cm

Burrow H
Culvert
Aspect: 50° (NE)
Height: 28 cm
Width: 34 cm

Burrow I
Culvert
Aspect: 240° (SW)
Height: 23 cm
Width: 37 cm

Burrow J
Pipe
Aspect: 300° (NW)
Height: 15 cm
Width: 15 cm

Burrow Site 64: Burrows A-K (Continued)
Location: Area 8, 8D Road, Pad
Ecoregion: Transition
Elevation: 1384 m
Topography: Piedmont Slope
Vegetation: Disturbance

Burrow K
Pipe
Aspect: 120° (SE)
Height: 17 cm
Width: 17 cm

Burrow Site 65: Burrows A and B
Location: Area 5, 5-01 Road, FACE #3
Ecoregion: Mojave Desert
Elevation: 1006 m
Topography: Hilltop
Vegetation: *Larrea tridentata/ Ambrosia dumosa* Shrubland Association

Burrow A
Earthen
Aspect: 240° (SW)
Height: 18 cm
Width: 31 cm

Burrow B
Earthen
Aspect: 80° (E)
Height: 22 cm
Width: 25 cm

Burrow Site 66: Burrow A
Location: Area 9, 9-01 Road and Old Mercury Highway Intersection
Ecoregion: Transition
Elevation: 1280 m
Topography: Piedmont Slope
Vegetation: *Ephedra nevadensis-Grayia spinosa* Shrubland Association

Burrow A
Culvert
Aspect: 350° (NE)
Height: 15 cm
Width: 36 cm

Burrow Site 67: Burrows A-E
Location: Area 2, 2-07 Road, 2L-18 Pad
Ecoregion: Transition
Elevation: 1329 m
Topography: Piedmont Slope
Vegetation: Disturbance

Burrow Site 72: Burrow A

Location: Area 5, RWMS Expansion Area
Ecoregion: Mojave Desert
Elevation: 988 m
Topography: Piedmont Slope
Vegetation: *Larrea tridentata/ Ambrosia dumosa* Shrubland Association

Unavailable

Burrow A
Earthen (Crushed)
Aspect: Unknown
Height: Unknown
Width: Unknown

Burrow Site 73: Burrows A and B

Location: Area 9, 9-01 Road, 9G-11
Ecoregion: Transition
Elevation: 1323 m
Topography: Piedmont Slope
Vegetation: Disturbance

Burrow A
Culvert
Aspect: 110° (E)
Height: 7 cm
Width: 33 cm

Burrow B
Culvert
Aspect: 290° (W)
Height: 11 cm
Width: 25 cm

Burrow Site 74: Burrow A

Location: Area 5, RWMS South Gate
Ecoregion: Mojave Desert
Elevation: 970 m
Topography: Piedmont Slope
Vegetation: *Larrea tridentata/*

Burrow Site 75: Burrow A

Location: Area 2, U-2ge
Ecoregion: Transition
Elevation: 1326 m
Topography: Basin Floor
Vegetation: Disturbance

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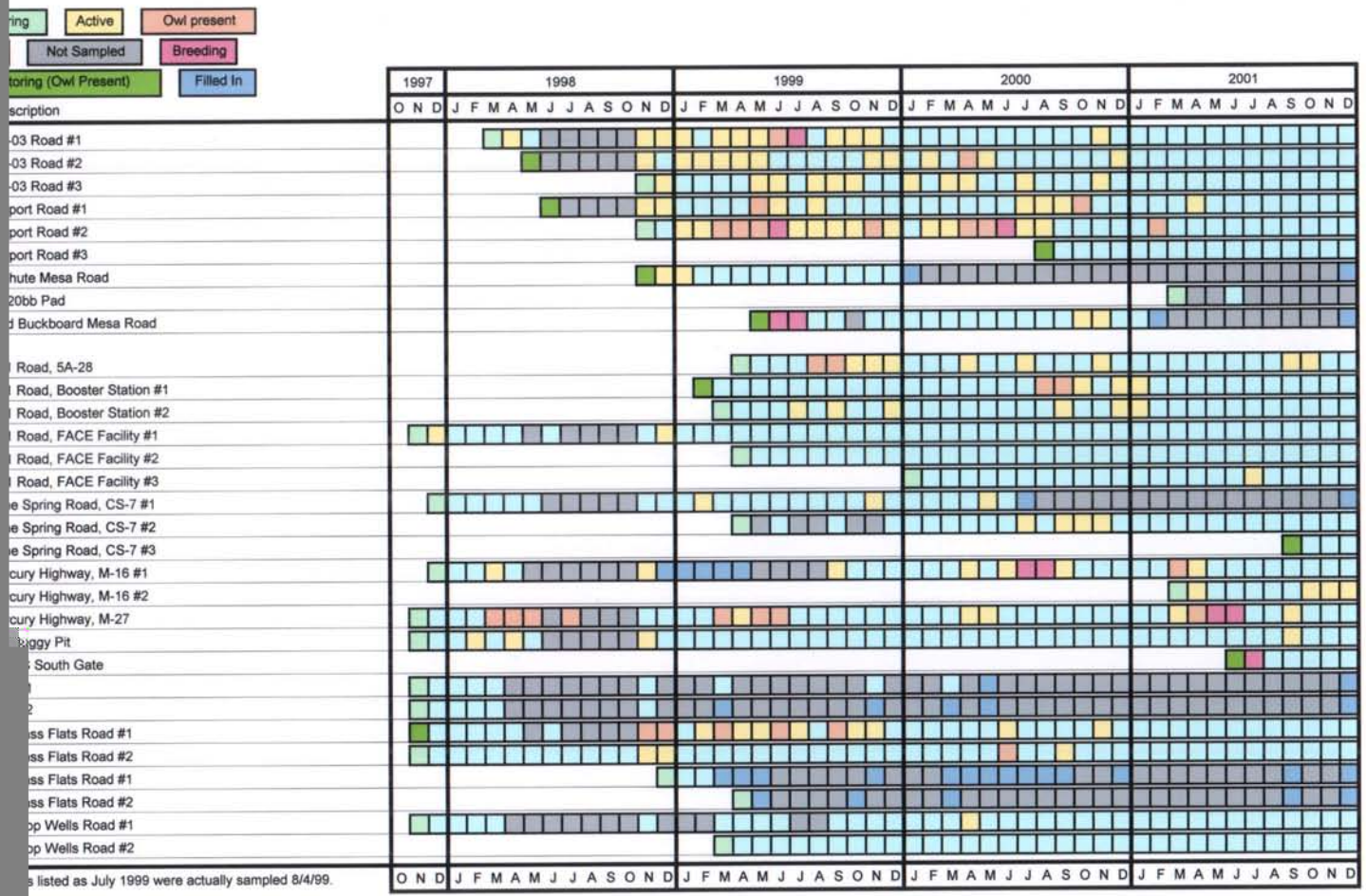
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Road, Booster Station #1
Road, Booster Station #2
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Road, FACE Facility #2
Road, FACE Facility #3
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e Spring Road, CS-7 #2
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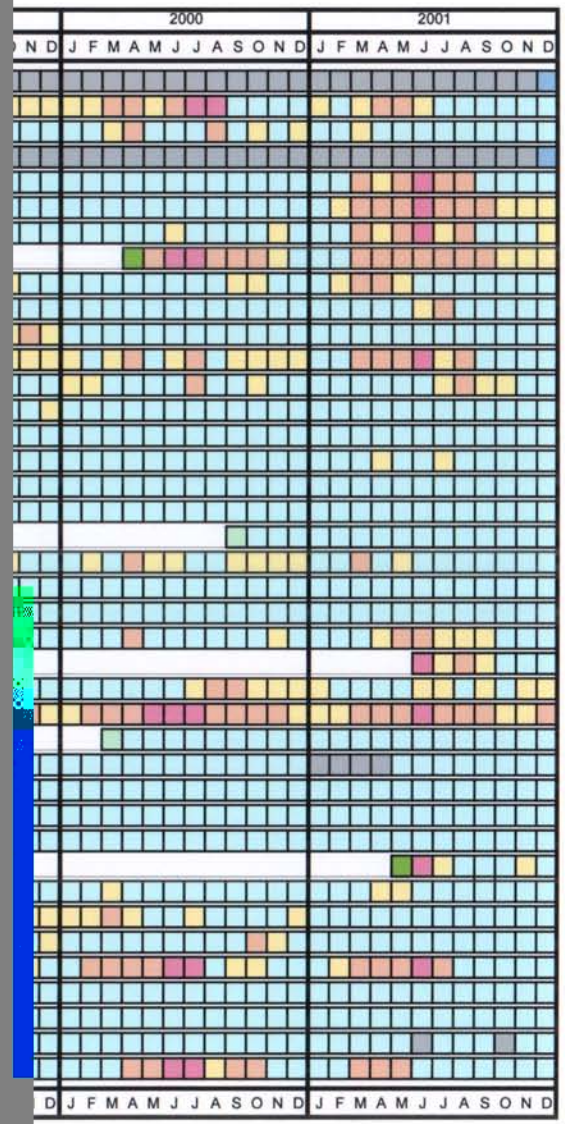
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Appendix C

Burrow Use Rates by Burrow Site (BURS) Including the Number of Months a Burrow Site was Monitored and the Number of Months Fresh Sign was Detected from November 1997 to December 2001 (n=56; only includes active burrows monitored for at least seven months).

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Site Description (Burrow Site Number)	Burrow Type[a]	Number of Months		BURS
Great Basin Desert ecoregion		**Detected A**	**Monitored B**	**A/B x 100**
Area 18, 18-03 Road #1 (#9)	EM	14	41	34.1
Area 18, 18-03 Road #2 (#11)	EM	13	39	33.3
Area 18, 18-03 Road #3 (#37)	EM	12	38	31.6
Area 18, Airport Road #1 (#16)	EM	11	39	28.2
Area 18, Airport Road #2 (#38)	EM	21	38	55.3

Site Description	Burrow Type[a]	Number of Months		BURS
Transition ecoregion		**Detected A**	**Monitored B**	**A/B x 100**
Area 1, Orange Road, O-30 #1, Road (# 21)	EM	1	11	9.1
Area 1, Orange Road, O-30 #2, Wash (# 43)	EN	22	35	62.9
Area 1, Orange Road, O-30 #3, Ditch (# 22)	EM	10	44	22.7
Area 2, 2-04 and 2L Roads Intersection (# 2)	C	10	46	21.7
Area 2, 2-04 Road, East (# 4)	C	15	46	32.6
Area 2, 2-04 Road, West (# 3)	C	16	46	34.7
Area 2, 2-07 Road, 2L-18 Pad (# 67)	CP	18	21	85.7
Area 2, 2-07 Road, 2L-20 Pad (# 1)	CP	11	41	26.8

Appendix D

Monthly Owl Burrow Use Summary Data Set by Ecoregion, November 1997 through December 2001.

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	Great Basin Desert	Mojave Desert	Transition

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Appendix E

TrailMaster® Camera System Results by Ecoregion and Burrow for the Breeding Seasons of 1999-2001.

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GREAT BASIN DESERT ECOREGION

Area 18, 18-03 Road #1 (#9)
Burrow A
7/16-7/19/99—1 owl
Burrow B
6/24-6/26/99—2 adult owls
7/23-7/27/99—1 young owl

Area 18, 18-03 Road #2 (#11)
Burrow A
6/5-6/8/00—Woodrat; antelope ground squirrel; desert cottontail rabbit; black-tailed jackrabbit

Area 18, 18-03 Road #3 (#37)
4/10-4/12/00—Passerine; 2 ravens
7/31-8/2/00—Badger; desert cottontail rabbit

Area 18, Airport Road #1 (#16)
7/31-8/2/00—Nothing
4/25-4/27/01—Woodrat; rodent

Area 18, Airport Road #2 (#38)
Burrow A
5/22-5/25/00—1 owl; woodrat
6/22-6/26/00—4 young owls (camera shifted to north)
7/28-7/31/00—Desert cottontail rabbit; antelope ground squirrel
Burrow B
6/26-6/29/99—3 young
4/10-4/12/00—2 adult owls
5/22-5/25/00—2 adult owls; unknown animal; prey items
6/22-6/26/00—8 young owls
7/28-7/31/00—Desert cottontail rabbit

Area 30, Old Buckboard Mesa Road (#61)
6/29-7/1/99—6 young owls

MOJAVE DESERT ECOREGION

Area 5, 5-01 Road, 5A-28 (#50)
4/24-4/26/00—Nothing
8/4-8/7/00—Nothing

Area 5, 5-01 Road, Booster Station #2 (#48)
Burrow A
8/19-8/24/99--Nothing

Area 5, Cane Spring Road, CS-7 #1 (#27)
5/25-6/1/00—Antelope ground squirrel

Area 5, Mercury Highway, M-16 #1 (#33)
4/24-4/26/00—Nothing
7/3-7/6/00—3 young owls
8/4-8/7/00—3 young owls (camera problems; only 5 pictures)
5/25-5/29/01—1 kit fox

Area 5, Mercury Highway, M-16 #2 (#71)
5/25-5/29/01—Nothing

Area 5, Mercury Highway, M-27 (#32)
6/7-6/11/99—1 adult owl
4/17-4/19/00—Nothing
5/25-6/1/00—Nothing
4/27-4/30/01—2 adult owls
5/31-6/4/01—3 young owls; 1 adult owl with prey
8/13-8/15/01—Nothing

Area 5, RWMS South Gate (#74)
6/29-7/3/01—4 owls (at least 3 young)
8/13-8/15/01—Nothing

Area 22, Jackass Flats Road #1 (#36)
6/11-6/14/99—1 adult owl (camera tilted)
8/24-9/9/99—Nothing
6/29-7/3/00—Nothing

Area 22, Jackass Flats Road #2 (#35)
6/29-7/3/00—Antelope ground squirrel; unidentified animal; (cable cut)

Area 25, Lathrop Wells Road #1 (#34)
Burrow B
4/26-5/1/00—2 kit foxes

TRANSITION ECOREGION

Area 1, Orange Road, O-30 #2, Wash (#43)
7/7-7/10/99—Nothing
7/30-8/4/99—3 young owls (camera tilted, low battery 7/30-8/2)
4/12-4/14/00—2 adult owls (camera tilted)
6/2-6/5/00—2 adult owls
7/3-7/6/00—5 young owls
8/2-8/4/00—2 owls (at least 1 young); desert cottontail [illegible]

4/25-4/27/01—2 adult owls (non-breeding pair); desert cottontail rabbit
5/31-6/4/01—1 adult owl (only 3 pictures, camera problems)
6/15-6/18/01—Antelope ground squirrel; badger; 2 desert cottontail rabbits (1 adult, 1 juvenile); (Low battery on receiver, 15 pictures)

Area 1, Orange Road, O-30 #3, Ditch (#22)
Burrow A
4/12-4/14/00—Desert cottontail rabbit
Burrow B
4/26-5/1/00—2 adult owls (Non-breeding pair)

Area 2, 2-04 and 2L Roads Intersection (#2)
Burrow A
5/18-5/21/01—2 adult owls (1 with prey)
6/20-6/22/01—1 young owl; 2 adult owls
7/30-8/1/01—3 owls; woodrat; desert cottontail rabbit
Burrow B
5/18-5/21/01—2 adult owls
6/20-6/22/01—2 adult owls; at least 1 young owl; black-tailed jackrabbit
7/30-8/1/01—2 owls; antelope ground squirrel; woodrat?

Area 2, 2-04 Road, East (#4)
Burrows A and B
5/21-5/23/01—2 adult owls
6/25-6/27/01—5 owls (at least 4 young)
8/3-8/6/01—4 owls; desert cottontail rabbit
Burrows C, D, and E
5/21-5/23/01—1 adult owl; black-tailed jackrabbit
6/25-6/27/01—6 owls (2 adults, 4 young); desert cottontail rabbit
8/3-8/6/01—1 owl; black-tailed jackrabbit; desert cottontail rabbit

Area 2, 2-04 Road, West (#3)
Burrow A
7/14-7/16/99—Nothing
6/12-6/15/00—Film split in two no pictures
6/19-6/22/00—Desert cottontail rabbit; black-tailed jackrabbit
5/14-5/16/01—1 adult owl; black-tailed jackrabbit; desert cottontail rabbit
6/22-6/25/01—4 young owls; black-tailed jackrabbit
8/1-8/3/01—1 adult owl; desert cottontail rabbit; black-tailed jackrabbit
Burrow B
5/14-5/16/01--2 adult owls; desert cottontail rabbit
6/22-6/25/01—1 adult owl, 1 young owl (cable cut, camera tilted down, only 5 pictures)
8/1-8/3/01—1 adult owl; desert cottontail rabbit

Area 2, 2-07 Road, 2L-18 Pad (#67)

Burrows A and C

4/6-4/10/00—2 adult owls
5/11-5/15/00—2 adult owls (camera tilted)
5/15-5/18/00—1 owl; Hawk?
6/26-6/29/00—7 owls (at least 5 young; transmitter or receiver knocked over)
7/10-7/13/00—5 young owls
7/17-7/19/00—1 owl (Camera problems; only 2 pictures)
5/7-5/9/01—1 adult owl
6/11-6/13/01—2 adult owls (Non-breeding pair)
7/23-7/25/01—2 owls

Burrows B and D

7/17-7/19/00—6 owls (at least 4 young inferred)
5/7-5/9/01—unknown
6/11-6/13/01—2 adult owls
7/23-7/25/01—2 owls (1 adult, 1 juvenile); Not a breeding burrow, too late in season and no juveniles detected before this

Burrow E

6/26-6/29/00—2 owls (transmitter or receiver knocked over; only 7 pictures)
7/10-7/13/00—2 young owls; antelope ground squirrel
6/29-7/3/01—Desert cottontail rabbit; black-tailed jackrabbit
7/25-7/27/01—Desert cottontail rabbit; kangaroo rat

Area 2, 2-07 Road, 2L-20 Pad (#1)

Burrow A

5/9-5/11/01—Black-tailed jackrabbit; desert cottontail rabbit

Burrow B

5/11-5/13/01—Black-tailed jackrabbit; antelope ground squirrel

Burrow C

5/9-5/11/01—Kangaroo rat; black-tailed jackrabbit; desert cottontail rabbit

Burrow E

5/11-5/13/01—Kangaroo rat; black-tailed jackrabbit; desert cottontail rabbit

Area 2, 2E and 2K Roads Intersection (#63)

Burrow A

7/5-7/9/01—1 young owl; 1 adult owl with prey; antelope ground squirrel; kangaroo rat; raven; Not a breeding burrow, no sign detected before this
8/8-8/13/01—Nothing

Burrow B

7/12-7/14/99—Nothing
7/5-7/9/01—2 adult owls; raven
8/8-8/13/01—Antelope ground squirrel; desert cottontail rabbit

Area 2, 2L Road, 2L-5 (#8)

Burrow A

4/14-4/17/00—1 owl; black-tailed jackrabbit

7/19-7/21/00—4 owls (at least 2 young inferred); black-tailed jackrabbit; Not a breeding burrow
5/16-5/18/01—2 adult owls
6/27-6/29/01—8 owls (1 adult, 7 young)
8/6-8/8/01—2 owls
Burrow C
6/5-6/8/00—Nothing
7/19-7/21/00—1 owl; antelope ground squirrel; desert cottontail rabbit
5/16-5/18/01—1 adult owl with prey; antelope ground squirrel; black-tailed jackrabbit; desert cottontail rabbit
6/27-6/29/01—3 juvenile owls; raven
8/6-8/8/01—2 owls; desert cottontail rabbit

Area 2, U-2gg Sump, Pad (#51)
Burrow A
8/15-8/20/01—1 owl; desert cottontail rabbit
Burrow B
8/15-8/20/01—Desert cottontail rabbit
Burrow F
8/2-8/4/00—Badger; kit fox; antelope ground squirrel

Area 3, 3-03 and 3-05 Roads Intersection (# 19)
Burrows A and B
7/10-7/12/99—Desert cottontail rabbit
8/9-8/17/99—Desert cottontail rabbit (camera tilted)

Area 4, 4-04 Road #2, Pad (#52)
Burrow F
8/9-8/11/99—Desert cottontail rabbit

Area 4, North of 4-04 Road (#14)
Burrow A
6/22-6/24/99—Nothing
8/6-8/9/99—Nothing
4/14-4/17/00— 2 adult owls (Non-breeding pair)
6/1-6/5/00—Antelope ground squirrel; kangaroo rat
4/27-4/30/01—No owls; kangaroo rat; antelope ground squirrel; black-tailed jackrabbit; unknown animal

Area 6, Orange Road, O-13 (#23)
7/1-7/7/99—Nothing
7/30-8/6/99—3 young owls (7/30-8/2—camera tilted)

Area 8, 8D Road, 8D-2 #1 (#59)
Burrow B (East)
6/16-6/19/99—2 adult owls
7/26-7/28/99—3 young owls

4/17-4/19/00—1 owl; desert cottontail rabbit
5/4-5/7/01—Desert cottontail rabbit; black-tailed jackrabbit
Burrow A (West)
5/4-5/7/01--1 owl; 2 desert cottontail rabbits; black-tailed jackrabbit; antelope ground squirrel
6/13-6/15/01—1 owl; 3 desert cottontail rabbits; black-tailed jackrabbit; 2 birds; rodent
7/18-7/20/01—Rodent; desert cottontail rabbit

Area 8, 8D Road, 8D-2 #2 (#76)
Burrow A
6/13-6/15/01—9 owls (8 young, 1 adult)
7/18-7/20/01—Black-tailed jackrabbit

Area 8, 8D Road, North of 8D-2 (#58)
Burrow A (West)
7/26-7/28/00—6 owls (at least 4 young inferred); black-tailed jackrabbit
7/20-7/23/01—Desert cottontail rabbit; antelope ground squirrel; rodent
Burrow B (East)
7/20-7/23/01—Desert cottontail rabbit; rodent

7/24-7/26/00—Antelope ground squirrel; desert cottontail rabbit
5/2-5/4/01—2 adult owls
6/8-6/11/01—6 young owls
7/13-7/16/01—Desert cottontail rabbit
Burrow F
5/2-5/4/01—1 adult owl; rodent
6/8-6/11/01—3 owls
7/13-7/16/01—Bobcat; antelope ground squirrel; black-tailed jackrabbit; desert cottontail rabbit; coyote; kangaroo rat
Burrow J
7/16-7/18/01—Desert cottontail rabbit
Burrow K
7/16-7/18/01—Kit fox with rabbit

Area 9, 9-01 Road, 9G-11 #73
Burrow A (East)
6/18-6/20/01—7 owls (at least 6 young; feeding frenzy)
7/27-7/30/01--Nothing
Burrow B (West)
6/18-6/20/01—8 owls (at least 7 young)
7/27-7/30/01—kangaroo rat; desert cottontail rabbit; antelope ground squirrel

Area 9, 9-01 Road, 9G-15 (#13)
5/23-5/25/01—Nothing

Area 9, 9-01 Road, North of 9G-15 #2, Pad (#41)
Burrows A and B
8/6-8/9/99—1 adult owl; black-tailed jackrabbit
Burrows D and E
4/6-4/10/00—Rodent
7/21-7/24/00—Nothing (Camera cable cut and transmitter and receiver knocked over; only a few pictures)

Area 9, Powerline Road, Pad (#15)
6/14-6/16/99—2 adult owls
7/27-7/30/99—2 adult owls
8/11-8/17/99—2 adult owls (Non-breeding pair)
8/24-9/9/99—2 adult owls (transmitter dead?)
2/22-3/8/00—1 owl
3/8-3/22/00—1 owl (camera did not work 3/13-3/22)
3/22-3/25/00—2 adult owls
4/4-4/6/00—2 adult owls
5/11-5/15/00—2 adult owls (transmitter knocked over and other problems; 21 pictures)
5/15-5/18/00—2 adult owls
6/19-6/22/00—5 young owls
7/21-7/24/00—1 young owl

5/23-5/25/01—2 adult owls
6/15-6/18/01—7 owls (at least 6 young)
7/25-7/27/01—Desert cottontail rabbit

Area 26, Cane Spring Road, Wash (#30)
Burrow A (West)
6/3-6/4/99—Nothing
7/19-7/21/99—Badger (transmitter moved)
8/17-8/19/99—Nothing
4/19-4/24/00—2 adult owls
6/8-6/12/00—1 owl; 2 desert cottontail rabbits; antelope ground squirrel; black-tailed jackrabbit; cable cut and low battery on receiver
7/6-7/10/00—1 adult owl and 4 young owls; cable cut and exposed film (only 13 pictures)
7/13-7/17/00—5 owls (at least 3 young inferred); 2 desert cottontail rabbits; cable cut (only 17 pictures)
5/29-5/31/01—woodrat; desert cottontail rabbit; kangaroo rat
7/3-7/5/01—woodrat?
Burrow B (East)
6/4-6/7/99—Nothing
7/21-7/23/99—Nothing
8/17-8/24/99—2 adult owls
4/19-4/24/00—2 adult owls; desert cottontail rabbit
6/8-6/12/00—6 young owls
7/6-7/10/00—1 young owl
7/13-7/17/00—5 young owls; desert cottontail rabbit
5/29-5/31/01—1 adult owl with prey
7/3-7/5/01—Desert cottontail rabbit; antelope ground squirrel; rodent

Appendix F

Equipment and Material Costs and Time Required to Use the TrailMaster® Camera System to Document Owl Reproduction.

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ITEM		COST*
TM 1500 camera system		$550.00
TM portable data collector		$250.00
StatPack® software and cable		$150.00
Film		$ 7.29
Film developing (1 hour, full roll)		$ 8.64
12 C-cell alkaline batteries		$ 13.50
Camera battery		$ 6.26
Extra camera cable (each)		$ 10.00
	Total	$995.69

TASK		TIME
TM1500 camera set up		15 minutes
TM1500 camera take down		10 minutes
Uploading data		10 minutes
Photo analysis and labeling (full roll)		50 minutes
	Total	85 minutes

*=Year 2003 dollars

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Appendix G

Owl Sighting Data, Including Climatic Variables and Flushing Information (DNC=Data Not Collected).

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te	Time	Number of owls	Air Temp (C)	Apron Temp (C)	Wind Speed (mph)	Wind Direction	% Cloud Cover	Flushing Distance (m)	Walking/ Vehicle
2001	1:30:00 PM	2	22.4	25.0	0-5	S	85	24, 22	W,W
shed at 24m, one at 22 m while walking									
2001	2:00:00 PM	1	25.0	26.8	10-20	S	40	8	W
B, flushed at 8m while walking									
2001	11:30:00 AM	2	21.3	24.0	0-5	S	85	26, 31	V, V
fence post at A flushed at 26m stopped in vehicle; One on fence post at B flushed at 31m stopped in vehicle									
001	11:20:00 AM	1	31.3	36.2	5-11	S	5	17	V
A, flushed at 17m to moving vehicle									
001	9:55:00 AM	1	30.0	32.5	0-9	DNC	10	30	V
ushed to vehicle (30m)									
001	2:30:00 PM	1	30.5	33.5	2-10	DNC	0	20	W
ushed to walking at 20m									
001	7:20:00 PM	2	21.9	DNC	5-10	NW	0	DNC	DNC
001	5:17:00 PM	2	36.1	39.5	6-15	S	15	9, 12	V,W
ushed at 9m to stopped vehicle and 1 at 12 m to walking									
999	11:35:00 AM	2	19.0	22.8	0-5	SE	50	18, 20	DNC
post, Owl on ground (cackled)									

g e (m)	Walking/ Vehicle
	DNC
	V, V
	W
	DNC
	W
	V
	DNC
	W
	W, W
	DNC

Site Number	Date	Time	Number of owls	Air Temp (C)	Apron Temp (C)	Wind Speed (mph)	Wind Direction	% Cloud Cover	Flushing Distance (m)	Walking/ Vehicle
4	7/25/2001	DNC	1	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Comments:	Owl at D									
4	8/29/2001	1:30:00 PM	1	37.4	39.3	4-12	SW	5	35	W
Comments:	Owl near A and B, flushed at 35m while walking									
4	9/20/2001	1:30:00 PM	1	32.3	35.7	6-14	SE	0	DNC	DNC
Comments:	Owl at CDE									
5	2/3/1998	10:00:00 AM	1	10.0	DNC	0-5	S	100	DNC	DNC
Comments:										
5	2/2/1999	11:40:00 AM	1	13.4	DNC	0-5	N	0	DNC	DNC
Comments:										
8	9/30/1999	12:00:00 PM	1	31.6	33.7	0-5	SW	0	20	DNC
Comments:	Owl flushed from burrow A entrance									
8	3/20/2001	11:15:00 AM	1	21.3	DNC	0-6	S	85	DNC	DNC
Comments:	Owl near A flushed and called									
8	4/18/2001	12:40:00 PM	1	26.3	29.6	10-20	S	35	12	V
Comments:	Owl near A, flushed at 12m while stopped in vehicle									
8	5/16/2001	11:30:00 AM	1	29.0	29.7	0-1	DNC	70	20	W
Comments:	Owl flushed to me walking at 20m from 5 ft perch (pole)									
8	5/18/2001	9:30:00 AM	2	29.5	33.5	0-9	DNC	10	10,4	W,W
Comments:	2 owls at A, 1 flushed from top of metal box at 10m while walking, 1 flushed from apron at 4m while walking									

Site Number	Date	Time	Number of owls	Air Temp (C)	Apron Temp (C)	Wind Speed (mph)	Wind Direction	% Cloud Cover	Flushing Distance (m)	Walking/ Vehicle
8	5/23/2001	12:30:00 PM	2	36.6	40.8	0-5	SW	10	42, 17	V, W
Comments:	One owl on post at A, flushed at 42m while stopped in vehicle; one owl on post at C, flushed at 17m while walking									
8	6/13/2001	7:30:00 PM	1	DNC	DNC	5-10	NW	0	DNC	DNC
Comments:	1 owl									
8	6/25/2001	4:20:00 PM	7	32.0	33.6	10-20	S	40	19, 18	W, V
Comments:	3 owls at C, flushed at 19m while walking; 4 owls at A, flushed at 18m while stopped in vehicle									
8	6/27/2001	1:07:00 PM	1	33.6	34.6	9-17	S	0	5	W
Comments:	1 owl flushed to walking at 5m									
9	6/16/1999	8:30:00 AM	1	25.5	26.8	0-5	SW	10	DNC	DNC
Comments:	Owl on apron of south burrow as I drove by									
9	6/26/1999	11:50:00 AM	1	29.0	34.2	0-5	SW	0	20	DNC
Comments:	Owl perched on fourwing saltbush; stayed close after flushing									
9	7/19/1999	1:50:00 PM	2	31.2	35.3	0-5	SE	DNC	DNC	DNC
Comments:	One owl on apron; one on rock on top of roadcut									
9	7/23/1999	11:45:00 AM	2	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Comments:										
9	7/27/1999	10:30:00 AM	1	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Comments:	Owl flushed from south burrow									
9	8/4/1999	3:15:00 PM	2	33.3	37.6	0-7	SE	15	DNC	DNC
Comments:	One owl at A, one owl at B									

Apron Temp (C)	Wind Speed (mph)	Wind Direction	% Cloud Cover	Flushing Distance (m)	Walking/ Vehicle
26.8	5-10	SW	75	6	V
DNC	DNC	DNC	40	DNC	DNC
NA	NA	NA	NA	NA	NA
23.5	0-5	NE	0	80	W
DNC	5	DNC	0	30	DNC
10.0	0-5	S	10	DNC	DNC
DNC	0	NA	DNC	DNC	DNC
DNC	0-5	SE	DNC	DNC	DNC
DNC	5-10	S	100	DNC	DNC
DNC	0-5	W	0	20	DNC

lumber of owls	Air Temp (C)	Apron Temp (C)	Wind Speed (mph)	Wind Direction	% Cloud Cover	Flushing Distance (m)	Walking/ Vehicle
1	DNC	DNC	DNC	DNC	DNC	DNC	DNC
1	11.3	DNC	0-5	S	100	DNC	DNC
2	16.0	23.2	0-5	S	20	44, 32	DNC
2	21.6	25.8	0-5	W	20	21, 21	DNC
2 rea	25.5	29.5	5-10	N	60	DNC	DNC
1	DNC	DNC	DNC	DNC	0	DNC	DNC
1	19.5	20.0	0-5	SW	60	DNC	DNC
0 that owl had been killed	NA	NA	NA	NA	NA	NA	NA
1	36.6	DNC	5-10	SE	50	DNC	DNC
1 e getting out of truck	25.0	27.0	0-2	DNC	DNC	66	W

	Time	Number of owls	Air Temp (C)	Apron Temp (C)	Wind Speed (mph)	Wind Direction	% Cloud Cover	Flushing Distance (m)	Walking/ Vehicle
)0	2:40:00 PM	1	10.0	10.1	5-15	SW	100	53	V
l east burrow at 53m from moving vehicle									
)0	DNC	1	21.0	DNC	0-4	S	80	30	W
in fenced area); flushed at 30m while getting out of vehicle									
)0	2:15:00 PM	1	11.4	12.0	0-2	N	95	DNC	DNC
vert inside fenced area									
1	3:20:00 PM	1	22.7	24.7	5-10	S	50	DNC	DNC
vert inside fenced area									
9	10:50:00 AM	1	13.8	18.5	0-5	S	25	25	DNC
into burrow									
)	11:00:00 AM	1	18.7	20.9	10-15	S	5	35	DNC
into burrow; back out 10 minutes later									
9	1:00:00 PM	2	24.4	DNC	0-5	S	10	20, 12	DNC
bobbed and called; 1 back into burrow									
9	6:40:00 PM	2	22.7	23.0	10-15	N	DNC	DNC	DNC
ron									
9	11:15:00 AM	2	22.3	24.7	5-10	N	60	DNC	DNC
on apron (1 light- and 1 dark-colored)									
)	6:20:00 PM	2	22.8	24.0	0-5	N	0	DNC	DNC
nd 1 on apron									

Time	Number of owls	Air Temp (C)	Apron Temp (C)	Wind Speed (mph)	Wind Direction	% Cloud Cover	Flushing Distance (m)	Walking/ Vehicle
2:40:00 PM	2	24.5	27.5	0-5	SW	60	DNC	DNC
apron								
12:00:00 PM	1	35.4	38.8	8-15	SW	10	DNC	DNC
n								
11:00:00 AM	1	DNC	DNC	5-10	SW	10	DNC	DNC
n								
9:50:00 AM	2	DNC	DNC	DNC	DNC	DNC	DNC	DNC
1:30:00 PM	1	32.7	35.5	5-10	S	50	DNC	DNC
n								
12:10:00 PM	2	37.0	42.5	3-12	S	40	DNC	DNC
apron								
12:10:00 PM	2	26.6	33.3	0-5	SW	0	DNC	DNC
apron								
12:25:00 PM	1	16.7	19.3	0-5	N	40	DNC	DNC
, ducked into burrow								
10:45:00 AM	1	7.2	7.7	7-12	S	100	DNC	DNC
lush; I was within 5-10 meters of it the whole time								
2:40:00 PM	1	26.5	28.1	0-5	NW	0	7	W
; ducked into burrow at 7m while walking; came back out								

Site Number	Date	Time	Number of owls	Air Temp (C)	Apron Temp (C)	Wind Speed (mph)	Wind Direction	% Cloud Cover	Flushing Distance (m)	Walking/ Vehicle
15	3/22/2000	9:20:00 AM	2	13.5	17.3	5-10	NE	0	5	V, W
Comments:	Both owls on apron; one ducked in burrow while in truck, one flushed at 5m while walking, cackled and bobbed up and down, stayed w/in 40 m of burr									
15	4/4/2000	2:10:00 PM	1	26.5	DNC	15-20	SW	0	DNC	DNC
Comments:	Owl in burrow; hissed several times while I was near burrow									
15	4/6/2000	1:15:00 PM	1	27.7	32.0	0-5	NW	0	15	W
Comments:	Ducked in burrow at 15m walking									
15	5/11/2000	1:10:00 PM	1	16.1	20.5	5-10	N	5	15	W
Comments:	Owl on apron; flushed at 15m while walking									
15	5/15/2000	6:00:00 PM	1	21.1	21.6	15-20	S	50	12	W
Comments:	1 owl flushed at 12m while walking									
15	5/18/2000	10:25:00 AM	1	22.5	26.0	4-12	N	5	10	W
Comments:	1 owl on apron, gave territorial call; flushed at 10m while walking									
15	6/16/2000	2:50:00 PM	1	34.9	39.2	0-5	S	10	44	W
Comments:	1 owl ducked in burrow at 44m while walking									
15	6/19/2000	6:10:00 PM	2	31.4	33.2	5-15	SW	0	50	W
Comments:	Both ducked into burrow at 50m while walking									
15	6/22/2000	10:20:00 AM	2	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Comments:	2 owls at apron									
15	6/29/2000	10:20:00 AM	4	34.3	39.3	5-12	S	25	DNC	DNC
Comments:	1020-30 2 young by apron, 1 adult on post,1 adult W. of apron:1040 3 young, 1 adult on post:1049 2 young, 1 adult on post:1050 1 young into burrow									

Site Number	Date	Time	Number of owls	Air Temp (C)	Apron Temp (C)	Wind Speed (mph)	Wind Direction	% Cloud Cover	Flushing Distance (m)	Walking/ Vehicle
15	7/3/2000	7:00:00 PM	7	25.7	25.2	DNC	DNC	0	DNC	DNC
Comments:	1900-15 5 young, 1 adult on post, 1 adult by gray pipe:1915-45 1 young into burrow and back out, 5 young by apron, 1 adult on post, 1 adult by gray pi									
15	7/6/2000	6:00:00 PM	3	DNC	DNC	10-16	SW	0	DNC	DNC
Comments:	1800-1815 2 young on apron, 1 adult by gray pipe: 1815-1845 2 young near apron, 1 adult by gray pipe									
15	7/6/2000	10:00:00 AM	3	26.6	31.1	5-11	SW	0	DNC	DNC
Comments:	1000-1015 2 young on apron, 1 adult by gray pipe: 1015-1045 2 young on apron, 1 adult by gray pipe									
15	7/10/2000	6:00:00 PM	1	DNC	DNC	0-5	SW	0	59	W
Comments:	1800-1815 1 adult owl: 1815-1845 1 adult owl: Vehicle parked at 65m from burrow: flushed at 59m while walking									
15	7/24/2000	12:00:00 PM	1	36.8	40.2	0-6	S	5	7	V
Comments:	1 owl flew out of burrow at 7m while in vehicle									
15	3/20/2001	2:10:00 PM	2	23.2	25.6	0-5	S	50	20, 23	W,W
Comments:	One owl flushed at 20m and one at 23m while walking									
15	4/18/2001	2:55:00 PM	1	23.0	23.6	10-20	S	85	28	W
Comments:	Owl flushed at 28m while walking									
15	5/23/2001	3:35:00 PM	1	35.1	39.1	0-5	SW	10	43	V
Comments:	Owl flushed at 43m while moving in truck; owl hissing like rattlesnake inside burrow									
15	6/15/2001	6:10:00 PM	2	31.7	33.8	5-10	S	0	16, 22	V
Comments:	1 owl on post flushed at 16m, 1 owl on apron ducked in burrow at 22m									
15	6/18/2001	6:25:00 PM	2	33.7	35.1	9-13	DNC	0	16, 5	V,V
Comments:	1 adult flushed to moving vehicle, 1 young ducked in burrow									

me	Number of owls	Air Temp (C)	Apron Temp (C)	Wind Speed (mph)	Wind Direction	% Cloud Cover	Flushing Distance (m)	Walking/ Vehicle
:00 PM	4	28.6	29.2	10-20	S	50	25,16,16	V, W, W
row at 25m while moving in truck; one owl flushed at 16m while walking; one ducked in burrow at 16m while walking								
:00 PM	2	31.7	33.9	5-11	SE	60	20, 15	V, V
n and one at 15m while moving in vehicle								
:00 AM	1	DNC	DNC	DNC	DNC	0	DNC	DNC
:00 PM	1	17.0	17.7	0-5	S	30	11	DNC
across road from burrow								
:00 PM	1	31.7	35.3	10-25	SW	0	DNC	DNC
:00 PM	1	29.5	32.8	0-8	SW	10	12	V
ile slowing down in vehicle								
NC	3	DNC	DNC	DNC	DNC	DNC	DNC	DNC
owls here, probably nest with young								
:00 AM	2	DNC	DNC	DNC	DNC	DNC	DNC	DNC
ller") who works at BEEF								
:00 PM	2	24.9	25.3	5-10	S	0	DNC	DNC
D								
:00 AM	1	26.8	31.3	5-12	N	50	DNC	DNC

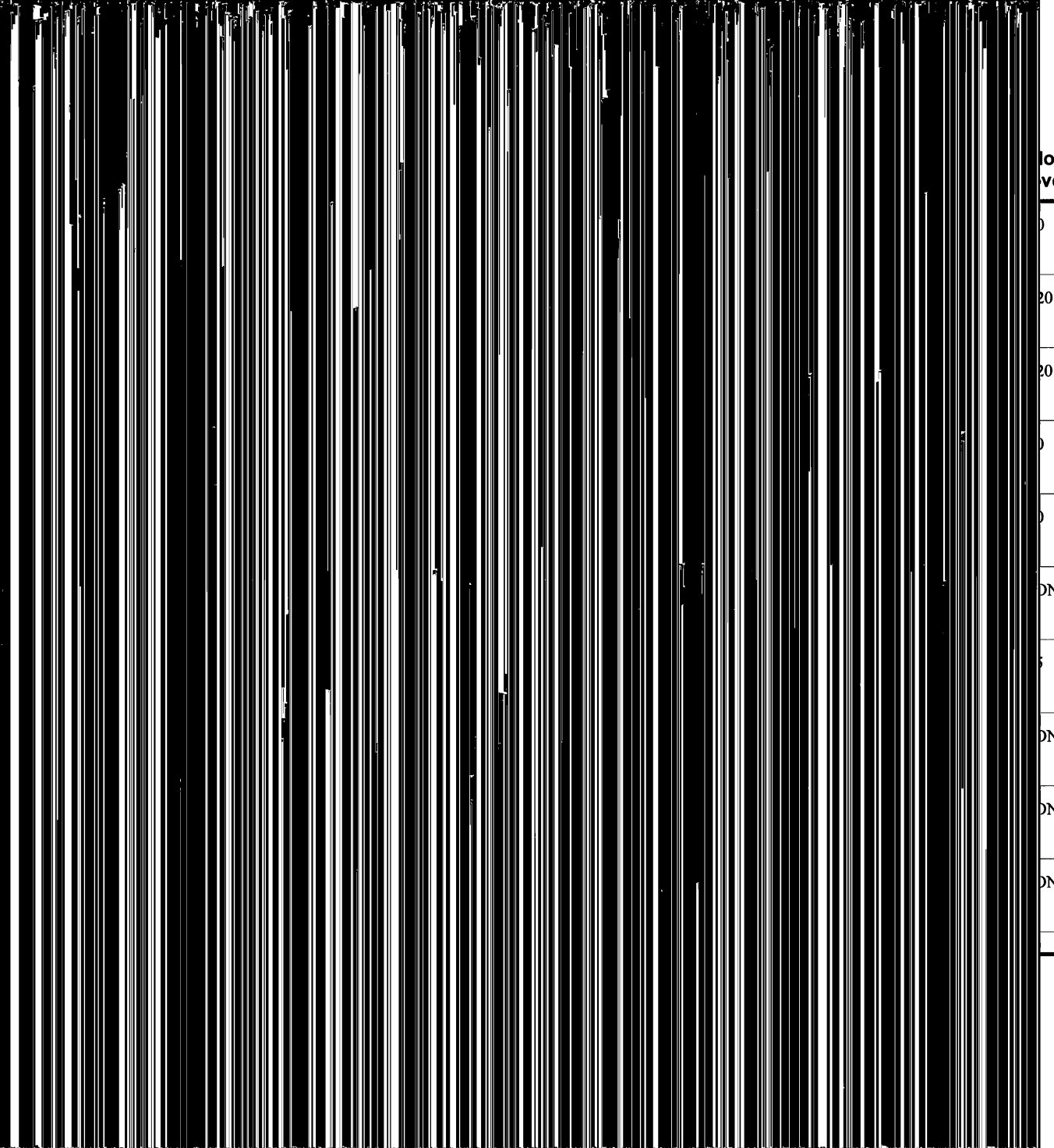
Number of owls	Air Temp (C)	Apron Temp (C)	Wind Speed (mph)	Wind Direction	% Cloud Cover	Flushing Distance (m)	Walking/ Vehicle
2	31.9	34.9	10-15	SW	10	DNC	DNC
1	24.7	DNC	5-10	N	80	DNC	DNC
1	DNC	DNC	DNC	DNC	DNC	DNC	DNC
1	10.3	DNC	5-10	S	DNC	DNC	DNC
2	DNC	DNC	5-10	DNC	10	DNC	DNC
1	DNC	DNC	DNC	DNC	5	3	W
neters while walking							
1	19.0	22.0	3-5	DNC	0	DNC	DNC
1	21.1	21.1	5-10	SW	70	DNC	DNC
2	16.0	16.0	0-5	N	100	DNC	DNC
ed; Owl on ground 8m from apron bobbed up and down							
2	35.5	39.0	0-5	SE	0	DNC	DNC
on berm							

Site Number	Date	Time	Number of owls	Air Temp (C)	Apron Temp (C)	Wind Speed (mph)	Wind Direction	% Cloud Cover	Flushing Distance (m)	Walking/ Vehicle
23	7/7/1999	7:45:00 PM	2	30.6	30.8	5-10	SE	40	DNC	DNC
Comments:	One adult owl on berm; one small gray chick inside burrow									
23	7/10/1999	7:15:00 PM	1	26.2	DNC	5-10	N	80	DNC	DNC
Comments:										
23	7/30/1999	1:30:00 PM	1	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Comments:	Owl flushed from shrubs near burrow									
23	8/4/1999	10:00:00 AM	2	33.3	35.3	0-5	S	5	DNC	DNC
Comments:	Both owls on berm									
23	8/6/1999	5:20:00 PM	1	30.4	31.7	10-20	S	5	DNC	DNC
Comments:	Owl on berm									
29	9/20/2001	11:00:00 AM	1	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Comments:	Flushed from a predator burrow									
30	11/5/1997	1:20:00 PM	1	27.5	19.3	2-5	S	0	DNC	DNC
Comments:	1 owl									
30	3/25/1998	9:30:00 AM	1	14.0	13.4	0-5	S	70	DNC	DNC
Comments:										
30	3/3/1999	10:15:00 AM	1	DNC	20.0	DNC	DNC	DNC	DNC	DNC
Comments:	owl stayed around (territorial?)									
30	3/18/1999	11:40:00 AM	2	DNC	24.0	DNC	DNC	DNC	DNC	DNC
Comments:										

Site Number	Date	Time	Number of owls	Air Temp (C)	Apron Temp (C)	Wind Speed (mph)	Wind Direction	% Cloud Cover	Flushing Distance (m)	Walking/ Vehicle
30	4/15/1999	10:00:00 AM	4	17.5	DNC	DNC	DNC	0	DNC	DNC
Comments:	2 pairs of owls seen, 1 pair at each burrow									
30	4/20/1999	3:30:00 PM	3	DNC	DNC	5-10	DNC	50	DNC	DNC
Comments:	2 in shade at A; 1 at B on apron									
30	6/3/1999	3:45:00 PM	2	17.3	19.3	5-15	S	DNC	DNC	DNC
Comments:	One owl at west burrow; one owl at east burrow									
30	6/7/1999	1:10:00 PM	1	26.8	30.7	5-10	DNC	DNC	DNC	DNC
Comments:	Owl at burrow entrance sitting in shade									
30	6/29/1999	11:20:00 AM	1	38.0	DNC	DNC	DNC	DNC	DNC	DNC
Comments:	Owl at west burrow									
30	7/19/1999	3:15:00 PM	1	33.2	35.2	0-10	SE	DNC	DNC	DNC
Comments:	Owl near east burrow									
30	7/21/1999	1:30:00 PM	1	34.2	38.0	0-5	SW	DNC	DNC	DNC
Comments:	Owl flushed from east burrow									
30	7/23/1999	9:30:00 AM	1	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Comments:	Owl flushed from east burrow									
30	8/4/1999	DNC	1	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Comments:	Owl flushed from shrub above west burrow									
30	8/17/1999	6:45:00 PM	1	34.0	DNC	0-5	SW	25	DNC	DNC
Comments:	Owl at west burrow									

Air mp (C)	Apron Temp (C)	Wind Speed (mph)	Wind Direction	% Cloud Cover	Flushing Distance (m)	Walking/ Vehicle
DNC	DNC	DNC	DNC	0	135, 33	V, W
om moving vehicle; 2nd owl landed near first and both flushed at 33m walking						
28.0	DNC	0-8	S	60	50	W
33.0	33.0	8-16	S	10	15	W
on of east burrow						
30.0	30.5	0-8	SW	85	130,130,130,25	W,W,W,W
king; 3 owls on apron at B, ducked in at 130m while leaving vehicle						
29.2	34.3	10-17	SW	0	DNC	DNC
36.7	39.1	DNC	DNC	50	122	V
at 122m while in vehicle						
29.3	30.1	5-10	SW	0	142,82	W,W
le walking						
DNC	DNC	0-1	N	0	35	W
B						
32.5	34.5	0-5	S	25	45	W
d at 45m while walking						
DNC	DNC	DNC	DNC	DNC	DNC	DNC

te	Time	Number of owls	Air Temp (C)	Apron Temp (C)	Wind Speed (mph)	Wind Direction	% Cloud Cover	Flushing Distance (m)	Walking/ Vehicle
001 B	DNC	1	DNC	DNC	DNC	DNC	DNC	DNC	DNC
998	DNC	1	10.7	DNC	0-3	S	DNC	DNC	DNC
998	10:30:00 AM	2	DNC	DNC	DNC	DNC	0	DNC	DNC
999	DNC	1	DNC	DNC	DNC	DNC	DNC	DNC	DNC
999	DNC	1	DNC	DNC	DNC	DNC	DNC	DNC	DNC
999	2:00:00 PM	1	25.5	DNC	DNC	DNC	DNC	DNC	DNC
99 urrow entrance	2:10:00 PM	1	30.2	33.9	7-12	DNC	DNC	DNC	DNC
001	3:05:00 PM	1	32.1	DNC	0-5	SW	0	DNC	DNC
00 shed at 50m while walking	5:20:00 PM	1	31.6	34.5	DNC	DNC	0	50	W
00 flushed at 55m and one at 40m while walking	12:05:00 PM	2	30.2	34.2	10-19	SW	0	55,40	W,W



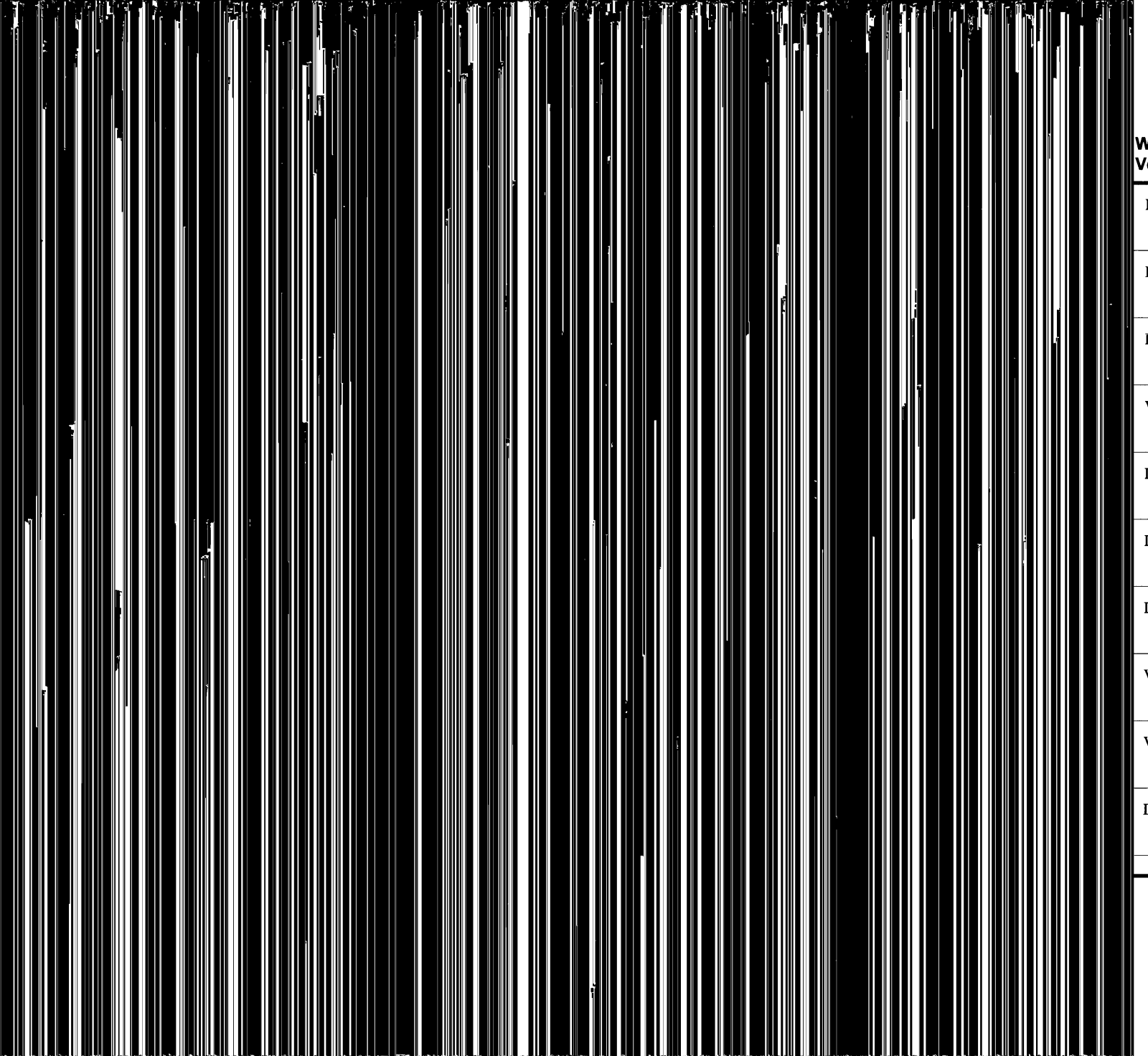
loud ver	Flushing Distance (m)	Walking/ Vehicle
0	40,40	W,W
20	36, 7	W,W
20	50,60	W
0	DNC	DNC
0	60	W
DNC	DNC	DNC
5	DNC	DNC
DNC	DNC	DNC
DNC	DNC	DNC
DNC	DNC	DNC

Site Number	Date	Time	Number of owls	Air Temp (C)	Apron Temp (C)	Wind Speed (mph)	Wind Direction	% Cloud Cover	Flushing Distance (m)	Walking/ Vehicle
38	3/17/1999	3:10:00 PM	1	20.1	26.5	0-5	S	10	19	DNC
Comments:										
38	4/20/1999	1:40:00 PM	1	25.4	28.8	5-10	N	20	20	DNC
Comments:	On apron at B									
38	4/21/1999	3:45:00 PM	2	22.0	DNC	5-15	DNC	10	DNC	DNC
Comments:	Pair observed at burrow entrance									
38	5/24/1999	5:40:00 PM	1	16.7	17.3	0-5	S	20	15	DNC
Comments:	Owl on apron									
38	6/24/1999	1:10:00 PM	1	31.2	34.6	10-23	SW	0	DNC	DNC
Comments:	Owl on apron									
38	6/29/1999	2:50:00 PM	1	37.3	41.0	5-10	SE	DNC	DNC	DNC
Comments:	Owl perched on camera post									
38	4/4/2000	10:25:00 AM	2	22.6	21.3	5-10	S	0	30, 30	V, W
Comments:	Both owls on apron in shade; 1 owl flushed to shrub and bobbed at 30m while in truck; 1 owl flushed at 30m while walking									
38	4/10/2000	11:30:00 AM	1	16.2	18.8	7-13	DNC	50	8	V
Comments:	Flushed at 8m from moving vehicle									
38	4/27/2000	10:20:00 AM	1	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Comments:	Owl on apron in shade, did not flush as I drove past									
38	5/8/2000	1:20:00 PM	1	27.0	DNC	0-5	S	DNC	DNC	DNC
Comments:	Flushed at unknown distance									

peed h)	Wind Direction	% Cloud Cover	Flushing Distance (m)	Walking/ Vehicle
burrow	S	10	100	V
ove burrow B	S	0	16,28	V, V
	DNC	DNC	DNC	DNC
	S	DNC	50	W
	S	20	10	V
	S	30	17	V
	NA	20	12	DNC
	S	10	DNC	DNC
	S	0	DNC	DNC
	NW	0	47	V

Site Number	Date	Time	Number of owls	Air Temp (C)	Apron Temp (C)	Wind Speed (mph)	Wind Direction	% Cloud Cover	Flushing Distance (m)	Walking/ Vehicle
41	3/22/2000	11:05:00 AM	1	17.5	20.5	0-8	NE	0	14	W
Comments: Owl on apron; flushed at 14 m while walking										
43	5/24/1999	9:25:00 AM	2	17.3	17.5	0-5	N	90	19, 20	DNC
Comments:										
43	6/24/1999	10:35:00 AM	1	36.5	39.5	0-5	SE	0	DNC	DNC
Comments:										
43	7/10/1999	7:25:00 PM	1	24.2	DNC	5-10	N	80	DNC	DNC
Comments:										
43	8/4/1999	10:15:00 AM	1	33.7	36.0	0-5	S	5	DNC	DNC
Comments: Owl perched on camera										
43	9/30/1999	9:10:00 AM	1	27.7	29.3	0-5	N	0	17	DNC
Comments: Owl flushed from top of washbank										
43	3/13/2000	9:00:00 AM	2	17.8	19.6	0-5	NE	0	16	W
Comments: Owls near apron; both flushed at 16m while walking										
43	3/14/2000	12:10:00 PM	1	29.0	31.1	0-5	N	10	DNC	DNC
Comments: Owl just off of apron; Flushed but did not get distance										
43	3/22/2000	8:00:00 AM	1	12.3	14.5	5-7	NE	0	22	W
Comments: Owl on apron; flushed at 22m while walking										
43	4/4/2000	8:55:00 AM	1	21.5	22.8	0-5	SE	0	48	W
Comments: Owl on apron; ducked in burrow at 48m while walking										

Site Number	Date	Time	Number of owls	Air Temp (C)	Apron Temp (C)	Wind Speed (mph)	Wind Direction	% Cloud Cover	Flushing Distance (m)	Walking/ Vehicle
43	7/3/2000	6:15:00 PM	2	29.7	30.7	5-12	S	0	33	V
Comments: 1 flew and perched on shrub; 1 on fourwing saltbush flushed at 33m while in vehicle										
43	7/6/2000	11:25:00 AM	1	28.7	31.5	5-15	S	0	22	W
Comments: 1 owl flushed at 22m while walking										
43	4/18/2001	9:45:00 AM	1	24.0	27.0	10-15	S	35	9	W
Comments: Owl flushed at 9m while walking										
43	5/23/2001	10:15:00 AM	1	32.2	37.6	2-8	SE	15	23	W
Comments: Owl flushed at 23m while walking										
43	5/31/2001	2:05:00 PM	1	35.2	42.0	3-8	SE	0	14	W
Comments: Owl flushed at 14 m from burrow while walking										
44	2/11/1999	9:40:00 AM	1	4.0	DNC	0-8	N	0	DNC	DNC
Comments:										
44	8/14/2000	2:30:00 PM	1	36.0	DNC	0-8	DNC	0	30	W
Comments: Owl flushed from Burrow B at 30 m while walking										
44	9/6/2000	1:30:00 PM	1	DNC	DNC	0-1	N	0	25	W
Comments: 1 owl flushed at 25m while walking										
49	8/31/1999	1:20:00 PM	1	28.0	DNC	5-10	S	0	DNC	DNC
Comments: Flushed to fence post										
50	8/31/1999	DNC	1	28.5	DNC	8-15	DNC	DNC	DNC	DNC
Comments: Owl flushed from apron										



Walking/ Vehicle
DNC
DNC
DNC
V
DNC
DNC
DNC
V
V
DNC

Site Number	Date	Time	Number of owls	Air Temp (C)	Apron Temp (C)	Wind Speed (mph)	Wind Direction	% Cloud Cover	Flushing Distance (m)	Walking/ Vehicle
59	5/24/1999	1:40:00 PM	1	24.6	28.3	0-5	N	75	DNC	DNC
Comments:	Owl on apron									
59	6/19/1999	11:40:00 AM	1	33.0	37.2	5-15	S	10	DNC	DNC
Comments:	Owl perched on fence post; Retrieved TM1500 at 10:50 am same day									
59	7/26/1999	4:15:00 PM	1	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Comments:	Owl flushed from west culvert									
59	9/30/1999	12:25:00 PM	1	31.0	34.0	5-10	S	0	DNC	DNC
Comments:	Owl at burrow A; flushed to north									
59	4/6/2000	11:50:00 AM	1	25.5	28.6	6-15	NW	0	21	V
Comments:	Owl flushed at 21m while stopped in 2 trucks									
59	6/6/2001	2:10:00 PM	1	35.5	36.8	DNC	DNC	0	70	W
Comments:	Owl flushed to walking at 70m									
59	6/6/2001	3:05:00 PM	1	36.3	38.7	2-10	S	5	20	V
Comments:										
59	6/6/2001	3:05:00 PM	2	36.3	38.7	2-10	S	5	15,20	W,V
Comments:	1 owl flushed from apron at 15m while walking, 1 owl flushed from 5 ft perch at 20m to moving vehicle									
59	6/15/2001	5:00:00 PM	1	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Comments:	1 owl at A									
59	6/25/2001	4:40:00 PM	2	30.9	32.6	10-20	S	40	11, 4	W, W
Comments:	Adult owl flushed at 11m while walking, young owl flushed at 4m while walking									

Site Number	Date	Time	Number of owls	Air Temp (C)	Apron Temp (C)	Wind Speed (mph)	Wind Direction	% Cloud Cover	Flushing Distance (m)	Walking/ Vehicle
61	5/5/1999	12:00:00 PM	1	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Comments: Owl perched on post and then flew to ground										
61	5/24/1999	6:25:00 PM	1	19.6	19.8	0-5	NW	10	20	DNC
Comments: Owl flushed from apron										
61	8/4/1999	3:50:00 PM	1	35.5	37.0	5-10	S	10	DNC	DNC
Comments: Owl on apron										
63	5/24/1999	12:30:00 PM	1	17.5	18.3	0-5	S	60	DNC	DNC
Comments: Owl on apron flushed as I drove by										
64	5/24/1999	1:10:00 PM	1	21.2	24.2	0-5	SW	60	60	W
Comments: Flew toward North of 8D-2 Burrow; saw it at latter and flushed back to Drill Pad										
64	6/16/1999	1:30:00 PM	1	33.5	35.5	10-20	SW	10	DNC	DNC
Comments: Owl on mound near apron										
64	6/19/1999	11:15:00 AM	1	31.0	36.6	5-13	S	10	DNC	DNC
Comments: Owl on apron										
64	6/29/1999	12:20:00 PM	2	37.0	41.0	0-5	SE	DNC	DNC	DNC
Comments: Both on apron										
64	8/4/1999	DNC	1	34.5	38.5	8-12	SE	50	DNC	DNC
Comments: Owl on apron										
64	8/4/1999	5:50:00 PM	2	33.8	34.0	5-12	S	20	DNC	DNC
Comments: One adult owl on apron, one young owl on berm near apron										

ing nce (m)	Walking/ Vehicle
C	DNC
C	DNC
C	DNC
C	DNC
C	DNC
C	DNC
	V
C	DNC
	V
C	DNC

Site Number	Date	Time	Number of owls	Air Temp (C)	Apron Temp (C)	Wind Speed (mph)	Wind Direction	% Cloud Cover	Flushing Distance (m)	Walking/ Vehicle
64	4/6/2000	12:00:00 PM	1	26.8	28.6	0-18	NW	0	DNC	DNC
Comments:	Owl at Burrow E									
64	5/8/2000	4:00:00 PM	2	DNC	DNC	DNC	DNC	DNC	57, 52	V, W
Comments:	1 owl flushed at 57m moving slow in vehicle, 1 owl flushed at 52m while walking									
64	5/18/2000	12:00:00 PM	1	22.0	23.0	0-2	N	40	50	W
Comments:	Owl flushed from apron (burrow E) to me walking at 50M.									
64	5/22/2000	10:15:00 AM	1	31.8	DNC	0	NA	10	60	W
Comments:	Owl perched on post (6ft) flushed to me walking at 60m. This occurred north of burrow B.									
64	5/22/2000	10:30:00 AM	1	33.5	40.0	0-1	S	10	10	W
Comments:	Owl perched on post(5-6ft) flushed to me walking at 10m. Note: Direct soil temp at apron was 50C-hence owl on perch									
64	6/5/2000	3:15:00 PM	4	32.7	36.2	10-15	S	5	19	V
Comments:	1 owl at D, 1 at B, 2 at E (1 young); Owl at B flushed at 19m in truck									
64	6/7/2000	10:45:00 AM	4	DNC	DNC	DNC	DNC	0	DNC	DNC
Comments:	1045-1100 1 adult at F, 2 adults at A: 11-1130 2 adults at A: 1130-1145 1 adult at F, 1 chick at E, 2 adults at A									
64	6/16/2000	4:40:00 PM	3	35.5	40.1	0-5	SE	10	60	W
Comments:	1 young owl at A ducked in burrow at 60m getting out of vehicle; 1 owl at B; 1 owl on shrub near E									
64	6/19/2000	5:35:00 PM	2	31.8	34.0	8-12	S	0	DNC	DNC
Comments:	1 adult owl on shrub near E; 1 young owl at B									
64	6/29/2000	8:55:00 AM	3	31.5	36.5	0-5	S	25	DNC	DNC
Comments:	0855-0910 3 young at E all ducked in burrow: 0922 1 young came to entrance and ducked back in									

Site Number	Date	Time	Number of owls	Air Temp (C)	Apron Temp (C)	Wind Speed (mph)	Wind Direction	% Cloud Cover	Flushing Distance (m)	Walking/ Vehicle
64	7/3/2000	8:00:00 PM	2	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Comments: 1 adult and 1 young near E and F										
64	7/6/2000	8:35:00 AM	6	24.5	29.2	5-17	SE	0	DNC	DNC
Comments: 0835-0850 1 adult, 2 young at B 1 flew from B to A, 1 young at E: 0850-0920 1 adult, 2 young at B; 1 adult, 1 young at A; 1 young at E										
64	7/6/2000	7:05:00 PM	5	DNC	DNC	5-10	S	0	DNC	DNC
Comments: 1905-1920 1 adult at B: 1920-1950 1 adult at B, 1 adult and 3 young at A (1950)										
64	7/10/2000	7:35:00 PM	3	DNC	DNC	0-5	S	0	DNC	DNC
Comments: 1935-1950 3 young at B 1 flew away: 1950-2020 2 young at B 1 left at 2000 and 1 left at 2013: Vehicle parked at 76m from E and 55m from B										
64	7/26/2000	12:45:00 PM	3	36.5	39.0	10-16	S	0	15,15,15	W,W,W
Comments: 3 owls at A, flushed at 15m while walking; apron temp taken 6" in shade										
64	7/28/2000	4:20:00 PM	1	36.5	40.0	2-12	SW	15	18	W
Comments: 1 owl at B in burrow, flushed at 18m while walking; apron temp taken in shade of burrow where owl was										
64	8/14/2000	2:50:00 PM	3	36.0	DNC	2-4	DNC	15	10, 10, 5	V, V, W
Comments: 2 owls flushed at 10m driving in truck at Burrow A; 1 owl flushed at 5m while walking at Burrow E										
64	9/6/2000	1:00:00 PM	1	25.5	30.1	0-5	NW	0	14	V
Comments: 1 owl at G flushed at 14m while in truck										
64	9/6/2000	12:55:00 PM	1	25.7	29.1	2-10	N	0	22	V
Comments: 1 owl at A flushed at 22m while in truck										
64	10/4/2000	2:10:00 PM	1	28.2	30.1	5-10	SE	65	22	V
Comments: Owl at A; flushed at 22m while stopped in vehicle										

ud er	Flushing Distance (m)	Walking/ Vehicle
	6	V
0	11	V
	29, 29	W, W
	80	V
	DNC	DNC
	DNC	DNC
	15	W
	25,20	W,V
	DNC	DNC
	DNC	DNC

Site Number	Date	Time	Number of owls	Air Temp (C)	Apron Temp (C)	Wind Speed (mph)	Wind Direction	% Cloud Cover	Flushing Distance (m)	Walking/ Vehicle
64	6/25/2001	5:05:00 PM	3	30.1	34.1	10-20	S	40	30	V
Comments:	Owl at D, flushed at 30m while stopped in vehicle									
64	6/25/2001	5:30:00 PM	2	30.2	32.0	5-15	S	40	18, 13	W, W
Comments:	2 adult owls at J, one flushed at 13m one at 18m while walking									
64	8/29/2001	2:00:00 PM	1	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Comments:	Owl at E									
64	9/20/2001	2:00:00 PM	1	33.5	37.5	5-8	S	0	15	V
Comments:	Owl at A, flushed to B and then to North of 8D-2; Flushed at 15m to moving vehicle									
64	12/19/2001	12:30:00 PM	1	11.0	12.7	0-5	SE	70	9	V
Comments:	Owl at B, ducked in burrow at 9m while stopped in vehicle									
67	4/4/2000	DNC	1	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Comments:	Owl on apron									
67	4/6/2000	12:30:00 PM	1	26.7	28.5	5-12	NW	0	44	W
Comments:	Ducked in burrow at 44m walking									
67	5/8/2000	4:20:00 PM	1	28.0	29.4	0-5	SW	15	37 ?	V, W
Comments:	Owl in shrub; flew to apron of A while I was in truck; flushed to E at 37m while walking									
67	5/11/2000	1:55:00 PM	1	DNC	DNC	5-10	N	10	29	W
Comments:	1 owl at A; flushed at 29m while walking									
67	5/15/2000	6:30:00 PM	1	20.5	21.1	DNC	DNC	20	26	W
Comments:	1 owl east of A; flushed at 26m while walking									

Site Number	Date	Time	Number of owls	Air Temp (C)	Apron Temp (C)	Wind Speed (mph)	Wind Direction	% Cloud Cover	Flushing Distance (m)	Walking/ Vehicle
67	5/18/2000	11:10:00 AM	1	23.0	27.0	8-12	N	30	50	V
Comments:	Owl flushed from apron as vehicle approched site.									
67	6/5/2000	2:50:00 PM	2	33.0	36.5	10-15	S	5	57, 57	W, W
Comments:	2 owls flushed at 57m while walking									
67	6/26/2000	11:10:00 AM	2	36.7	39.1	0-5	DNC	DNC	10	W
Comments:	2 owls at E; one flushed to vehicle unknown distance; one flushed at 10m while walking									
67	6/29/2000	9:50:00 AM	2	32.3	36.5	0-10	SE	25	65,48	V,W
Comments:	1 owl at E on fence post; flushed to burrow at 65m while in vehicle;1 owl on fence post at AC; bobbed up and down; flushed at 48m while walking									
67	7/6/2000	8:00:00 PM	9	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Comments:	9 owls, 7 young and 2 adults; some young flew									
67	7/6/2000	9:40:00 AM	2	26.6	29.0	5-15	SE	0	DNC	DNC
Comments:	2 adult owls, 1 at C and 1 at E									
67	7/10/2000	7:15:00 PM	5	DNC	DNC	0-5	SW	0	DNC	DNC
Comments:	1 adult and 4 young at A									
67	7/13/2000	5:15:00 PM	3	35.8	39.8	5-12	S	60	DNC	DNC
Comments:	3 owls at AC									
67	7/17/2000	9:35:00 AM	3	29.6	32.0	5-10	S	0	52,52,52	W,W,W
Comments:	3 owls at AC, flushed at 52m while walking									
67	7/19/2000	1:10:00 PM	1	DNC	DNC	DNC	DNC	DNC	30	V
Comments:	1 owl at AC, flushed at 30m to vehicle									

ion	% Cloud Cover	Flushing Distance (m)	Walking/ Vehicle
C	15	DNC	DNC
W	0	18	V
E	50	DNC	DNC
	85	34, 22	W, W
	40	57	V
V	0	DNC	DNC
	10	23	W
C	5	15	W
	0	25	W
C	0	DNC	DNC

Site Number	Date	Time	Number of owls	Air Temp (C)	Apron Temp (C)	Wind Speed (mph)	Wind Direction	% Cloud Cover	Flushing Distance (m)	Walking/ Vehicle
67	6/15/2001	5:45:00 PM	2	32.7	36.6	2-6	S	0	DNC	DNC
Comments: 2 owls at A										
67	7/23/2001	2:20:00 PM	1	35.0	43.3	0-7	SE	0	12	V
Comments: 1 owl ducked in burrow to miving vehicle at 12m										
67	8/29/2001	3:30:00 PM	1	36.8	39.5	4-9	SW	15	25	V
Comments: Owl at E, flushed at 25m while moving in vehicle										
67	9/20/2001	2:20:00 PM	1	32.7	36.7	2-10	S	0	40	V
Comments: Flew to E and back to C, bobbed up and down; Flushed at 40m to moving vehicle										
68	8/14/2000	11:15:00 AM	1	DNC	DNC	DNC	DNC	5	DNC	DNC
Comments: Owl flushed from apron										
71	3/20/2001	4:30:00 PM	1	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Comments: Owl flushed from burrow on return trip from M-16#1										
73	5/25/2001	8:30:00 AM	1	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Comments: Owl flying										
73	6/15/2001	6:05:00 PM	1	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Comments: 1 owl										
73	6/25/2001	6:40:00 PM	4	28.6	29.2	10-20	S	50	21, 21, 14	W, W, W
Comments: 4 young; 2 flushed at 21m and one ducked in burrow at 14m while walking										
74	6/12/2001	4:30:00 PM	2	33.3	35.1	5-10	NW	20	6	W
Comments: 2 owls; 1 owl flushed at 6m while walking										

Site Number	Date	Time	Number of owls	Air Temp (C)	Apron Temp (C)	Wind Speed (mph)	Wind Direction	% Cloud Cover	Flushing Distance (m)	Walking/ Vehicle
74	6/26/2001	DNC	2	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Comments: 2 owls										
74	7/3/2001	10:10:00 AM	2	39.6	DNC	DNC	DNC	DNC	DNC	DNC
Comments: 2 owls in shade of building										
76	6/13/2001	11:10:00 AM	1	20.1	22.3	5-15	N	0	25	V
Comments: owl at A flushed to moving vehicle at 25m										
76	6/13/2001	6:25:00 PM	6	24.1	DNC	3-10	N	0	DNC	DNC
Comments: 2 adults, 4 young at A; 2 young ducked in burrow										
76	6/15/2001	5:00:00 PM	2	DNC	DNC	3-8	S	0	DNC	DNC
Comments: 2 owls at A										
76	6/15/2001	5:30:00 PM	5	31.8	38.0	3-12	S	0	25,25,25,10, 10	V,V,V,W,W
Comments: 3 owls at Aducked in burrow to driving, 2 flushed to walking. (1 from perch)										
76	6/25/2001	4:55:00 PM	1	30.2	34.2	5-20	S	40	10	V
Comments: Owl at A, flushed at 10m while stopped in vehicle										
76	7/18/2001	DNC	1	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Comments: 1 owl on fence post at A										
76	8/29/2001	1:50:00 PM	1	34.5	38.2	3-7	SW	10	12	V
Comments: Owl at B, flushed at 12m while moving in vehicle										
82	5/12/1999	DNC	2	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Comments: Natural burrow; breeding pair (GT Sharp); YMP; Jim Boone, personal communication										

Site Number	Date	Time	Number of owls	Air Temp (C)	Apron Temp (C)	Wind Speed (mph)	Wind Direction	% Cloud Cover	Flushing Distance (m)	Walking/ Vehicle
106	11/25/1997	4:05:00 PM	1	13.7	DNC	0-5	N	100	DNC	DNC
Comments:	Found during Road Survey on North Route; No burrow									
107	8/19/1998	DNC	1	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Comments:	Saw during Anabat road survey; owl standing in middle of road, possibly foraging on large grasshoppers in the area									
108	7/6/1998	DNC	1	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Comments:	Seen during other resource survey									
1006	1/5/1998	DNC	1	DNC	DNC	DNC	DNC	DNC	DNC	DNC
Comments:	YMP; Jim Boone, personal communication									

Appendix H

Traffic Rate, Distance to Nest Burrow (m), Productivity, and Owl Activity Data for Burrows Monitored With Traffic Counters During the Breeding Seasons of 2000 and 2001.

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dults/Sign	Owl Activity Rating
e	None
ng	Breeding
e	None
ng	Breeding
ng	Breeding
ellets/1 date	Low owl activity
ng	Breeding
at on 3 dates	Moderate owl activity
n 3 dates	Moderate owl activity
on 1 date	Low owl activity
ng	Breeding
ng	Breeding
pellet	Low owl activity
e	None
ng	Breeding
n 1 date	Low owl activity
n 2 dates	Low owl activity
ng	Breeding
ts/scat	Moderate owl activity
2 dates	Low owl activity
ng	Breeding
ng	Breeding
ng	Breeding
ng	Breeding
ng	Breeding
dates	Low owl activity
ng	Breeding
in April	Low owl activity
ng	Breeding
ng	Breeding
3 dates	Moderate owl activity
on 5 dates	High owl activity
n April	Moderate owl activity
ng	Breeding
et/scat	Low owl activity
arch/April	Low owl activity

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Burrowing Owl Variablesa Regressed	Sample Size (n)	R2 Value	p-Valueb	Equation of Line
Site characteristics				
BURS vs. number of burrow openings per site	56	0.12	0.01	y = .0373 x + .1925
BURS vs. burrow aspect	19	0.37	0.01	y = .0010 x + .0965
Distance to potential disturbances				
BURS vs. average distance to paved road	34	0.003	0.78	y = 0.0001 x + 0.2547
BURS vs. average distance to gravel road	19	0.3	0.02	y = 0.0021 x + 0.2646
BURS vs. average distance to dirt road	17	0.002	0.86	y = 0.0001 x + 0.2464
BURS vs. average distance to building	10	0.01	0.84	y = - 0.0001 x + 0.2409
BURS vs. average distance to powerline	8	0.01	0.87	y = 0.0002 x + 0.3075
BURS vs. average distance to roadsign	9	0.06	0.52	y = 0.0006 x + 0.2064
BURS vs. average distance to drill pad	22	0.2	0.04	y = - 0.0016 x + 0.4375
BURS vs. average distance to man-made mound/low perch	9	0.32	0.11	y = - 0.0013 x + 0.4125
Other				
Number of owl young vs. traffic rate and distance from nest to closest road	17	0.12	0.41	y = - 0.0052 rate + .0017 distance + 5.5062
Seasonal BURS (March-August) vs. traffic rate and distance from nest to closest road	36	0.12	0.12	y = -0.0006 rate + .0010 distance + .5686
Owl flushing distance vs. length of study period	216	0.02	0.03	y=-.0147 x + 39.9494
Owl flushing distance vs. ambient air temperature	193	0.007	0.26	y=.2788 x + 20.9765
Owl flushing distance vs. apron (soil) temperature	177	0.003	0.49	y=.174 x + 23.3579
Owl flushing distance vs. time of day	214	0.0208	0.04	y=-28.644 x + 46.3549

[a]BURS=Burrow use rate by burrow site (number of months site was active/number of months site was monitored)

[b] Significant p-value (<0.05) indicates slope of line is significantly different from zero

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Appendix J

Minimum Distance (m) to Selected Disturbances Measured Within a 2.2-kilometer R

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Burrow Site Number	Dirt Road	Gravel Road	Paved Road	Building	Power Line	Power Pole	Pad	Man-made Mound/Low Perches
1			53.2				0	
2		7	59	17.5		172.5		
3		6		110.3		72.66		
4		160.4	78.2	176.4			166.4	
5	4.75	35.25					170.5	
6		143		190.5			110.5	40
7	28.66	7					128.7	
8		10.7						50.3
9	101.6		7.6					
10	5		16	152.5				
11			7.5					
12	2	110					0	60
13		59					80	106
14	59.33						43.66	
15		115			79		0	
16		4						
17	31.25		8	53.5	31.25		10.1	
18			59					
19			7	109				27
20	80		30					
21			9					190
22			228					
23			8		30			
24	18			28	24			
25	200	350		1000				
26	500	800		700				
27	132		117		217			
28	119							
29	265		377					295
30	15		159					
31	734	704	824					
32			50					0
33	238		287					
34	408							
35			105					75
36			300					
37			10					
38			9					
39			13					
40			5					
41	37.2	130					0	102.8
42			24					
43			35					40
44			148.7	181.3				

Burrow Site Number	Road sign	Crater Edge	Road Junction	Borrow Pit	Other Disturbance
1					
2					
3			92.3		
4					
5					170 to Active construction Fall 2001
6		26.5			
7					128 to Active construction Fall 2001
8					
9	20.3				
10					
11	85				
12					
13		25			
14					
15		120			
16	47		95		
17					33.5 to Beef Staging Entrance
18					
19			80		237 to Area 3 RWMS entrance
20					
21	16				
22					0 to ditch
23					
24					
25					
26					
27					
28				0	
29	385				
30					
31					
32					
33					
34					
35					84 to cable-line trenching
36					278 to cable-line trenching
37	163				
38				128	
39					
40					
41		129.7			
42					5 to cable-line trenching
43					139 to ditch
44					

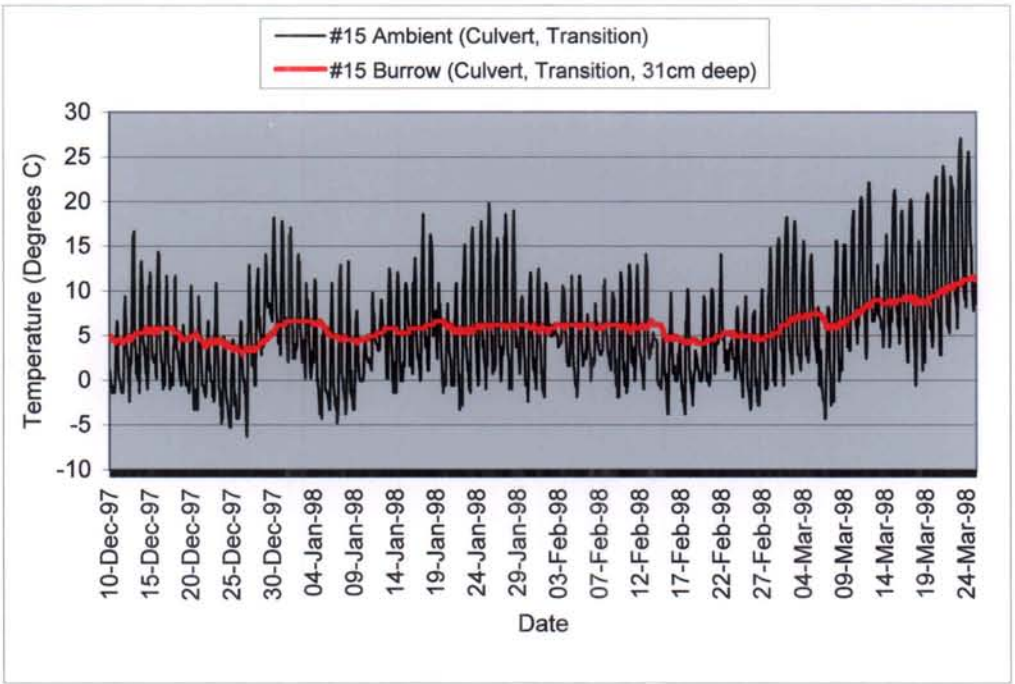
Burrow Site Number	Dirt Road	Gravel Road	Paved Road	Building	Power Line	Power Pole	Pad	Man-made Mound/Low Perches
45			149				36	
46			6					
47			96	223	115			70
48			292	277				
49	6	13.5					339.5	290
50			330					
51	18.3		157.1	138.8			0	
52			48.7				0	
53			7.5				77.5	
54			2200				780	
55	395		533.3					
56								
57			350					
58		5					40	
59		8.5			93		102	
60	56.5		12.5					21.5 m
61	38							
62	115		169					
63	26.7	9.7	12.7				34.7	
64		205.7					0	
65	110		190					
66		8	94	85				
67			43.2				0	
68		7	110				57	
69		7						
70		80					0	
71	81		138					
72		350	600					
73		6					44	
74		5	270	20				
75	80						0	
76		5.7			180.3		25.7	
77		8				220	5	40
78			13					
79	10						40	

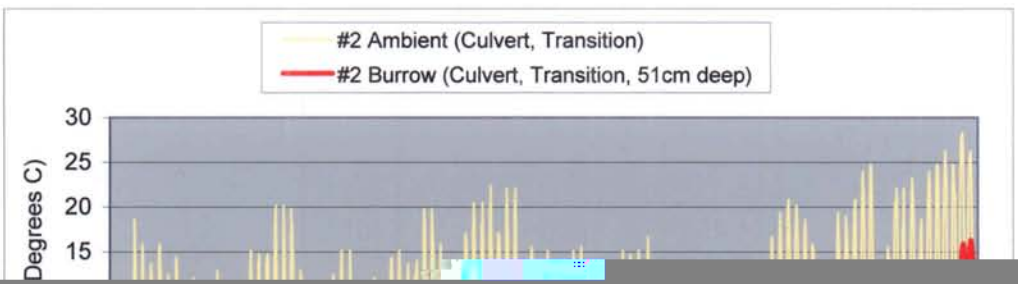
Burrow Site Number	Road sign	Crater Edge	Road Junction	Borrow Pit	Other Disturbance
45					
46					
47					
48					
49		170.5			
50					
51	111.8				162 to Sump U2GG bladed area
52				115	
53				20	
54					
55					
56					
57					
58					
59					
60					
61					
62					
63	22.7	133.7			
64					
65					
66					
67					
68	108				
69					
70					
71					
72					
73		162.5			
74					250 to RWMS Buildings
75		134		90	
76					
77					
78					
79					

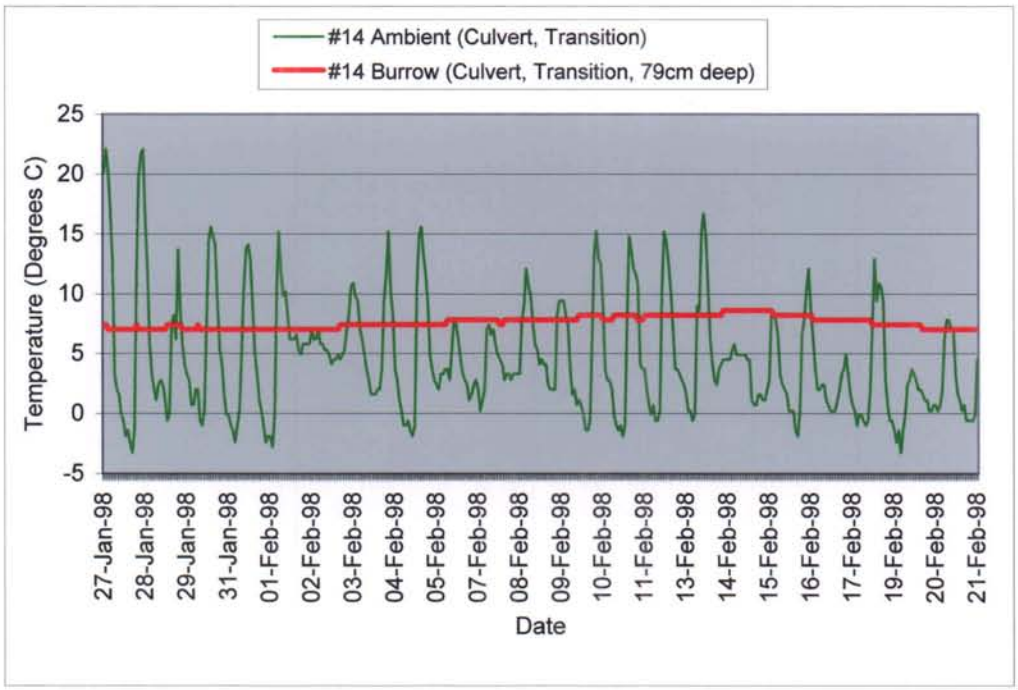
Appendix K

Graphs of Ambient Air and Burrow Temperatures for Six Burrows (Burrow Site #15, #2, #14, #36, #13, and #30) from December 1997 to March 1998 and Six Burrows (#2, #41, #14, #36, #30, and #9) from D

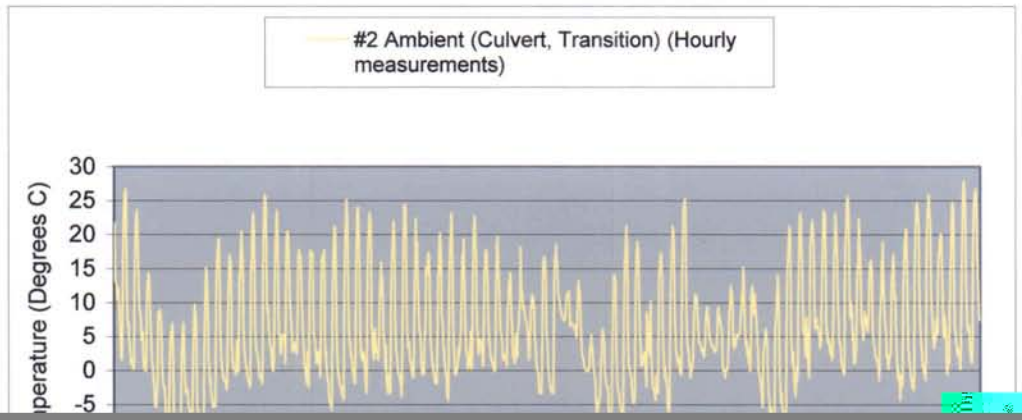
1997-1998

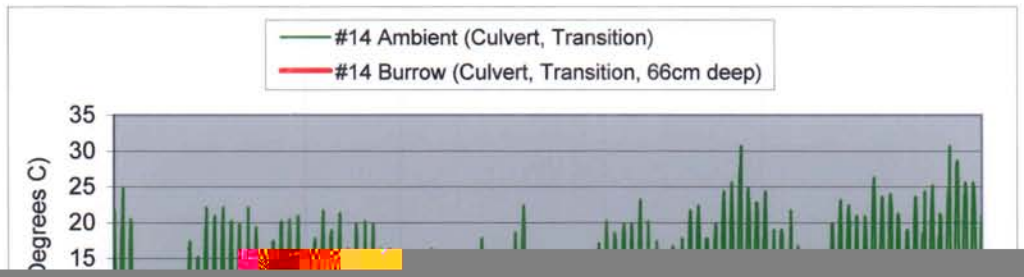

#15 Ambient (Culvert, Transition)
#15 Burrow (Culvert, Transition, 31cm deep)
Temperature (Degrees C)
30
25
20
15
10
5
0
-5
-10
10-Dec-97
15-Dec-97
20-Dec-97
25-Dec-97
30-Dec-97
04-Jan-98
09-Jan-98
14-Jan-98
19-Jan-98
24-Jan-98
29-Jan-98
03-Feb-98
07-Feb-98
12-Feb-98
17-Feb-98
22-Feb-98
27-Feb-98
04-Mar-98
09-Mar-98
14-Mar-98
19-Mar-98
24-Mar-98
Date


#2 Ambient (Culvert, Transition)
#2 Burrow (Culvert, Transition, 51cm deep)
Degrees C)
30
25
20
15


#14 Ambient (Culvert, Transition)
#14 Burrow (Culvert, Transition, 79cm deep)
Temperature (Degrees C)
25
20
15
10
5
0
-5
27-Jan-98
28-Jan-98
29-Jan-98
31-Jan-98
01-Feb-98
02-Feb-98
03-Feb-98
04-Feb-98
05-Feb-98
07-Feb-98
08-Feb-98
09-Feb-98
10-Feb-98
11-Feb-98
13-Feb-98
14-Feb-98
15-Feb-98
16-Feb-98
17-Feb-98
19-Feb-98
20-Feb-98
21-Feb-98
Date

1998-1999


#2 Ambient (Culvert, Transition) (Hourly measurements)
30
25
20
15
10
5
0
-5


#14 Ambient (Culvert, Transition)
#14 Burrow (Culvert, Transition, 66cm deep)
35
30
25
20
15
Degrees C)

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