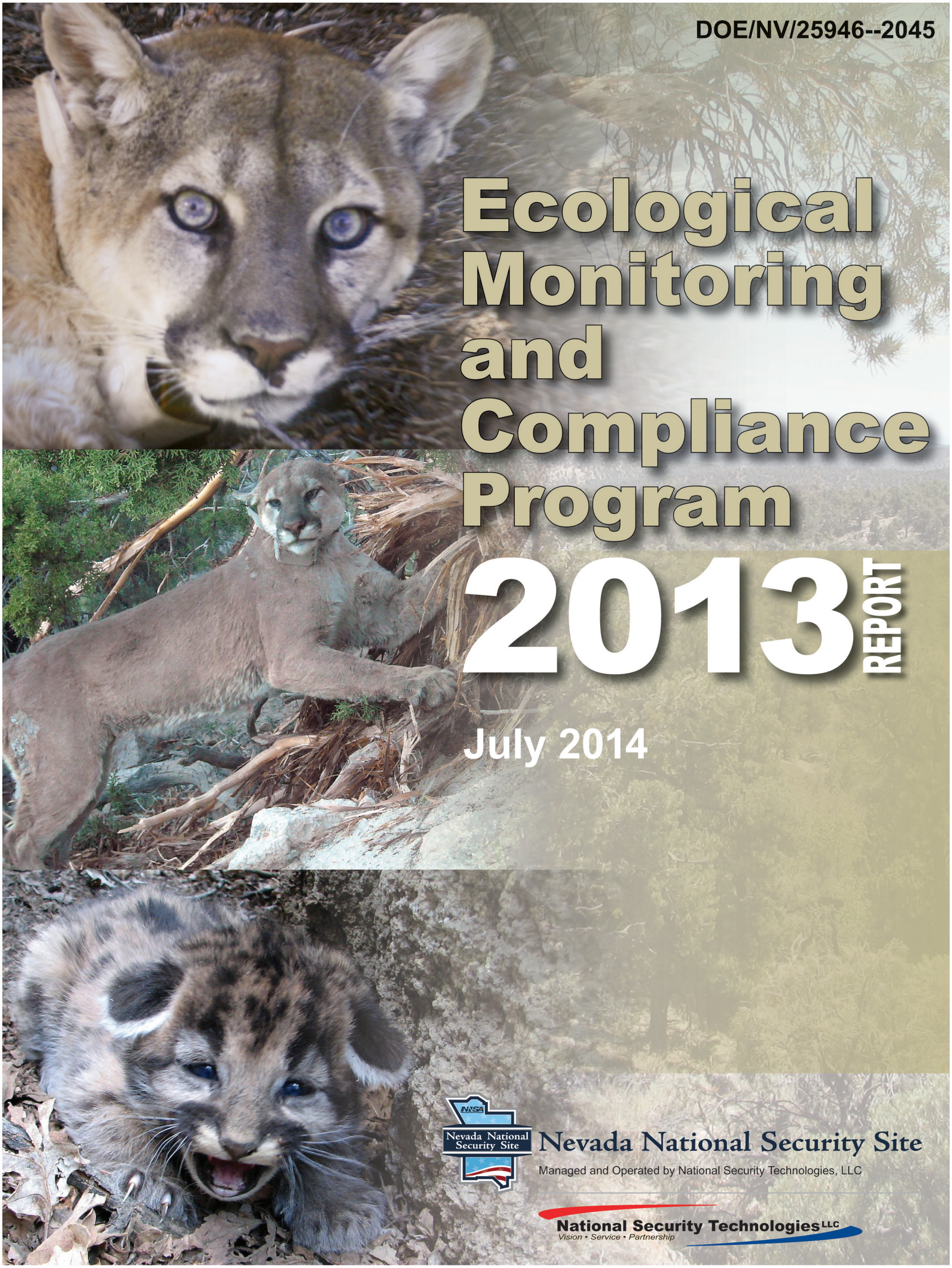

DOE/NV/25946--2045

Ecological Monitoring and Compliance Program

2013 REPORT

July 2014

Nevada National Security Site

Managed and Operated by National Security Technologies, LLC

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Ecological Monitoring and Compliance Program 2013 REPORT

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EXECUTIVE SUMMARY

The Ecological Monitoring and Compliance Program (EMAC), funded through the U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office (NNSA/NFO, formerly Nevada Site Office), monitors the ecosystem of the Nevada National Security Site (NNSS) and ensures compliance with laws and regulations pertaining to NNSS biota. This report summarizes the program's activities conducted by National Security Technologies, LLC (NSTec), during calendar year 2013. Program activities included (a) biological surveys at proposed activity sites, (b) desert tortoise compliance, (c) ecosystem monitoring, (d) sensitive plant species monitoring, (e) sensitive and protected/regulated animal monitoring, and (f) habitat restoration monitoring. During 2013, all applicable laws, regulations, and permit requirements were met, enabling EMAC to achieve its intended goals and objectives.

Sensitive and protected/regulated species of the NNSS include 42 plants, 1 mollusk, 2 reptiles, 236 birds, and 27 mammals. These species are protected, regulated, or considered sensitive according to state or federal regulations and natural resource agencies and organizations. The desert tortoise (*Gopherus agassizii*) is the only species on the NNSS protected under the *Endangered Species Act*. Biological surveys for the presence of sensitive and protected/regulated species and important biological resources on which they depend were conducted for 13 projects. A total of 484.26 hectares (ha) was surveyed for these projects. Sensitive and protected/regulated species and important biological resources found during these surveys included Joshua trees (*Yucca brevifolia*) and cacti. NSTec provided to project managers a written summary report of all survey findings and mitigation recommendations, where applicable.

Of the 13 projects on the NNSS, 10 occurred within the range of the threatened desert tortoise. Approximately 4.84 ha of desert tortoise habitat were disturbed. No desert tortoises were accidentally killed or captured, and all flagged desert tortoise burrows were avoided during project activities. Two desert tortoises were killed by vehicles. Seven tortoises were removed from roads to avoid being killed or injured. Seven desert tortoises were captured, radio-transmittered, and tracked as part of a study to understand how they interact with roads and to learn more about their fine-scale habitat use. NSTec biologists began monitoring more than 40 juvenile desert tortoises as part of a collaborative effort to study survival and temperament of translocated animals.

From 1978 until 2013, there has been an average of 11.2 wildland fires per year on the NNSS with an average of about 83.7 ha burned per fire. There were only three wildland fires documented on the NNSS during 2013, all caused by lightning, burning a total of 0.4 ha.

West Nile virus (WNV) surveillance continued in 2013 during 15 surveys at 10 sites. A total of 39 mosquitoes were captured and all tested negative for WNV. A 10-year summary of mosquito sampling is discussed. Surveys for road-killed reptiles were conducted, which detected 65 individuals, representing eight snake and seven lizard species. Selected natural water sources were monitored to assess trends in physical and biological parameters, and two new water sources were found. Several plastic-lined sumps were visited, and no dead animals were found in the sumps. Surveys for dragonflies and damselflies were conducted at several sites. In order to minimize the impact to wildlife from drying up four well ponds as a water conservation measure, five water troughs were installed. Motion-activated cameras were set up at each trough to document wildlife use.

Botanical field surveys in 2013 focused on *Astragalus beatleyae* locations on the Nevada Test and Training Range just off the northwestern boundary of the NNSS. The focus was to relocate and evaluate the current status of several populations known to occur in this area but not surveyed since the early 1990s. Surveys were conducted off the southwestern edges of Pahute Mesa into the Rocket Wash region, the far western reaches of Pahute Mesa in the vicinity of the Ribbon Cliffs, and approximately 1 kilometer

from the base of the north slope of Black Mountain. Plants were found at three of four historical locations, and one new location was found.

Surveys of sensitive and protected/regulated animals during 2013 focused on bats, wild horses (*Equus caballus*), mule deer (*Odocoileus hemionus*), and mountain lions (*Puma concolor*). Bats are using the water troughs at the dry well ponds. The wild horse population is stable at about 30 individuals, with some foals surviving through the year, possibly due to the death of a mountain lion known to prey on horse foals. Mule deer abundance and density measured with standardized deer surveys showed a 50% increase. A total of 56 mountain lion images (i.e., photographs or video clips) were taken during 192,359 camera hours at 12 of 32 sites sampled. Information is also presented about other noteworthy wildlife observations, bird mortalities, Migratory Bird Treaty Act compliance, and a summary of nuisance animals and their control on the NNSS.

A mountain lion telemetry study continued in 2013. NNSS7 was re-captured in early June. NNSS4 and NNSS7 were tracked using global positioning system satellite transmitters to determine food habits, home range, and habitat use. NNSS4 died on February 21, 2013. He ate two coyotes (*Canis latrans*) and one golden eagle (*Aquila chrysaetos*) during January and February. The cause of death is unknown but appears to be from natural causes. NNSS7 was tracked for the whole year. He consumed 30 mule deer, 12 desert bighorn sheep (*Ovis canadensis nelsoni*), and 1 badger (*Taxidea taxus*). Mule deer are primarily taken in the summer and fall, while bighorn sheep are primarily taken in the winter and spring.

Two previously revegetated sites on the NNSS and two on the Tonopah Test Range (TTR) were monitored in 2013. The cover cap on the U-3ax/bl disposal unit, revegetated in 2000, and the 92-Acre Site at the Area 5 Radioactive Waste Management Complex, revegetated in 2011, were the restoration sites monitored on the NNSS. The Corrective Action Unit (CAU) 400-Five Points Landfill site, revegetated in 1997, and the CAU 407 Rollercoaster RADSAFE site, revegetated in 2000, were the restoration sites monitored on the TTR. Plant cover and density were recorded at the sites, and reclamation success standards were evaluated, where applicable. Remedial revegetation at the 92-Acre Site was implemented.

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ACRONYMS AND ABBREVIATIONS

A	area sampled
AIC	Akaike's Information Criterion
BYU	Brigham Young University
CAU	Corrective Action Unit
CI	Confidence Interval
cm	centimeter(s)
CORA-EPNE	*Coleogyne ramosissima–Ephedra nevadensis* Shrubland
CP	Control Point
D	density
DOE/NV	U.S. Department of Energy, Nevada Operations Office
EEM	Ecological and Environmental Monitoring
ELU	Ecological Landform Unit
EM	Environmental Monitor
EMAC	Ecological Monitoring and Compliance Program
ESA	Endangered Species Act
ESW	Effective Strip Width
FWS	U.S. Fish and Wildlife Service
g	gram(s)
GIS	Geographic Information System
GPS	Global Positioning System
ha	hectare(s)
ICR	San Diego Zoo Institute for Conservation Research
ISIS	Integrated Standoff Inspection System
kg	kilogram(s)
km	kilometer(s)
km^2	square kilometer(s)
L	transect length
LANL	Los Alamos National Laboratory
L/min	liter(s) per minute
m	meter(s)
m^2	square meter(s)
MCL	midline carapace length
MDC	minimum detectable concentration

ACRONYMS AND ABBREVIATIONS (continued)

mm	millimeter(s)
n	Sample Size
NAC	Nevada Administrative Code
NNHP	Nevada Natural Heritage Program
NNPS	Nevada Native Plant Society
NNSA/NFO	U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office
NNSS	Nevada National Security Site
NOAA	National Oceanic and Atmospheric Administration
NSTec	National Security Technologies, LLC
NTTR	Nevada Test and Training Range
pCi/L	picocurie(s) per liter
PIMO/ARNO	*Pinus monophylla*/*Artemisia nova* Woodland
PIMO/ARTR	*Pinus monophylla*/*Artemisia tridentata* Woodland
PLS	Pure Live Seed
RNCTEC	Radiological/Nuclear Countermeasures Test and Evaluation Complex
RWMC	Radioactive Waste Management Complex
SNHD	Southern Nevada Health District
SOC	Special Operations Center
sd	standard deviation
spp.	species
ssp.	subspecies
TCS	tortoise clearance survey
TTR	Tonopah Test Range
USGS	U.S. Geological Survey
var.	variety
VHF	Very High Frequency
W_i	habitat use index
WNV	West Nile virus

1.0 INTRODUCTION

In accordance with U.S. Department of Energy (DOE) Order DOE O 231.1B, "Environment, Safety, and Health Reporting," the Office of the Assistant Manager for Environmental Management of the U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office (NNSA/NFO, formerly Nevada Site Office) requires ecological monitoring and biological compliance support for activities and programs conducted at the Nevada National Security Site (NNSS). National Security Technologies, LLC (NSTec), Ecological and Environmental Monitoring (EEM) has implemented the Ecological Monitoring and Compliance Program (EMAC) to provide this support. EMAC is designed to ensure compliance with applicable laws and regulations, delineate and define NNSS ecosystems, and provide ecological information that can be used to predict and evaluate the potential impacts of proposed projects and programs on those ecosystems. During 2013, all applicable laws, regulations, and permit requirements were met, enabling EMAC to achieve its intended goals and objectives.

This report summarizes the EMAC activities conducted by NSTec during calendar year 2013. Monitoring tasks during 2013 included six program areas: (a) biological surveys, (b) desert tortoise compliance, (c) ecosystem monitoring, (d) sensitive plant monitoring, (e) sensitive and protected/regulated animal monitoring, and (f) habitat restoration monitoring. The following sections of this report describe work performed under these six areas.

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2.0 BIOLOGICAL SURVEYS

Biological surveys are performed at project sites where land-disturbing activities are proposed. The goal is to minimize adverse effects of land disturbance on sensitive and protected/regulated plant and animal species (Table 2-1), their associated habitat, and other important biological resources. Sensitive species are defined as species that are at risk of extinction or serious decline or whose long-term viability has been identified as a concern. They include species on the Nevada Natural Heritage Program (NNHP) Animal and Plant At-Risk Tracking List (NNHP 2014) and bat species ranked as moderate or high in the Revised Nevada Bat Conservation Plan Bat Species Risk Assessment (Bradley et al. 2006). Protected/regulated species are those that are protected or regulated by federal or state law. Many species are both sensitive and protected/regulated (Table 2-1). Important biological resources include cover sites, nest or burrow sites, roost sites, or water sources important to sensitive species. Survey reports document species and resources found and provide mitigation recommendations.

2.1 Sites Surveyed and Sensitive and Protected/Regulated Species Observed

During 2013, biological surveys for 13 projects were conducted on the NNSS (Figure 2-1 and Table 2-2). Three projects had multiple site locations. Scientists surveyed a total of 484.26 hectares (ha) for the projects (Table 2-2). Ten projects were within the range of the threatened desert tortoise (*Gopherus agassizii*). Sensitive and protected/regulated species and important biological resources found included Joshua trees (*Yucca brevifolia*), Mohave yucca (*Yucca schidigera*) and several species of cacti (Table 2-2). NSTec provided written summary reports to project managers of survey findings and mitigation recommendations, where applicable (Table 2-2).

2.2 Potential Habitat Disturbance

Surveys are conducted for all activities that would disturb habitat, including new projects, routine maintenance activities, or cleanup activities at old industrial or nuclear weapons testing sites. These surveys are required whenever vegetation has re-colonized old disturbances and sensitive or protected/regulated species are known to occur in the area. For example, desert tortoises may move through revegetated earthen sumps and may be concealed under vegetation during activities where heavy equipment is used. Biological surveys and tortoise clearance surveys are conducted to ensure that desert tortoises are not in harm’s way. Burrowing owls frequently inhabit burrows and culverts at disturbed sites, so surveys are conducted to ensure that adults, eggs, and nestlings are not harmed.

Of the 13 projects surveyed, 10 were within sites previously disturbed (e.g., road shoulders, old building sites, industrial waste sites, or existing well pads) (Table 2-2). Three projects were located totally or partially in areas that had not been previously disturbed. These projects could potentially disturb roughly 17.0 ha of land that were previously considered undisturbed (some projects have been proposed, but the activity has not yet occurred). Two of these projects occurred in areas designated as important habitats (Table 2-3 and Figure 2-2). During vegetation mapping of the NNSS (Ostler et al. 2000), Ecological Landform Units (ELUs) were evaluated for importance. Some ELUs were identified as *Pristine Habitat* (having few human-made disturbances), *Unique Habitat* (containing uncommon biological resources such as a natural wetland), *Sensitive Habitat* (containing vegetation associations that recover very slowly from direct disturbance or are susceptible to erosion), and *Diverse Habitat* (having high plant species diversity) (U.S. Department of Energy, Nevada Operations Office [DOE/NV] 1998). A single ELU could be classified as more than one type of these four types of important habitats.

Table 2-1. List of sensitive and protected/regulated species known to occur on or adjacent to the NNSS

Plant Species	Common Names	Status[a]
Moss Species		
Entosthodon planoconvexus	Planoconvex cordmoss	S, H
Flowering Plant Species		
Arctomecon merriamii	White bearpoppy	S, M
Astragalus beatleyae	Beatley's milkvetch	S, H
Astragalus funereus	Black woollypod	S, H
Astragalus oophorus var. *clokeyanus*	Clokey eggvetch	S, W
Camissonia megalantha	Cane Spring suncup	S, M
Cymopterus ripleyi var. *saniculoides*	Sanicle biscuitroot	S, M
Eriogonum concinnum	Darin buckwheat	S, M
Eriogonum heermannii var. *clokeyi*	Clokey buckwheat	S, W
Frasera pahutensis	Pahute green gentian	S, M
Galium hilendiae ssp. *kingstonense*	Kingston Mountains bedstraw	S, H
Hulsea vestita ssp. *inyoensis*	Inyo hulsea	S, W
Ivesia arizonica var. *saxosa*	Rock purpusia	S, H
Penstemon fruticiformis ssp. *Amargosae*	Death Valley beardtongue	S, H
Penstemon pahutensis	Pahute Mesa beardtongue	S, W
Phacelia beatleyae	Beatley scorpionflower	S, M
Phacelia filiae	Clarke phacelia	S, M
Phacelia mustelina	Weasel phacelia	S, Ma
Agavaceae	Yucca (3 species), Agave (1 species)	CY
Cactaceae	Cacti (18 species)	CY
Juniperus osteosperma	Juniper	CY
Pinus monophylla	Pinyon	CY

Table 2-1. List of sensitive and protected/regulated species known to occur on or adjacent to the NNSS (continued)

Animal Species	Common Name	Status[a]
Mollusk Species		
Pyrgulopsis turbatrix	Southeast Nevada pyrg	S, A
Reptile Species		
Plestiodon gilberti rubricaudatus	Western red-tailed skink	S, IA
Gopherus agassizii	Desert tortoise	LT, S, NPT, A
Bird Species[b]		
Accipiter gentilis	Northern goshawk	S, NPS, IA
Alectoris chukar	Chukar	G, IA
Aquila chrysaetos	Golden eagle	EA, NP, IA
Buteo regalis	Ferruginous hawk	S, NP, IA
Callipepla gambelii	Gambel's quail	G, IA
Coccyzus americanus	Western yellow-billed cuckoo	C, S, NPS, IA
Falco peregrinus	Peregrine falcon	S, NPE, IA
Haliaeetus leucocephalus	Bald eagle	EA, S, NPE, IA
Ixobrychus exillis hesperis	Western least bittern	S, NP, IA
Lanius ludovicianus	Loggerhead shrike	NPS, IA
Oreoscoptes montanus	Sage thrasher	NPS, IA
Phainopepla nitens	Phainopepla	S, NP, IA
Spizella breweri	Brewer's sparrow	NPS, IA
Toxostoma bendirei	Bendire's thrasher	S, NP, IA
Toxostoma lecontei	LeConte's thrasher	S, NP, IA
Mammal Species		
Antilocapra americana	Pronghorn antelope	G, IA
Antrozous pallidus	Pallid bat	M, NP, A
Cervus elaphus	Rocky Mountain elk	G, IA
Corynorhinus townsendii	Townsend's big-eared bat	S, H, NPS, A
Equus asinus	Burro	H&B, A
Equus caballus	Horse	H&B, A
Euderma maculatum	Spotted bat	S, M, NPT, A

Table 2-1. List of sensitive and protected/regulated species known to occur on or adjacent to the NNSS (continued)

Animal Species	Common Name	Status[a]
Lasionycteris noctivagans	Silver-haired bat	M, A
Lasiurus blossevillii	Western red bat	S, H, NPS, A
Lasiurus cinereus	Hoary bat	M, A
Lynx rufus	Bobcat	F, IA
Microdipodops megacephalus	Dark kangaroo mouse	NP, A
Microdipodops pallidus	Pale kangaroo mouse	S, NP, A
Myotis californicus	California myotis	M, A
Myotis ciliolabrum	Small-footed myotis	M, A
Myotis evotis	Long-eared myotis	M, A
Myotis thysanodes	Fringed myotis	S, H, NP, A
Myotis yumanensis	Yuma myotis	M, A
Ovis canadensis nelsoni	Desert bighorn sheep	G, IA
Odocoileus hemionus	Mule deer	G, A
Pipistrellus hesperus	Western pipistrelle	M, A
Puma concolor	Mountain lion	G, A
Sylvilagus audubonii	Audubon's cottontail	G, IA
Sylvilagus nuttallii	Nuttall's cottontail	G, IA
Tadarida brasiliensis	Brazilian free-tailed bat	NP, A
Urocyon cinereoargenteus	Gray fox	F, IA
Vulpes macrotis	Kit fox	F, IA

[a]Status Codes:

Endangered Species Act, U.S. Fish and Wildlife Service

LT - Listed Threatened
C - Candidate for listing

U.S. Department of Interior

H&B - Protected under *Wild Free Roaming Horses and Burros Act*
EA - Protected under *Bald and Golden Eagle Act*

State of Nevada – Animals

S - Nevada Natural Heritage Program – Animal and Plant At Risk Tracking List
NPE - Nevada Protected-Endangered, species protected under Nevada Administrative Code (NAC) 503
NPT - Nevada Protected-Threatened, species protected under NAC 503
NPS - Nevada Protected-Sensitive, species protected under NAC 503

Table 2-1. List of sensitive and protected/regulated species known to occur on or adjacent to the NNSS (continued)

NP - Nevada Protected, species protected under NAC 503
G - Regulated as game species under NAC 503
F - Regulated as fur-bearer species under NAC 503

State of Nevada – Plants
S - Nevada Natural Heritage Program (NNHP) – Animal and Plant At-Risk Tracking List
CY - Protected as a cactus, yucca, or Christmas tree

NNSS Sensitive Plant Ranking
H - High
M - Moderate
W - Watch
Ma - Marginal

Long-term Animal Monitoring Status for the NNSS
A - Active
IA - Inactive

The Revised Nevada Bat Conservation Plan – Bat Species Risk Assessment
H - High
M - Moderate

[b] All bird species on the NNSS are protected by the *Migratory Bird Treaty Act* except for chukar, Gambel's quail, English house sparrow, Rock dove, and European starling.

Sources used: NNHP 2014, Nevada Native Plant Society (NNPS) 2014, NAC 2014, U.S. Fish and Wildlife Service (FWS) 2014, Bradley et al. 2006

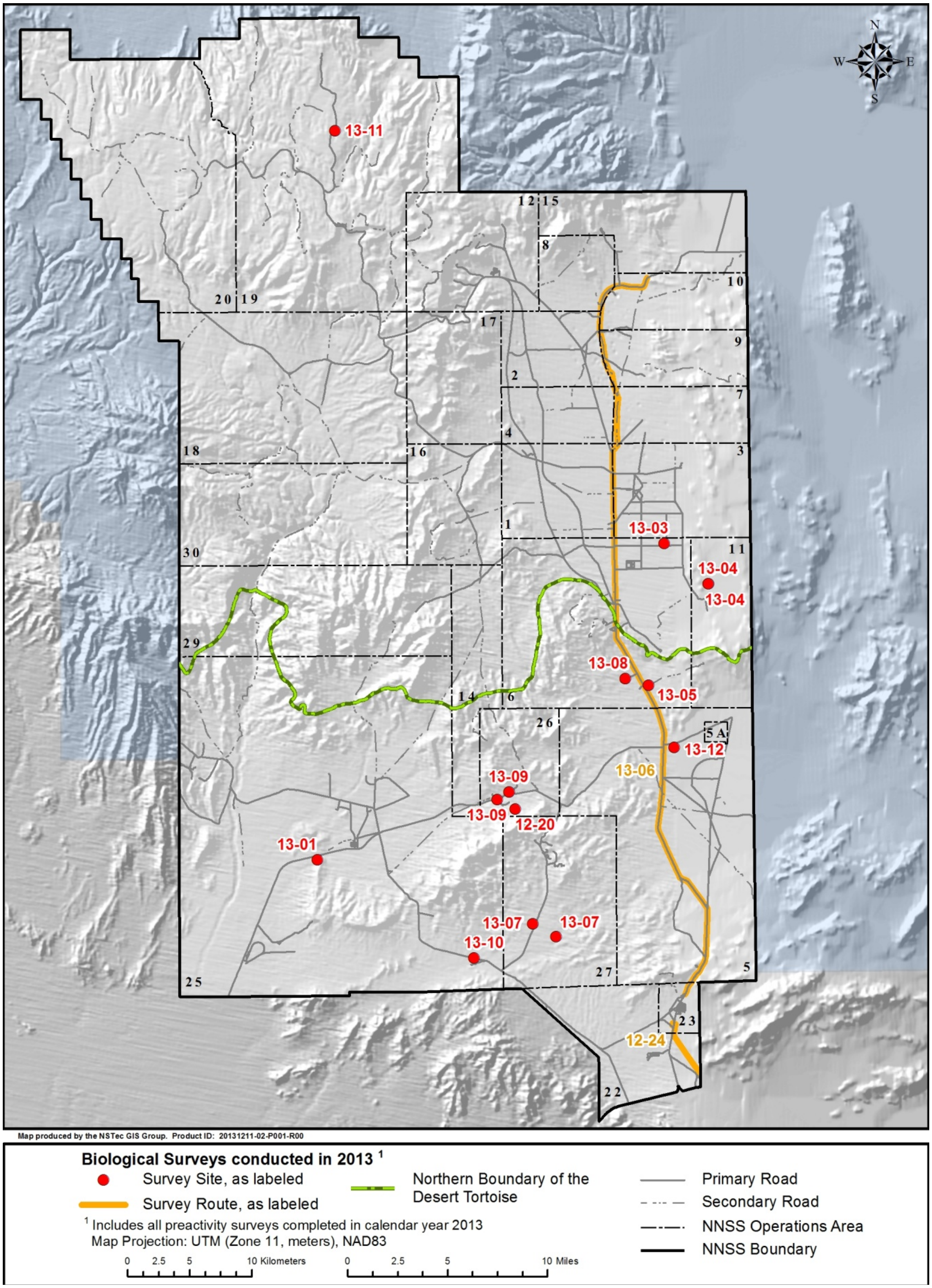

Figure 2-1. Biological surveys conducted on or near the NNSS during 2013

Table 2-2. Summary of biological surveys conducted on or near the NNSS during 2013

Project No.	Project	Important Species/Resources Found	Area Surveyed (ha)	Proposed Project Area in Undisturbed Habitat (ha)	Mitigation Recommendations
12-20	Port Gaston Blast Pad Number 3	None	2.17	2.17	Mitigation required, EM needed
12-24	Innovation to Mercury Power Line (Valley Electric Association)	Yuccas, cacti	3.84	2.67	Mitigation required, EM needed
13-01	Lathrop Wells Road Borrow Pit	None	0.26	0	None
13-03	Particle Release experiments Area 6	None	140.00	0	None
13-04	Corrective Action Unit 366 Landfills	None	0.54	0	None
13-05	RNCTEC Expansion ISIS	None	12.15	ongoing	TCS required
13-06	Mercury Highway Weed Abatement	None	316.94	0	TCS required for part
13-07	Rock Valley Seismic Drilling	None	1.00	0	TCS required
13-08	Device Assembly Facility Barriers	None	0.10	0	TCS required
13-09	Port Gaston Road Shoulder Clearing	Two Joshua trees, cacti	2.38	0	TCS required
13-10	Jackass Flats Road Repair	None	1.58	0	TCS required
13-11	Dead Horse Flats Road Repair	None	1.50	0	None
13-12	Frenchman Flats Power Line Repair	None	1.80	0	TCS required
		Total ha	**484.26**	**4.84**	

EM – Environmental Monitor
TCS – Tortoise Clearance Survey

Table 2-3. Total area disturbed in hectares within important habitats in 2013 and cumulative over the past 15 years

Project No.	Project Name	Pristine Habitat	Unique Habitat	Sensitive Habitat	Diverse Habitat
12-20	Port Gaston Blast Pad Number 3	0	0	2.04	0
12-24	Innovation to Mercury Power Line (Valley Electric Association)	0	0	0	1.22
	2013 Total: 3.26	0	0	2.04	1.22
	1999–2013 Grand Total: 453.66	9.46	17.31	339.84	87.05

Figure 2-2 shows the distribution of these important habitats, ranked so that pristine habitat overlays unique habitat, which then overlays sensitive habitat, which then overlays diverse habitat. The area disturbed in important habitats due to 2013 projects is 3.26 ha (Table 2-3). Both projects had only a portion of the area that was in important habitats. Since 1999, the total area of important habitat disturbed by NNSA/NFO activities is 453.66 ha. This tally is used to document the loss of important habitat on the NNSS.

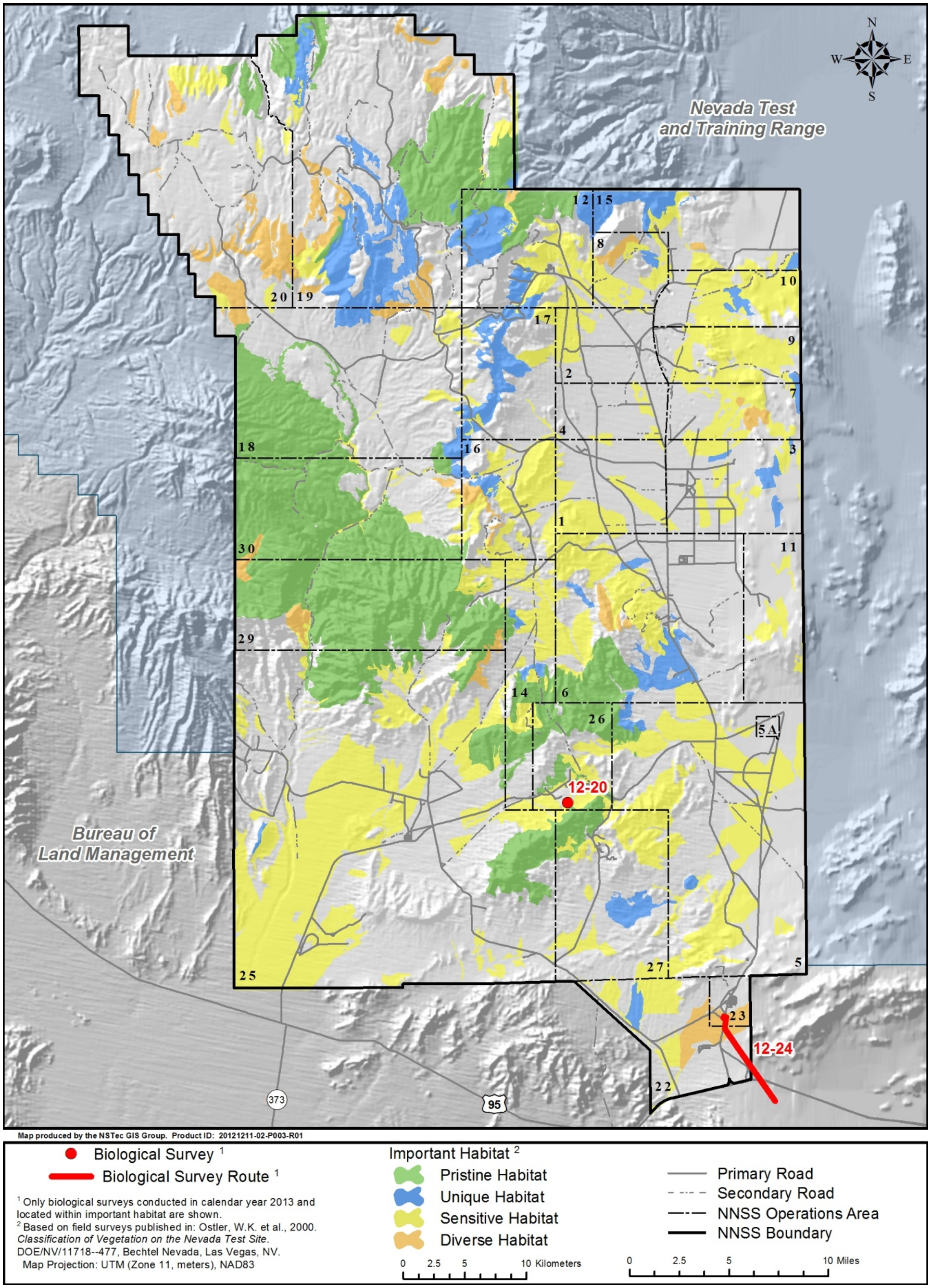

Figure 2-2. Biological surveys conducted in important habitats of the NNSS during 2013

3.0 DESERT TORTOISE COMPLIANCE

Desert tortoises occur within the southern one-third of the NNSS. This species is listed as threatened under the *Endangered Species Act* (ESA). In December 1995, NNSA/NFO completed consultation with the U.S. Fish and Wildlife Service (FWS) concerning the effects of NNSA/NFO activities, as described in the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE/NV 1996), on the desert tortoise. NNSA/NFO received a final Biological Opinion (Opinion) from FWS in August 1996 (FWS 1996). On July 2, 2008, NNSA/NFO provided FWS with a Biological Assessment of anticipated activities on the NNSS for the next 10 years and entered into formal consultation with FWS to obtain a new Opinion for the NNSS. NNSA/NFO received the final Opinion on February 12, 2009 (FWS 2009). This Opinion covers the anticipated activities at the NNSS until 2019.

The Desert Tortoise Compliance task of EMAC implements the terms and conditions of the 2009 Opinion, documents compliance actions taken by NNSA/NFO, and assists NNSA/NFO in FWS consultations. All terms and conditions listed in the Opinion were implemented by NSTec staff biologists in 2013, including (a) conducting clearance surveys at project sites within 1 day from the start of project construction, (b) ensuring that project managers have environmental monitors on site during site clearing and heavy equipment operation, (c) developing effects analysis for proposed disturbances to append to the Opinion, and (d) preparing an annual compliance report for NNSA/NFO submittal to the FWS.

3.1 Project Surveys and Compliance Documentation

During 2013, biologists conducted desert tortoise clearance surveys prior to ground disturbing activities for ten proposed projects within the range of the desert tortoise on the NNSS. Two projects (12-20, 12-24) were submitted for FWS approval in 2012 and appended to our Opinion, but work did not start until 2013 (Table 3-1 and Figure 3-1). Most of the remaining projects were in, or immediately adjacent to, roads, existing facilities, or other disturbances. No desert tortoises were observed in project areas, and several potential tortoise burrows found during tortoise clearance surveys for Project 12-24 were flagged and avoided during construction.

Three projects were initiated that disturbed previously undisturbed desert tortoise habitat. Projects 12-20 and 12-24 disturbed 4.84 ha of desert tortoise habitat in 2013 (Table 3-1). A mitigation fee of $3,491.10 was paid for 1.74 ha of anticipated disturbance on January 10, 2013. The post-activity survey for this project in 2013 showed that more area was disturbed (2.17 ha) than originally anticipated (1.74 ha). The project deposited an additional $850.50 in the Conservation Fund to pay for the additional 0.43 ha that was disturbed. The Innovation to Mercury Power Line project (12-24) was submitted to the FWS in mid-December and was appended in February 2013. A mitigation fee of $24,390.40 was paid for the anticipated disturbance of 11.98 ha. The post activity survey of the site showed only 2.67 ha were disturbed. The third project, Radiological/Nuclear Countermeasures Test and Evaluation Complex (RNCTEC) Expansion Integrated Standoff Inspection System (ISIS) (13-05), is still ongoing; however, payment for all of the RNCTEC Expansion projects was made in 2011.

Post-activity surveys to quantify the acreage of tortoise habitat actually disturbed were conducted for nine projects during this reporting period (Table 3-1). All projects stayed within proposed project boundaries. Post-activity surveys are generally not conducted if the projects are located within previously disturbed areas or if the environmental monitor documented that the project stayed within its proposed boundaries.

Table 3-1. Summary of tortoise compliance activities conducted by site biologists during 2013

Project Number	Project	Compliance Activities 100% Coverage Clearance Survey	Tortoise Habitat Disturbed (Ha)
12-20	Port Gaston Blast Pad Number 3	Yes, post-activity survey completed	2.17
12-24	Innovation to Mercury Power line (Valley Electric Association)	Yes, post-activity survey completed	2.67
13-01	Lathrop Wells Road Borrow Pit	Yes, post-activity survey completed	0
13-05	RNCTEC Expansion ISIS	Ongoing	0
13-06	Mercury Highway Weed Abatement	Yes, post-activity survey completed	0
13-07	Rock Valley Seismic Drilling	Yes, post-activity survey completed	0
13-08	Device Assembly Facility Barriers	Yes, post-activity survey completed	0
13-09	Port Gaston Road Shoulder Work	Yes, post-activity survey completed	0
13-10	Jackass Flats Road Repair	Yes, post-activity survey completed	0
13-12	Frenchman Flat Power Pole Repair	Yes, post-activity survey completed	0
		TOTAL	4.84

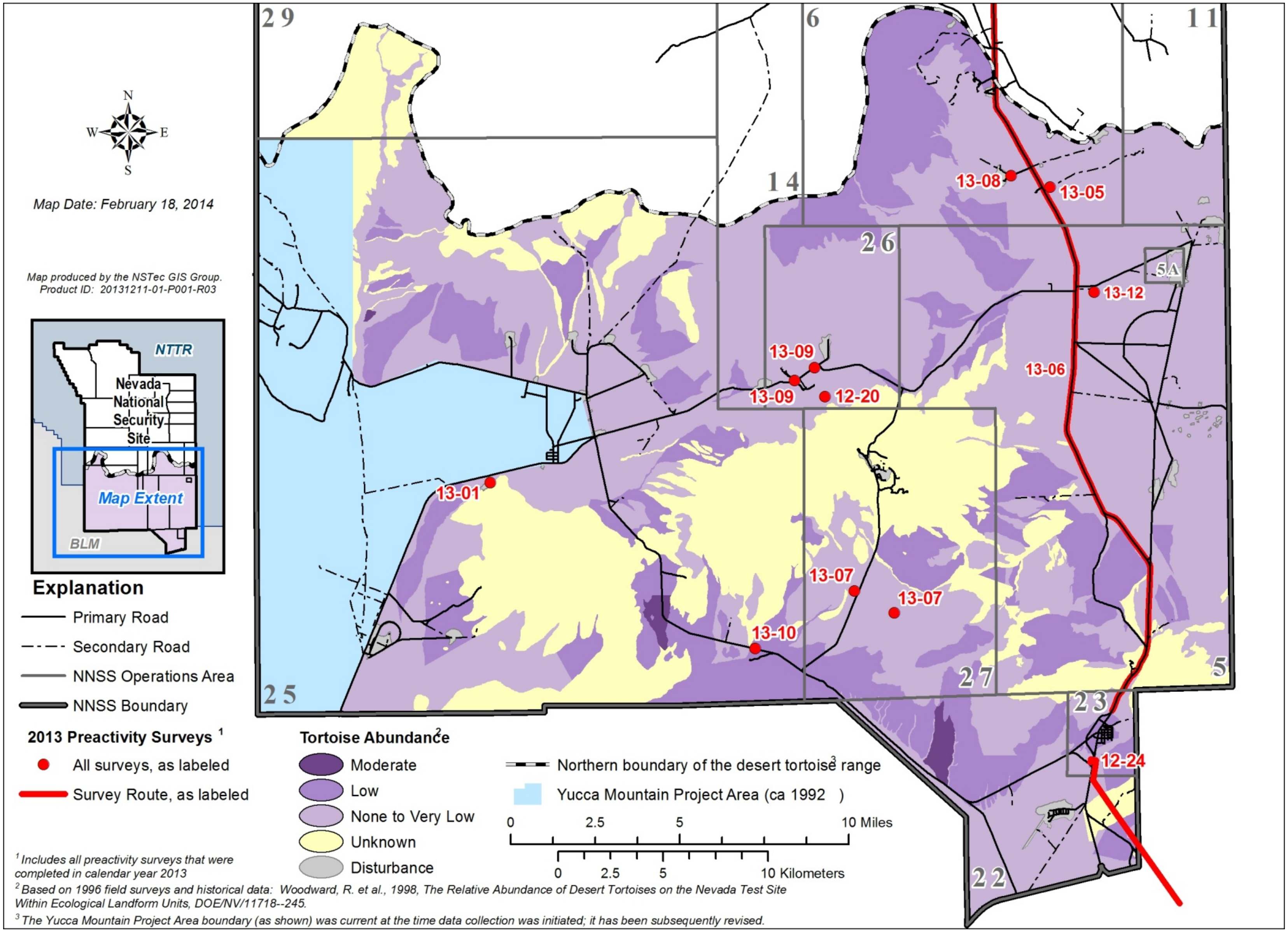

Figure 3-1. Biological surveys conducted in desert tortoise habitat on the NNSS during 2013

In January 2013, the annual report that summarized tortoise compliance activities conducted on the NNSS from January 1 through December 31, 2012, was submitted to the FWS. This report, required under the Opinion, contains (a) the location and size of land disturbances that occurred within the range of the desert tortoise during the reporting period; (b) the number of desert tortoises injured, killed, or removed from project sites; (c) a map showing the location of all tortoises sighted on or near roads on the NNSS; and (d) a summary of construction mitigation and monitoring efforts.

Compliance with the Opinion ensures that the desert tortoise is protected on the NNSS and that the cumulative impacts on this species are minimized (DOE/NV 1998). In the Opinion, the FWS determined that the "incidental take" of tortoises on the NNSS and the cumulative acreage of tortoise habitat disturbed on the NNSS are parameters that should be measured and monitored annually. During this calendar year, the threshold levels established by the FWS for these parameters were not exceeded (Table 3-2). No desert tortoises were accidentally injured or killed by project activities. Two tortoises were killed by vehicles during 2013 (Figure 3-2). The first take occurred on August 20 along Jackass Flats Road and was reported to the FWS the same day. The tortoise was approximately 15 cm long. The second take occurred on September 3 along Mercury Highway in Frenchman Flat. This take was reported to the FWS on September 4, 2013. This tortoise was also 15 cm long but was hard to get an exact measurement given the damage to the shell. On seven occasions, tortoises were moved off the road and out of harm's way. These are included in tortoise observations in Figure 3-2. Seven tortoises were found and transmitters attached as part of an approved study to assess impacts of vehicles on tortoises on the NNSS (see Section 3.3.1, Desert Tortoise Road Study). The seven tortoises that were moved from roads and seven that received transmitters bring the total take for Roads in the "Other" category to 59 for 2009 to 2013 (Table 3-2). The two losses this year brings the cumulative take of tortoises killed or injured on NNSS roads to seven from 2009 to 2013 (Table 3-2).

Table 3-2. Cumulative incidental take (2009–2013) and maximum allowed take for NNSA/NFO programs

Program	Number of Hectares Impacted (maximum allowed)	Number of Tortoises Anticipated to be Incidentally Taken (maximum allowed)	
		Killed/Injured	Other
Defense	2.27 (202)	0 (1)	0 (10)
Waste Management	0 (40)	0 (1)	0 (2)
Environmental Restoration	0 (4)	0 (1)	0 (2)
Non-Defense R&D	0 (607)	0 (2)	0 (35)
Work for Others	6.29* (202)	0 (1)	0 (10)
Infrastructure Development	3.33 (40)	0 (1)	0 (10)
Roads	0 (0)	7 (15)	59 (125)
Totals	**13.12 (1,095)**	**7 (22)**	**59 (194)**

*One project is not yet completed but is anticipated to disturb 42.2 hectares. The actual amount disturbed will be reported in the 2014 report.

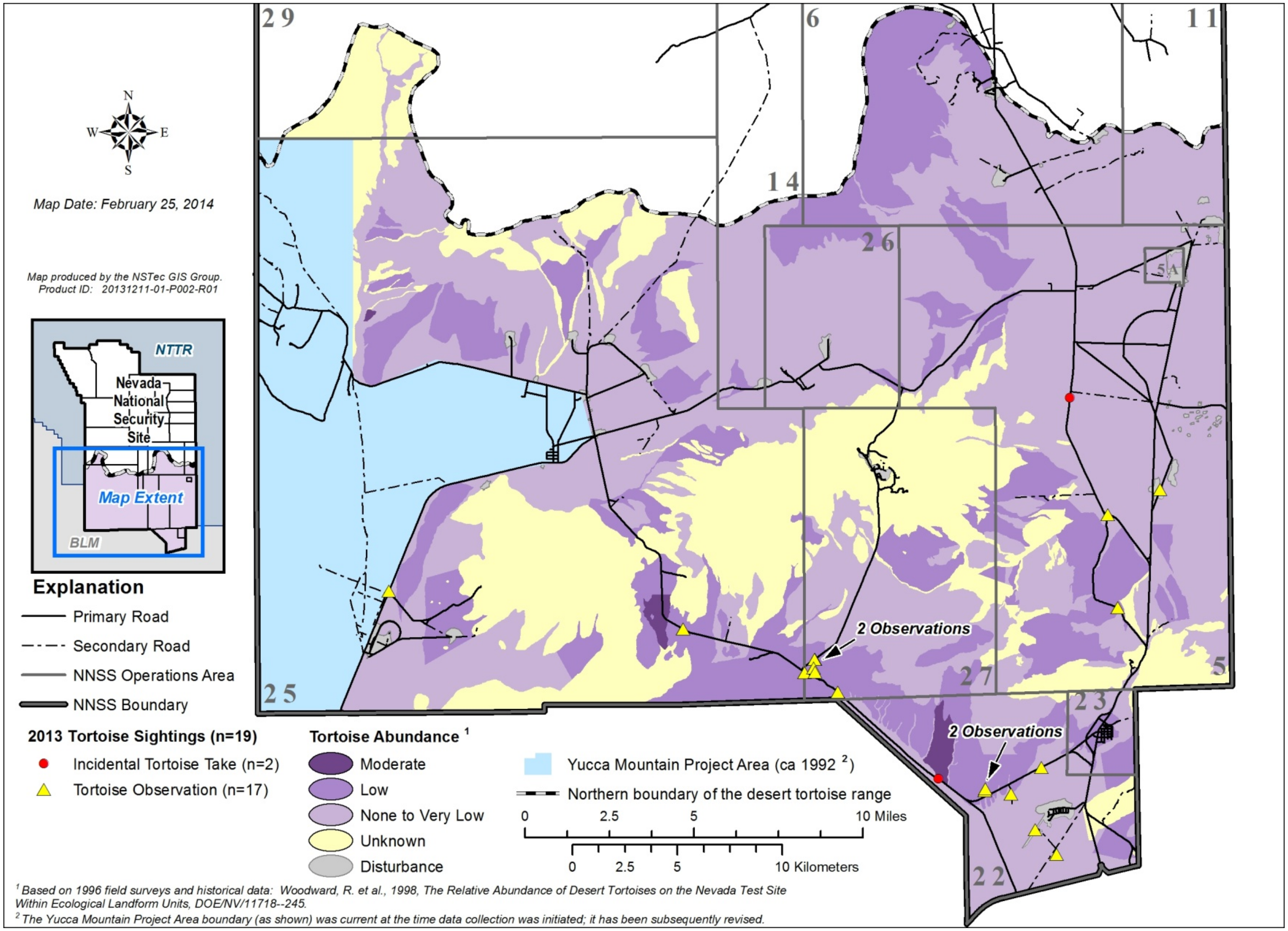

Figure 3-2. Observations of desert tortoises generally found along roads during 2013

3.2 Mitigation for Loss of Tortoise Habitat

Mitigation for the loss of tortoise habitat is required under the terms and conditions of the Opinion. The Opinion requires NNSA/NFO to perform one of two mitigation options: (a) prepay funds into the Desert Tortoise Mitigation Funds, or (b) prepay mitigation funds at the current rate, then revegetate disturbed habitat following specified criteria; once the revegetation is successful, the money paid for mitigation will be refunded. Two projects (12-20 and 12-24) paid a total of $28,732.00 into the Desert Tortoise Mitigation Fund to mitigate the 4.84 ha of land that was disturbed in 2013. The other area disturbed as part of the RNCTEC Expansion was paid for in 2011.

3.3 Conservation Recommendation Studies

Three desert tortoise projects have been approved by the FWS and are being implemented by NNSS biologists. The following is a synopsis of activities conducted for each of these projects since 2012. One of the conservation recommendations of the Opinion (FWS 2009) states that NNSA/NFO:

> ***should develop a strategy to minimize road mortalities on the NNSS by focusing efforts on roads that have a history of mortality or that traverse higher density desert tortoise areas (page 29 of the Opinion).***

In order to address this conservation recommendation, results from prior desert tortoise surveys and historical roadside observation/mortality data were analyzed using a Geographic Information System (GIS) to identify areas with higher densities of desert tortoises and areas that may be at higher risk for tortoise mortalities caused by vehicles along NNSS roads. This analysis suggested a need for a better understanding of desert tortoise activity near roads with high desert tortoise use and the effects of the zone of depression (up to 0.4 kilometers [km]) on tortoise abundance in order to better develop the strategy to minimize road mortalities.

Desert tortoises may be drawn to roads to forage and drink, especially after summer rains when water collects in depressions on or along roads, thus creating a short-term source of drinking water that may be critical to their survival. Further, roadside vegetation is typically more succulent than non-roadside vegetation due to a water-harvesting effect and roadside maintenance activities such as mowing or blading, which typically stimulates plant growth. In addition, while some efforts to model desert tortoise habitat in the Mojave Desert have been made (Weinstein 1989, Andersen et al. 2000, Nussear et al. 2009), knowledge about fine-scale patterns of habitat use is still lacking.

3.3.1 Desert Tortoise Road Study

A desert tortoise road study was initiated in May 2012. The main objectives of this study are to (a) determine fine-scale patterns of habitat use of desert tortoises found near roads on the NNSS, and (b) assess the risk of desert tortoise road mortality on the NNSS. A secondary objective is to assess the health and condition of desert tortoises on the northern periphery of their range. The first tortoise found on an NNSS road was on May 10, 2012. It was fitted with a Global Positioning System (GPS) transmitter and a Very High Frequency (VHF) radio transmitter and monitored throughout 2012. A total of 11 desert tortoises were found during the tortoise activity period, fitted with transmitters and their movements monitored in 2012.

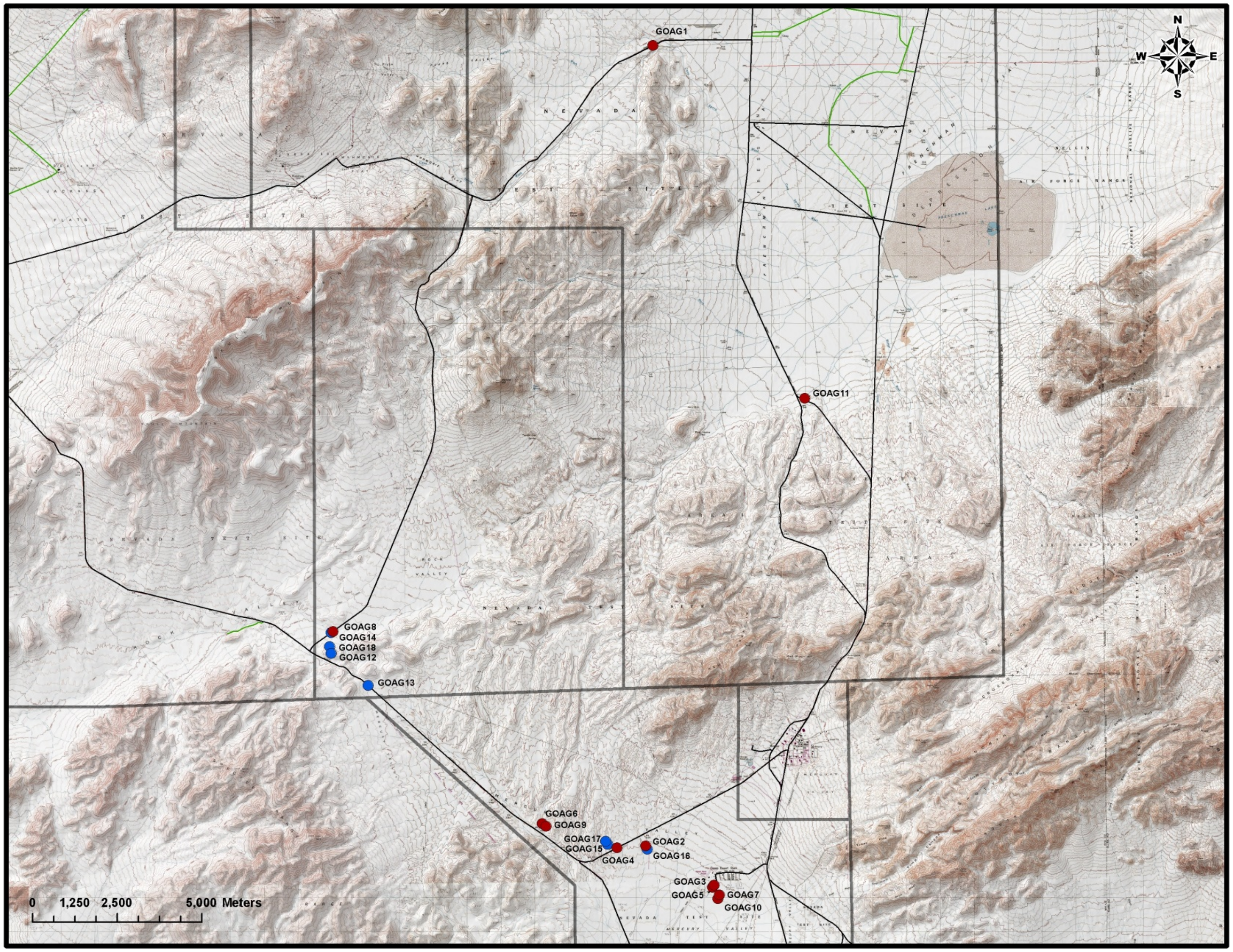

Figure 3-3. Initial desert tortoise capture locations during 2012 (red) and 2013 (blue) at the NNSS

During 2013, an additional seven desert tortoises (five males and two females) were captured (Figure 3-3) and transmitters were attached to their shells. Three of these were captured opportunistically as a result of reports of desert tortoises spotted along roads by workers. Four of the seven were male tortoises (GOAG 15, 16, 17, and 18) and were radio-tagged when they were found interacting with tagged female tortoises. All 18 desert tortoises were monitored with VHF transmitters through 2013 except GOAG 13, which was either killed or scavenged by a coyote or bobcat and was found dead on June 26, 2013. It was missing both rear legs and its head. This animal was originally found on May 14, 2013, so data were only collected on this animal for 5 weeks. Fifteen tortoises were monitored with the GPS transmitters due to the limited number of transmitters available.

Table 3-3 lists capture information for each of the 18 tortoises. An example of tortoise movements for the fourth tortoise that was caught (GOAG 4) for 2012 and 2013 is shown in Figure 3-4. GPS data for this figure are mostly in 15-minute increments during the active period (March–October) and three times a day (1000, 1200, and 1400 hours) during the inactive period (November–February) starting on May 24, 2012, and continuing through September 19, 2013. Clusters of dots generally represent a burrow that was used by GOAG 4.

Additional animals are anticipated to be captured and monitored in 2014. The processing and analysis of data from the GPS transmitters attached to the tortoises is ongoing. The goal is to have a minimum of 2 years of data for analysis. When the data is fully processed and summarized, it will be provided to FWS.

Table 3-3. Desert tortoise captures information for the NNSS road mitigation project (MCL=midline carapace length)

Tortoise ID	Capture Date	Capture Time	Body Condition Score	Bladder Voided	Sex	Weight (g)	Size MCL (mm)
GOAG 1	5/10/2012	1110	4	No	F	3,938	285
GOAG 2	5/15/2012	0900	6	No	F	1,938	233
GOAG 3	5/17/2012	0945	5	Yes	M	4,688	288
GOAG 4	5/24/2012	1100	4	No	F	3,368	257
GOAG 5	5/29/2012	1100	4	No	F	2,928	243
GOAG 6	6/01/2012	0645	5	No	M	2,208	227
GOAG 7	6/11/2012	1055	5	No	F	2,338	238
GOAG 8	6/13/2012	1000	4	No	F	2,988	258
GOAG 9	6/26/2012	0825	4	No	F	2,298	251
GOAG 10	7/12/2012	0922	5	No	M	2,264	230
GOAG 11	9/27/2012	1220	5	No	M	3,788	257
GOAG 12	4/30/2013	0900	4	No	F	3,958	277
GOAG 13	5/14/2013	0815	3.5	Yes	M	1,800	206
GOAG 14	6/12/2013	0905	4	No	F	2,168	214
GOAG 15	8/14/2013	1000	4.5	No	M	4,180	280
GOAG 16	9/04/2013	1000	4	No	M	5,700	307
GOAG 17	9/05/2013	0740	4	No	M	4,360	282
GOAG 18	9/11/2013	1256	4	No	M	4,020	277

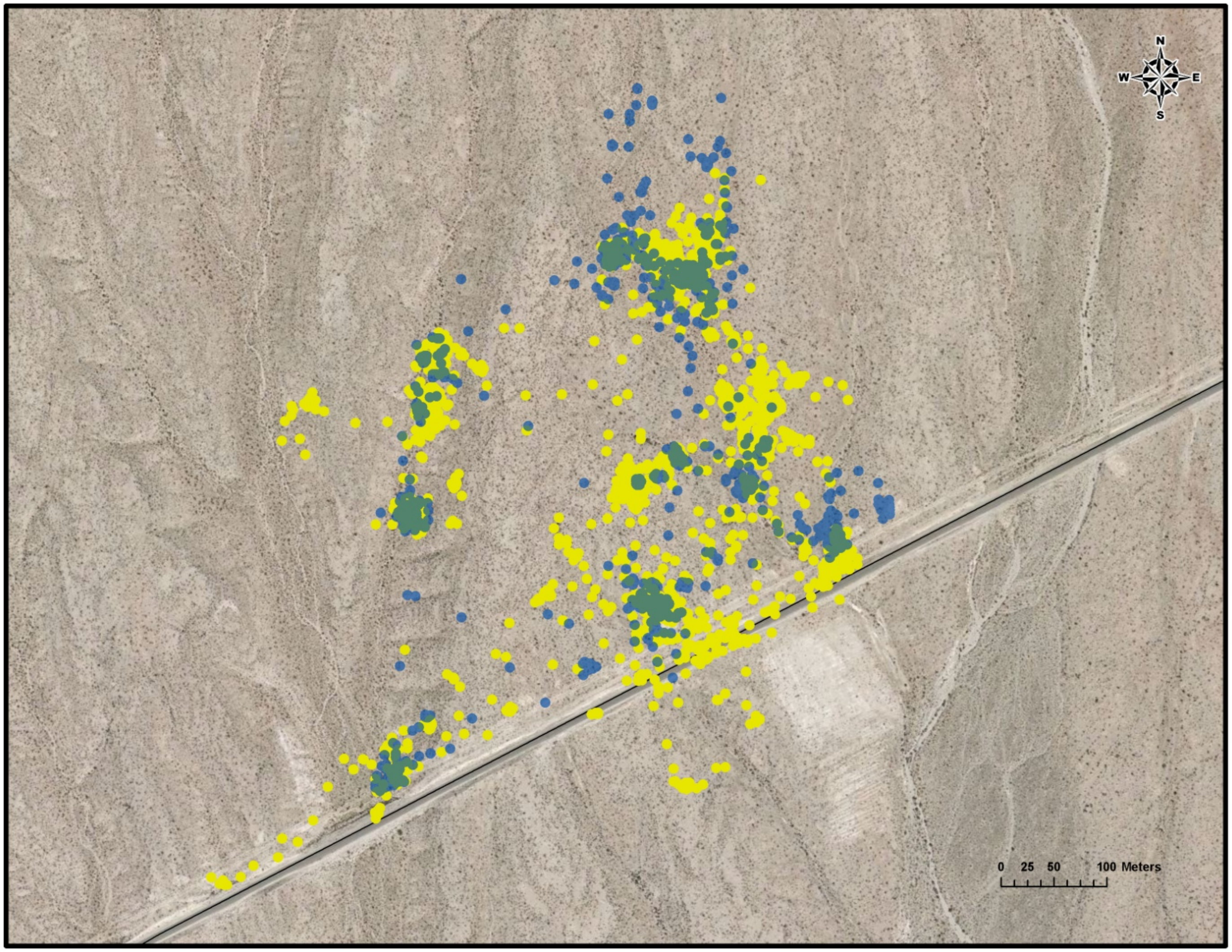

Figure 3-4. Movement data collected from GPS transmitters for GOAG 4 during 2012 (blue circles) and 2013 (yellow circles). Areas of overlap are displayed as green circles.

3.3.2 Juvenile Translocation Study

In September 2012, 60 juvenile tortoises were translocated to the southern-most part of the NNSS in Area 22 to evaluate the survival of juvenile tortoises released in the wild. The NNSS provides one of the largest protected habitat areas in southern Nevada. The project is part of a long-term collaborative effort involving the FWS, NNSS, and the San Diego Zoo Institute for Conservation Research (ICR) to assess translocation as a means of recovery of the tortoise. The area for the juvenile translocations covered approximately 400 ha. Each tortoise had a VHF transmitter attached to its shell for tracking purposes (Figure 3-5). Tortoises were located daily for about 2 weeks by ICR personnel until their movements decreased and then they were monitored weekly through September 2013. The study was transferred to NSTec biologists who began weekly monitoring in mid-September 2013. Weekly monitoring continued through October and then changed to twice a month during November and once a month during December. At the time NSTec started monitoring, there were 43 of the original 60 (72%) juveniles still alive. By early January 2014, 37 (62%) tortoises were still alive. Of the six that died between September 2013 and January 2014, all showed signs of being chewed on by canid predators. Whether they were killed by coyotes (*Canis latrans*) or kit foxes (*Vulpes macrotis*) or scavenged after they died is impossible to determine.

Table 3-4 contains information about the 43 juvenile tortoises NSTec began monitoring. On average, the distance between the release location and first winter burrow (i.e., the burrow a juvenile was in the first part of January) was 488 meters (m) (Range 9–6,132 m; standard deviation [sd] 1,036 m). The average distance between the first winter burrow and the second winter burrow was substantially less at 150 m (Range 1–1,022 m; sd 227 m) with at least six utilizing the same winter burrow both years.

Figure 3-5. Juvenile tortoise with a VHS transmitter attached prior to release on the NNSS
(Photo by D. B. Hall, September 21, 2012)

Table 3-4. Release locations and distance between release sites and winter burrows for 43 juvenile desert tortoises

Tortoise Number	Release UTM Easting	Release UTM Northing	Distance (m) Release to Winter 2012–2013	Distance (m) Winter 2012–2013 to Winter 2013–2014
4000	0580750	4058457	119	2
4001	0580758	4058483	60	57
4003	0581520	4058216	2278	408
4004	0580758	4058313	183	67
4005	0579377	4058952	156	49
4007	0581532	4058240	42	148
4009	0579415	4059052	32	2
4010	0571527	4058272	533	703
4011	0580763	4058345	240	121
4013	0580758	4058601	633	8
4014	0580785	4058621	567	65
4015*	0580795	4058644	77	468
4017*	0581544	4058300	24	35
4018	0579447	4059108	124	76
4019	0580830	4058653	215	22
4020**	0579464	4059136	420	Not Applicable
4021	0579475	4059164	9	23
4024	0581556	4058322	704	121
4025	0580696	4058787	1069	336
4028	0580680	4058762	49	32
4029*	0581563	4058361	88	2
4030	0581564	4058394	68	45
4033	0580663	4058737	89	3
4034	0579549	4059133	20	95
4035	0579537	4059109	1171	2
4036	0581565	4058426	19	612
4037	0581563	4058452	147	60
4038	0581584	4058477	16	63
4040	0580657	4058705	62	505
4041	0581568	4058505	42	11
4042	0581571	4058531	43	70
4043***	0580648	4058676	107	Not Applicable
4044	0580643	4058653	102	293
4045	0580635	4058624	158	75
4046	0579516	4059063	398	1
4047**	0581568	4058557	17	Not Applicable
4048	0581575	4059584	37	2
4049	0579507	4059033	1136	89
4050	0581585	4058608	60	92
4052	0581593	4058634	810	1022
4053	0579501	4059000	332	4
4055	0581617	4058683	6132	179
4057	0580629	4058565	2414	30

*=Found dead mid-January 2014 **=Found dead on 9/16/13 ***=Found dead on 10/21/13

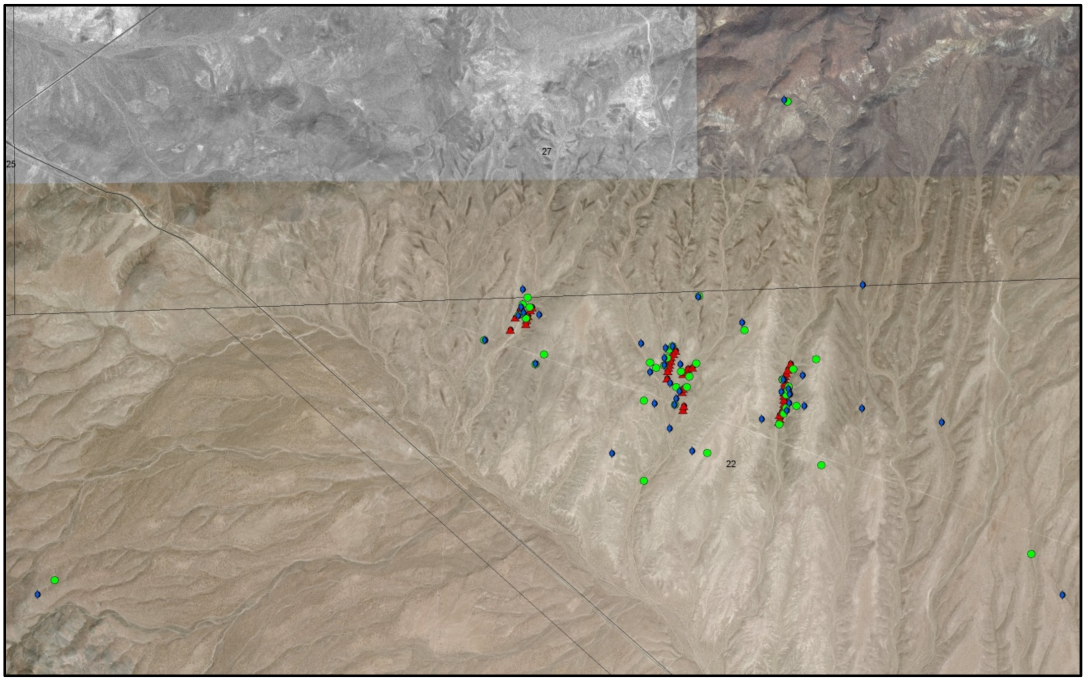

Figure 3-6. Distribution of 43 juvenile tortoises (red triangle=release location, September 2012; green circle=winter burrow, 2012–2013; blue diamond=winter burrow, 2013–2014)

Figure 3-6 depicts the spatial distribution of the 43 juvenile tortoises NSTec started monitoring in September 2013. All juveniles were at their winter 2013–2014 burrow by October 21, 2013. Nearly three-fourths of them were at their winter 2013–14 burrow by October 1, 2013. NSTec will continue monitoring the remaining juveniles for 1–5 years or possibly longer. Data analysis and publications will be jointly shared between NNSA/NFO and ICR.

3.3.3 USGS Rock Valley Study

As part of continuing research pertaining to desert tortoises, the U.S. Geological Survey (USGS) in collaboration with the FWS, ICR, and Penn State University is using three fenced 9 ha enclosures in Rock Valley for a portion of their epidemiology study. The three Rock Valley enclosures are located along the southern boundary of the NNSS in Area 25. In the spring of 2013, 15 tortoises were placed in each plot to reside in the plots for a year. Each tortoise was fitted with a proximity sensor, which is activated when two tortoises come within a specified distance of each other. This allows scientists to document tortoise interactions and social structure. In the spring of 2014, the second phase will be initiated, when up to five additional tortoises will be placed in the enclosures, for a total of 20 per enclosure. This will serve as a model for how translocated tortoises may interact with residents. Additional manipulations may be necessary, and are planned in the succeeding years (2015–2018). NNSS staff biologists assisted with weekly locations of these tortoises during the initial release in the spring of 2013.

3.4 Coordination with Other Biologists and Wildlife Agencies

During February 17–19, 2013, an NSTec biologist attended the Desert Tortoise Council's 38th annual meeting and symposium. This meeting was held in Las Vegas, Nevada, and included numerous presentations on desert tortoise biology, ecology, and recovery efforts. Several times during the spring and fall of 2013, NSTec biologists were trained in various tortoise-handling procedures, including how to attach and remove transmitters.

4.0 ECOSYSTEM MONITORING

Ecological Services began comprehensive mapping of plant communities and wildlife habitat on the NNSS in 1996. Data were collected, describing selected biotic and abiotic habitat features within field mapping units called ELUs. ELUs are landforms (Peterson 1981) with similar vegetation, soil, slope, and hydrology. Boundaries of the ELUs were defined using aerial photographs, satellite imagery, and field confirmation. ELUs are considered by site biologists to be the most feasible mapping unit by which sensitive plant and animal habitats can be described. In 2000 and 2001, topical reports describing the classification of vegetation types on the NNSS were published and distributed (Ostler et al. 2000, Wills and Ostler 2001). Ten vegetation alliances and 20 associations were reported to occur on the NNSS.

In addition to ELU mapping, ecosystem monitoring also entails monitoring a wide variety of terrestrial and aquatic habitats and non-sensitive and protected/regulated species. Efforts during 2013 focused on wildland fire fuels surveys**,** West Nile virus (WNV) surveillance, reptile sampling, natural wetlands monitoring, Odonate surveys, and constructed water source monitoring.

4.1 Wildland Fire Hazard Assessment

In 2003, the DOE implemented DOE O 450.1, "Environmental Protection Program," which placed greater emphasis on protection of site resources from wildland and operational fires. In response to this order, a Wildland Fire Management Plan was developed for the NNSS. As part of this plan, three data needs were identified: (a) an assessment of the location of past wildland fires on the NNSS, (b) an assessment of the woody and fine fuels on the NNSS, and (c) an assessment of climatic conditions that may contribute to fuel loading and wildland fires. These initial assessments were reported in *A Survey of Vegetation and Wildland Fire Hazards on the Nevada Test Site* (Hansen and Ostler 2004). Since that document, updates of fires and wildland fuel loads are provided to the NNSS Fire and Rescue Department each year to assist in wildland fire planning for the upcoming fire season.

4.1.1 Fires in 2013

From 1978 to 2013, there has been an average of 11.2 wildland fires per year on the NNSS with an average of about 83.7 ha burned per fire (Table 4-1). Historically most wildland fires are caused by lightning and do not occur randomly across the NNSS, but occur more often in particular vegetation types (e.g., *Coleogyne ramosissima* [blackbrush] plant communities). These types have sufficient woody and fine-textured fuels that are conducive to ignition and spread of wildland fires. Once a site burns, it is much more likely to burn again because of the invasive annual plants that quickly colonize these areas (Brooks and Lusk 2008).

Only three wildland fires occurred on the NNSS during 2013, well below the average of 11 fires per year. All three fires were caused by lightning, burning a total of only 0.4 ha. (Table 4-2). Fire names were assigned by the first firefighter to arrive at a fire. Some fires are unnamed except for the name of the general area. Locations of fires on the NNSS in 2013 are shown in Figure 4-1. None of the fires had their perimeters mapped because they were so small.

4.1.2 Fuel Survey Methods

Beginning in 2004, and in response to DOE O 231.1B, surveys were initiated on the NNSS to identify wildland fire hazards. Vegetation surveys were conducted in April and May 2013 at sites located along and adjacent to major NNSS corridors to estimate the abundance of fuels produced by native and invasive plants. Information about climate and wildland fire-related information reported by other government agencies was also identified and summarized as part of the wildland fire hazards assessment. Survey findings and fuels assessment maps were compiled and reported to NNSS Fire and Rescue Department.

Table 4-1. Number and area of wildland fires on the NNSS, 1978–2013

Year	Fires	Hectares
1978	10	3,197
1979	6	1
1980	26	5,465
1981	13	3
1982	6	1
1983	16	7,402
1984	17	458
1985	11	651
1986	12	96
1987	14	86
1988	23	332
1989	15	131
1990	7	3
1991	4	2
1992	12	97
1993	7	3
1994	8	6
1995	8	1,864
1996	2	688
1997	6	6
1998	9	1,044
1999	7	20
2000	11	61
2001	8	198
2002	7	146
2003	4	2
2004	8	3
2005	31	5,261
2006	16	3,486
2007	15	6
2008	20	1
2009	17	95
2010	3	0.4
2011	20	3,636
2012	11	216.9
2013	3	0.4
37-Year Total	**413**	**34,667.3**
Average Per Year	**11.2**	**937.0**
Average Per Fire		**83.7**

Table 4-2. Date, location, acreage, and cause of wildland fires on the NNSS in 2013

Incident No.	Date-Time	Location (Name of Fire)	Hectares Burned	Cause
13-295	07/20/13-2037 hrs	Army Well Road (Area 22 Fire)	<1	Lightning
13-300	07/23/13-1643 hrs	Stockade Wash Road (Area 18 Fire)	<1	Lightning
13-333	08/18/13-1509 hrs	North of Camp 17 Camp (Area 19)	<1	Lightning
		Total Ha Burned	0.4	

The abundance of fine-textured (grasses and herbs) and coarse-textured (woody) fuels were visually estimated on numerical scales using an 11-point potential scale: 0 to 5 (in 0.5 increments, where 0.0 is barren and 5.0 is near maximum biomass encountered on the NNSS). Details of the methodology used to conduct the spring survey for assessing wildland fire hazards on the NNSS are described in a report by Hansen and Ostler (2004).

Photographs of sites typifying these different scale values are found in Appendix A of the *Ecological Monitoring and Compliance Program Calendar Year 2005 Report* (Bechtel Nevada 2006). Additionally, the numerical abundance rating for fine fuels at a site was added to the numerical abundance rating of woody fuels to derive a combined fuels rating for each site that ranged from 0 to 10 in 0.5 integer increments. The index ratings for fuels at these survey sites were then plotted on a GIS map and color-coded for abundance to indicate the wildland fire fuel hazards at various locations across the NNSS.

4.1.3 Fuel Survey Results

4.1.3.1 Climate

There are 17 rain gauges on the NNSS (Hansen and Ostler 2004) that have been used historically to measure precipitation. Data from these weather station gauges extends back more than 30 years (National Oceanic and Atmospheric Administration [NOAA] 2013). In the fall of 2011, most of the rain gauges on the NNSS were upgraded from weighing gauges to tipping-bucket style gauges with data transmitted directly to NOAA via telecommunications, rather than manually retrieving and processing the data (Hansen 2012). In most cases, the new gauges were relocated nearby to facilitate data collection. The changes were made to reduce costs, improve data reliability, and improve access time to the data after precipitation events. As a result of these modifications, only 14 rain gauges remain from the original gauge stations. The Cane Spring, Tippipah Spring, and Rock Valley gauge stations were decommissioned. The Jackass Flats gauge was moved to Port Gaston in Area 26. The Little Feller 2 gauge was moved from the eastern part of Area 18 to the northwestern corner of Area 18. Precipitation data collected in 2013 reflect the changes and attempt to match, as closely as possible, data collected historically. The rain gauge at Yucca Dry Lake (west side) was not functional during the month of January. Mean values were recalculated to account for periods when gauges were not functional.

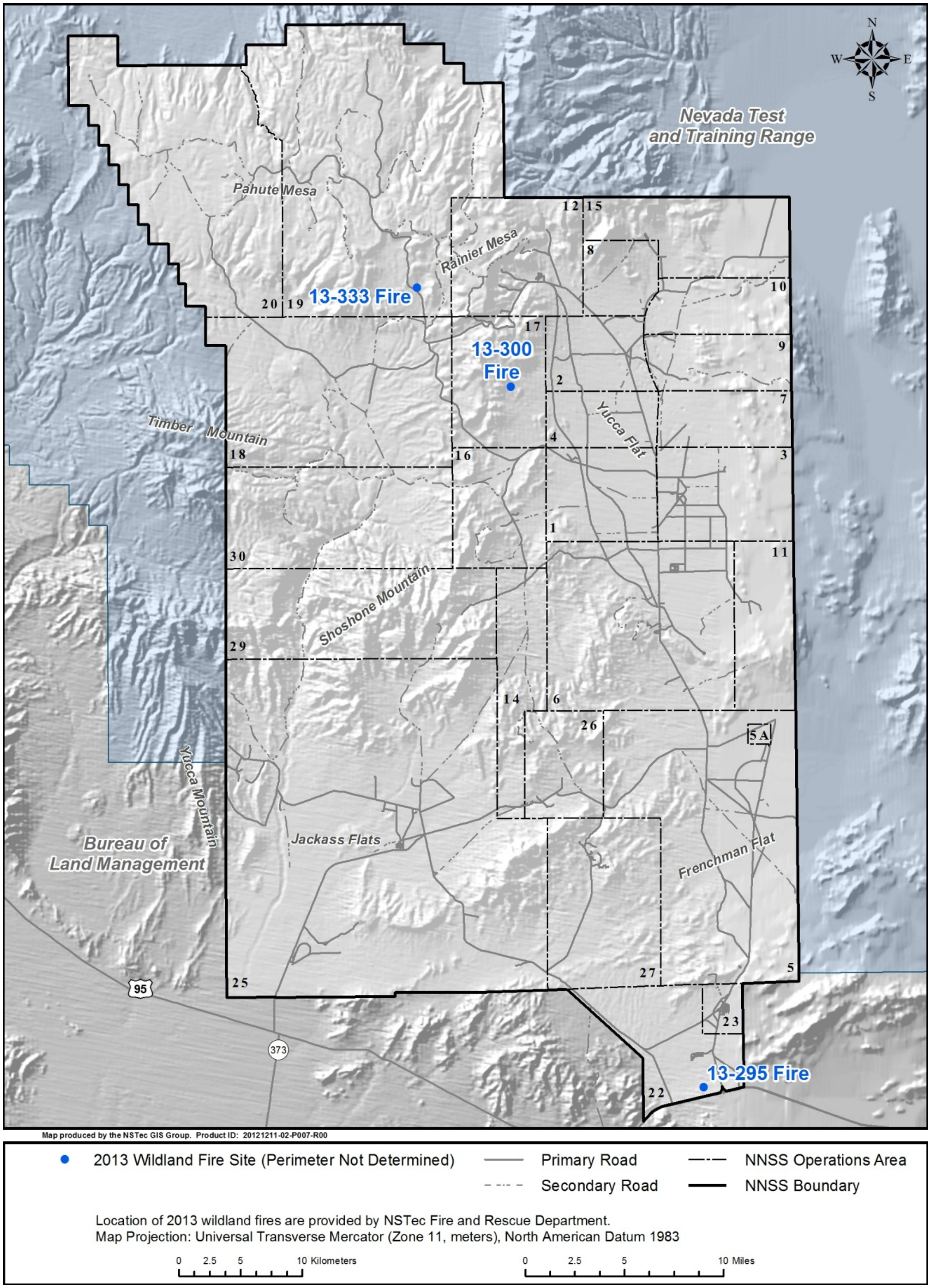

Figure 4-1. Location of wildland fires on the NNSS during 2013

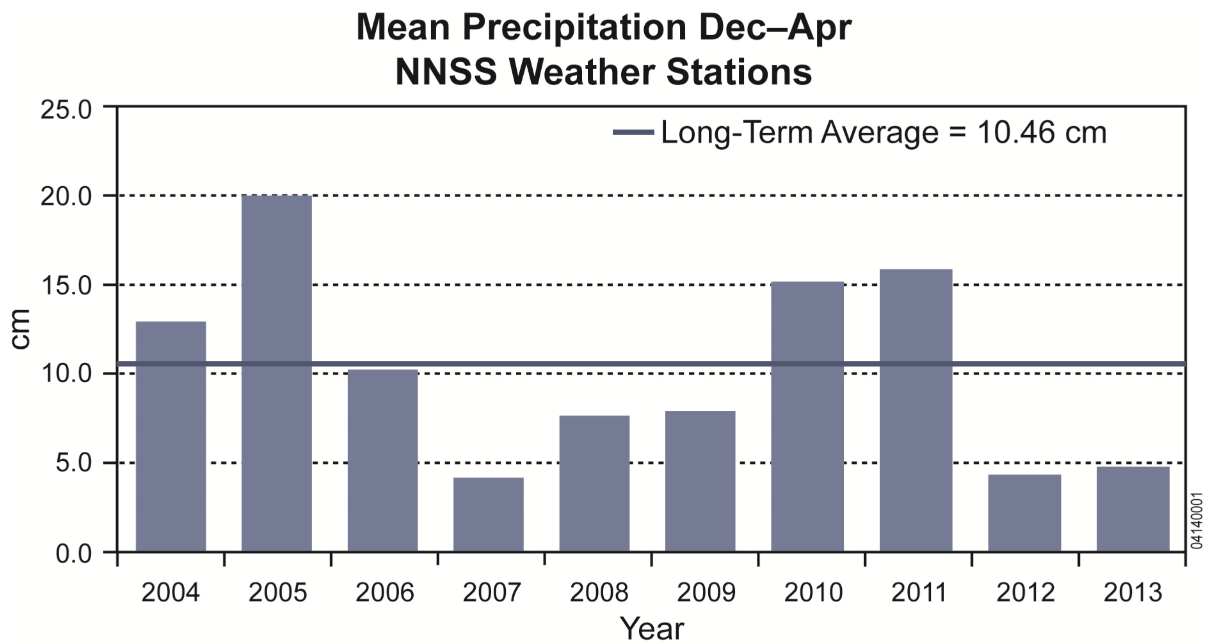

Figure 4-2. Average precipitation from December (previous year) through April for the years 2004 through 2013

In order to assess whether the spring of the year would be relatively wet, normal, or a dry year, a simple measure of precipitation was needed. Precipitation during the months of December, January, February, March, and April was selected because of its simplicity and ease of calculation (Figure 4-2). While it is recognized that precipitation from other months is also important, as is the influence of temperature, winds, relative humidity, and precipitation during these months strongly influences plant growth on the NNSS as observed along the survey route. This period occurs before the beginning of the fire season in June, so it can be used to predict the fuels that may be present. During the 10 years of conducting fire fuel evaluations, the mean precipitation during these 5 months is correlated (R^2= 0.770) with our estimations of the combined fuel loads. During 2013, the average precipitation from the remaining 14 rain gauge stations on the NNSS during December–April was 4.80 centimeters (cm), or about 46.0% of the normal amount (i.e., the average precipitation for the last 30 years—10.46 cm) (Figure 4-2). Temperatures were near normal during these months.

4.1.3.2 Fuels

Because of the below-normal precipitation that occurred during the spring of 2013, few annual or perennial plant seeds germinated. Perennial herbaceous grasses and forbs had little, if any, production during the spring of 2013.

The woody fuels index value was slightly higher in 2013 (2.49) compared to 2012 (2.43), as foliar canopy cover increased slightly (Table 4-3). This was the second lowest ranking since 2004 when index values were initiated. The fine fuels index also increased in 2013 (2.03) compared to 2012 (1.75), but still ranked the fourth lowest since 2004 (Table 4-3).

Table 4-3. Woody fuels, fine fuels and combined fuels index values for 2004–2013

Year	Average Woody Fuels Index	Average Fine Fuels Index	Average Combined Fuels Index
2004	2.75	2.13	4.88
2005	2.80	2.83	5.64
2006	2.80	2.46	5.26
2007	2.62	1.52	4.13
2008	2.59	2.23	4.81
2009	2.63	1.95	4.52
2010	2.61	2.27	4.89
2011	2.58	2.56	5.14
2012	2.43	1.75	4.17
2013	2.49	2.03	4.52

The combined index values (fine fuels plus woody fuels) for 2013 corresponds to the potential for fuels on the NNSS to support wildland fires once fuels are ignited. The higher the index, the greater the potential for wildland fires to spread. The NNSS average combined index value for fine fuels and woody fuels for 2013 was 4.52, the third lowest since 2004 (Table 4-3), suggesting below normal fuels for the NNSS. However, most fuels in the spring of 2013 appeared to be well cured and highly susceptible to ignition due to the low moisture content in the residual fuels and the low relative humidity of air from the below-normal precipitation on the NNSS.

Figure 4-3 shows the mean combined fuel index values. The droughts of 2007 and 2012 significantly reduced the amount of fine fuels and to a lesser extent woody fuels produced those years.

The locations and results of the fine fuels, woody fuels and combined fuels surveys at 104 stations on the NNSS inspected during 2013 are shown in Figures 4-4, 4-5, and 4-6, respectively. Two stations were not sampled due to inaccessibility. High combined index values occurred in Fortymile Canyon and Big Burn Valley.

Photographs were taken from permanent locations for all 106 sites during the past 10 years. Figure 4-7 shows photographs of Site 99 in Yucca Flat for the last 4 years. These photographs are valuable for many reasons, including providing a permanent record of previous site conditions, comparing site conditions among sites and years, and evaluating current year production with residual fuels from previous years.

As in past years, sites dominated by blackbrush and annual grasses appeared to respond to precipitation with greater variation in the amount of fine fuels and woody fuels than other vegetation community types (e.g., *Larrea tridentata* [creosote bush] or *Pinus monophylla*/*Juniperus osteosperma* [pinyon/juniper communities]), resulting in increases in fine fuels at these sites more than sites in the Mojave Desert (southern one-third of the NNSS) or the Great Basin Desert (northern one-third of the NNSS).

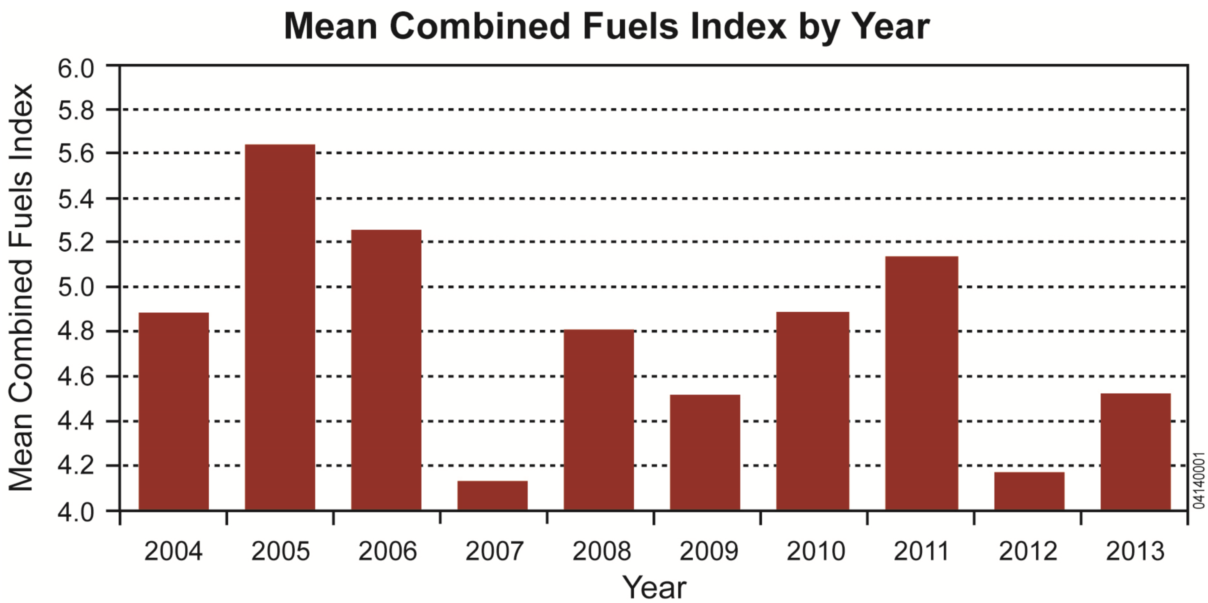

Figure 4-3. Mean combined fuels index for the years 2004 to 2013

Fine fuels produced in 2013 were almost completely lacking in most areas of the NNSS due to drought conditions. Overall, the hazards of residual fuels contributing to wildland fires are lower than average, but the dry conditions of both fine and woody fuels make them more susceptible to ignition by lightning or other sources. Once ignited, high ambient temperatures and high winds contribute to the spread of fire in areas where the abundance of fuels is sufficient to carry the flames of the fire. Rapid response by NNSS Fire and Rescue after fires are ignited is a key factor in minimizing wildland fire spread and severity.

4.1.3.3 Invasive Plants

The three most commonly observed invasive annual plants to colonize burned areas on the NNSS are *Schismus arabicus* (Arabian schismus), found at low elevations; *Bromus rubens* (red brome), found at low to moderate elevations; and *Bromus tectorum* (cheatgrass), found at middle to high elevations (Table 4-4). Most of the invasive annual plants failed to germinate during the spring of 2013. *B. tectorum* was the most common invasive plant occurring at over 70% of the study sites although most plants were stunted due to lack of adequate rainfall. Both *B. rubens* (19.2%) and *S. arabicus* (9.6%) had low germination over the NNSS. Precipitation history (Figure 4-2, shown previously) is also important in determining the percent presence of species across the NNSS. During periods of low precipitation, most annual species have low percent presence (i.e., the number of sites in which the plant was observed to be present and growing). Percent presence is generally greatest during periods of high precipitation, and appears to be a good indication of germination. Higher percent presence is also expected to occur when regional storms provide precipitation to a greater number of operational areas across the NNSS. However, the responses of some species, both invasive and native species, suggest that other variables, such as the timing of precipitation or temperatures required for germination, may also be contributing to plant response.

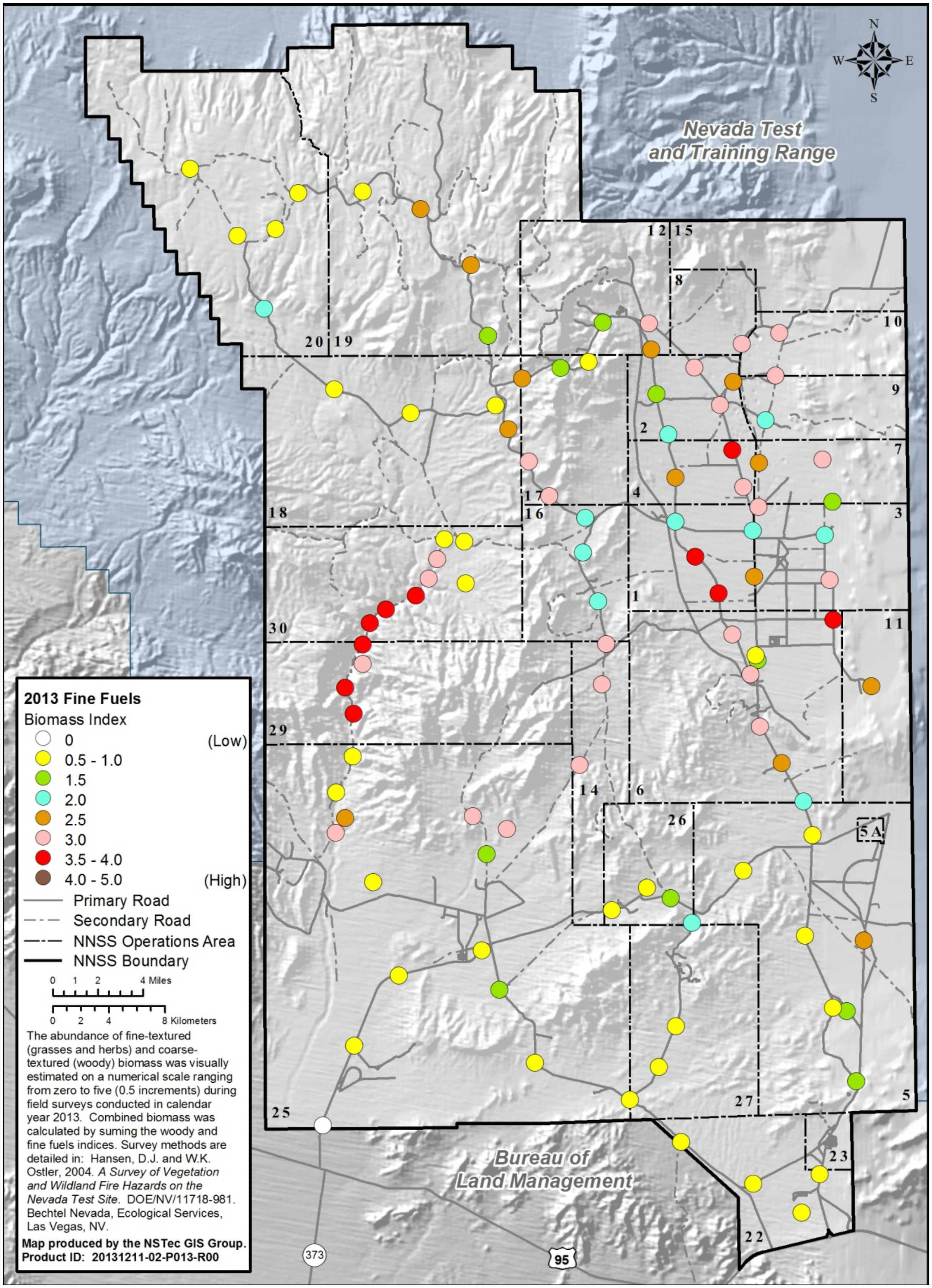

Figure 4-4. Index of fine fuels for 104 survey stations on the NNSS during 2013

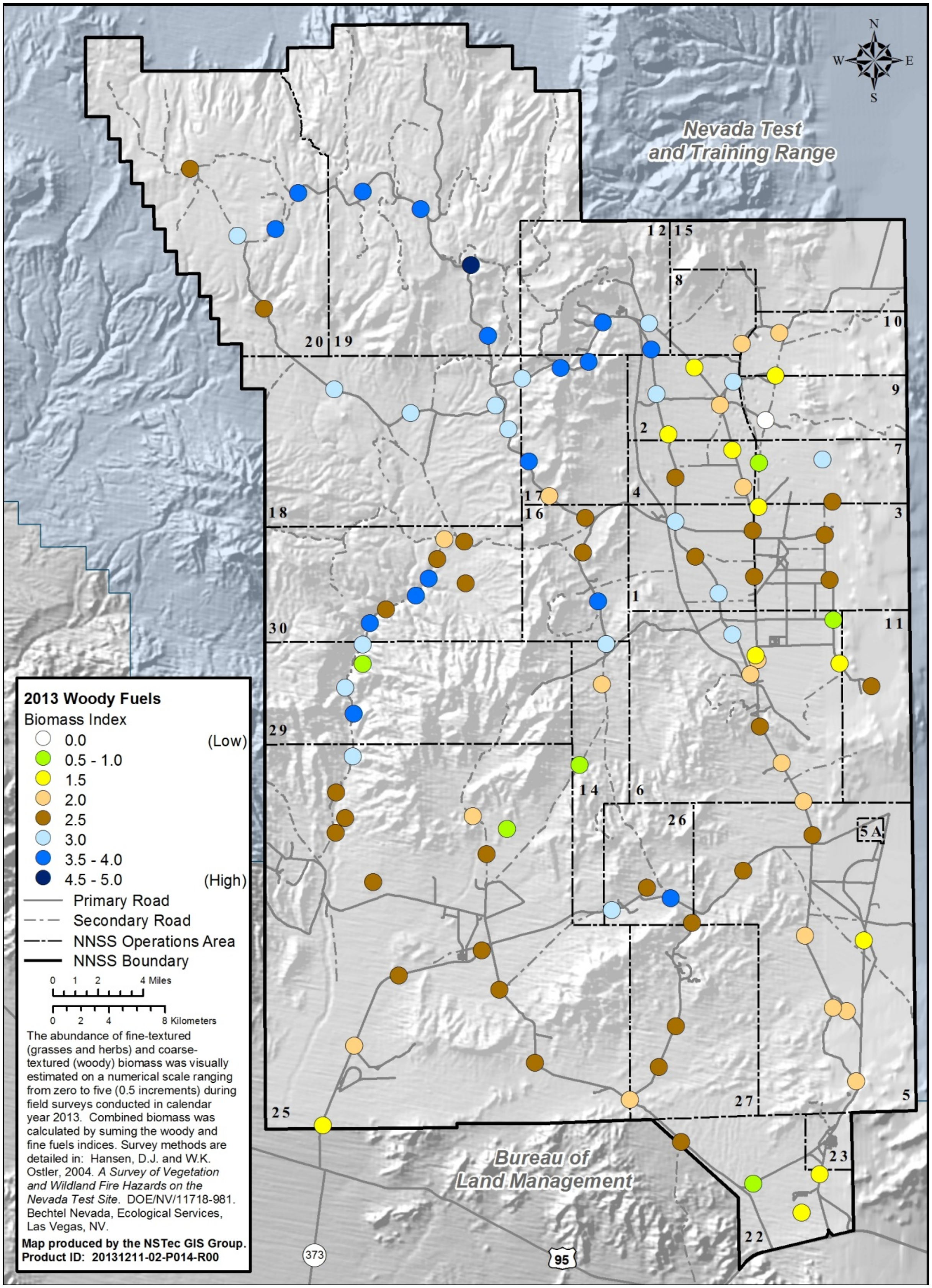

Figure 4-5. Index of woody fuels for 104 survey stations on the NNSS during 2013

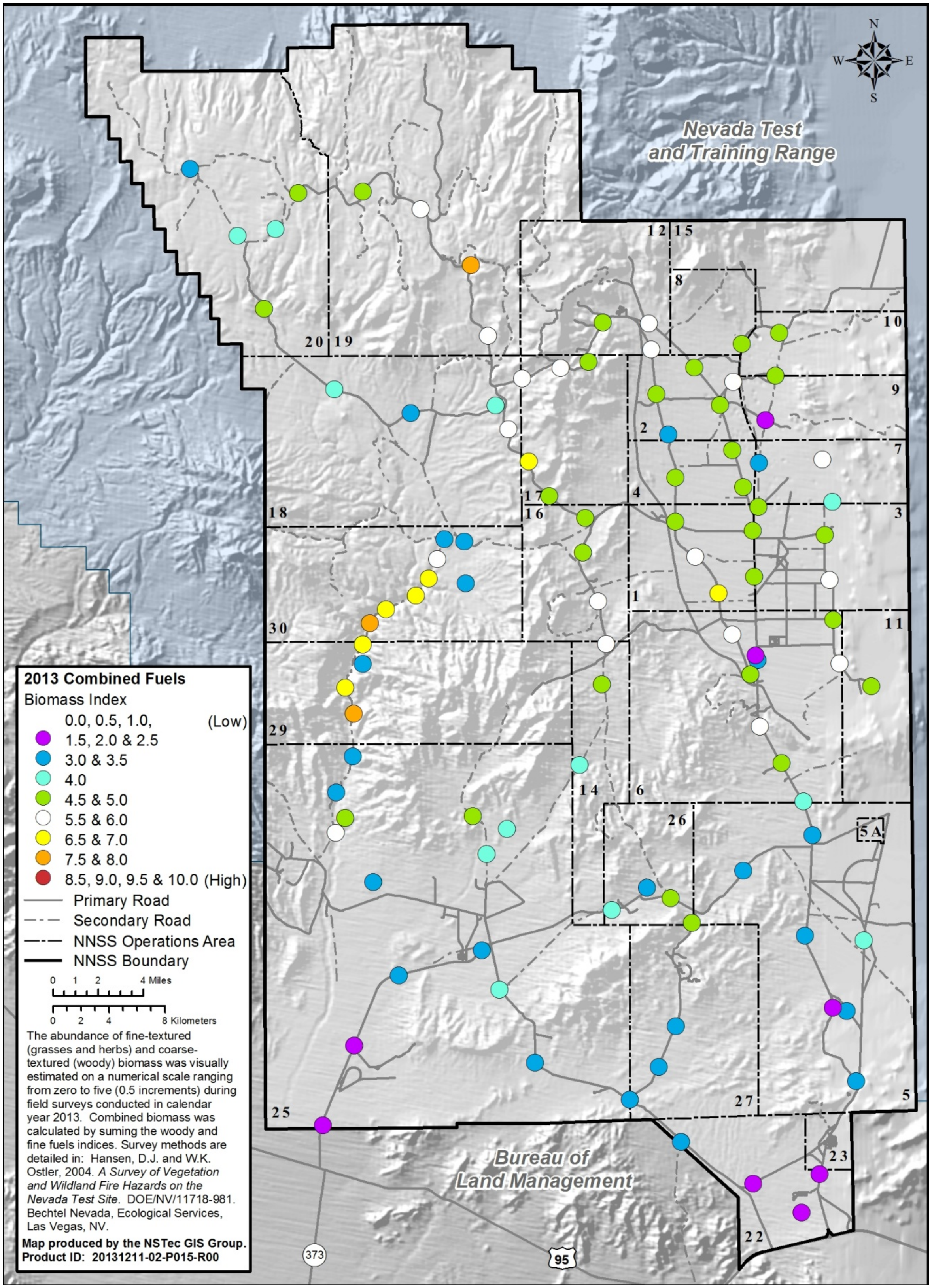

Figure 4-6. Index of combined fine fuels and woody fuels for 104 survey stations on the NNSS during 2013

Figure 4-7. Site 99 on the west side of Yucca Flat in 2010–2013

(Photos by W. K. Ostler, May 3, 2010 [top left]; April 26, 2011 [top right]; April 10, 2012 [bottom left]; and April 22, 2013 [bottom right])

Table 4-4. Precipitation history and percent presence of key plant species contributing to fine fuels at surveyed sites

Precipitation History	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Mean Precipitation (cm)* (December–April)	12.90	19.99	10.19	4.06	7.65	7.87	15.14	15.85	4.34	4.80
Invasive Introduced Species										
Bromus rubens (red brome)	51.7	64.4	67.8	0	63.0	63.2	58.5	62.3	0	19.2
Bromus tectorum (cheatgrass)	40.3	54.0	60.7	0	59.2	66.0	67.0	79.2	17.0	70.2
Erodium cicutarium (filaree or redstem stork's bill)	5.2	6.2	24.6	0	21.3	27.4	33.0	42.4	0.9	37.5
Schismus arabicus (Arabian schismus)	4.7	2.8	5.2	0	11.4	9.4	3.8	11.3	0	9.6
Native Species										
Amsinckia tessellata (bristly fiddleneck)	34.0	62.0	16.1	0	63.0	48.1	67.9	63.2	1.8	41.3
Mentzelia albicaulis (whitestem blazingstar)	49.8	8.1	0	0	2.4	18.9	51.9	16.0	3.7	6.7
Chaenactis fremontii (pincushion flower)	27.0	8.0	0	0	1.4	11.3	13.2	0.5	0	6.7

*Long-term mean precipitation for the historical 17 rain gauges on the NNSS for the period of January–April 1981–2011 is 8.86 cm.

Colonization by invasive species increases the likelihood of future wildland fires because they provide abundant fine fuels that are more closely spaced than native vegetation. *C. ramosissima* vegetation types appear to be the most vulnerable plant communities to fire, followed by *P. monophylla*/*J. osteosperma*/ *Artemisia* species (spp.) vegetation types. Wildland fires are costly to control and to mitigate once they occur. Revegetation of severely burned areas can be very slow without reseeding or transplanting with native species and other rehabilitation efforts. *C. ramosissima*, *Artemisia* spp., *J. osteosperma*, and *P. monophylla* do not resprout following fires. Untreated areas become much more vulnerable to future fires once invasive species, rather than native species, colonize a burned area.

Growth of fine fuels produced by invasive, introduced annual species (especially *B. tectorum*) and other native annual species during 2013 was fourth lowest since 2004. Only 2007, 2009, and 2012 had lower germination and percent presence of annual and perennial herbaceous species. Germination and growth of fine fuels during 2013 was lowest at lower elevations and greatest at middle elevations, particularly in Forty-mile Canyon and Yucca Flat.

4.2 West Nile Virus Surveillance

WNV is a potentially serious illness that spreads to humans and other animals through mosquito bites. It was first discovered in Uganda in 1937 and was not detected in North America until 1999. In southern Nevada, it was not detected until the spring of 2004. WNV surveillance on the NNSS continued in 2013 for the 10th consecutive year. WNV surveillance consists of setting mosquito traps baited with dry ice overnight at sites where standing water provides potential breeding sites for mosquitoes. As the dry ice sublimates, it produces carbon dioxide, which attracts mosquitoes. Ten sites were sampled during 15 surveys from May to September (Table 4-5). Mosquitoes collected during the surveys were taken to the Southern Nevada Health District (SNHD) for species identification and WNV testing. A total of 39 mosquitoes were trapped (38 *Culex tarsalis* and 1 *Anopheles franciscanus*), and all tested negative for WNV.

Over the last 10 years, a total of 556 mosquitoes have been caught and identified at 20 sites around the NNSS during 139 surveys. Species include 494 *Culex tarsalis*, 49 *Culiseta inornata*, 5 *Anopheles franciscanus*, 4 *Ochlerotatus dorsalis*, 3 *Culex erythrothorax*, and 1 *Culiseta incidens* (Figure 4-8). All but *O. dorsalis* are known to carry WNV. However, WNV has not been detected conclusively on the NNSS. Two samples, both *Culiseta inornata*, were suspect for WNV in 2005 and 2006 at Well 3 Pond (Figure 4-9) (Bechtel Nevada 2006, NSTec 2007). Suspect means that it could be weakly positive for WNV, have background inflorescence from the probe, or could have some cross contamination. Repeated sampling at this site in subsequent years failed to detect the presence of WNV. Sampling sites were selected primarily to be in close proximity to work locations (e.g., Mercury, Area 5 Radioactive Waste Management Complex [RWMC], Control Point [CP] Area 6, and Wet and Wild). Other locations were also selected to define mosquito distribution. Most of the mosquitoes were captured in Areas 5 and 6. No mosquitoes were captured around Mercury. These results suggest that although mosquitoes occur in many areas of the NNSS, albeit in low numbers, the risk of NNSS workers being exposed to WNV on the site is very low.

Table 4-5. Results of WNV surveillance on the NNSS in 2013

Location	Date	Number Captured	Species	WNV
Camp 17 Pond, Area 18	5/28/13	1	*Culex tarsalis*	Negative
Well 5B Pond, Area 5	5/28/13	6	*Culex tarsalis*	Negative
Yucca Playa Pond, Area 6	5/28/13	2	*Culex tarsalis*	Negative
Well C1 Pond, Area 6	6/19/13	0	NA	NA
LANL Pond, Area 6	6/19/13	0	NA	NA
Mercury SOC Park, Area 23	6/19/13	0	NA	NA
Camp 17 Pond, Area 18	7/16/13	1	*Anopheles franciscanus*	Negative
Well 5B Pond, Area 5	7/16/13	0	NA	NA
Camp 17 Pond, Area 18	8/20/13	0	NA	NA
LANL Pond, Area 6	8/20/13	2	*Culex tarsalis*	Negative
Cane Spring, Area 27	8/20/13	2	*Culex tarsalis*	Negative
Shaker Plant, Area 1	9/17/13	0	NA	NA
3-03 Road Crater	9/23/13	11	*Culex tarsalis*	Negative
Well 5C, Area 5	9/23/13	14	*Culex tarsalis*	Negative
Mercury SOC Park, Area 23	9/23/13	0	NA	NA

LANL: Los Alamos National Laboratory
SOC: Special Operations Center
WNV: West Nile virus

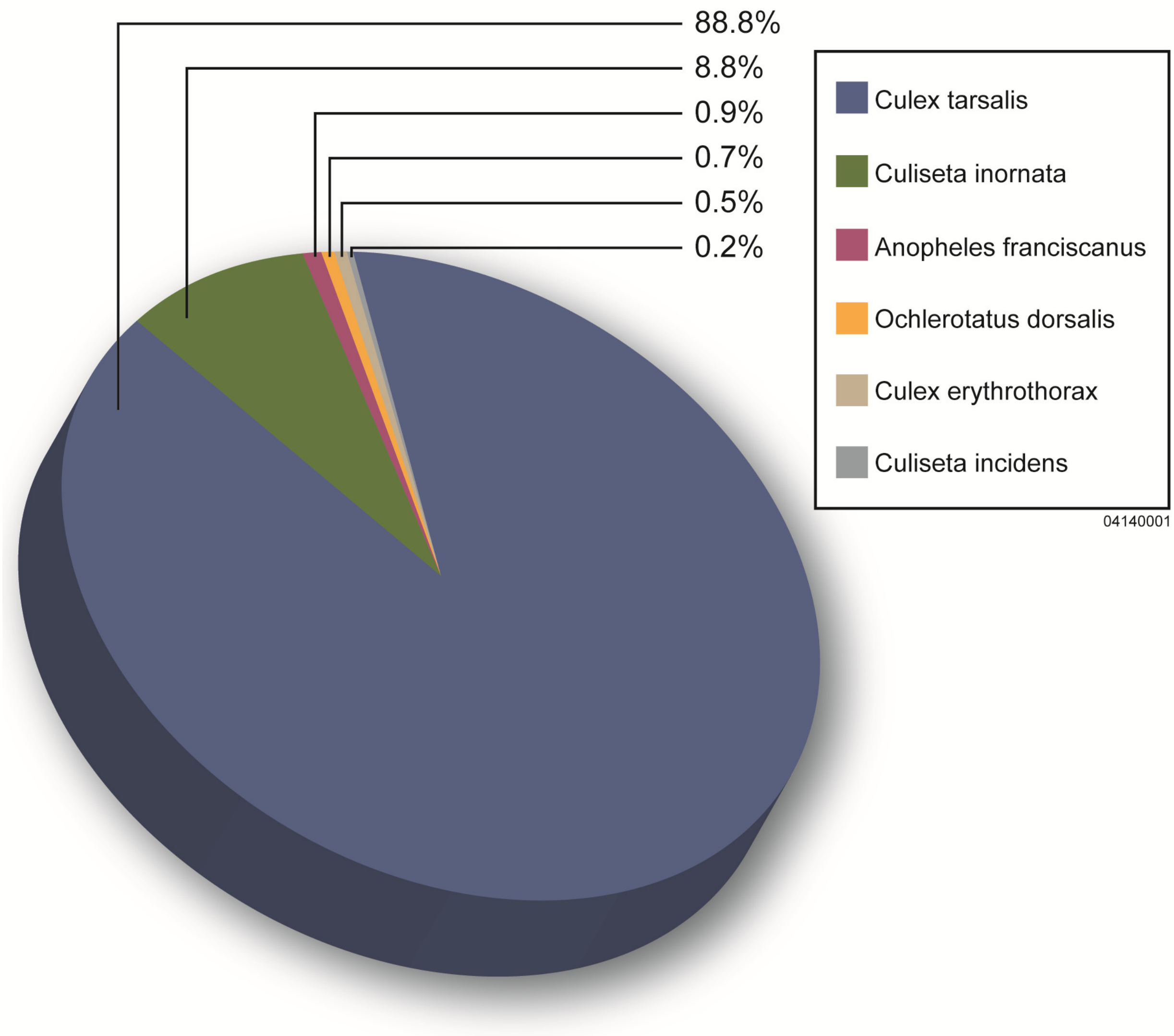

Figure 4-8. Percent occurrence of mosquito species captured on the NNSS (2004–2013)

A secondary objective of WNV surveillance is to define the distribution of mosquitoes on the NNSS, which has not been documented. Six species were captured and identified at 13 of the 20 sites sampled (Figure 4-9). *Culex tarsalis* was the most abundant (89%) and ubiquitous occurring at 12 of 20 sites. *Culiseta inornata* was detected at 8 of the 20 sites and accounted for 9% of captures. The remaining four species were captured at three or fewer sites and accounted for about 2% of captures combined. All species detected on the NNSS were also detected during other WNV surveillances conducted in Nye County. An additional 11 species were detected during other surveillances that were not found on the NNSS. Mosquito abundance was also substantially lower on the NNSS compared to other areas in Nye County (SNHD 2006, 2010).

Several birds were also opportunistically collected and tested for WNV, including 3 red-tailed hawks (*Buteo jamaicensis*) (1 in 2005, 2 in 2006), 1 golden eagle (*Aquila chrysaetos*) (2005), 4 barn owls (*Tyto alba*) (1 in 2005, 3 in 2006), 1 prairie falcon (*Falco mexicanus*) (2006), and 15 common ravens (*Corvus corax*) (2009). All tested negative for WNV.

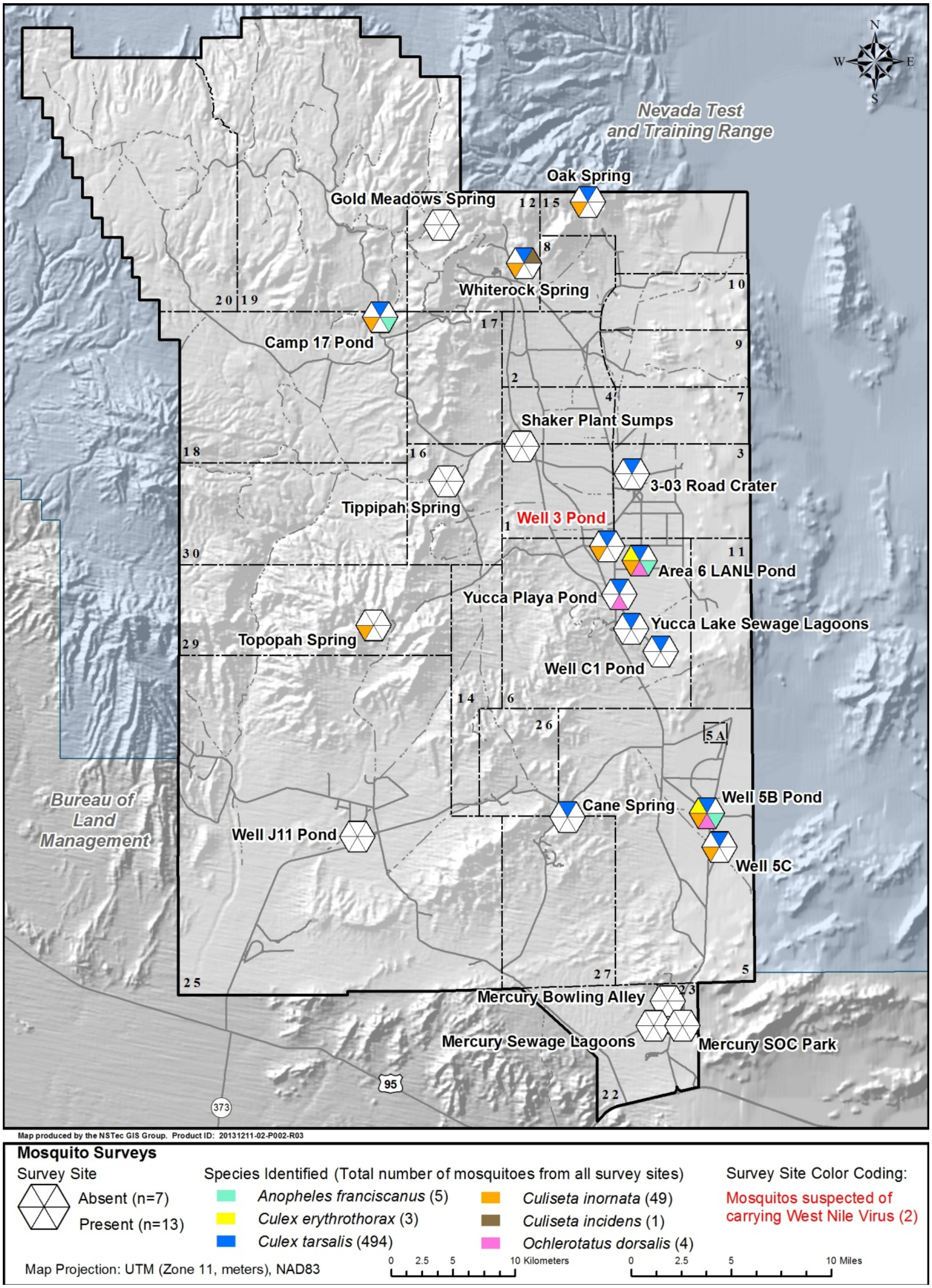

Figure 4-9. Mosquito distribution map and results of WNV sampling on the NNSS (2004–2013)

4.3 Reptile Sampling

The purpose of additional reptile sampling is to fill in data gaps for distribution of species that are rarely encountered or have been little studied in the past. The field mapping effort for reptile distributions continued in 2013 using the following techniques: (a) trapping; (b) recording opportunistic observations and responding to calls of trapped reptiles by NNSS personnel, often in and near buildings; and (c) conducting driving surveys searching for road-killed reptiles primarily in Mercury Valley, West Mercury Valley, and Frenchman Flat

4.3.1 Reptile Trapping

Trapping involved setting 15 un-baited funnel traps at a site and trapping for 2 to 4 weeks in forward areas of the NNSS. Trapping occurred at eight sites over a total of 250 trap nights. Captures included 15 individual reptiles and included the side-blotched lizard (*Uta stansburiana*), western whiptail (*Cnemidophorus tigris*), yellow-backed spiny lizard (*Sceloporus magister*), and Great Basin fence lizard (*S. occidentalis*).

4.3.2 Reptile Observations

Thirty-six individual reptiles representing 17 species were observed at 30 new locations in 2013. Hatchling western ground snakes (*Sonora semiannulata*) were commonly observed in buildings in Mercury during summer. We responded to seven instances of reptiles caught in glue traps in buildings in Mercury, where we removed, cleaned, and released six individuals. (The seventh had already been released without identification.) These included three western ground snakes, one long-nosed snake (*Rhinocheilus lecontei*), one red racer (*Masticophis flagellum*), and one desert banded gecko (*Coleonyx variegatus*). An additional noteworthy record was a western skink (*Plestiodon skiltonianus*) observation during a mountain lion survey on August 14 on Pahute Mesa in Area 19.

4.3.3 Road-killed Reptile Surveys

Reptile roadkills were monitored in the southern third of the NNSS (see Table 4-6, Figure 4-10) along a 67 km route driven weekly during April through September. Opportunistic road surveys were also conducted in the northern portion of the NNSS. Overall, we detected 15 species of road-killed reptiles and 65 individuals site-wide, with a peak in May (Table 4-6). No road-killed reptiles were observed in July. A cluster of roadkills appears on the Mercury Highway around Mercury Hill Summit (Figure 4-10), a heavily traveled corridor.

There were eight species of snakes recorded as roadkill (Table 4-6). As expected, one of the most common snakes in the southern region, the red racer, was the most numerically impacted species with >50% of the detections (Table 4-6). Other snakes recorded were the striped whipsnake (*Masticophis taeniatus*) located further north on the NNSS, the widespread gopher snake (*Pituophis catenifer*), the sidewinder rattlesnake (*Crotalus cerastes*), the speckled rattlesnake (*Crotalus mitchellii*), and the western patch-nosed snake (*Salvadora hexalepis*). Surprisingly, a ring-necked snake (*Diadophis punctatus*), an uncommon species on the site and normally seen in the more mesic northern region of the NNSS, was recorded as a roadkill near Mercury Hill Summit (Figure 4-10). No hatchling road-killed snakes were detected in 2013.

There were seven species of lizards detected as roadkill in 2013 and included leopard lizards (*Gambelia wislizenii*), horned lizards (*Phrynosoma platyrhinos*), zebra-tailed lizards (*Callisaurus draconoides*), Great Basin collared lizards (*Crotaphytus bicinctores*), the ubiquitous western whiptail, the common yellow-backed spiny lizard, and the Great Basin fence lizard, which occurs much further north on the NNSS (Table 4-6).

Table 4-6. Roadkill reptiles by month recorded in 2013 on the NNSS

	Number of Roadkills by Month						
	April	May	June	July	August	Sept	**Totals**
Snakes							
Chionactis occipitalis		1					1
Crotalus cerastes	1	1	1		1		4
Diadophis punctatus		1					1
Masticophis flagellum	4	6	3		8	3	24
Masticophis taeniatus			1				1
Pituophis catenifer	1	2			1		4
Rhinocheilus lecontei		2					2
Salvadora hexalepis		1	1			1	3
Total	**6**	**14**	**6**	**0**	**10**	**4**	**40**
Lizards							
Callisaurus draconoides		2	1		1	1	5
Cnemidophorus tigris					1		1
Crotaphytus bicinctores			2				2
Gambelia wislizenii		1	4		1	4	10
Phrynosoma platyrhinos		2	2				4
Sceloporus occidentalis		1			1		2
Sceloporus magister		1					1
Total	**0**	**7**	**9**	**0**	**4**	**5**	**25**
Grand Total	**6**	**21**	**15**	**0**	**14**	**9**	**65**

4.3.4 Historical Reptile Records

NSTec biologists received data on snakes and lizards from Rock Valley through the special efforts of Phil Medica, a retired biologist with the USGS who did considerable work at the NNSS. Data included about 236 records of reptiles including about 140 records of western shovel-nosed snakes that he captured, marked, and weighed during 1964–1968 on can trap plots at the Rock Valley Validation site. Also received were records of the yellow-backed spiny lizard (55), red racer (30), long-nosed snake (7), western patch-nosed snake (1), and the speckled rattlesnake (3). Western shovel-nosed snakes were the most abundant species of snake captured at that time. These data were entered into the EEM reptile database, which now contains over 6,300 records.

In addition, an NSTec biologist visited the Monte L. Bean Museum at Brigham Young University (BYU) in 2013 to examine selected reptile specimens from the NNSS and clarify the limited historical and ecological information on the spotted leaf-nosed snake (*Phyllorhynchus decurtatus*), which historically was detected in sandy areas in the southern portion of the NNSS. New data obtained and added to the reptile database included numerous specific site locations and snout-vent length and weight of 37 individuals that had been collected on the NNSS in the 1960s. Special thanks is extended to Dr. Jack Sites for facilitating the museum visit. The last record of the spotted leaf-nosed snake recorded on the NNSS was a roadkill from June 1992 on south Frenchman flat. This species now appears to be rare on the NNSS and warrants further investigation.

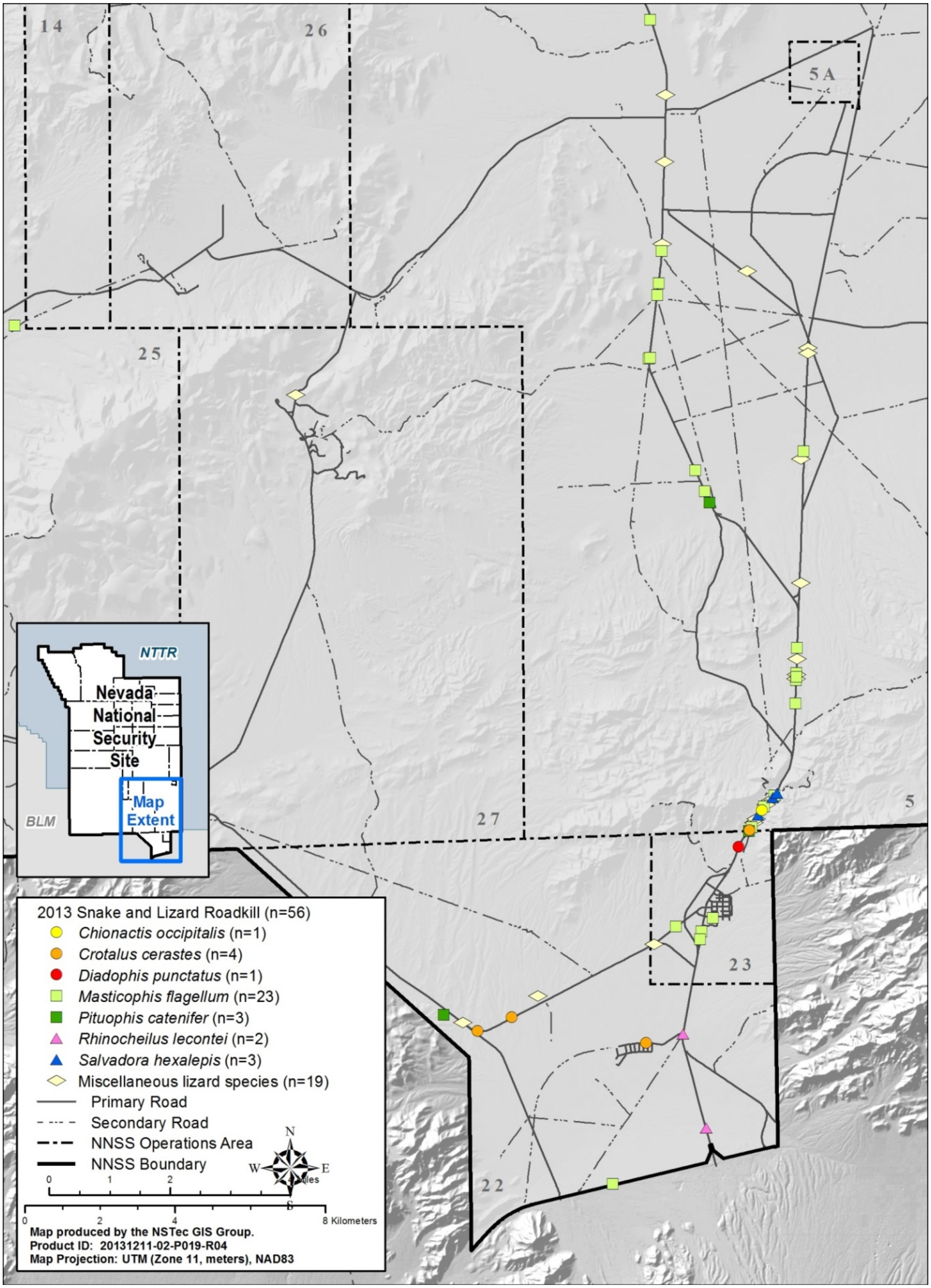

Figure 4-10. Reptile roadkill locations on the southern third of the NNSS

4.4 Natural Water Source Monitoring

4.4.1 Existing Water Sources

Water sources were monitored this year to characterize physical and biological parameters. Eleven water sources were visited at least once during 2013 to record wildlife use, the presence/absence of land disturbance, water flow rates when applicable, and surface area of standing water (Table 4-7).

Flow was estimated by collecting a known volume of water from a permanently installed pipe over a known time period. This method yields an approximate measurement and is generally an underestimate of true flow. Water collects at some sites, but there is no way to estimate flow, which was the situation at Gold Meadows Spring, Pahute Mesa Pond, and Yucca Playa Pond. Flow occurs as seepage through the local sediments or by overland flow into the pond collection area. Because monitoring of wetlands is qualitative, the objectives are to identify large or obvious changes over time. Smaller, more subtle changes in flow are not readily detectable from this method. Sizes of the monitored water sources varied greatly from very small areas (<1 square meter [m^2]) to moderately sized springs (180–600 m^2) to large temporary playa pools (28,000 m^2). Surface flow rates were typically low (<5 liters per minute [L/min]) at most water sources where flow was measurable. Disturbance from horses was noted at three sites and some forms of natural change (dense spread of wetlands plants) occurred at another site (Table 4-7). Locations of natural water sources on the NNSS are shown in Figure 4-11.

Wildlife use data recorded during site visits are summarized in Table 4-8. Mule deer (*Odocoileus hemionus*), burros (*Equus asinus*), and horses (*Equus caballus*) benefit significantly from the water sources. Burros seem to have expanded their range from Area 5 onto southern Yucca Flat this year at Yucca Playa Pond (Table 4-8). Overall in 2013, few birds including chukar (*Alectoris chukar*) and mourning doves (*Zenaida macroura*) were observed throughout the NNSS (Table 4-8), indicative of a dry year. An extensive trapping effort for another project yielded no birds. Of interest is the uncommon sighting of a group of short-eared owls (*Asio flammeus*) at Upper Gap wash seep (Table 4-8), which needs further investigation to see if this habitat offers some significant value or not. Also the canyons around Captain Jack Spring support canyon wrens (*Catherpes mexicanus*), a secretive species almost always identified first by their calls (Table 4-8).

Monitoring for the presence of the southeast Nevada pyrg snail (*Pyrgulopis turbatrix*) at Cane Spring continued in 2013. It was found in the outflow about 10 m from the cave pool below the southern cattails (*Typha domingensis*). The southeast Nevada pyrg snail is considered a sensitive species in Nevada (Table 2-1) and occurs at only eight springs in southern Nevada.

4.4.2 New Water Sources

Two new water sources were discovered during 2013 on the NNSS: Paintbrush Canyon Tanks and Upper Gap Wash Seep (Figure 4-11). Tanks collect water from overland flow after precipitation events (e.g., runoff from rain or melting snow). Depending on the depth and size of the tank, rock type, surrounding topography, and timing of precipitation, these tanks may hold water for a few weeks to several months. These are important, albeit ephemeral, sources of water for several species of wildlife.

Paintbrush Canyon Tanks (Figure 4-12) are a series of rock catchments in exposed, welded volcanic tuff. They were found during mountain lion monitoring on November 20. Surface area of the biggest tank was about 12 m^2. Elevation at the site is 1,380 m above sea level, and dominant vegetation in the area is *Rhus trilobata* (skunkbrush sumac), *Ericameria* species, and *Coleogyne ramosissima*. A striped whipsnake (*Masticophis taeniatus*), remains of a desert bighorn sheep (*Ovis canadensis nelsoni*), and mountain lion (*Puma concolor*) scat found in the area suggest this is an important site for wildlife.

Table 4-7. Hydrology and disturbance data recorded at natural water sources on the NNSS during 2013

Spring	Date	Surface Area of water (m^2)	Flow rate (L/min)	Impacts at Spring
Cane Spring	9/26/2013	15	NM	Heavy growth of cattails
Captain Jack Spring	4/17/2013	15	NM	None
Gold Meadows Spring	9/3/2013	800	NA	Horse grazing and trampling of vegetation
Little Wildhorse Seep	12/6/2013	0	NA	Horse trampling and horse trails
Pahute Pond	8/22/2013	0	NA	None
Pahute Pond	11/14/2013	350	NA	None
Tippipah Spring	9/26/2013	150	NM	None
Topopah Spring	6/03/2013	0	NM	Dry
Upper Gap Wash Seep	11/20/2013	2.0	NA	None
Whiterock Spring	9/26/2013	5	NM	None
Wildhorse Seep	12/6/2013	3	NA	Horse trampling and horse trails
Yucca Playa Pond	9/26/2013	28,000	NA	None
Yucca Playa Pond	11/17/2013	8,000	NA	None

NA= not applicable due to diffuse flow

NM = flow present but not measured

Upper Gap Wash Seep (Figure 4-13) is located in exposed, welded volcanic tuff at an elevation of 1,640 m above sea level. Surface area was about 1 m^2 on November 20 when it was discovered. Dominant vegetation in the area is *Artemisia tridentata* (big sagebrush), *Quercus gambelii* (Gambel oak), and *Juniperus osteosperma* (Utah juniper). The presence of several short-eared owls, mule deer sign, feral horse sign, and coyote scat suggest this is an important site for wildlife. Further evidence of this being an important water source was an old barrel with a faucet attached and other historical artifacts indicating human use at this site.

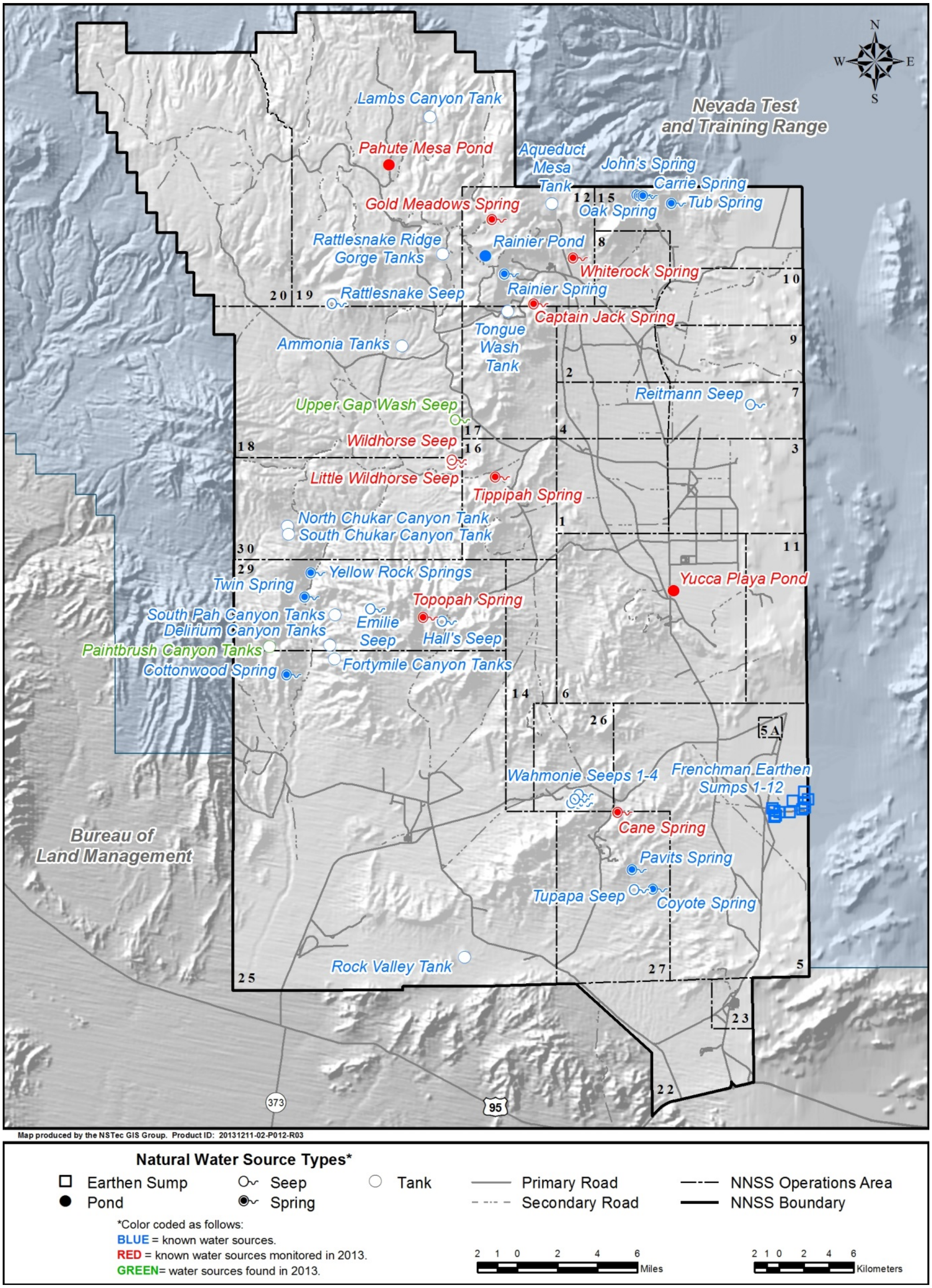

Figure 4-11. Natural water sources on the NNSS, including those monitored in 2013

Table 4-8. Number of wildlife species observed or inferred (P=Present) at NNSS natural water sources in 2013

Wildlife Species Observed	Cane Spring	Captain Jack Spring	Gold Meadows Spring	Little Wildhorse Seep	Pahute Pond	Pahute Pond	Tippipah Spring	Topopah Spring	Whiterock Spring	Upper Gap Wash Seep	Wildhorse Seep	Yucca Playa Pond	Yucca Playa pond
Date Observed (month/day)	**9/26**	**4/17**	**9/3**	**12/12**	**8/22**	**11/14**	**9/26**	**6/03**	**9/26**	**11/20**	**12/12**	**9/26**	**11/7**
Mammals													
Coyote (*Canis latrans*)	P	P	P	P	P	P	P	P	P	P	P	P	P
Feral horse (*Equus caballus*)			5	P						P	P		
Mule deer (*Odocoileus hemionus*)	P	P	P	P	P	2	P	P	P	P	P	P	P
Burro (*Equus asinus*)												P	P
Birds													
Barn Owl (*Tyto alba*)												2	2
Canyon Wren (*Catherpes mexicanus)*		2											
Common Raven (*Corvus corax)*							2					2	1
Chukar (*Alectoris chukar*)	P	P						15			P	P	
Coopers Hawk (*Accipiter cooperii)*						1							
Horned Lark (*Eremophila alpestris)*												2	10
Long-eared owl (*Asio otus*)													1
Mourning dove *(Zenaida macroura)*		3						30					
Oregon Junco (*Junco hyemalis)*		2											
Pinion Jay (*Gymnorhinus cyanocephalus*)						10							
Short-eared Owl (*Asio flammeus*)										20			
White-crowned Sparrow (*Zonotrichia leucophrys*)												2	2
Number of bird species detected	**1**	**4**	**0**	**0**	**0**	**2**	**1**	**2**	**0**	**1**	**1**	**5**	**5**

Figure 4-12. Paintbrush Canyon Tanks in the foothills of Yucca Mountain (Area 29)
(Photo by D. B. Hall, November 20, 2013)

Figure 4-13. Upper Gap Wash Seep in Area 18
(Photo by D. B. Hall, December 12, 2013)

4.5 Odonate Sampling at Water Sources on the NNSS

Odonates (i.e., damselflies and dragonflies) are important predators of many kinds of flying insect pests such as mosquitoes, midges, etc. that are caught while flying. There is presently a great deal of interest locally in their study by local hobbyists and collectors, and little is known about Odonates that occur on the NNSS. In 2013, two local biologists, Neil McDonal and Bruce Lund, made a visit to the NNSS for the purpose of collecting Odonates. They recently finished a region-wide distribution study of Odonates for the National Refuge System around Las Vegas in southern Nevada. Their intent was to build upon this work by doing additional sampling in southern Nevada further north of their completed study at the refuge system near Las Vegas. Odonates are elaborately and uniquely colored (see Figure 4-14, a close-up photo of variegated meadowhawk [*Sympetrum corruptum*] with important colorful markings on the adult thorax).

4.5.1 Analysis of the Archival Collection of Odonates at the NNSS

The archived collection of Odonates made by previous investigators on the NNSS was analyzed by the two visiting biologists. Most of these specimens were collected in the early 1990s with one collection dated 1972. None of these had been identified to the species level until now. Nine species from the NNSS were identified from the archived samples (Table 4-9).

4.5.2 Field Sampling

Nine sites were sampled on September 26, 2013, for Odonates including Cane Spring and trough, Well 5C trough, dry Well 5B Pond, Well C1 trough and dry pond, Yucca Playa Pond, Area 6 LANL trough and dry pond, Tippipah Spring, Camp 17 Pond, and Whiterock Spring. Odonates were collected with hand nets using quick swooping motions at or near areas with vertically oriented vegetation. Only four specimens were captured due to cold, windy weather. One additional new species of damselfly, the Black Fronted Fork-tail (*Ischnura denticolis*), was detected at Tippipah Spring (Table 4-9). Another new species for the NNSS, the common green darner (*Anax junius*), was opportunistically found on Mercury Highway in Area 5 on September 10. Additional work for 2014 is planned.

Figure 4-14. A variegated meadowhawk dragonfly adult captured at Well 5B dry pond (Photo by P. D. Greger, September 26, 2013)

Table 4-9. Historical collections of Odonates and 2013 Odonate samples

Archived Samples				
Dates	**Location Description**	**Common Name**	**Genus**	**Species**
Dragonflies				
8/22/1972	Area 5 Well 5B Pond	Flame Skimmer	*Libellula*	*saturata*
7/16/1991	Area 25 Nuwax Pond	Flame Skimmer	*Libellula*	*saturata*
7/9/1991	Area 25 Well J-12 Pond	Flame Skimmer	*Libellula*	*saturata*
7/16/1991	Area 25 Nuwax Pond	Widow Skimmer	*Libellula*	*luctuosa*
7/11/1991	Area 5 Well 5B Pond	Widow Skimmer	*Libellula*	*luctuosa*
7/30/1990	Area 5 Well 5B Pond	Blue Dasher	*Pachydiplax*	*longipennis*
7/9/1991	Area 25 Well J-11 Pond	Blue Dasher	*Pachydiplax*	*longipennis*
7/16/1991	Area 25 Nuwax Pond	Variegated Meadowhawk	*Sympetrum*	*corruptum*
7/9/1991	Area 25 Well J-12 Pond	Black Saddlebags	*Tramea*	*lacerata*
7/16/1991	Area 25 Nuwax Pond	Red Saddlebags	*Tramea*	*onusta*
Damselflies				
7/25/1991	Area 6 C1 Pond	Bluets	*Enallagma*	spp.
7/8/1991	Area 5 Mercury Highway	Dancers	*Argia*	spp.
7/30/1990	Area 5 Well 5B Pond	Pacific Forktail	*Ischnura*	*cervula*
Recent Samples				
Dragonflies				
9/10/2013	Area 5 Mercury Highway	Common Green Darner	*Anax*	*junius*
9/26/2013	Area 5 Well 5B dry Pond	Variegated Meadowhawk	*Sympetrum*	*corruptum*
9/26/2013	Area 6 Yucca Playa Pond	Variegated Meadowhawk	*Sympetrum*	*corruptum*
Damselflies				
9/26/2013	Area 16 Tippipah Spring	Black-Fronted Forktail	*Ischnura*	*denticolis*
9/26/2013	Area 16 Tippipah Spring	Black-Fronted Forktail	*Ischnura*	*denticolis*

4.6 Constructed Water Source Monitoring

4.6.1 Plastic Sump Monitoring

Site biologists conducted quarterly monitoring of selected constructed plastic-lined water sources. Many animals rely on these human-made structures as sources of water from precipitation or from pumping. However, wildlife have drowned under certain conditions in steep-sided plastic-lined sumps from entrapment especially when sumps are new. Therefore, ponds were monitored to assess their use and impacts to wildlife. Over time, mitigation measures, such as the emplacement of sediment ramps, have been used to prevent entrapment or significant harm to wildlife. There were no new sumps constructed on the NNSS in 2013.

During March, July, October, and December 2013, biologists visited 37 constructed water sources at 19 locations (Table 4-10, Figure 4-15). At each site, the presence or absence of standing water and the presence of animals or their sign around the water source were recorded. Sediment ramps, which allow animals to escape if they enter a sump, have been installed at many plastic-lined sumps at the NNSS. The presence, absence, and condition of these sediment mounds are examined annually. Any dead, injured, or entrapped animals in or adjacent to a human-made water source are recorded.

Monitoring frequency was reduced in 2013 because of low water availability and because many of the older sumps appear to have very low risk of entrapping animals. Older liners become less slippery over time due to weathering, allowing animals to escape. During 2013, no dead animals were detected in sumps on the NNSS (Table 4-10). Most sumps were dry from spring to midsummer as in 2012. Substantial rainfall events occurred in July, September, and December, and water accumulated in several sumps during this time period. Observed wildlife use was very limited to common species of passerine birds and shorebirds.

Where sediment mounds have been installed, they have been very effective in allowing animals to exit sumps under conditions of deep water. Sediment ramps that are used by wildlife (typically coyotes and deer) have fresh tracks. In the future, sediment ramps should be installed in new sumps when they are constructed, especially if water is deep.

Table 4-10. Results of monitoring plastic-lined sumps for wildlife mortality on the NNSS for 2013

Months	Number of Ponds Monitored	Number of Ponds with Water	Surface Area (m^2)	Number of Sediment Ramps	Number of Dead Animals Detected
Jan–Mar	5	0	0	1	0
Apr–Jun	0	0	0	0	0
Jul–Sep	11	0	0	8	0
Oct–Dec	21	5	550	8	0

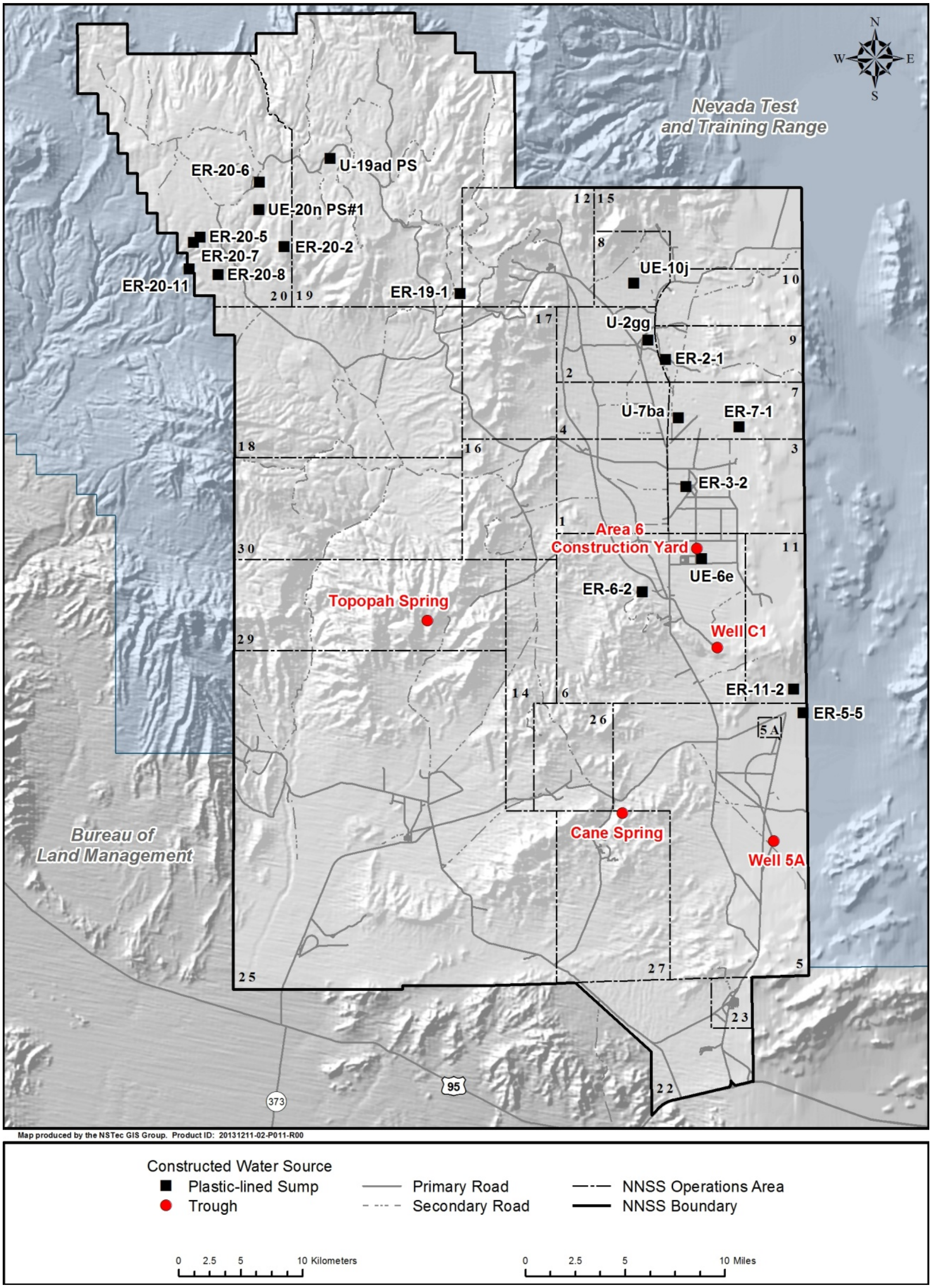

Figure 4-15. Constructed water sources monitored for wildlife use and mortality

4.6.2 Mitigating Water Loss for Wildlife

Water conservation measures were implemented on the NNSS during 2012 at four sites: Area 6 Construction Yard (Area 6, LANL Pond), Well C1 Pond, Well 5B Pond, and J11 Pond. In order to conserve millions of gallons of water being lost to drainage and evaporation, pumping water to fill these ponds was stopped. Wildlife observation data gathered over several decades documented more than 100 species of wildlife using these artificial water sources. These included carnivores, ungulates, rabbits, bats, and dozens of species of waterfowl, passerines, and other birds.

Drying these ponds up resulted in the loss of valuable wildlife habitat, so water troughs were installed to help mitigate the loss of the well ponds. The water troughs were not meant to replace the well ponds as wildlife habitat, but were meant to provide at a minimum some supplemental water in areas with very limited perennial water sources and at sites where animals had become accustomed to finding water. Water troughs were installed adjacent to the Area 6, LANL Pond and Well C1 Pond to mitigate the loss of these ponds, at Well 5A (Well 5C) to mitigate the loss of the Well 5B Pond, and at Cane Spring and Topopah Spring to mitigate the loss of the J11 Pond (Figure 4-15). Motion-activated cameras were set up at each trough during the fall of 2012 and monitored during 2013 to document wildlife use and were also added to the network of cameras used for monitoring mountain lions.

The Area 6, LANL Pond was dry by at least June 19. Wildlife use of the trough was heavy especially from mid-March to mid-June. Activity during this time was dominated by common ravens, with over 800 photographs recorded of this species. At least 10 species (5 mammals, 5 birds) were documented through the year (Table 6-4 in Section 6.4.1, Motion-Activated Cameras). A noteworthy record was the presence of three wild burros at the trough on July 18. These are most likely the same three burros that have been documented at the Well C1 Pond trough and Well 5C trough and is the northernmost record for this species on the NNSS. Coyotes and pronghorn antelope (*Antilocapra americana*) were regular visitors. Birds dominated the activity with some interesting photos showing the interaction of multiple species at the trough. Figure 4-16 shows a red-tailed hawk, two turkey vultures (*Cathartes aura*), and a common raven all sitting on the trough together.

Wildlife use at Well C1 trough during 2013 was moderate with at least 14 species (6 mammals, 8 birds) documented at the trough (Table 6-4). The well pond was dry by at least June 19. Use peaked during the dry, summer months. Wild burros consistently used the trough with an occasional visit by pronghorn antelope and mule deer (Figure 4-17). Several images of bobcats (*Lynx rufus*) (Figure 4-18) and coyotes were also taken.

Wildlife use at Well 5C was heavy with at least 11 species (7 mammals, 4 birds) photographed at the trough (Table 6-4). Well 5B Pond was dry by at least June 19. Three wild burros visited the trough regularly during the spring and winter, and numerous images of coyotes were taken during fall. Several images of kit fox (Figure 4-19) were also documented during fall. Common ravens were particularly prevalent during fall also.

Wildlife use at the trough at Cane Spring was very light with only eight photos of mule deer, four photos of turkey vultures, and one photo of a common raven taken (Table 6-4). However, due to a camera malfunction and human error, no photos were taken for about 4 months between April and August. Wildlife use at Cane Spring for the same period of time the camera was working at the trough was light similar to use at the trough with 26 photos taken of mule deer, 2 photos of a bobcat, 2 photos of chukar (*Alectoris chukar*), and 1 photo of a desert cottontail rabbit (*Sylvilagus audubonii*) (Table 6-4). A total of 240 photos of nine species was documented from early June to early August on the camera at the spring. It is unknown if use at the trough was similar.

Wildlife use at the Topopah Spring trough was heavy with 12 species (7 mammals, 5 birds) documented (Table 6-4). Most of the activity was from chukar and mourning doves (*Zenaida macroura*), but four photos of mountain lions were also taken near the trough (Figure 4-20). Wildlife use at Topopah Spring was fairly similar to use at the trough with 13 species (9 mammals, 4 birds) recorded (Table 6-4). Noteworthy differences include the following; more photos of mountain lions were taken at the spring than the trough (16 versus 4), 98 photos of bighorn sheep were taken at the spring while none were taken at the trough, more mule deer photos were taken at the trough than the spring (175 versus 34), and more bird photos were taken at the trough than the spring (1183 versus 798).

In summary, several wildlife species are using the water troughs, indicating the troughs are benefiting many wildlife species on the NNSS, especially certain bird species, ungulates, and coyotes. Our data also imply that some species such as bighorn sheep and mountain lions may prefer natural springs over the troughs. Waterfowl and shorebirds do not appear to be using the troughs very much and undoubtedly have been negatively impacted by the removal of the well ponds. Although the water troughs did not replace the well ponds as a wildlife resource, they still attract and benefit a multitude of wildlife species.

Figure 4-16. Red-tailed hawk, turkey vultures, and raven at the Area 6, LANL Pond trough
(Photo taken July 4, 2013, by motion-activated camera)

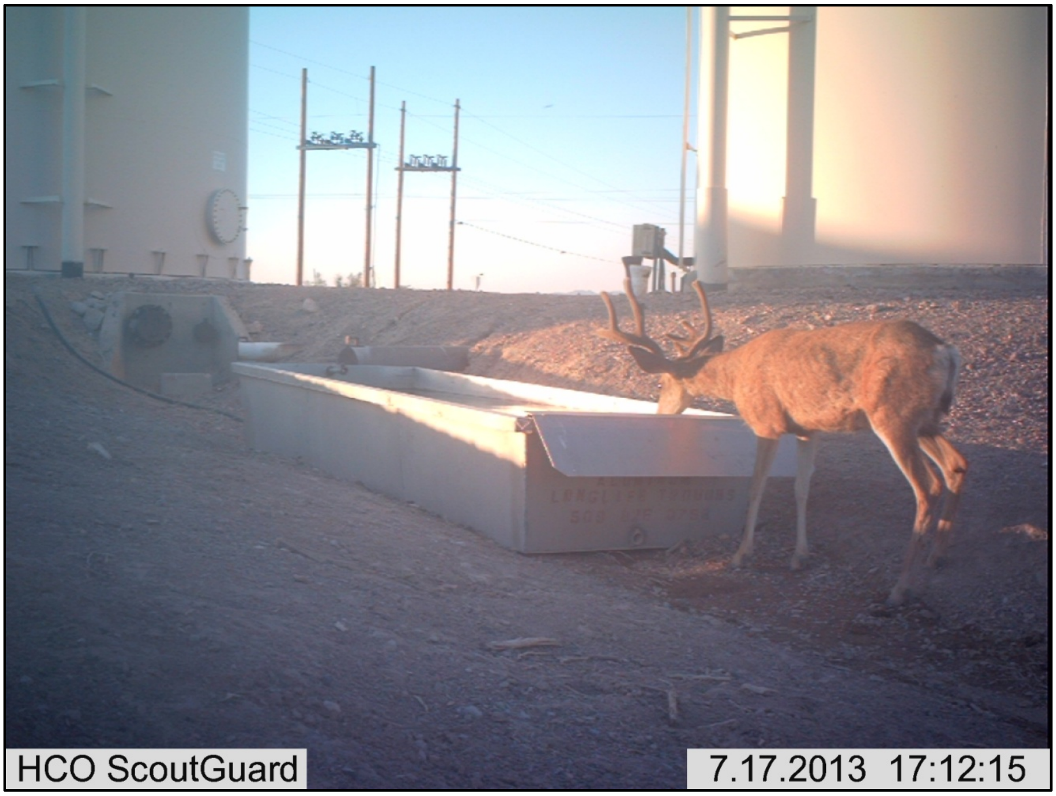

Figure 4-17. Mule deer buck drinking at water trough near Well C1, Area 6
(Photo taken July 17, 2013, by motion-activated camera)

Figure 4-18. Bobcat drinking from water trough at Well C1, Area 6
(Photo taken July 5, 2013, by motion-activated camera)

Figure 4-19. Kit fox at Well 5C Trough
(Photo taken October 18, 2013, by motion-activated camera)

Figure 4-20. Mountain lion (NNSS7) walking near trough at Topopah Spring
(Photo taken November 14, 2013, by motion-activated camera)

4.6.3 Monitoring Wildlife Use at Contaminated Water Sources

During 2013, cameras were set up at two potentially contaminated water sources, ER 20-5 and ER 20-11, to determine which wildlife species were using these resources and how frequently they were using them. Monitoring was done to assess the potential of radionuclides being transported off site by wildlife and the potential impact to wildlife from these contaminated water sources. The cameras were also added to the network of cameras used for mountain lion monitoring. There are seven, plastic-lined sumps at ER 20-5. The camera was set up at the sump in the northwest corner and monitored for about 7 weeks. Periodically, contaminated groundwater is pumped into this sump. Additionally, water from natural precipitation events and melting snow runs off the slope, carrying soil and other debris, and accumulates in this sump. This water may then also become contaminated. Although water from precipitation may be diluted compared to the pumped contaminated groundwater, it is still a source of contaminants to wildlife. Sampling of the water and sediment will occur next year to determine radionuclide concentrations that wildlife may be exposed to. Results from the camera indicated light wildlife use at the site with only 21 photos of animals taken—1 photo of a buck pronghorn antelope walking in the bottom of the sump (Figure 4-21) and 20 photos of birds, mostly ravens and turkey vultures.

Contaminated groundwater from the well at ER 20-11 was pumped into the sump. Because it is an earthen, un-lined sump, the water did not remain in it for very long. The camera at ER 20-11 was set up for about 10 weeks, and wildlife use was light with only nine photos of mule deer and one photo of an unknown bird taken at the site. A great egret (*Casmerodius albus*) was seen at the sump on August 5, but was not detected by the camera. Tritium levels averaged around 180,000 picocuries per liter (pCi/l). Therefore, wildlife drinking water from the sump were exposed to tritium. However, the resultant concentration of tritium in these animals is not expected to be harmful.

Figure 4-21. Pronghorn antelope walking in ER 20-5 sump, Area 20
(Photo taken July 12, 2013, by motion-activated camera)

4.7 Coordination with Scientists and Ecosystem Management Agencies

Site biologists interfaced with other scientists and ecosystem management agencies in 2013 for the following activities:

- Participated in a meeting of the Mojave Desert Initiative designed to address research needs in the areas of wildfires and reclamation of Mojave Desert lands.
- Led an ecology tour of the NNSS for the U.S. Department of Agriculture Western Education Research Activities scientists interested in succession and reclamation of desert lands.
- Assisted Todd Esque (USGS) on selection of areas suitable for a common garden experiment on the NNSS, testing suitable species/ecotypes for revegetation of disturbed lands in the Mojave Desert.
- Participated in several conference calls of the Executive Committee of the Shrub Research Consortium and reviewed proposals for organization restructuring.
- Assisted several researchers from Cornell, USGS, and Flora of North America on literature and other information regarding species and fires on the NNSS.
- Reviewed a manuscript for USGS Western Ecological Research Center on Joshua tree growth and survivorship.
- Edited *Annotated Bibliographies for Desert Experimental Range and Great Basin Experimental Station* for E. Durant McArthur, Emeritus Scientist, U.S. Forest Service, Rocky Mountain Research Station.

5.0 SENSITIVE PLANT MONITORING

The list of sensitive plants on the NNSS is reviewed annually to ensure that the appropriate species are included in the NNSS Sensitive Plant Monitoring Program. The review takes into consideration information gathered on sensitive plants during the current year by NSTec botanists as well as input from regional botanists with expertise or knowledge with particular species. As part of the Adaptive Management Plan for Sensitive Plant Species (Bechtel Nevada 2001), the status of each plant is monitored periodically to ensure NNSS activities are not impacting the species. Field surveys are also routinely conducted to verify previously reported locations, to better define population boundaries, and to identify potential habitat for sensitive plant species known to occur on or adjacent to the NNSS. Information gathered during the year on sensitive plants is disseminated to state and federal agencies and other interested entities.

5.1 List of Sensitive Plant Species on the NNSS

The sensitive plants included in the NNSS Sensitive Plant Monitoring Program are included on the list of 'At-Risk' species published by the NNHP and the status list prepared by the NNPS. Currently there are 17 vascular plants and 1 non-vascular plant considered sensitive that are included in the NNSS Sensitive Plant Monitoring Program (Table 2-1).

5.2 Program Awareness

The annual Rare Plant Workshop, sponsored by NNHP and the NNPS, will be held during the spring of 2014. No workshop was held in 2013.

Field surveys conducted on lands adjacent to the NNSS in 2011 (Nellis Air Force Base 2012) reported populations of *Arctomecon merriami* (white bearpoppy) 30–40 km east of the NNSS boundaries in the southern end of the Pintwater Range. A population of *Phacelia parishii (*Parish's phacelia) was also recorded approximately 50 km east of the NNSS eastern boundary in the Indian Springs Valley bottoms. This species was thought to occur on the NNSS, but all previously reported sites were recently confirmed to be *P. filiae* (Clark phacelia) and not *P. parishii*. *Eriogonum concinnum* (Darin buckwheat) was also found at several locations in East Thirsty Canyon about 8 km west of the closest known population on the NNSS.

Of particular interest was the report of a population of *Astragalus beatleyae* (Beatley's milkvetch) in the Stonewall Mountains (Nellis Air Force Base 2012). If the plant collected in the Stonewall Mountains is indeed *A. beatleyae,* it would be the northernmost recorded location for this species. The closest population is north of Black Mountain about 80 km southeast of the newly reported location.

5.3 Monitoring

Monitoring sensitive plant populations on the NNSS was scheduled in 2013 for *Camissonia megalantha* (Cane Spring suncup) and *E. concinnum*, which had been re-scheduled from previous years. However, growing conditions continue to be less than optimal, and no monitoring was completed for these species this year. Monitoring will be conducted when growing conditions are favorable.

5.4 Field Surveys and Opportunistic Sightings

The lack of precipitation on the NNSS resulted in less than optimal growing conditions again this year, and field surveys were limited. No opportunistic sightings of any of the sensitive plants were reported this year during field activities associated with other environmental monitoring tasks.

5.4.1 Astragalus beatleyae*, Beatley's milkvetch*

Field surveys were conducted this year for *A. beatleyae* by NSTec biologists on the Nellis Test and Training Range (NTTR) just off the northwestern boundary of the NNSS. The focus was to relocate and evaluate the current status of several populations of *A. beatleyae* (Figure 5-1) known to occur in this area but not surveyed since the early 1990s (Blomquist et al. 1995).

Surveys were conducted off the southwestern edges of Pahute Mesa into the Rocket Wash region, the far western reaches of Pahute Mesa in the vicinity of the Ribbon Cliffs and approximately 1 km from the base of the north slope of Black Mountain. The Rocket Wash location was of particular interest because this location is at an elevation of around 1,615 m in *Atriplex confertifolia/Ephedra nevadensis* (Shadscale saltbush/Nevada jointfir) habitat, whereas most other populations of *A. beatleyae* typically occur at higher elevations (1,750 m) in *Artemisia/Pinus monophylla-Juniperus osteosperma* (Sagebrush/Pinyon-Juniper) habitat. Surveys were conducted on May 5, 2013, in an area between Rocket Wash and the East Fork of Thirsty Canyon and May 21, 2013, along the Ribbon Cliffs and north of Black Mountain.

Figure 5-1. ***Astragalus beatleyae*** **habitat, ridge between East Thirsty Canyon and Rocket Wash (**Photograph by D. C. Anderson, May 5, 2013)

Typical field survey techniques included a meandering survey method focusing on key characteristics of *A. beatleyae* habitat. A hand-held GPS was used to record the location of each individual plant encountered. Locations were transferred to a mapping program to display and generate survey areas, plant densities, and population boundaries.

The area surveyed between Rocket Wash and the East Fork of Thirsty Canyon encompassed approximately 50 ha. Approximately 300 individuals of *A. beatleyae* were located during a 1-day survey by two NSTec botanists. The 300 individuals were widely scattered over much of the site (Figure 5-2). Typically, there were large areas where individuals were absent and isolated pockets where plants were relatively abundant. The dominant shrubs in the area were *A. confertifolia* and *E. nevadensis* with scattered individuals of *Purshia stansburiana* (Stansbury cliffrose) and *Yucca brevifolia* (Joshua tree), *Menodora spinescens* (spiny menodora), and *A. canescens* (fourwing saltbush). *Ericameria nana* (dwarf goldenbush) is common where *A. beatleyae* is found. Common grasses included *Achnatherum speciosum* (desert needlegrass), *Elymus elymoides* (squirreltail), and *Pleuraphis jamesii* (James' galleta). Several forbs were found over the site, including *Linum lewisii* (Lewis flax), *Sphaeralcea ambigua* (desert globemallow), and *Cryptantha confertiflora* (basin yellow cryptantha).

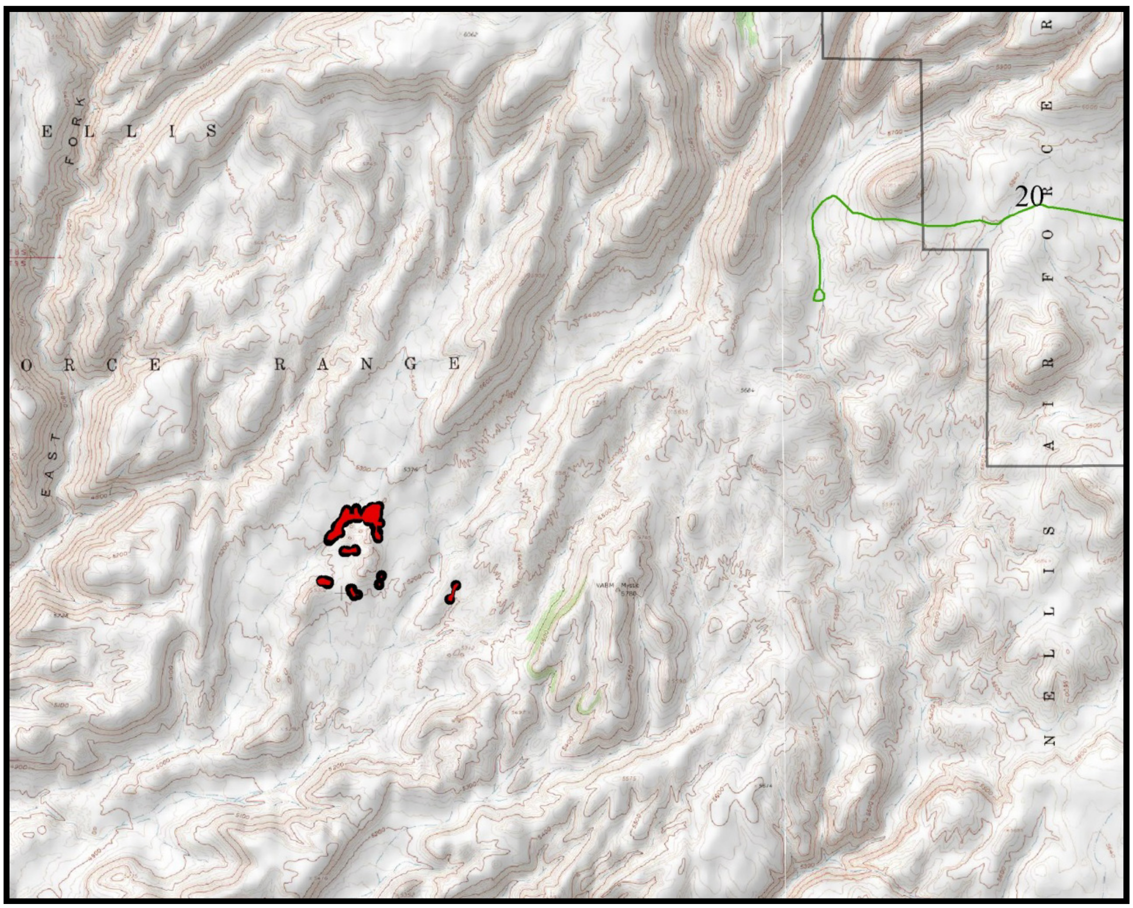

Figure 5-2. Locations of *Astragalus beatleyae* (red highlight) in the Rocket Wash/Thirsty Canyon area on the NTTR

This population of *A. beatleyae* was first encountered in 1994 during a biological survey conducted prior to the construction of well pads and associated roads in the area. At that time the population was estimated to be from 1,000 to 10,000 individuals. However, this was most likely an estimate of the overall density based on counts within one of the pockets where density was higher, and then extrapolated to the entire area where *A. beatleyae* could potentially occur. Most of the area identified in 1994 appears to be favorable habitat for the species. However, surveys conducted this year suggest that *A. beatleyae* only occurs in small pockets and is not evenly distributed over the entire area. A little over 300 individuals were counted this year and occupied about 7 ha of the 45 ha surveyed. Growing conditions this year were less than favorable, suggesting that in years when growing conditions are better, higher densities might be expected to approach estimates made in 1994. One of the objectives for future surveys will be to conduct them during seasons where growing conditions are favorable for this species.

The locations of approximately 160 individuals of *A. beatleyae* were recorded in a 5 km strip along the western slopes of Ribbon Cliff. A total of 25 ha were surveyed and *A. beatleyae* was found on about 10 ha. Field surveys focused on three previously reported locations of *A. beatleyae.* One location was at the far northern region of Ribbon Cliff, a second about 1.5 km further south, and the third another 1 km south. Only 15 individuals were found at the first site, although the habitat was typical of *A. beatleyae* habitat. No individuals were found at the second site, and 109 individuals were found at the third site. A new site of *A. beatleyae* was located another 2 km south of site three. Approximately 5 ha were surveyed at this site and 34 individuals were located. Other locations could potentially be found during better growing seasons. Habitat at all of the sites was typical *A. beatleyae* habitat. *E. nana* was abundant where *A. beatleyae* was found. Dominant shrubs and trees in the area included *A. nova* (black sagebrush), *P. stansburiana, P. monophylla, J. osteosperma*. *Poa secunda* (Sandberg bluegrass), and *Hesperostipa comata* (needle and thread) were common perennial grasses.

A. beatleyae was first reported in the Ribbon Cliff area in 1981 (WESTEC Services, Inc. 1981). During a follow-up survey in 1984 (O'Farrell and Collins 1984), the three sites previously mentioned were mapped. A survey of those three sites was conducted in 1994 (Blomquist et al. 1995). At site one, the furthest north site, 74 individuals were located in 1994, compared to 50 individuals in 1984 and 15 in 2013. At the second site, 1.5 km south of site one, the number of individuals was simply reported as "common" in 1984. There were 60 located in 1994, and no plants were found this year. At site three, 15 plants were located in 1984, 90 in 1994, and 109 in 2013. A fourth site was located approximately 2 km south of site three and along the eastern rim of Thirsty Canyon. The 34 individuals were widely scattered over the 5 ha that were surveyed.

The final population of *A. beatleyae* surveyed this year was located 6 km west of Ribbon Cliff along the western regions of Pahute Mesa and north of Black Mountain. Approximately 15 ha were surveyed for *A. beatleyae*, and 38 plants were found in small pockets scattered over the site. The habitat at this site was characterized by *A. nova, E. nana*, and *E. viridis* (Mormon tea).

In 1984, O'Farrell and Collins surveyed approximately 6.5 ha and estimated there to be 650 individuals at this site. Ten years later Blomquist and others surveyed the same site and counted 65 individuals. The total number of hectares surveyed was not reported. In 2013, 8 ha were surveyed and 38 individuals were located.

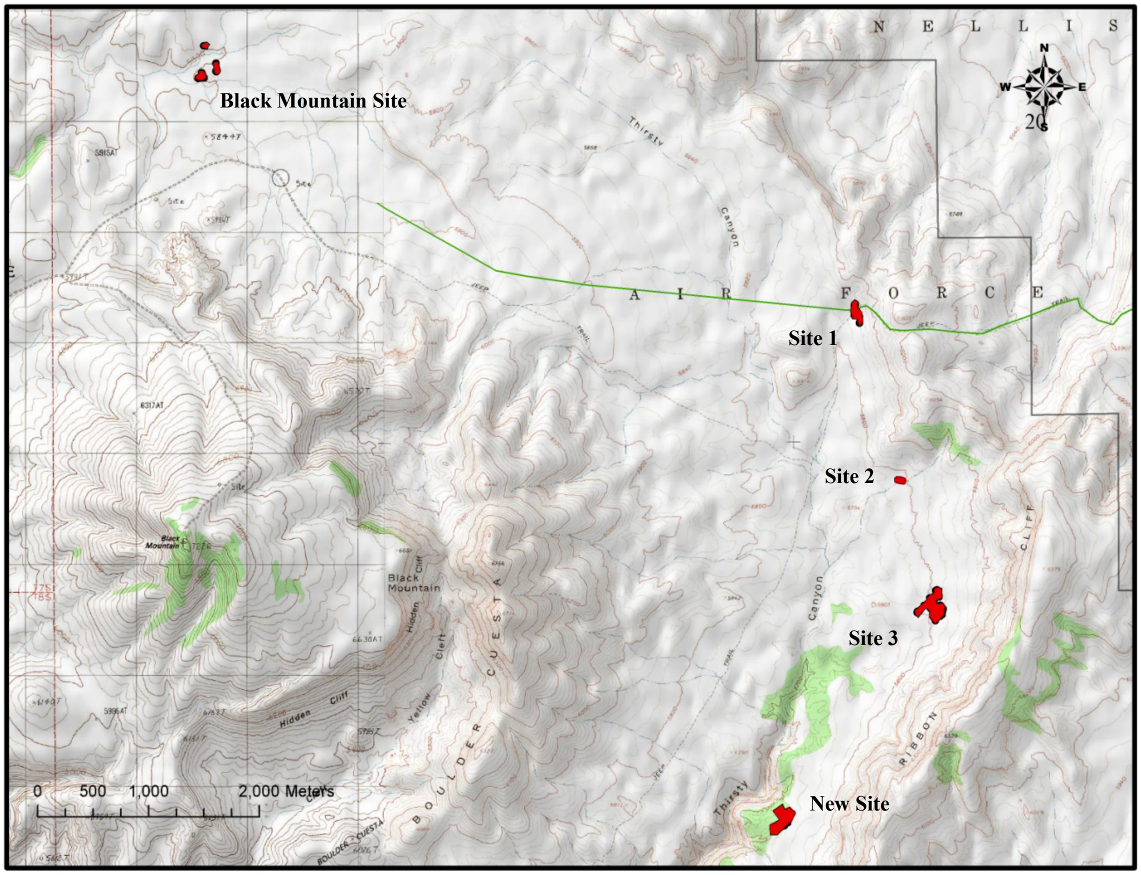

Figure 5-3. Locations of *Astragalus beatleyae* (red highlight) in the Ribbon Cliff and West Pahute Mesa area on the NTTR

Potential *A. beatleyae* habitat can be found at all three of the areas surveyed this year. Field surveys in future years will be conducted when growing conditions are optimal, which may increase the possibility of finding additional sites. There are no activities in any of these areas that have detrimentally impacted *A. beatleyae*. Fluctuations in reported numbers are related to growing conditions and, to some extent, field survey techniques and not anthropogenic impacts.

6.0 SENSITIVE AND PROTECTED/REGULATED ANIMAL MONITORING

The NNHP Animal and Plant At-Risk Tracking List; NAC 503, "Hunting, Fishing and Trapping; Miscellaneous Protective Measures"; and other sources were reviewed to determine if any changes had been made to the status of animal species known to occur on the NNSS. No changes were made to the status of NNSS species. The complete list with current designations is found in the Sensitive and Protected/Regulated Animal Species List (Table 2-1, shown previously).

Surveys of sensitive and protected/regulated animals during 2013 focused on (a) bats, (b) wild horses, (c) mule deer, and (d) mountain lions. Information about other noteworthy wildlife observations, bird mortalities, and a summary of nuisance animals and their control on the NNSS is also presented.

6.1 Bat Surveys

In 2013, bat monitoring focused on passive acoustic monitoring of bat activity at Camp 17 Pond, monitoring bat use of water troughs, and removing bats from buildings and documenting bat roosts.

6.1.1 Passive Acoustic Monitoring System at Camp 17 Pond

To learn more about long-term bat activity through different seasons and years, a passive acoustic monitoring system (Anabat II) was installed at Camp 17 Pond on September 22, 2003. Hundreds of thousands of electronic files containing bat calls have been recorded and are being analyzed by O'Farrell Biological Consulting as funding becomes available. Bat vocalizations and climatic data (e.g., temperature, humidity, wind, barometric pressure) were recorded again in 2013, but no analysis was performed due to a limited budget.

6.1.2 Bat Activity at Water Troughs

Bat monitoring was conducted at four water troughs to evaluate how bats were using these artificial water sources installed to help mitigate the loss of perennial water at well ponds. Techniques used to document bat activity included acoustic monitoring using an Anabat detector, capturing bats using mist-nets, and videotaping bat activity over the trough with a thermal imaging camera (Figure 6-1). Recorded bat calls were analyzed to species by O'Farrell Biological Consulting. Troughs were selected for large surface areas and installed with no cross braces or supports to make them bat-friendly. Data collected during 2013 were compared to data collected in prior years to assess bat use before and after trough installation and the drying up of the well ponds.

Area 6, LANL Pond. Two bat species were detected acoustically at the trough on August 27, 2013: California myotis (*Myotis californicus*) (31 files) and canyon bat (*Parastrellus hesperus*) (3 files). No bats were captured and bat activity was low and sporadic with some drinking passes (bats drinking from the trough) attempted. Monitoring at the pond on August 29, 2001, acoustically detected the presence of seven bat species: canyon bat (349 files), California myotis (58 files), Yuma myotis (*M. yumanensis*) (38 files), Brazilian free-tailed bat (*Tadarida brasiliensis*) (34 files), small-footed myotis (*M. ciliolabrum*) (16 files), pallid bat (*Antrozous pallidus*) (5 files), and big brown bat (*Eptesicus fuscus*) (3 files). One adult male California myotis was captured but no videotaping occurred. Bat activity and species richness was substantially greater at the pond in 2001 than at the trough in 2013. Wind may have reduced activity in 2013 with wind speeds reaching 15 miles per hour. In 2001, wind was below 8 miles per hour.

Well C1 Pond. Four bat species were detected acoustically at the trough during monitoring on September 3, 2013: canyon bat (143 files), California myotis (51 files), pallid bat (2 files), and Brazilian free-tailed bat (1 file). Eight canyon bats were captured including five males and three females. Bat activity was low and sporadic with some drinking passes observed. Monitoring on September 7, 1999, at the pond resulted in five species detected acoustically: canyon bat (360 files), California myotis (199 files), big brown bat (17 files), small-footed myotis (2 files), and pallid bat (2 files). One unknown bat species was captured at the pond and no videotaping occurred. More acoustic files were documented during 1999 at the pond than during 2013 at the trough, but captures were higher in 2013. This may best be explained by the much larger surface area of the pond, allowing for more bats to access it, and the smaller surface area of the trough, allowing for better capture efficiency of the mist net (i.e., greater mist net to surface area ratio).

Well 5C. Two bat species were detected acoustically at the trough on June 10, 2013: California myotis (288 files) and canyon bat (106 files). Seven adult female California myotis were captured of which three appeared to be pregnant or lactating. Bat activity was moderate and consistent with many drinking passes observed. Monitoring on June 10, 2004, at the puddle acoustically detected the presence of three bat species: California myotis (324 files), canyon bat (213 files), and pallid bat (3 files). A total of 28 bats were captured: 19 California myotis and 9 canyon bats, several of which were pregnant or lactating. No videotaping occurred. Bat activity as measured by number of acoustic files and captures was greater in 2004 than 2013. The main difference at the site was the trough instead of just a puddle and Well5B Pond was dry in 2013 and full in 2004.

Figure 6-1. Typical bat monitoring setup, Well 5C trough
(Photo taken by D. B. Hall, June 10, 2013)

Topopah Spring. At the trough, 23 bats were captured on June 3, 2013: 11 long-legged myotis (*M. volans*), 6 small-footed myotis, 3 California myotis, and 3 canyon bats. An equipment malfunction prevented the recording of bat calls. Results from videotaping showed moderate and consistent activity over the trough with few drinking passes observed. Several small moths were seen, so the bats could have been focused on foraging more than drinking. At the spring cave pool, eight bats were captured: three fringed myotis (*M. thysanodes*), three small-footed myotis, one long-legged myotis, and one unknown myotis species. Activity determined by three 20-minute observations of the cave pool by a biologist using night vision goggles was low and sporadic. More bats were captured at the trough than the spring, and activity appeared to be greater at the trough as well, suggesting bats may prefer the more accessible surface water of the trough rather than having to fly into the small cave. It is interesting to note that no fringed myotis were captured at the trough. On May 24, 2001, four small-footed myotis and two fringed myotis were captured, and over 600 acoustic files containing calls of eight bat species were recorded at the cave pool. Also, at the cave pool on June 1, 2004, one California myotis was captured, and nearly 100 acoustic files containing calls of four bat species were recorded. Compared to historical monitoring, captures were higher at the trough in 2013 than captures at the spring cave pool in 2001 and 2004 combined. Unfortunately, it is impossible to compare acoustic activity.

Bats were using all four troughs to varying degrees. It is difficult to ascertain why use is different at troughs in 2013 compared to prior use, especially with just one night of monitoring. Several factors could be contributing to the difference, including greater surface area and habitat complexity of ponds versus troughs, weather, insect activity, population declines, or changes in roosts. Overall, the troughs are providing a valuable resource for bats. They may not be equivalent to a large well pond, but they do provide an important water source in locations where bats were accustomed to finding it.

6.1.3 Bats at Buildings

During 2013, site biologists responded to five nuisance bat calls. Four were at buildings around Mercury (two at Building 600, one at Building 550, and one at Building 726) and one was in Area 6 at the RNCTEC. One call was just the presence of guano inside a high bay and no bats were observed. Two of the bats were California myotis (a dead juvenile male, and a live adult male), one was a dead adult pallid bat, and one was a live, unidentified species stuck to a glue trap. Vegetable oil was used to remove the bat from the glue trap, but the fur was so matted that it died. The one live bat was removed from the building and released. Roost site locations were entered in the Ecological Geographic Information System faunal database.

6.2 Wild Horse Surveys

Horse monitoring provides information on the abundance, recruitment (i.e., survival of horses to reproductive age), and distribution of the horse population on the NNSS. Annual monitoring of individual horses at the NNSS began in 1989 and has continued through 2013. In 2013, NSTec biologists determined horse abundance and recorded horse sign (e.g., droppings and hoof prints) along roads. Some of the natural and human-made water sources were visited in the summer of 2013 to assess their influence on horse distribution and movements and to document the impact horses are having on NNSS water sources. Important information on horse abundance and recruitment from 1990 to 1998 is found in Greger and Romney (1999).

6.2.1 Abundance

In 2013, counts of horses were made during 22 non-consecutive days between May and November. A standard road course was driven to locate and identify horses. Motion-activated cameras at Camp 17 Pond, Gold Meadows Spring, and Captain Jack Spring were also used to photograph horses (Table 6-4). Individuals were identified by their unique physical markings (e.g., facial blazes) and classified as foal, yearling, or older when possible. Excluding foals, 30 horses were counted in 2013. This is a close approximation to the actual number of horses that are present. About seven horse bands were detected, which were composed of stallions, subordinate males, females, and their offspring. The NNSS horse population in 2013 is stable at about 30 individuals. Survival of yearlings and foals was moderately high in 2013, different from previous years (Figure 6-2). One of the mountain lions previously collared

(NNSS4) consumed five foals in 2012, and this animal was found dead on the NTTR in early 2013. Its notable absence from the NNSS this year appears to have resulted in 10–11 foals surviving through the fall–winter of 2013.

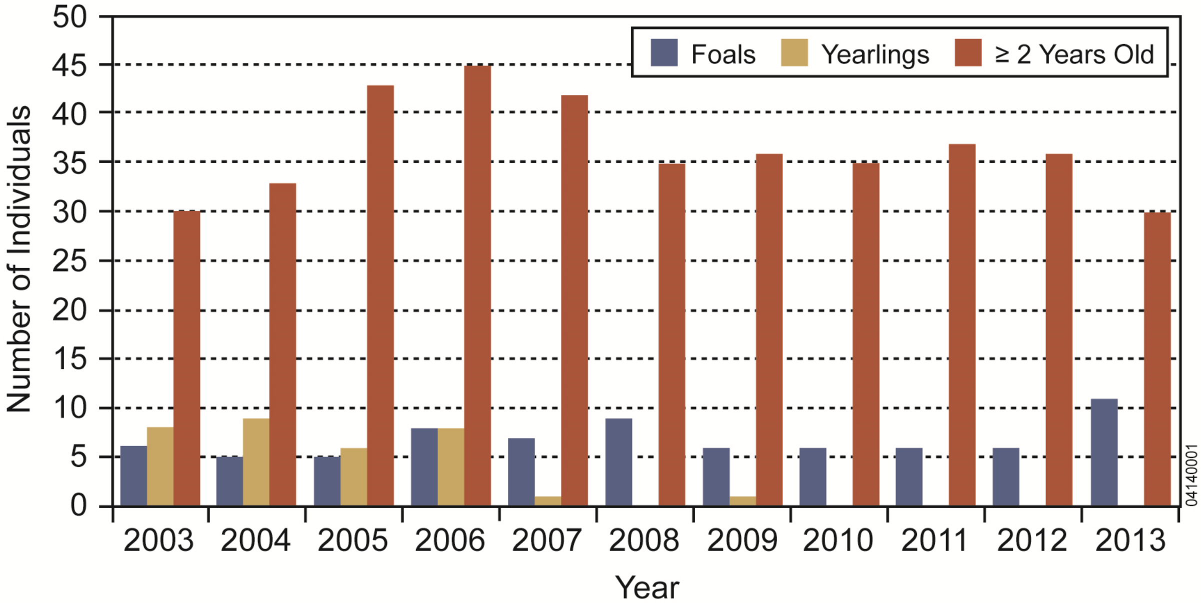

Figure 6-2. Trends in the age structure of the NNSS horse population from 2003 to 2013

Greger and Romney (1999) found that over 60 healthy foals were lost over a 5-year period at the NNSS, and hypothesized that mountain lion predation was the primary cause. Foal losses are a significant factor in controlling the size of the herd of horses on the NNSS, and the horse population has declined in size by about 40% since 1989 when horse population monitoring began. The horse population is expected to increase in 2014 with the apparent relaxed level of horse predation by mountain lions.

6.2.2 Annual Range Survey

During 2013, selected roads were driven within the NNSS, and all band sightings and fresh sign (estimated to be <1 year old) were recorded (Figure 6-3). Walking surveys were also done occasionally away from roads to document horse activity, which resulted in the discovery of a new seep, Upper Gap Wash Seep (Figure 6-3). Horse sign data collected during the road and walking surveys indicate that the horse range on the NNSS included Gold Meadows, the Eleana Range, the southwest foothills of the Eleana Range, Wildhorse Seeps in Area 30, and the western portion of Yucca Flat (Figure 6-3). Overall, the estimated annual horse range in 2013 (238 square kilometers [km^2]) is about 14% larger in size than in 2012. The horse range boundary line was approximated roughly using the locations of horses and fresh horse sign documented for 2013. Horse use has declined around the vicinity of Captain Jack Spring. Horses and fresh sign were commonly recorded on Yucca Flat expanding their range to the east in Areas 2 and 4 during 2013. Horses occupied areas south of the Eleana Range in Area 30 and near Red Rock Valley close to a new seep, Upper Gap Wash Seep, discovered in 2013 (Figure 6-3). Horse activity was heaviest along roads from Camp 17 Pond in all directions as shown by the concentration of points in Figure 6-3. The preferred horse range seems to be above 1,524 m (5,000 ft) elevation, especially during the summer months. The northern edge of the horse range, which normally extends onto Pahute Mesa near Echo Peak, seems to be reduced (Figure 6-3).

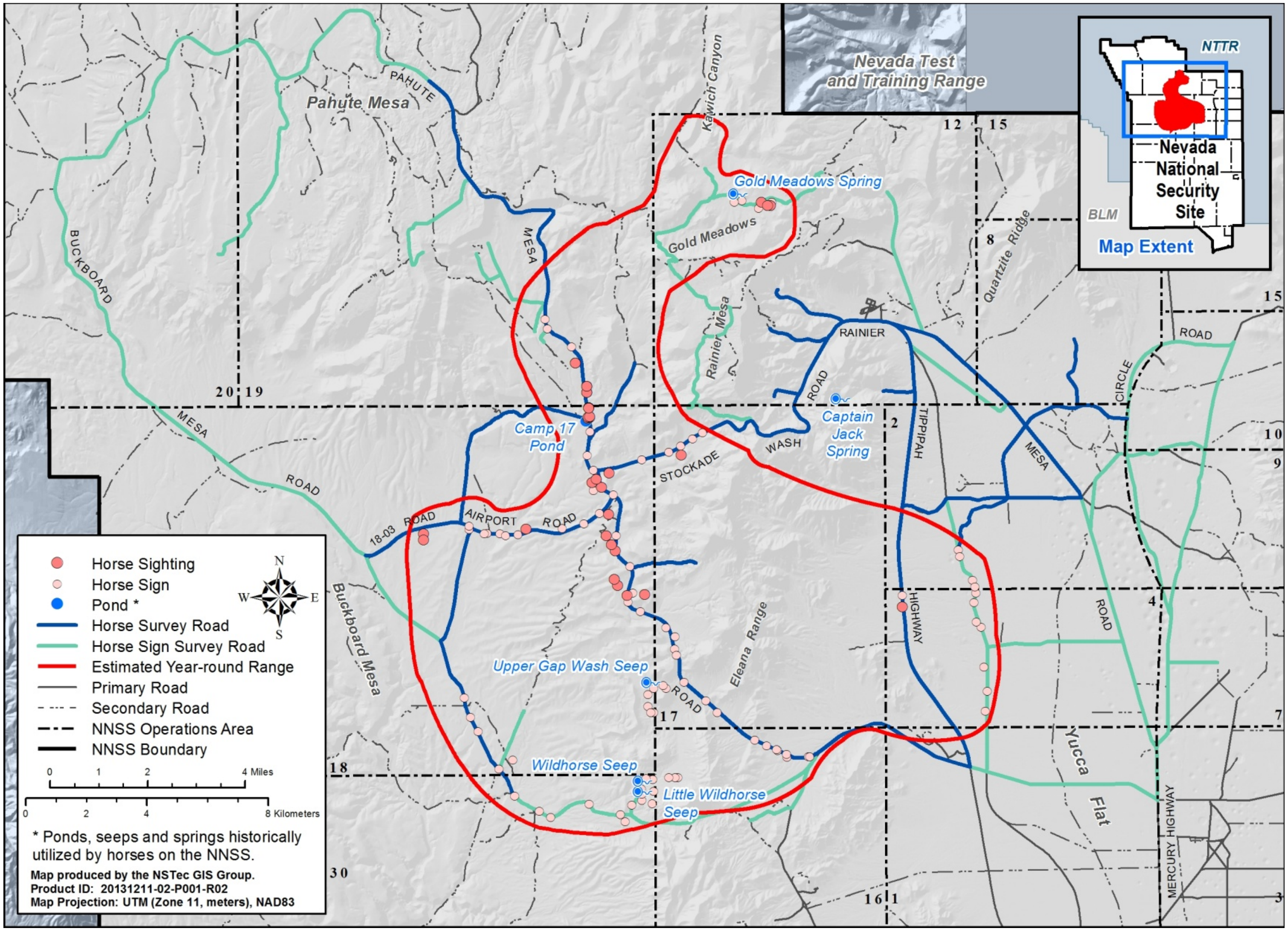

Figure 6-3. Feral horse sightings and horse sign observed on the NNSS during 2013

6.2.3 Horse Use of Water Sources

Camp 17 Pond and Gold Meadows Spring were two primary water sources used in 2013 by horses, as in previous years. Camp 17 Pond is permanent, and horse use generally begins in March and extends through November. Gold Meadows Spring use is normally temporary, but this year the sump refilled in August from rains, and horses continued to use this site into the winter. Wildhorse seeps in Area 30 are also temporary water sources in slick rock areas (Figure 6-3) containing several water tanks on the southern edge of the horse range. They are used mostly in fall and winter. Captain Jack Spring was not used by horses during 2011 through 2013. No plastic-lined sumps within or near the horse range were used by horses this year.

6.3 Mule Deer

Initial studies of mule deer at the NNSS were conducted by Giles and Cooper (1985) from 1977 to 1982 when they performed mark and recapture studies on about 100 marked deer. They estimated the population to be about 1,500–2,000 deer. Spotlighting surveys for deer on the NNSS were conducted in 1989–1994, 1999–2000, and 2006 to the present. The monitoring effort has emphasized estimating relative abundance and density.

6.3.1 Mule Deer Abundance

Mule deer abundance on the NNSS was measured by driving two standardized (74 km total length) road courses (Figure 6-4) to count and identify mule deer. One route was centered around Rainier Mesa and the second was centered around Pahute Mesa, the two main deer herd components on the NNSS (Giles and Cooper 1985).

Locations of mule deer and selected predators were recorded with a GPS from the road centerline. Perpendicular distance from the road to each deer group was measured with a laser range finder. Locations of deer groups were displayed using GIS methodology (Hansen et al. 2009).

During eight surveys conducted in 2013, total observations were made of 243 deer, which equates to an average of 30 deer per night. The deer counts in 2013 were 50% higher than counts in 2012 and near the long-term average of 32 deer per night. There appears to be no distinctive long-term trend; however, numbers appear stable on the NNSS (Figure 6-5). Numbers per distance on Rainier Mesa continue to be significantly higher (F=18.6, d. f. =145, P=0.0001) than numbers detected on Pahute Mesa from 2006 to 2013 (Figure 6-6). This is due in part to the low counts recorded in recent years in the western region of Pahute Mesa west of the Dead Horse Flat area.

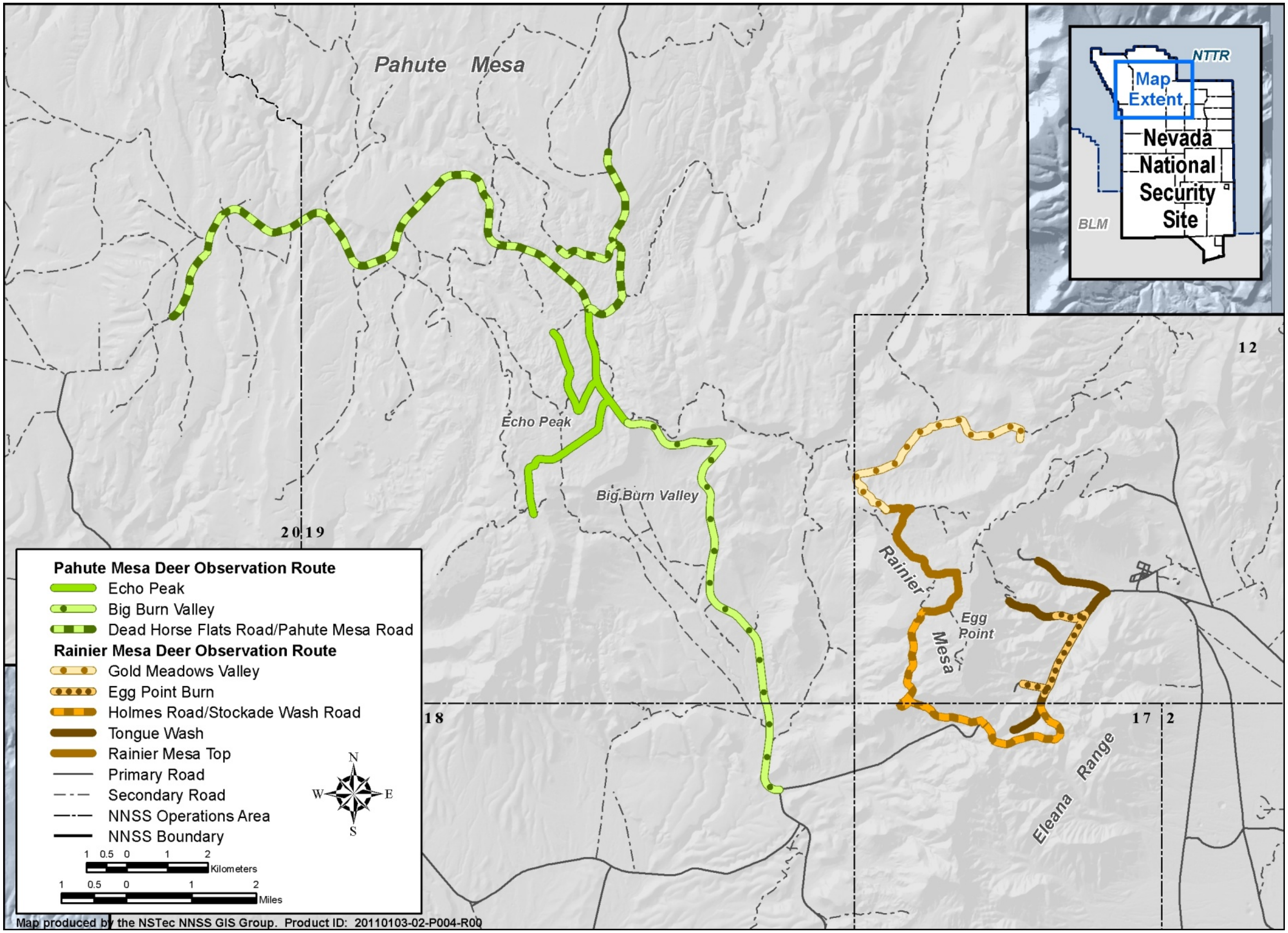

Figure 6-4. Road routes and sub-routes of two NNSS regions driven to count deer

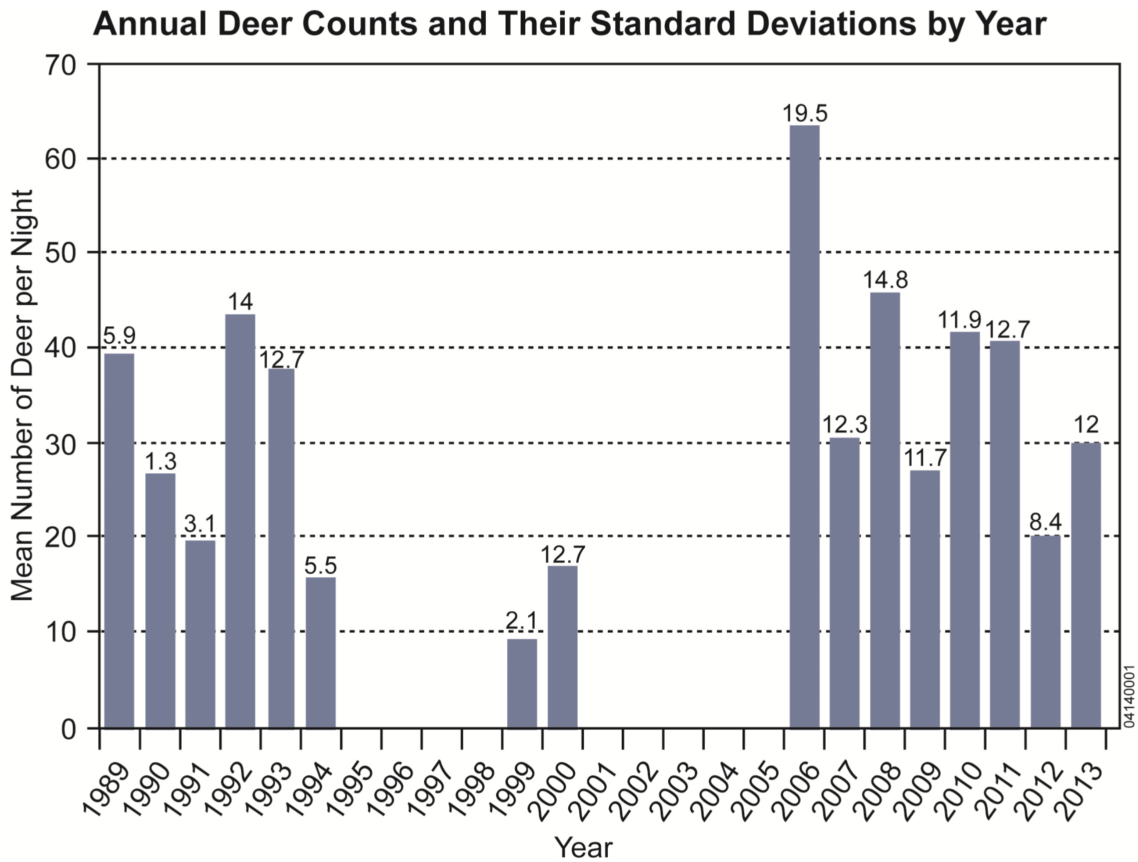

Figure 6-5. Trends in total deer count per night from 1989 to 2013 on the NNSS (surveys were not conducted during 1995–1998 or 2001–2005)

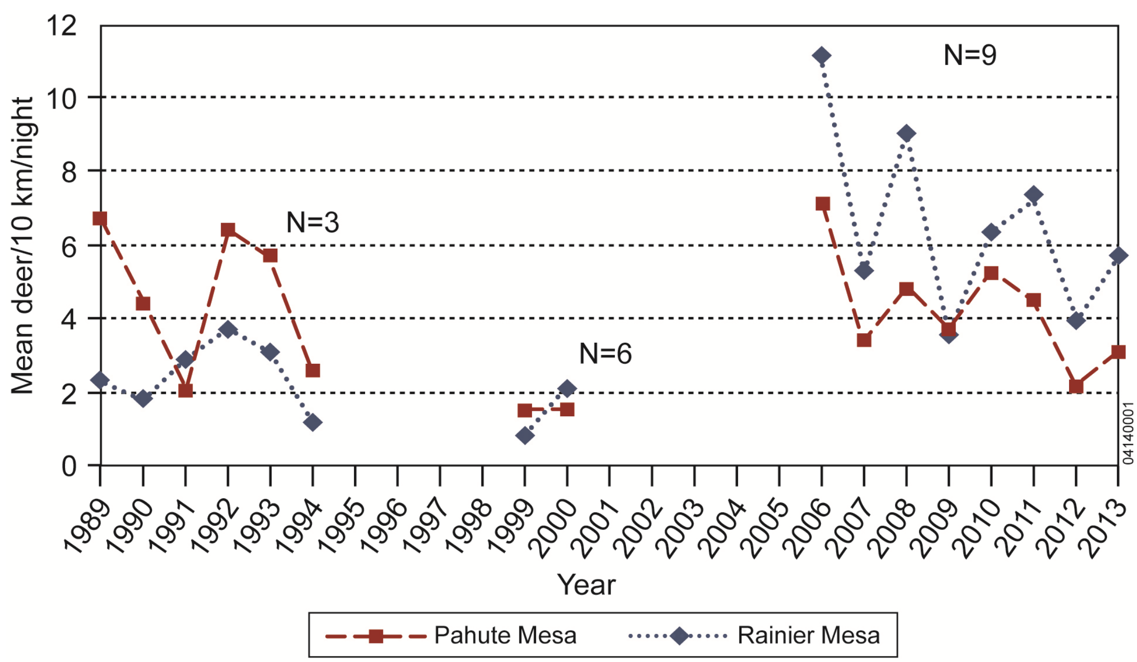

Figure 6-6. Mean number of mule deer per 10 km per night, counted on two routes (n=number of survey nights; for 2012, n=12, and 2013, n=8)

6.3.2 Mule Deer Density

Densities of deer were calculated using the software program DISTANCE (Thomas et al. 2006) on two routes and several sub-routes (Figure 6-4). Stratification of the data was based mostly on differences in topography and elevation. A statistic called Akaike's Information Criterion (AIC) is used to assess model fit. The procedure involves running several models simultaneously on the data set and choosing the model with the lowest AIC to calculate density. A series of tests such as likelihood ratios and goodness of fit tests are also used along with visual inspection to evaluate the overall fit. In DISTANCE, the model fit closest to the centerline is the most important area to be concerned about, and agreement here allows the best fit (i.e., lowest AIC value) and most reliable density estimate.

The effective strip width (ESW) or (half width) is an important parameter in DISTANCE that is used to calculate density (D), with n = the number of animals counted (mean cluster size × cluster density) in area (A) sampled, A = 2 × ESW × L, with L as the transect length.

During the eight surveys conducted in September and October 2013, 113 observations (deer groups) were detected. Group size varied from one to ten animals, and mean cluster size was 2.3 and 2.8 deer for the Rainier Mesa and Pahute Mesa routes, respectively. Total density estimates for the Pahute Mesa route and Rainier Mesa route averaged about 0.9 and 2.3 deer per km^2 (Table 6-1), respectively. As in previous years, the two areas with the highest deer density were Gold Meadows and Echo Peak (6.7 and 5.1 deer per km^2, respectively). These two areas had significantly higher deer density when compared to their respective region totals (Table 6-1: Confidence intervals [CIs] did not overlap). Echo Peak also had significantly higher densities than either Big Burn Valley or the Dead Horse Flat/Pahute Lake section on Pahute Mesa. On the Rainier Mesa region, Gold Meadows also was significantly higher than the Tongue Wash section deer density. However, Gold Meadows was not significantly higher in density than Rainier Mesa top section (CIs overlapped). Some areas with very low sample size had very high coefficients of variation; density estimates are provided but are not reliable. Also, some sub-routes in 2013 had counts that were too low to calculate density (Table 6-1), namely Stockade Wash to Holmes Road and the Egg Point Burn areas.

Table 6-1. Deer density estimates, confidence intervals, and other parameters for two routes and sub-routes of the NNSS for 2013 using Program DISTANCE software

Survey Routes/Sub-routes[a]	Route length (Km)	Total Obs.	Deer density D[b], n/Km^2	95% lower confidence interval of D	95% upper confidence interval of D	Coefficent of variation of D
Pahute Mesa Total	45.5	55	0.9	0.6	1.2	0.16
Big Burn Valley	13.0	4	0.2	0.1	0.9	0.7
Echo Peak Area	10.0	38	5.1	2.6	9.6	0.31
Dead Horse Flat Road to Pahute Lake	22.5	13	0.4	0.2	0.9	0.4
Rainier Mesa Total	28.5	58	2.3	1.5	3.7	0.22
Tongue Wash Area	4.9	5	1.2	0.4	3.3	0.5
Egg Point Burn	3.7	1	NE			
Stockade Wash Road to Holmes Road	7.5	1	NE			
Rainier Mesa Top	5.8	12	3.0	1.2	7.4	0.42
Gold Meadows	6.6	39	6.7	3.8	11.6	0.27

[a]Conventional distance sampling with major key, with cosine adjustments, 1 observer, and 1 parameter; 10% right data truncation

[b]Number of surveys is 8 for all estimates

NE=No estimate due to low counts

A typical plot of a distance probability detection curve is shown in Figure 6-7. As the model predicts, probability of detection of deer decreases with distance from the centerline. Errors in undercounting or over-counting (grouping or heaping) at specific intervals relative to model prediction can be easily inferred by simple inspection of the curves. Inspection of distance deer detection curves in 2013 as in previous years suggests that some undercounting of deer regularly occurs near the centerline (i.e., histogram height is below the predicted line from the model). When this occurs, it is considered an important type of error for this model, which should be adjusted. Undercounting can be due to missed animals in blind spots or from other counting errors (e.g., animals may move away from the road before being sighted). Roads and trails tend to have numerous blind spots and animals may be under-counted (Buckland et al. 2001), resulting in an underestimate of density. There may also be undercounting of animals far away from the centerline, for example near 180–200 m in Figure 6-7. Adjustments to the data are sometimes obviously needed, such as truncating left (centerline) or right (far) data; modifying interval sizes, which can change or lower the AIC inferring a better model fit to the data; and changing or reducing the error estimate (both desirable).

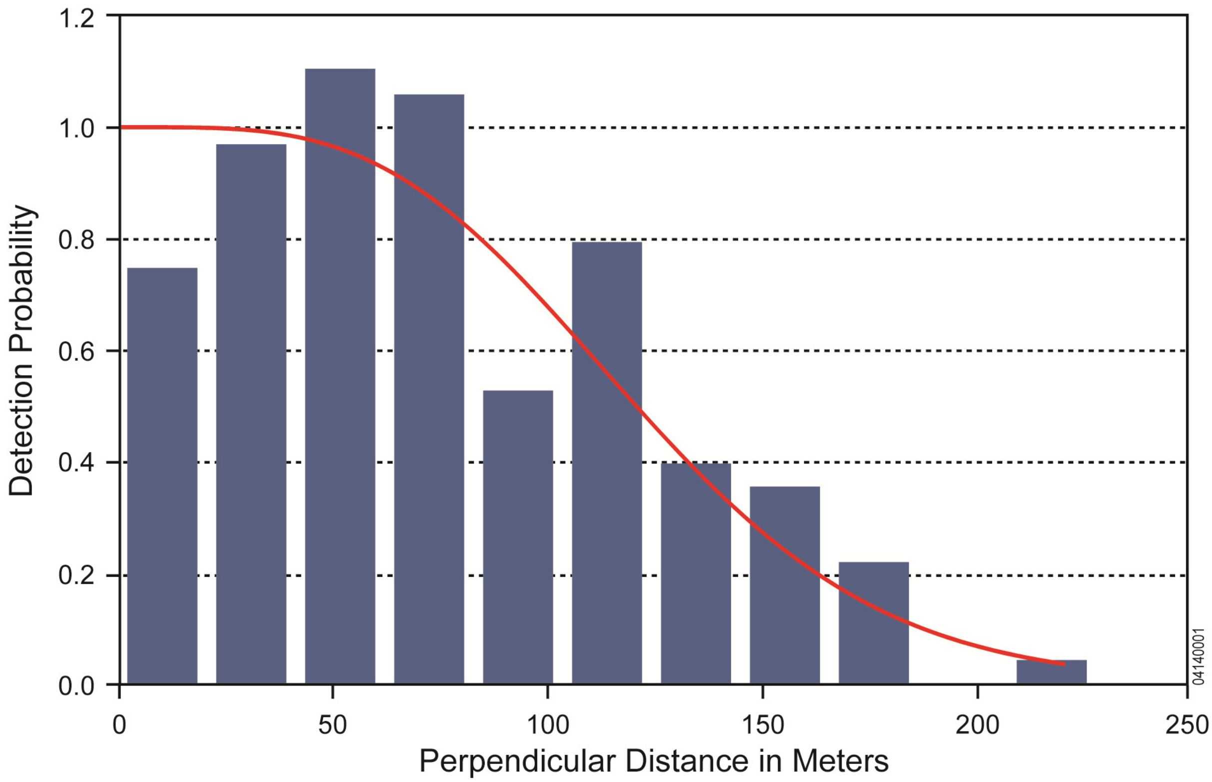

Figure 6-7. Example of a typical Deer Detection Probability plot using Program DISTANCE (data from Pahute Mesa 2011, n=141 groups, Half-normal key)

6.3.3 Sex and Fawn/Doe Ratios

Sex ratio (number of males/female) of deer was 1.56 in 2013 and averaged about 1.21 over 8 years (Table 6-2). Generally, deer populations in hunted areas in the western U.S. have fewer males compared to females in the population than is measured on the NNSS. Giles and Cooper (1985) attributed the higher number of males to a lack of hunting on the NNSS.

The number of fawns detected in 2013 was 31, and the fawn/doe ratio was 0.45. Giles and Cooper (1985) conducted fawn/doe surveys from July to October (1977–1981) and determined fawn/doe ratios ranged from 0.34 to 0.73. Values for 2013 fall into the range recorded historically by Giles and Cooper on the NNSS (Table 6-2).

Table 6-2. Mule deer classified by sex and age, with mean sex ratios, and fawn to doe ratios from 2006 to 2013 on the NNSS

Year	Male	Female	Unclassified Sex	Male/Female Ratio	Fawns	Fawn/Doe
2006	224	222	96	1.01	31	0.14
2007	148	68	59	2.18	0	0
2008	164	147	50	1.12	47	0.32
2009	98	102	35	0.96	7	0.07
2010	133	150	50	0.89	32	0.21
2011	189	184	67	1.03	37	0.19
2012	65	67	28	0.97	19	0.3
2013	106	68	38	1.56	31	0.45
Mean				1.21		0.21

6.3.4 Mule Deer Habitat Use

Deer habitat use was calculated again in 2013 similarly as in previous years, using associations and alliances described by Ostler et al. (2000). Details of the field methodology were reported in 2011 (Hansen et al. 2012). Deer habitat use indices (Table 6-3) were calculated by the quotient of percentage of deer habitat use and the percentage of available vegetative habitat (Stapp and Guttilla 2002). CIs of selection coefficients were calculated after Krebs (1999) to examine statistical differences (Table 6-3).

Two woodland associations, *Pinus monophylla*/*Artemisia tridentata* Woodland (*PIMO/ARTR*) and *Pinus monophylla*/*Artemisia nova* Woodland (*PIMO/ARNO*) comprise about 42% of the habitat where deer observations were made (Table 6-3). The *Artemisia* spp. Shrubland Alliance (*Artemisia* spp.) (29%) and the Miscellaneous/disturbed habitats (20%) were also substantial components of the habitat. However, *Coleogyne ramosissima–Ephedra nevadensis* Shrubland (*CORA-EPNE*) and the Egg Point Burn comprised minor components of the habitats on the deer routes (Table 6-3). The miscellaneous/disturbed category is composed of several elements, both minor vegetation types and land previously disturbed by NNSA/NFO activities. Minor vegetation types included *Cercocarpus* spp. (mountain mahogany) and the *Chrysothamnus-Ericameria* (rabbitbrush) Shrubland.

The most heavily used habitat for deer was the *Artemisia* spp. Alliance, which had a significant positive selectivity value (W_i =2.02) for use (Table 6-3). PIMO/ARNO Woodland, *CORA-EPNE* Shrubland and Miscellaneous-disturbed and the Egg Point Burn habitats all appeared to be avoided (W_i <1.0) relative to availability in 2013. PIMO/ARTR Woodland was second highest in use (24%) of the six classified habitats this year and was used relative to its abundance (CI overlapped 1.0).

Numbers of deer observed in most years are typically highest in the *Artemisia* spp. Alliance and second highest in the *PIMO/ARTR* Woodland association on the NNSS (Figure 6-8). These two habitats form an important habitat ecotone for mule deer because they thrive in “edge” habitat (i.e., wooded areas interspersed with open sagebrush meadows). Typically, deer will seek out “Thermal Cover” during daytime and will move into open foraging areas during dusk and night, when surveys are conducted. The movements between these habitats are probably dynamic and related to several factors of which weather or wind may be significant. For example, we have noted low counts during windy-rainy nights, possibly due to deer "hiding" or maintaining a "low profile" (i.e., lowered visibility) in available cover during those conditions. Differential use may also be due to detectability issues, such as good or poor visibility for observers based on habitat and topography, or a habitat may in fact be better for deer. Another factor, forage quality, may also explain where deer are found at night. Recent field inspections suggest one current hypothesis, which is that *Artemisia* spp. meadows have higher abundance of palatable plant species (e.g., *Purshia* [bitterbrush], miscellaneous forb, and grass species) than PIMO/ARTR uplands, although the latter may have better thermal cover.

Table 6-3. Habitat use index, W_i, from spotlighted mule deer on the NNSS during 2013

Habitat	Km of deer route in habitat type	Percent of available habitat (A)	Observed number deer groups	Percent deer use by habitat (B)	Habitat Use Index w_i = B/A	95% CI of w_i
PIMO/ARTR Woodland	18.1	24.50	28	24.10	0.98	(0.66,1.30)
PIMO/ARNO Woodland	12.6	17.10	6	5.20	0.30	(−0.06, 0.66)*
Artemisia spp. Alliance[1]	21.5	29.00	68	58.60	2.02	(1.71, 2.33)*
Miscellaneous-disturbed	14.8	20.00	8	7.00	0.35	(0.14, 0.56)*
CORA-EPNE Shrubland	3.8	5.10	5	4.30	0.84	(0.12, 1.56)
Egg Point Burn	3.2	4.30	1	0.80	0.18	(−0.20, 0.57)*
Total	**74**	**100**	**116**	**100**		

[1] *Artemisia* spp. Alliance = ARNO-ARTR, ARNO-CHVI, and ARTR-CHVI Shrubland Associations

* Habitats are denoted by an asterisk where selection is significant from 1.0 (i.e., confidence intervals [CI] did not include 1.0).

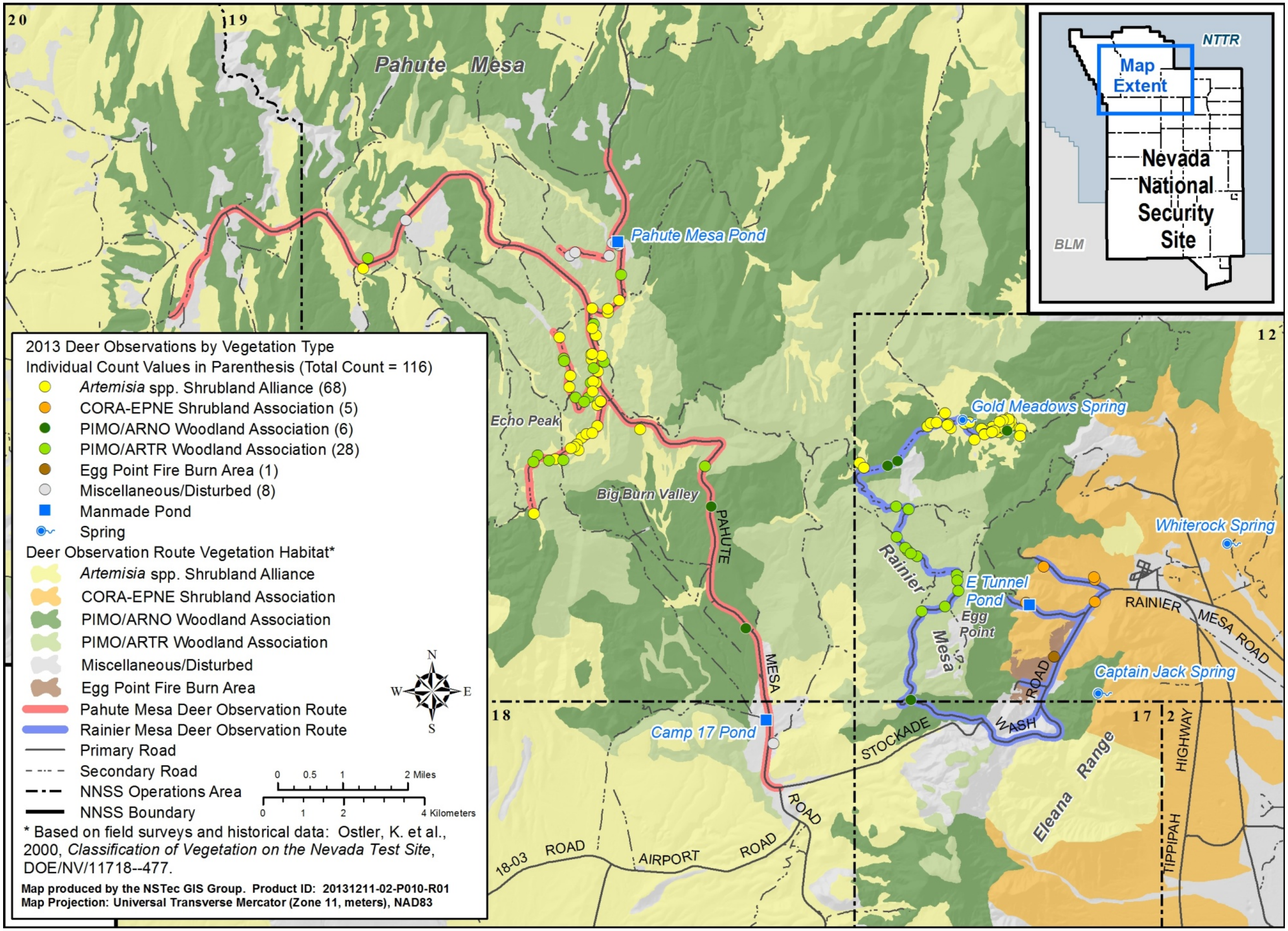

Figure 6-8. Mule deer observations by vegetation type on the NNSS for 2013

6.4 Mountain Lion Monitoring

6.4.1 Motion-Activated Cameras

Little data exist for mountain lion numbers and their distribution in southern Nevada, including the NNSS. Since 2006, site biologists have collaborated with Dr. Erin Boydston, a USGS research scientist, to use remote, motion-activated cameras to determine the distribution and abundance of mountain lions on the NNSS. Cameras used this way are referred to as camera traps. Camera traps have also been used the last few years to assist with the capture effort for the telemetry study by identifying where mountain lions occur as well as the frequency of occurrence at those sites. Additionally, camera traps were used during 2013 to assess the number of uncollared and collared mountain lions to estimate their relative abundance. Remote, motion-activated cameras were used at 32 sites, including four new sites (Figure 6-9 and Table 6-4). Sites were selected at locations with previous or new mountain lion sightings or sign, on roads that are potential movement corridors from one area to another, and in areas of good mule deer habitat (mule deer are a primary prey species for mountain lions). The number of images reported is based on a 1-minute interval between images taken during a single episode. Some images were taken during late 2012 and early 2014 due to the accessibility and scheduling of camera trap visits.

A total of 56 mountain lion images (i.e., photographs or video clips) were taken during 192,359 camera hours across all sites. This equates to about 0.3 mountain lion images per 1,000 camera hours (Table 6-4). Mountain lions were detected at 12 of the 32 sites, including six dirt roads, four water sources, and two canyons (Figure 6-9). Table 6-5 contains the camera trap results by month, location, and radio-collared animal, when possible to determine. NNSS7 was photographed 27 times at 10 sites in 2013 compared to 10 times at 6 sites during 2012. It was the only radio-collared mountain lion detected with camera traps during 2013. However, the only other radio-collared lion was NNSS4, and it was only alive until February 21, 2013. Multiple individuals were only documented once in a photo of two uncollared mountain lions near the Topopah Spring Trough on January 5, 2014, most likely a female and subadult juvenile. It is difficult to tell individual mountain lions apart in the images and therefore determine the exact number of mountain lions on the NNSS. At a minimum four individuals were known to occur on the NNSS during 2013, compared to a minimum of six in 2012.

In order to investigate temporal activity of mountain lions, camera detection data from all 8 years (2006–2013) were combined. Mountain lions were detected every month with peak occurrences during November (n=89). The number of images taken during summer and fall (June–November) (n=302) accounted for nearly three-fourths of all images compared to number of images taken during winter and spring (December-May) (n=114) (Figure 6-10). Mountain lions were detected most frequently from 1700 to 0800 hours, during which time more than 10 times as many images were recorded (n=375) compared to the time period from 0800 to 1700 hours (n=36) (Figure 6-11). From 2011 to 2013, twice as many images were taken when it was dark (n=142) compared to when it was light (n=73).

A secondary objective of the camera surveys is to detect other species using these areas to better define species distributions on the NNSS. A total of 7,637 images of at least 30 species other than mountain lions were taken during 192,359 camera hours across all sites (Table 6-4). This is about 40 images per 1,000 camera hours. The most prevalent species photographed (29% of all images) was mule deer (2,243 images at 20 of 32 sites). Also noteworthy is 1,579 images of chukar that were taken at Topopah Spring and the trough. Some of the rarer, more elusive species documented during camera surveys were desert bighorn sheep (see Section 6.6), bobcat (found at 12 of 32 sites), gray fox (*Urocyon cinereoargenteus*), badger (*Taxidea taxus*), wild burro, golden eagle (*Aquila chrysaetos*), great-horned owl (*Bubo virginianus*), greater roadrunner (*Geococcyx californianus*), and great blue heron (*Ardea herodias*). Greatest use and highest species richness was documented at water sources especially during the summer and fall, which emphasizes the importance of these water sources for several wildlife species, especially during the drier months.

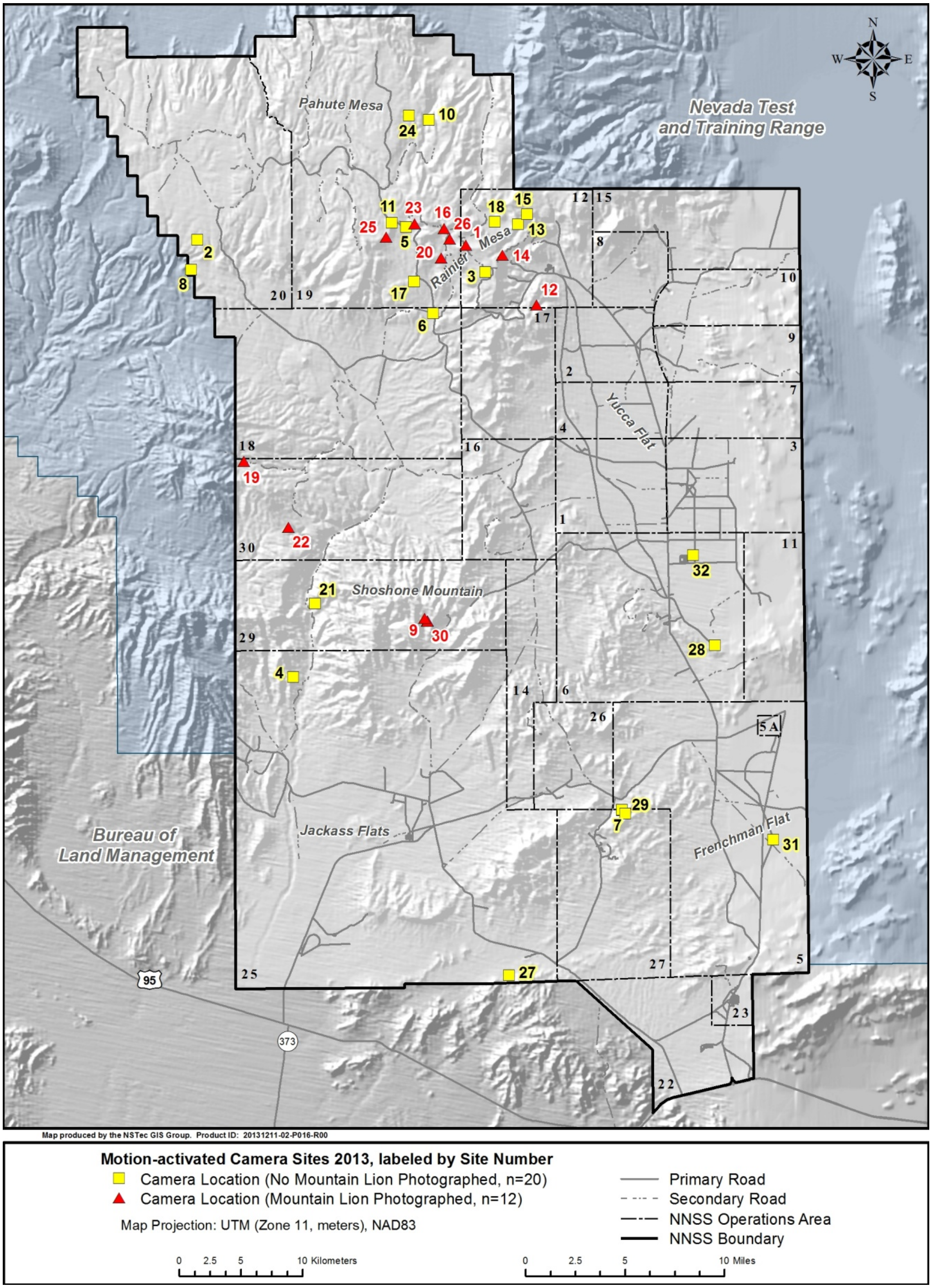

Figure 6-9. Locations of mountain lion photographic detections and motion-activated cameras on the NNSS during 2013

Table 6-4. Results of mountain lion camera surveys during 2013

Location (Site Number)	Dates Sampled	Camera Hours	Mountain Lion Images (Number of Images per 1,000 Camera Hours)	Other Observations (Number of Images)
Topopah Spring (#9)	12/20/12–1/7/14[b]	6,637	16 (2.4)	Bobcat (1), gray fox (1), coyote (15), desert bighorn sheep (98), mule deer (34), desert cottontail (3), black-tailed jackrabbit (9), rock squirrel (4), hawk (1), chukar (719), mourning dove (77), pinyon jay (1)
North Chukar Canyon Tank (#22)	12/11/12–12/17/13	8,904	12 (1.3)	Bobcat (13), coyote (48), desert bighorn sheep (2), hawk (3), chukar (31), mourning dove (13), pinyon jay (2), common raven (4)
12T-26, Rainier Mesa (#1)	12/12/12–12/16/13	8,858	9 (1.0)	Bobcat (1), coyote (3), mule deer (6), black-tailed jackrabbit (14), cottontail rabbit (3)
Topopah Spring Trough (#30)	12/20/12–1/7/14	9,196	4 (0.4)	Bobcat (1), gray fox (2), coyote (8), mule deer (175), black-tailed jackrabbit (1), rock squirrel (2), golden eagle (4), chukar (829), mourning dove (347), common raven (2), house finch (1)
East 19-01 Road (#16)	1/8/13–6/17/13[b]	3,560	3 (0.8)	Gray fox (1), black-tailed jackrabbit (3)
East Rim Pahute Mesa, Powerline Road (#25)[a]	5/16/13–8/21/13	2,328	2 (0.9)	Unknown
Captain Jack Spring (#12)	12/20/12–12/16/13[b]	7,524	2 (0.3)	Bobcat (16), gray fox (3), coyote (26), mule deer (1,036), desert cottontail (1), rock squirrel (14), golden eagle (1), turkey vulture (1), chukar (145), mourning dove (13), common raven (12)
Back Mesa Road Upper Wash (#26)[a]	1/8/13–8/21/13	5,400	2 (0.4)	Bobcat (2), cottontail rabbit (1)
Rattlesnake Ridge Gorge (#20)	1/8/13–12/16/13	8,206	2 (0.2)	Badger (1), coyote (2), cottontail rabbit (1)
East Cat Canyon (#19)	12/11/12–12/17/13	8,902	2 (0.2)	Bobcat (1), coyote (10), mule deer (71), black-tailed jackrabbit (9)

Table 6-4. Results of mountain lion camera surveys during 2013 (continued)

Location (Site Number)	Dates Sampled	Camera Hours	Mountain Lion Images (Number of Images per 1,000 Camera Hours)	Other Observations (Number of Images)
East of 19T-47 (#23)[a]	5/16/13–8/21/13	2,328	1 (0.4)	Unknown
Rainier Mesa Top, Above B Tunnel (#14)	12/12/12–12/17/13	8,877	1 (0.1)	Bobcat (1), gray fox (9), mule deer (32), black-tailed jackrabbit (1), rock squirrel (1)
Pahute Mesa Summit, Road (#11)	12/13/12–12/16/13	8,828	0	Mule deer (35), cliff chipmunk (1)
Dick Adams Cutoff Road, Rainier Mesa (#3)	12/12/12–12/17/13	8,877	0	Coyote (1), mule deer (30), black-tailed jackrabbit (9), cottontail rabbit (3), rock squirrel (2)
Gold Meadows Spring[a] (#18)	12/12/12–12/16/13[b]	30	0	Mule deer (3), horse (17), black-tailed jackrabbit (16)
Lambs Canyon #2 (#24)	10/1/12–4/18/13	4,774	0	Cottontail rabbit (4), dark-eyed junco (3)
Aqueduct Mesa Road (#15)	12/12/12–4/15/13	2,975	0	Gray fox (4), coyote (1), black-tailed jackrabbit (5), rock squirrel (7)
East Gold Meadows Pass (#13)	12/12/12–12/16/13	8,858	0	Bobcat (2), gray fox (1), coyote (5), mule deer (74), black-tailed jackrabbit (2)
Water Bottle Canyon (#17)	12/13/12–12/16/13	8,827	0	Coyote (1), mule deer (3), rock squirrel (1)
19-01 Road, 19T-47, (#5)[a]	11/19/12–9/26/13[b]	765	0	Coyote (1), mule deer (1)
Lambs Canyon Tank (#10)	10/1/12–4/18/13	4,773	0	Golden eagle (3), hawk (9), red-shafted flicker (3)
Camp 17 Pond[a] (#6)	1/8/13–1/15/14[b]	4,489	0	Coyote (11), mule deer (466), horse (121), black-tailed jackrabbit (2), great blue heron (2), golden eagle (1), turkey vulture (5)
Twin Spring (#21)	12/20/12–1/7/14	9,196	0	Mule deer (6)

Table 6-4. Results of mountain lion camera surveys during 2013 (continued)

Location (Site Number)	Dates Sampled	Camera Hours	Mountain Lion Images (Number of Images per 1,000 Camera Hours)	Other Observations (Number of Images)
Cottonwood Spring (#4)	7/11/13–1/7/14	4,320	0	None
Rock Valley Road, south of plots (#27)	6/12/13–1/6/14	5,001	0	None
Cane Spring (#7)	12/17/13–1/6/14[b]	7,320	0	Bobcat (15), badger (1), coyote (19), mule deer (220), desert cottontail (1), greater roadrunner (2), chukar (9), mourning dove (5), common raven (2)
Cane Spring Trough (#29)	12/17/13–1/6/14[b]	6,233	0	Mule deer (8), turkey vulture (4), common raven (1)
Well 5C Trough (#31)	12/17/12–6/10/13; 9/17/13–1/6/14[b]	6,868	0	Bobcat (1), kit fox (25), coyote (184), pronghorn antelope (22), mule deer (10), burro (194), black-tailed jackrabbit (9), red-tailed hawk (12), greater roadrunner (1), turkey vulture (6), common raven (153)
Area 6, LANL Pond Trough (#32)	12/17/12–1/6/13[b]	9,092	0	Coyote (107), pronghorn antelope (112), mule deer (6), burro (4), black-tailed jackrabbit (2), red-tailed hawk (28), owl (1), turkey vulture (178), mourning dove (26), common raven (972)
Well C1 Pond Trough (#28)	12/17/12–1/6/14[b]	7,609	0	Bobcat (40), coyote (87), pronghorn antelope (3), mule deer (18), burro (145), black-tailed jackrabbit (4), red-tailed hawk (16), great-horned owl (9), great blue heron (2), turkey vulture (5), mourning dove (42), yellow-headed blackbird (1), brown-headed cowbird (1), common raven (159)
ER 20-5 Plastic-lined Sump (#2)	6/19/13–8/5/13	1,127	0	Pronghorn antelope (1), turkey vulture (1)
ER 20-11 (#8)	6/27/13–9/5/13	1,677	0	Mule deer (9), great egret (1)

[a] Camera hours not known for some time periods. [b] Non-continuous operation due to camera problems, dead batteries, full memory cards, etc.

Table 6-5. Number of mountain lion images taken with camera traps by month, location, and animal number, if known

Camera Location (Site number)	Dec-12	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13	Jul-13	Aug-13	Sep-13	Oct-13	Nov-13	Dec-13	Jan-14
12T-26, Rainier Mesa (#1)				2-NNSS7	1-NNSS7	1-NNSS7	1-NNSS7		2-NNSS7		2 (1-NNSS7)			
Rainier Mesa top, above B Tunnel (#14)				1-NNSS7										
Back Mesa Road Upper Wash (#26)							2							
East 19-01 Road (#16)			1-NNSS7	2 (1-NNSS7)										
Rattlesnake Ridge Gorge (#20)				1							1-NNSS7			
East of 19T-47 (#23)							1-NNSS7							
East Rim Pahute Mesa, Powerline Road (#25)								2 (1-NNSS7)						
Captain Jack Spring (#12)													2	
East Cat Canyon (#19)			1-NNSS7										1-NNSS7	
North Chukar Canyon Tank (#22)			2-NNSS7	6			4 (3-NNSS7)							
Topopah Spring (#9)			1-NNSS7	2-NNSS7	3							7 (2-NNSS7)		3
Topopah Spring Trough (#30)												2 (1-NNSS7)		2 (1–2 pumas)

- [orange] Number of mountain lion images by animal number (if known)
- [yellow] Camera operational, no mountain lions detected
- [green] Camera not operational

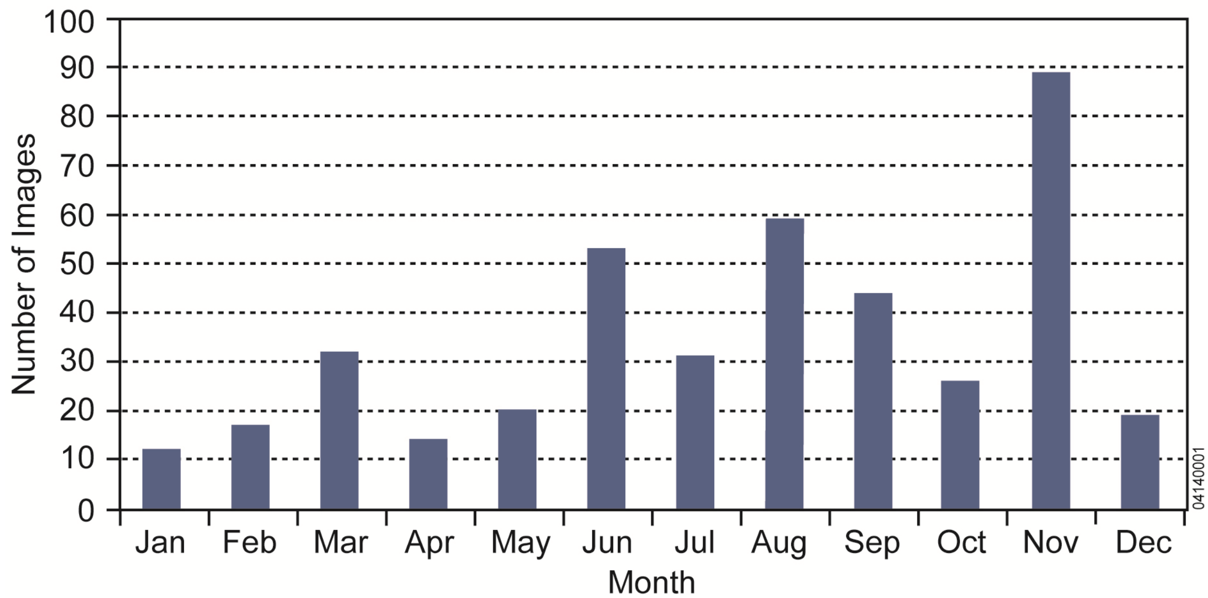

Figure 6-10. Number of mountain lion images by month for camera sites where mountain lions were detected from 2006 through 2013 (n=416)

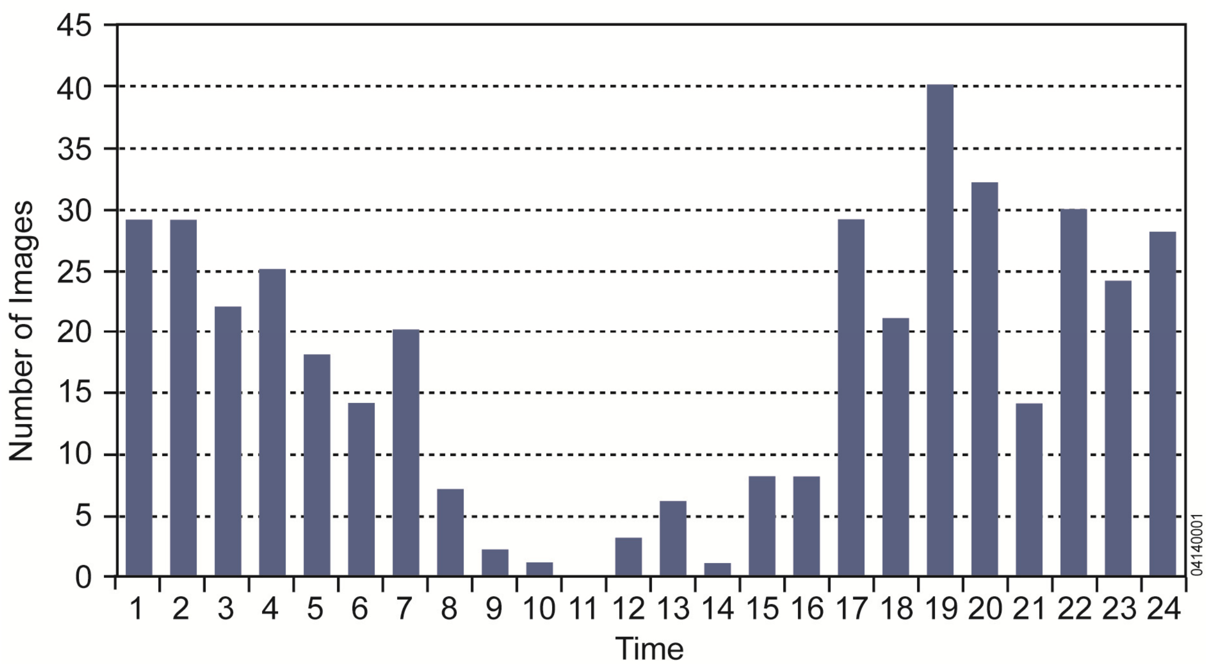

Figure 6-11. Number of mountain lion images by time of day (Pacific Standard Time) for camera sites where mountain lions were detected from 2006 through 2013 (n=411)

6.4.2 Mountain Lion Telemetry Study

A collaborative effort between Dr. David Mattson (USGS), Kathy Longshore (USGS), Brian Jansen (trapper), Kirsten Ironside (USGS), and site biologists continued during 2013 to provide information to assess the risk of human encounters with mountain lions on the NNSS and determine what mountain lions eat and where they make their kills. This effort also provides information about their natural history and ecology as well. The NNSS and surrounding areas, encompassing the NTTR, Tonopah Test Range (TTR), and Desert National Wildlife Range, constitute one of the largest areas (over 15,540 km^2) in North America where human-caused mountain lion mortality is extremely low. The size of this area is large enough to allow population dynamics to emerge that likely typify an unexploited population of lions. This area is also located in some of the driest ecosystems in North America with relatively low prey densities. The goal for 2013 was to capture or recapture and radio-collar four mountain lions and track them for 1–1.5 years.

Mountain lion trapping occurred during May and June for 12 trap nights at four locations where camera traps were set (east 19-01 Road, Aqueduct Canyon, west Rainier Mesa rim, and 19-01 Road). The trapper also trailed an uncollared lion on May 16 with his dogs northeast of Gold Meadows but ceased pursuit when it moved off the NNSS. The lion was east-bound onto the NTTR. NNSS7 was recaptured on June 1 at the east 19-01 Road camera location (Site #16). Age was reevaluated and estimated to be 7–9 years old as opposed to the estimate of 3–4 years old last year on June 17, 2012. It weighed 127 pounds this year compared to 121 pounds last year. The yellow ear tag in the right ear had come out, so it was replaced with a new white one. A second trapping effort lasted nearly 3 weeks during August with no captures at three trap locations on Timber Mountain for 6 trap nights. An uncollared mountain lion was detected moving south to north through the Timber Mountain area. The trapper trailed the mountain lion to the NNSS boundary without capturing it until it continued northwest onto the NTTR.

A new radio collar set to record six locations per day (every 4 hours starting at noon) was fitted on NNSS7, and it was tracked using the satellite GPS radio collar until December 31, 2013. Data collected during 2014 will be included in next year's report. Locations were recorded by the GPS units on the radio collars for NNSS4 and NNSS7 and uploaded via satellite during a certain window of time each day. The data were processed and then sent to site biologists via email. Data were converted to Universal Transverse Mercator coordinates and plotted in ArcMap Version 10.0. Data were searched to identify clusters of locations that were within 100 m of each other typically over a minimum 12-hour period. Coordinates and maps were printed and taken to the field to search for kill sites. A kill site is defined as the area where a mountain lion killed and/or cached its prey. It was difficult to ascertain the exact spot where the prey was killed, but evidence of the kill such as burial sites, the carcass, bone fragments, rumen contents, and hair quite often remained. Once a kill site was found prey species, sex, age, amount consumed, marrow color and consistency, number of burial sites, and dimensions of burial sites were recorded. Habitat data such as elevation, aspect, slope, landscape position, vegetative cover, and dominant plant species were also documented. Additionally, the number of latrines, scats, and beds was recorded. A field sketch was made detailing where key features were located, along with any other pertinent notes.

6.4.2.1 NNSS4

NNSS4 was radio-tracked from January 1, 2013, to February 21, 2013, when it died, apparently of natural causes. It was found dead in Kawich Valley on the NTTR on March 9, 2013 (Figure 6-12). The carcass was collected and stored in a freezer on the NNSS until a field necropsy was performed in August 2013. Detailed analyses of habitat use and home range have not been completed yet. However, a rough estimate of NNSS4's home range is 1,230 km^2. A study conducted in eastern Nevada between 1972 and 1982 found an average home range size of 580 km^2 for males (Ashman et al. 1983). NNSS4's home range is 2.1 times greater than the average found in eastern Nevada. NNSS4 killed a horse foal on December 27, 2012, and remained on that kill until January 4, 2013. It then moved south to Shoshone Mountain, spent

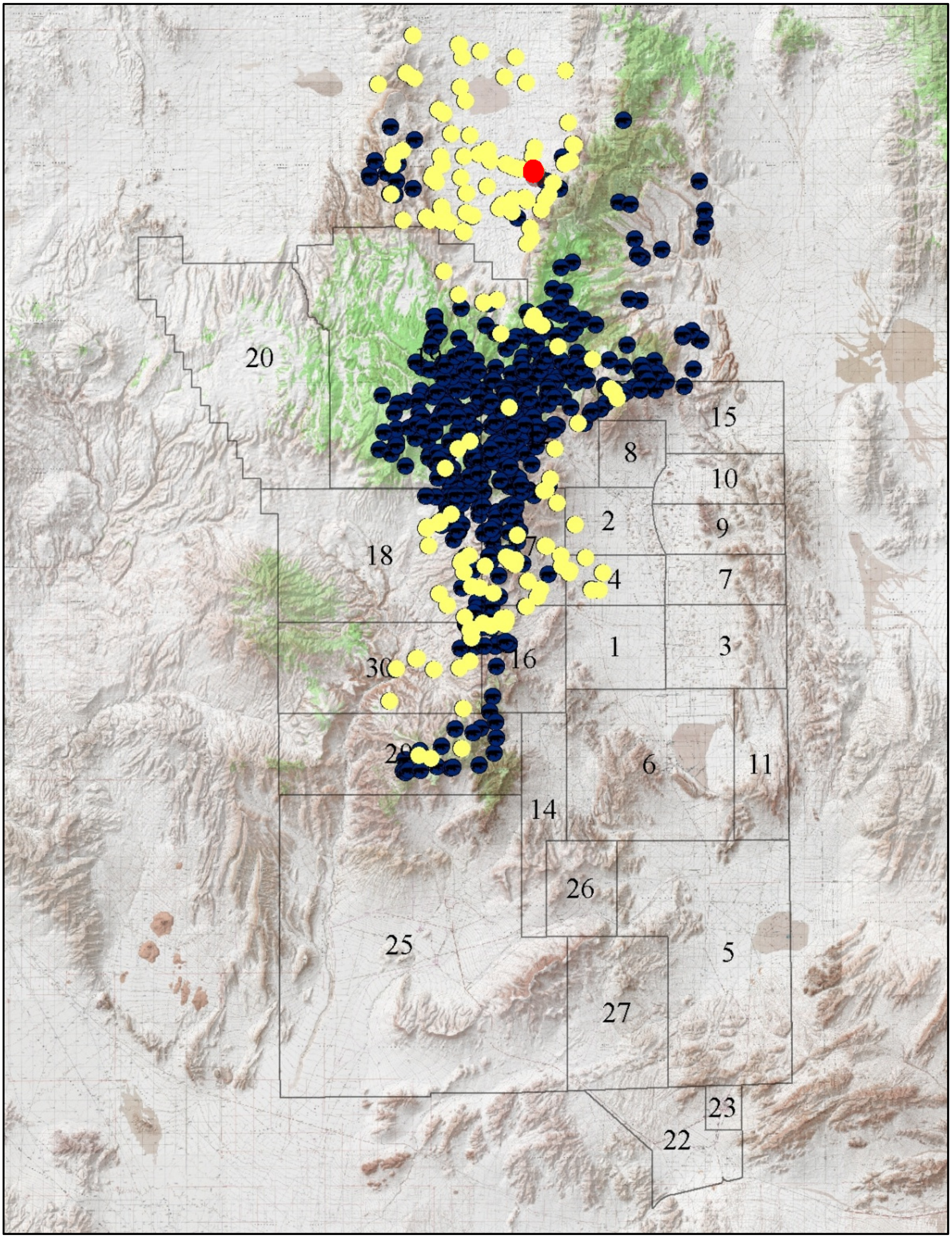

Figure 6-12. Documented locations of NNSS4 (blue dots=May 23 to December 31, 2012; yellow dots=January 1 to February 21, 2013; red dot=carcass)

some time in the southern Eleana Range, ventured out into the western portion of Yucca Flat, spent time in the upper Gap Wash area, and then around January 23 moved all the way north to Kawich Valley. It stayed in the Kawich Valley and the surrounding foothills until it died on February 21 (Figure 6-12).

During 2013, 15 clusters were investigated and prey remains were found at three sites including two coyotes and a golden eagle, all of which were found in Kawich Valley (Figure 6-13). One coyote was killed on January 26, the other one on February 1, and the golden eagle on February 5. The golden eagle is a rare prey item for mountain lions. The horse foal it killed in December was the last large prey item documented to have been eaten by NNSS4. Based on his movement patterns, NNSS4 traveled nearly the entire length of his home range twice during January and February (Figure 6-12) apparently hunting for food. It is difficult to determine the exact cause of death. The field necropsy did not show any broken bones or signs of trauma externally or internally, except for missing hair on the bottom side of the tail that suggested he was in a weakened condition and dragging his tail. Because this was an old animal with high energetic requirements during the winter, traveled long distances, and was unsuccessful at killing large prey, it appears he most likely died from starvation. It could not be determined whether he was weakened by lack of food or weakened by disease or illness that caused him to be unsuccessful at hunting.

6.4.2.2 NNSS7

NNSS7 (Figure 6-14) was radio-tracked from January 1, 2013, to December 31, 2013. The collar was still functioning at this point, and data beyond this date will be included in the 2014 annual report. Detailed analyses of habitat use and home range have not been completed yet. However, a rough estimate of NNSS7's home range since June 2012 is 1,715 km^2, which is 3 times greater than the average home range for male mountain lions in eastern Nevada (Ashman et al. 1983).

NNSS7's home range primarily covers the mountainous areas in the northern and western portions of the NNSS (i.e., Shoshone Mountain, Timber Mountain, Forty-mile Canyon, Eleana Range, Pahute Mesa, and Rainier Mesa), and extends west and north off the NNSS into Yucca Mountain, Thirsty Canyon, and Quartz Mountain on the NTTR (Figure 6-15). Location data indicate a seasonal shift with a majority of locations in the higher elevation habitat on Pahute Mesa and Rainier Mesa between June and late October and a majority of locations in the lower elevation habitat on Shoshone Mountain, Forty-mile Canyon, Yucca Mountain, Timber Mountain, Thirsty Canyon, and Quartz Mountain from January through May and late October through December. The higher elevation areas are dominated by *Pinus monophylla*, *Juniperus osteosperma*, *Artemisia tridentata*, *Purshia tridentata* (antelope bitterbrush), and *Quercus gambelii*. These areas are also prime mule deer summer habitat. The lower elevation areas contain pockets of high elevation habitat but are dominated by *Coleogyne ramosissima*, *Artemisia nova* (black sagebrush), *Ericameria* and *Chrysothamnus* spp., and *Purshia glandulosa* (desert bitterbrush). The shift to higher elevation habitat in late May/early June and to lower elevation habitat in late October roughly corresponds with the timing of migration of mule deer on and off their summer range, respectively (Giles and Cooper 1985). A similar shift to lower elevation habitat by NNSS7 was noted during late October 2012.

A total of 58 clusters were investigated during 2013, and prey remains were found at 41 sites (Figure 6-13). Double kills were documented at two sites, with a desert bighorn sheep ewe and lamb killed at one site and two mule deer fawns killed at another site (Figure 6-13). Thus, a total of 43 prey items were documented, including 30 mule deer (15 bucks, 4 does, 10 fawns, 1 unknown), 12 desert bighorn sheep (8 rams, 3 ewes, 1 lamb), and a mature badger during the 2013 calendar year. The badger was the first prey item taken after NNSS7's recapture. Seasonal prey switching occurs with more desert bighorn sheep being killed during winter and spring and more mule deer being killed during summer and fall (Figure 6-16). This can be explained by the movement of NNSS7 to lower elevations during winter and spring as he followed the mule deer migrating to their winter range. The mule deer winter range overlaps desert

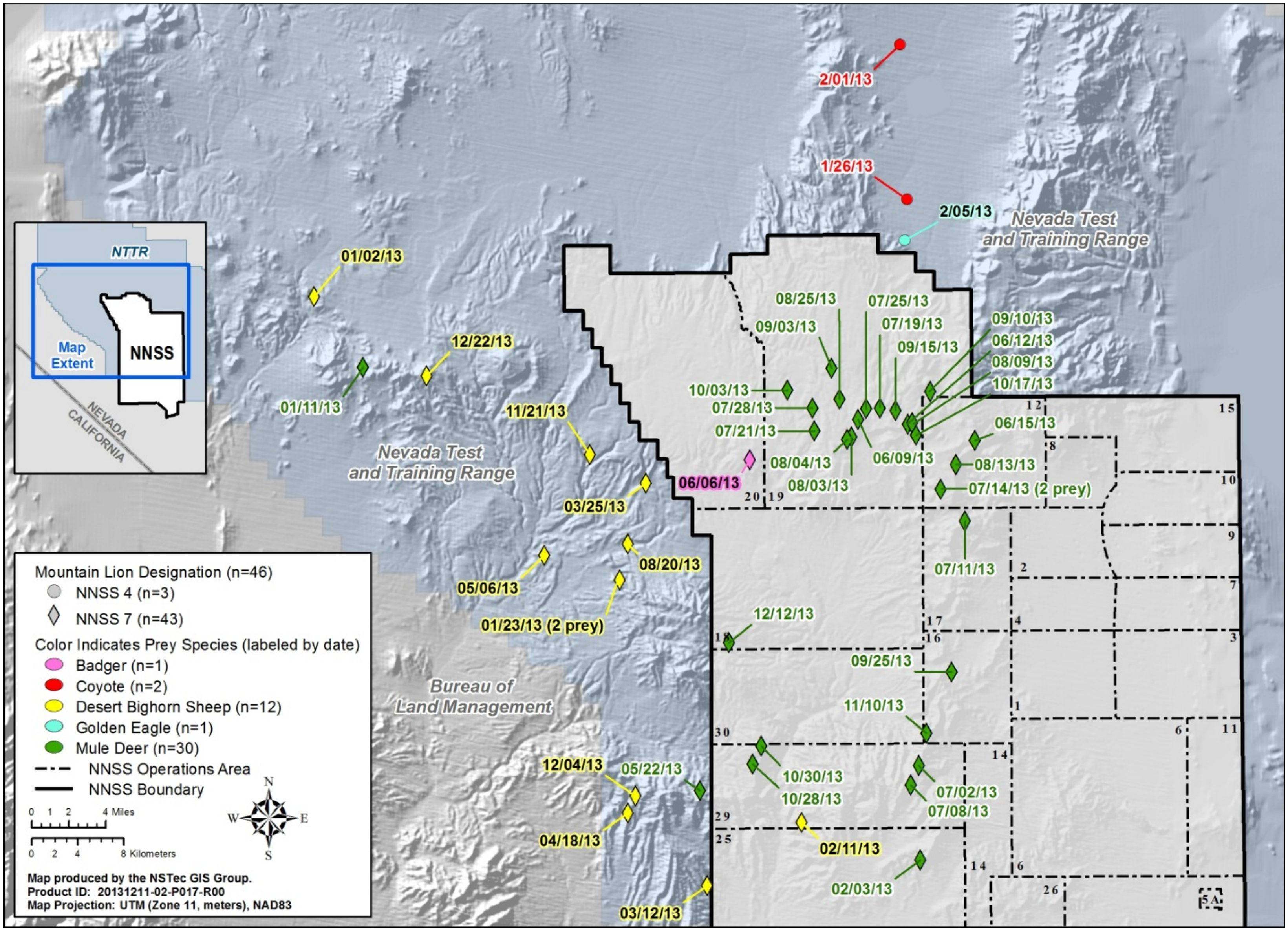

Figure 6-13. 2013 kill site locations for NNSS4 and NNSS7 by prey type

Figure 6-14. NNSS7 recapture
(Photo taken by B. Jansen, June 1, 2013)

bighorn sheep habitat making sheep available to mountain lions. The mule deer summer range is much smaller in comparison to their winter range and occurs primarily at the higher elevations of Pahute Mesa and Rainier Mesa on the NNSS, while the winter range is spread out over a large area at the lower elevations off the mesas (Giles and Cooper 1985). It is hypothesized that mule deer are dispersed over a large area during winter and spring and thus are more difficult to capture than desert bighorn sheep. Clearly, the preferred prey species for NNSS7 during the summer and fall of 2013 was mule deer. NNSS1 exhibited the same pattern with only desert bighorn sheep killed (n=13) between December 2011 and mid-May 2012 and only mule deer killed (n=18) between late May and mid-September when its collar failed. Likewise, NNSS4 shifted its range to lower elevations during winter, presumably following the mule deer. These data suggest that mule deer migration dictates the movement of mountain lions on the NNSS and may attract multiple mountain lions to this abundant prey source on the summer range. This may help explain why at least six mountain lions were observed on the summer range in 2012 (Hall et al. 2013). Timing of migration by mountain lions corresponded with the migration of mule deer in a study done in eastern California as well (Pierce et al. 1999). However, in the California study, mule deer and mountain lions congregated on the winter range as opposed to the summer range. Sawyer et al. (2009) suggest this is typical across the Intermountain West, "where winter ranges are restricted to relatively small areas due to snow cover and limited forage availability, whereas summer ranges often consist of entire mountain ranges." In contrast, the NNSS and surrounding environs are just the opposite with

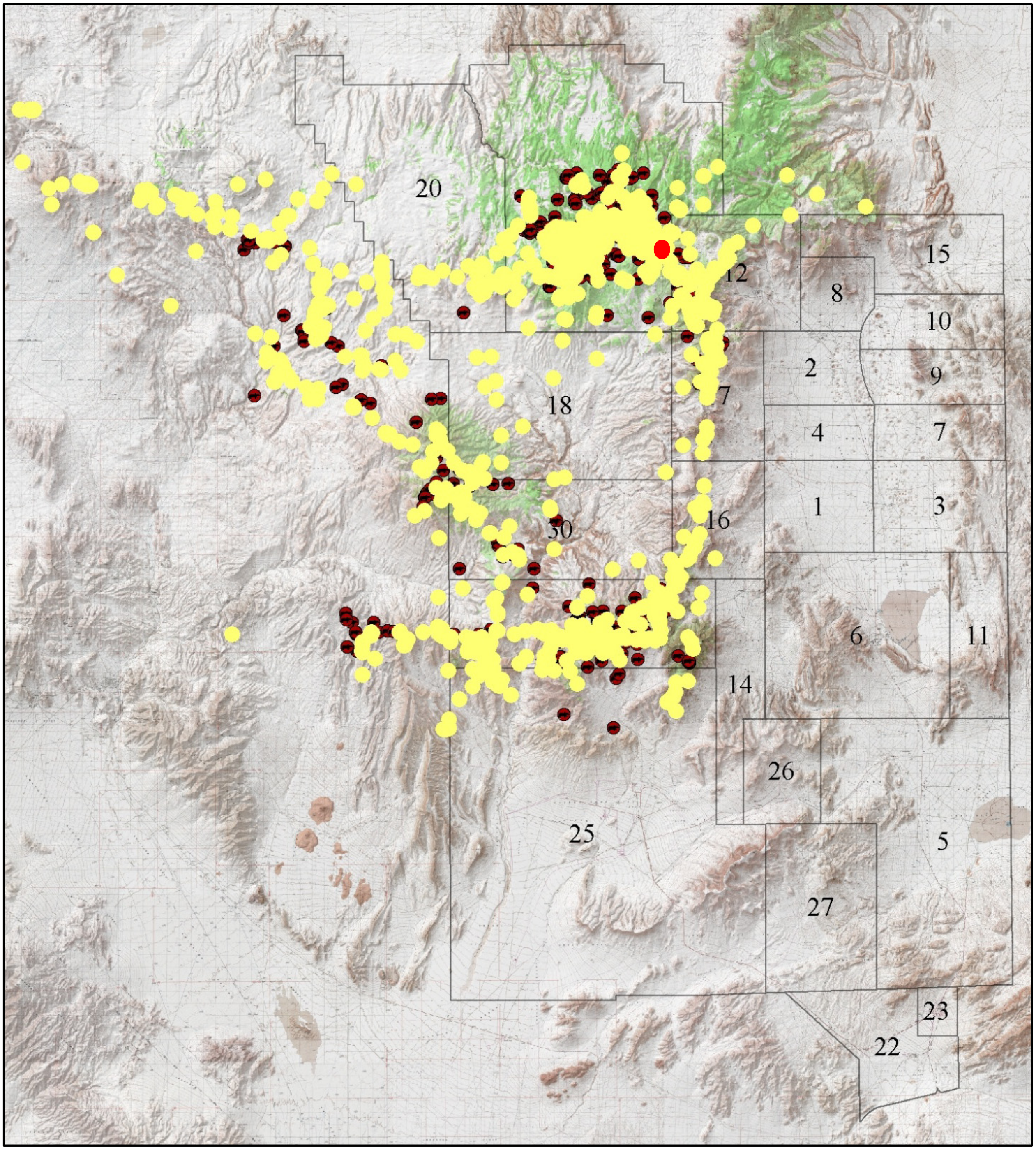

Figure 6-15. Documented locations of NNSS7 (Dark red dots=June 17 to December 31, 2012; yellow dots=January 1 to December 31, 2013; bright red dot=recapture location, June 1, 2013)

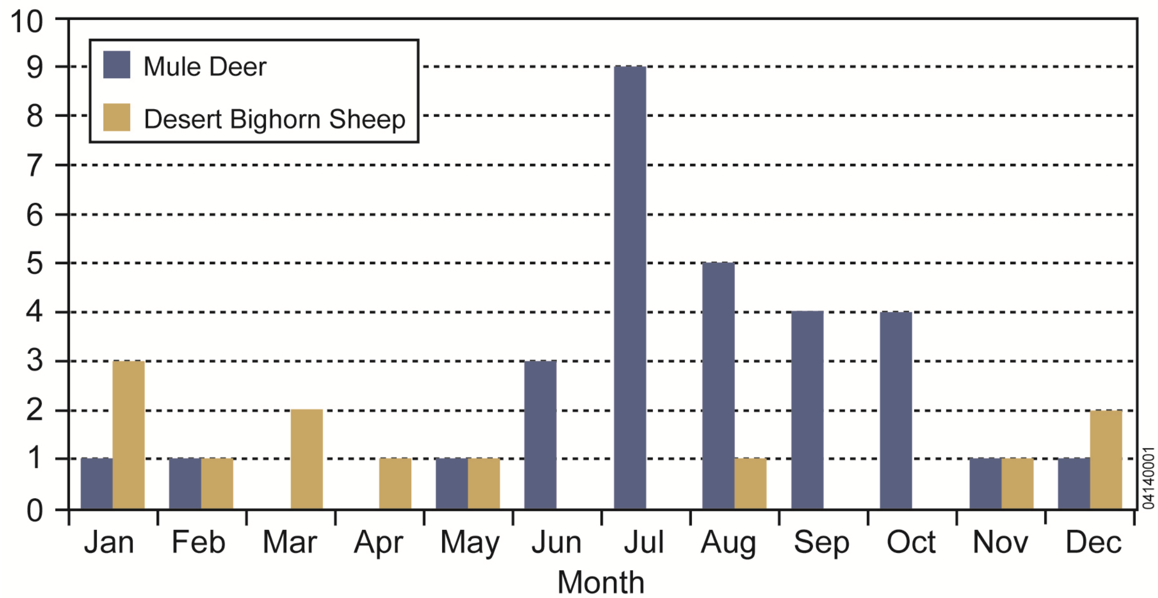

Figure 6-16. Number of ungulate prey items killed by NNSS7 by month during 2013

summer range restricted to relatively small areas of isolated high elevation habitat and expansive winter range at lower elevations. Other areas of southern Nevada or surrounding states that have limited summer range may exhibit similar patterns in mountain lion movements and predation patterns.

Large gaps in data acquisition occurred between September 1–3, October 6–9 and 13–15, and November 14–17, which may have resulted in missing clusters to check. Accounting for only visited clusters, NNSS7 made a kill, on average, every 8.5 days with time between kills ranging from 2 to 29 days. In contrast, during 2012, NNSS7 made a kill on average, every 13 days. Perhaps the death of NNSS4 reduced the competition and allowed NNSS7 to make more kills in those areas that NNSS4 used to frequent.

6.4.2.3 Risk to Humans

No observations of mountain lions were reported to NNSS biologists by NNSS workers during 2013. Based on recorded locations, it is evident that these animals prefer rugged, mountainous, typically forested habitat in the northern and western portions of the NNSS. Very few active projects occur in these areas, so the overall risk of human encounters with mountain lions on the NNSS appears to be quite low. Facilities in these areas include the Calico Hills firing range (Area 25), several tunnel complexes in Area 12 (e.g., G, U, V, and P Tunnels), and communication towers and power substations in Area 19 (Echo Peak and Pahute Mesa), Area 12 (DOE Point), and Area 29 (Shoshone Mountain). Personnel who work in these mountainous, remote areas (communication and power system maintenance workers, military personnel, etc.), especially at night, are most at risk and should be aware that mountain lions do occur around these facilities. One noted exception was NNSS4 who ventured into the western portion of Yucca Flat in Area 2 and Area 4. He came within 1–2 km of the Big Explosives Experimental Facility and the Area 1 Shaker Plant. He only spent a few days in these areas and was most likely hunting mule deer or possibly horses, as opposed to targeting facilities or workers since all the locations were at night between 2000 and 0400.

6.4.2.4 Radiological Testing

DOE facilities are required to estimate the radiological dose to the general public and biota caused by past and present facility operations. One potential pathway to the public is through game animals (e.g., mule deer, bighorn sheep, mountain lions) that migrate off the NNSS into areas where hunting is allowed that are then killed and consumed. Likewise, animals can uptake radiological contaminants from the environment through drinking and foraging. In order to help assess the potential dose to the public and animals, samples were taken from mountain lions and their dead prey for radiological analysis during mountain lion trapping and kill site investigations. Other biota sampling is done under the Routine Radiological Environmental Monitoring Plan, and those results are reported in the annual site environmental report.

A total of 20 samples (2 mountain lion blood, 6 mountain lion scat, 9 mule deer tissue, 3 desert bighorn sheep tissue) were collected. These were analyzed for tritium, a human-made radionuclide persisting in some portions of the NNSS as a result of nuclear weapons testing. Detectable levels of tritium were only found in one mountain lion scat (48,300 ± 4,910 picocuries per liter [pCi/L]; 288 pCi/L minimum detectable concentration [MDC]) and one mule deer (79,700 ± 12,200 pCi/L; 490 pCi/L MDC). These values are 2–4 times higher than the drinking water standard (20,000 pCi/L) set for safe human consumption by the U.S. Environmental Protection Agency (Code of Federal Regulations 2010). Nonetheless, the estimated dose (<0.2 millirem) from these concentrations is well below any level considered to be harmful to the animal or someone eating the animal. The most likely source of tritium was E Tunnel Pond in Area 12, which was within 3.5 km of both the mountain lion scat and the dead mule deer.

Four muscle tissue samples (NNSS4's carcass, two mule deer, and a desert bighorn sheep) were collected and analyzed for gamma-emitting radionuclides, plutonium, and americium. The only detection was the presence of cesium-137 in the muscle tissue of NNSS4 (0.106 ± 0.053 picocuries per gram-wet; 0.075 MDC). Again, this concentration is not considered to be harmful to the animal or someone eating the animal. Cesium-137 is known to bioaccumulate in muscle tissue and has a physical half-life of about 30 years, so it is difficult to determine the source of this contaminant. Cesium-137 is also known to be carried and deposited around the earth from global fallout.

These results indicate that mountain lions, mule deer, and potentially other animals can uptake detectable levels of tritium and cesium-137 from the environs of the NNSS by drinking contaminated water or eating contaminated plants and animals. It is important to underscore the fact that even though tritium and cesium-137 were detected in some of the animals sampled, the potential dose to both the animal or other animals, including people, eating them is well below levels considered to be harmful (DOE 2002).

6.5 Raptors and Bird Mortality

6.5.1 Raptors

Historically, 16 species of raptors have been recorded on the NNSS. Raptors include vultures, hawks, kites, eagles, ospreys, falcons, and owls. All are protected/regulated under the *Migratory Bird Treaty Act* and/or Nevada state law. Because these birds occupy the higher trophic levels of the food chain, they are regarded as indicators of ecosystem stability and health. There are nine raptor species known to breed on the NNSS, including the western burrowing owl (Hunter 1994).

6.5.1.1 Additional Historical Raptor Records for NNSS

An NSTec biologist retrieved several hundred field records of birds recorded by Hayward et al. (1963) from the L. Tom Perry Special Collections at BYU's Harold B. Lee Library. These records provide clarification as to where and when nearly 1,000 individual raptor sightings were recorded on the NNSS from1959 to 1962. The original publication is a summary and is not specific to exact dates, habitat types, or administrative areas where birds were recorded. This raptor data has been entered into the EEM Birds database (which now contains >9,000 records), and some preliminary analyses have been conducted. The interpretation of these data may be useful for future management of raptors on the NNSS.

6.5.2 Bird Mortality and Compliance with the Migratory Bird Treaty Act

Bird mortality is a measure of impacts that NNSA/NFO activities may have on protected bird species. NNSA/NFO activities that have affected birds typically have been of three types: collisions with buildings, electrocution from power lines, and vehicle mortalities. Workers and biologists work together to observe and report mortalities. Historically, reported deaths of birds are sometimes numerous, with episodes of predation and disease outbreaks involving larger numbers of dead birds occasionally during wet years (Figure 6-17).

Overall, few impacts to birds were observed and few mortalities were reported from onsite project activities. There were only 11 reported bird mortalities in 2013 (Figure 6-17) with only 2 reported electrocutions. Therefore, impacts to bird populations from NNSA/NFO activities at the NNSS appear to be low. Reducing the number of exposed grounding and electrified elements on poles with "unfriendly raptor perching configurations" will be encouraged on a case-by-case basis and when cost effective to reduce electrocutions on the NNSS. The Avian Power Line Interaction Committee (2006) has recommended numerous voluntary suggestions for improving safety for raptors on electrified poles.

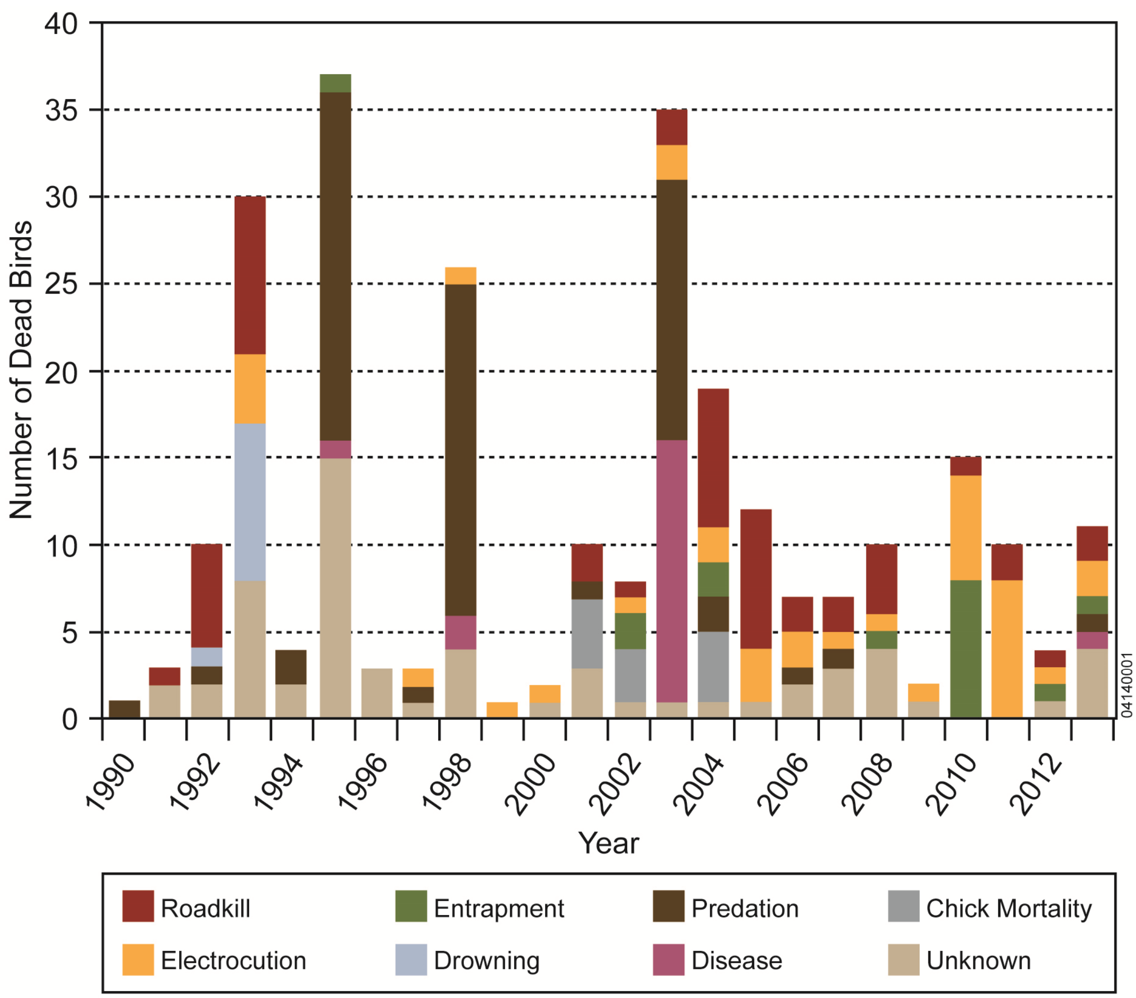

Figure 6-17. Historical records of reported bird deaths on the NNSS through 2013

6.6 Desert Bighorn Sheep

Up until a few years ago, desert bighorn sheep (sheep) appeared to be rare on the NNSS with only eight recorded observations of their presence on or near the NNSS between 1963 and 2009. These observations were recorded in the southern part of the NNSS (Areas 5, 23, and 25) and were most likely reintroduced sheep from the Spotted Range, east of Mercury, and the Specter Range, southwest of Mercury. Since then numerous observations of sheep and sheep sign (i.e., scat, beds, remains) have been detected with motion-activated cameras (Figure 6-18) and during the mountain lion study, including the discovery of ewes and lambs in the Yucca Mountain and Forty-mile Canyon area. These new data have expanded the known distribution of desert bighorn sheep on and near the NNSS (Figure 6-19). It is unknown if they have always occurred and were undetected or if they are colonizing new areas on the NNSS.

There are plans to conduct helicopter surveys to census the population during fall 2014. Periodic population counts after defining the baseline population may be used to determine trends in sheep. Sheep are a major game species in Nevada, and hunting units are in close proximity to the NNSS. Characterizing radionuclide burdens of sheep found on site and determining their movement patterns off site into huntable areas is important to assess as a potential dose pathway to humans. Sheep scat is also being collected for genetic analysis to try to determine how sheep on the NNSS are related to surrounding sheep populations. This is a collaborative effort with USGS biologists.

Figure 6-18. Four desert bighorn sheep rams at Topopah Spring
(Photo by motion-activated camera, August 29, 2013)

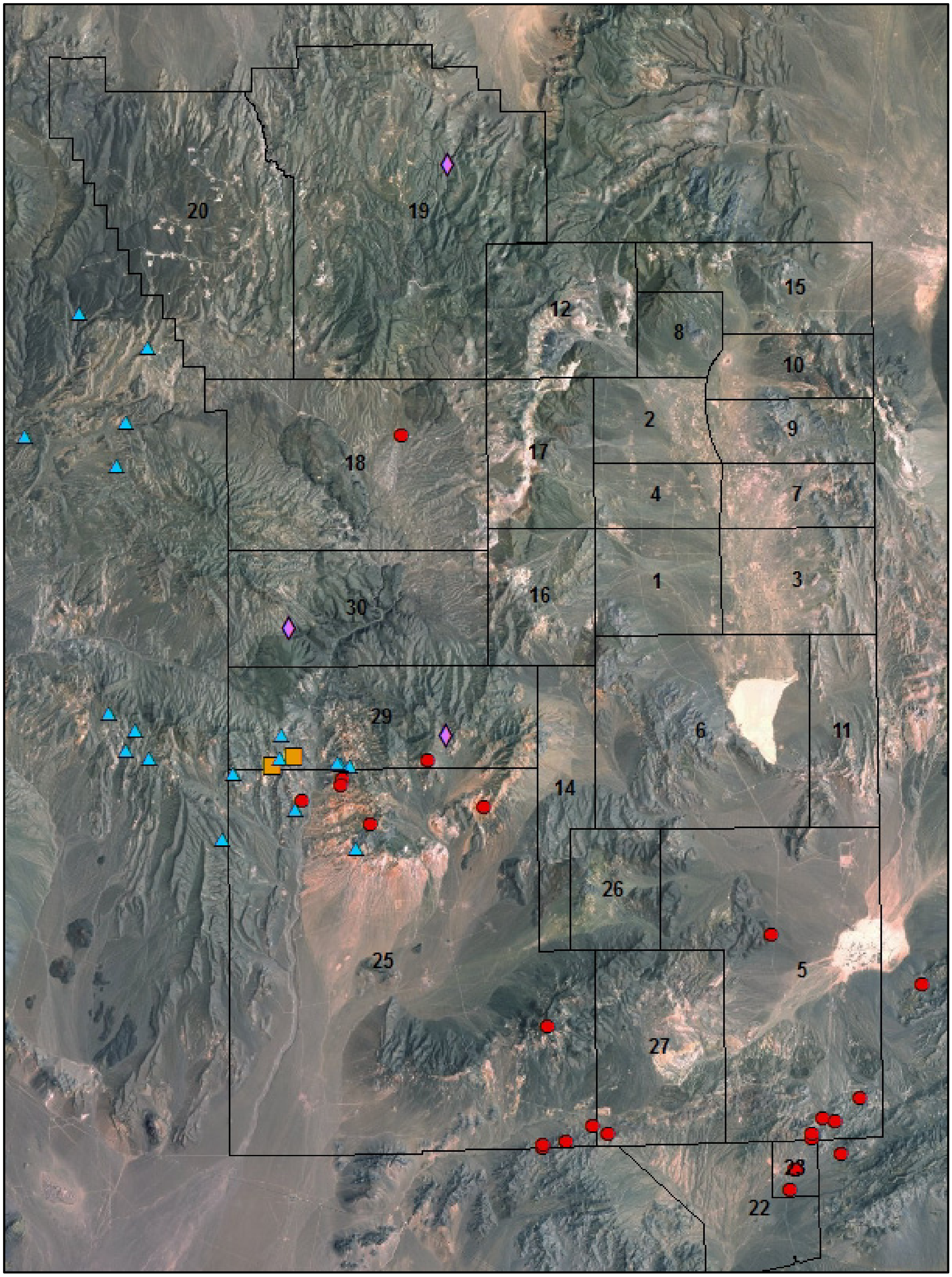

Figure 6-19. Desert bighorn sheep distribution on the NNSS and surrounding areas (1995–2013) (red circle=sighting [n=23], blue triangle=mountain lion kill [n=17], purple diamond=camera [n=3], orange square=scat [n=2])

6.7 Nuisance and Potentially Dangerous Wildlife

During 2013, site biologists responded to 30 calls regarding nuisance, injured, or potentially dangerous wildlife in or around buildings, power lines, and work areas. Problem or injured animals included bats (five calls), birds (seven calls), coyotes (nine calls), reptiles (eight calls), and rabbits (one call). Mitigation measures taken usually involved moving the animal away from people or disposing of dead animals. On several occasions, coyotes were chased out of facilities with an air-soft rifle to try to instill fear of humans in animals that were too comfortable around people because they had been fed. Notices were also communicated via radio, e-mail, safety meeting presentations, and various company publications to alert people to potentially dangerous situations involving wildlife and to remind employees not to feed wild animals on the NNSS.

6.8 Coordination with Biologists and Wildlife Agencies

A site biologist attended the Western Bat Working Group meeting in Santa Fe, New Mexico, and serves on the group's Bat Conservation Assessment Committee, which is re-assessing the conservation status of bat species in western North America. The biologist also attended a training course sponsored by Wildlife Acoustics to learn more about new acoustic bat detectors and bat call analysis. Site biologists also attended the Nevada Partners in Flight meeting and published a paper in the Journal of Environmental Radioactivity entitled "Radionuclides in Bats Using a Contaminated Pond on the Nevada National Security Site, USA" (Warren et al. 2014).

7.0 HABITAT RESTORATION MONITORING

7.1 CAU 110, U-3ax/bl Closure Cover

The status of the vegetative cover on Corrective Action Unit (CAU) 110, U-3ax/bl closure cover, was monitored in May 2013. Monitoring is performed to document the establishment of a native plant community and to identify any remedial actions that may be necessary to ensure the plant community persists.

Annual precipitation from January through May 2013 was 34 millimeters (mm), which is about 40% of the 52-year average for the same period. The 34 mm is slightly less than was recorded last year and the second lowest recorded over the last 10 years. Only in 2007 was less precipitation recorded during the first 5 months of the year.

Growing season precipitation, which includes precipitation recorded between October 2012 and May 2013, was 114 mm, which is just slightly less than the 52-average for this period (Table 8-1). Almost half of the precipitation during the growing season came from storms in October 2012 in which over 50 mm of rain was recorded. December 2012 precipitation was slightly above average. November 2012 precipitation was slightly below the 52-year average, as were January and March of 2013. In February and April 2013, no appreciable precipitation events occurred.

Table 8-1. Average annual and growing season precipitation at the BJY weather station near the U-3ax/bl closure site over the last 5 years

	52-Year Average	2009	2010	2011	2012	2013
Calendar Year Jan. to Dec. (mm)	160	98	249	80	173	34
Growing Season Oct. to May (mm)	118	99	146	192	42	114

7.1.1 Plant Cover

Plant cover on the closure cover this year was 23.8% (Table 8-2). Shrubs, primarily *Atriplex confertifolia* (shadscale), make up about three-fourths of the total plant cover. Forbs make up about a quarter of the cover, and invasive weeds make up less than 1%. *Eriogonum deflexum* (flatcrown buckwheat) made up most of the forb cover with lesser contributions from *Chaenactis stevioides* (Esteve's pincushion), *Sisymbrium altissimum* (tumblemustard), *Cryptantha circumscissa* (cushion cryptantha), and *E. nidularium* (birdnest buckwheat). *Bromus tectorum* (cheatgrass) was the only invasive plant present this year.

Plant cover on the reference site is an average of the data collected in 2010 and 2011. Total plant cover was 18.0%, which included shrub, grass, and forb lifeforms. Shrubs accounted for 81% of the total plant cover and forbs the remaining 19%. Perennial grasses did not contribute to plant cover in 2010 or 2011, and invasive weeds were not included (Table 8-2). *Grayia spinosa* (spiny hopsage) contributed the most to total plant cover, followed by *A. canescens* (fourwing saltbush), *Lycium andersonii* (wolfberry), and *Picrothamnus desertorum* (bud sagebrush). Other perennial shrubs contributing to plant cover included *Ephedra nevadensis* (Nevada jointfir), *Ericameria nauseosa* (rabbitbrush), *A. confertifolia*, and *Krascheninnikovia lanata* (winterfat). *Amsinckia tessellata* (bristly fiddleneck) contributed the most to forb cover followed by *E. maculatum* (spotted buckwheat) and *C. stevioides*. *B. rubens* (red brome) was the dominant invasive plant species.

7.1.2 Plant Density

Plant density this year was composed of three plant species, all native shrubs: *A. confertifolia, E. nevadensis*, and *K. lanata.* Over the past several years, these three shrubs have been the only perennial species present on the site. This year plant density for these three species was 1.1 shrubs/m^2 (Table 8-2). *A. confertifolia* continues to be the most abundant species present. The density of both *A. confertifolia* and *E. nevadensis* was slightly lower than it has been the last few years. The density of *K. lanata*, however, was the highest it has been for several years. There were no perennial grasses on the closure cover in 2013 as has been the situation for several years. There were eight different annual forbs and one invasive plant, *B. tectorum*, on the cover cap this year. *E. deflexum* and *C. stevioides* accounted for 86% of the annual forb density. *C. circumscissa* and *S. altissimum* were the only other annual forbs encountered more than rarely.

Table 8-2. Plant cover and density data collected on the U-3ax/bl closure cover in 2013

Lifeform		Plant Cover (%)			Plant Density (plants/m^2)		
		Cover Cap	**Reference**	**Standard**	**Cover Cap**	**Reference**	**Standard**
TOTALS	**Shrubs**	**18.0**	**14.5**	**10.2**	**1.1**	**0.7**	**0.5**
	Grasses	**0.0**	**0.0**	**0.0**	**0.0**	**0.2**	**0.1**
	Forbs	**5.8**	**3.5**	**2.5**	**13.4**	**18.5**	**13.0**
	Total Plant*	**23.8**	**18.0**	**12.7**	**14.5**	**19.4**	**13.6**
	Bare Ground/Rock	56.0	40.5				
	Litter	19.8	29.0				
	Invasive Plants	**0.4**	**12.5**		**8.0**	**24.7**	

* Does not include invasive weeds

Plant density on the reference area, like plant cover, is the average plant density over 2010 and 2011. Average plant density for the reference site was 44.1 plants/m^2. Shrub density was 0.7 plants/m^2, grass density 0.2 plants/m^2, forb density 18.5 plants/m^2, and invasive plant density 24.7 plants/m^2. Annual forbs and invasive plants were the most abundant groups of plants in 2010 and 2011. *G. spinosa* was the most abundant shrub present, followed by *K. lanata, A. canescens*, and *P. desertorum*. *Achnatherum hymenoides* (Indian ricegrass) was the most abundant perennial grass.

7.1.3 Species Richness

There was an average of 4.1 species within a 1 m^2 quadrat in 2013 (Table 8-3), up from the record low of just 1.0 species/quadrat last year. The 1.1 shrubs/quadrat is close to the same it has been the last 6 years. *A. confertifolia* and *E. nevadensis* continue to be the most common shrubs. *K. lanata*, although rarely encountered, was more common this year than in recent years.

The average species richness value for the reference area is 4.6 species/quadrat (Table 8-3). There were 23 different species found on the reference area. There was an average of 0.7 shrubs, 0.2 grasses, and 3.7 forbs found within each quadrat sampled. Overall, 5 shrub species, 2 different grasses, and 13 forbs are found on the reference area along with 3 invasive weedy species.

Table 8-3. Average species richness for the closure cover and reference site in 2013. Species richness is defined as the average number of different species found within a 1 m^2 quadrat.

Lifeform	Closure Cover	Reference*	Standard
Shrubs	1.1	0.7	0.5
Grasses	0.0	0.2	0.1
Forbs	2.2	3.7	2.6
Total	**3.3**	**4.6**	**3.2**
Invasive	0.8	1.4	

*Average of 2010 and 2011 data

7.1.4 Remedial Revegetation

The survival of the 125 shrubs planted at three small areas on the eastern edge of the closure cover was evaluated in May 2013. As of May 2013, 18% of the transplants planted in March 2010 have survived (Table 8-4). This percentage is not indicative of the survival of the 125 transplants, however. The middle area where the majority of the transplants were planted was subject to some remediation work that included soil surface scraping and the addition of several centimeters of soil, which severely impacted all of the transplants at this site. There were only four transplants still alive on the site this spring. This compares to 54 transplants found in good condition at this site in January 2011. The south site was not impacted by the remediation work, and transplant survival at this site was 52%, a decline from the nearly 90% survival rate in 2011. At the north site, only 13 transplants were planted in 2010. In January 2011, six were still alive. This year only two plants were found alive.

Excluding the middle site, *E. fasciculatum* shows the greatest percentage survival of the five species (Table 8-4), followed by *K. lanata*, *E. nevadensis*, *C. viscidiflorus*, and *G. spinosa*. Overall transplant survival on the north and south sites was 41%.

Table 8-4. Number of transplants by species planted on the U-3ax/bl closure cover in March 2010. The number of plants alive as of May 2013 is in parentheses.

Plant	South	Middle	North	All Sites
Eriogonum fasciculatum	5 (5)	13 (0)	2 (0)	20 (5) 25%
Ephedra nevadensis	9 (5)	26 (3)	5 (1)	40 (9) 23%
Grayia spinosa	5 (1)	13 (0)	2 (0)	20 (1) 5%
Krascheninnikovia lanata	5 (3)	13 (1)	2 (1)	20 (5) 25%
Chrysothamnus viscidiflorus	7 (2)	16 (0)	2 (0)	25 (2) 8%
Totals	**31 (16)**	**81 (4)**	**13 (2)**	**125 (22)**
Percent Survival	**52%**	**5%**	**15%**	**18%**

7.1.5 Summary

The vegetative cover on the U-3ax/bl cover cap appears to be a stable plant community with persistent perennial shrubs and new plant recruitment. The annual forb component of the plant community fluctuates with the availability and timing of precipitation. There was a marked increase in the amount of shrub cover this year, probably the result of the late summer and fall rains received in 2012. The 17% *A. confertifolia* cover this year was the second highest recorded at the site. *A. confertifolia* density decreased slightly from last year, but the increase in cover suggests that even though there are fewer plants, the ones that remain are increasing in size. *E. nevadensis* cover increased also and, like

A. confertifolia, density decreased. Many *E. nevadensis* plants were flowering and setting seed, something not observed in recent years (Figure 8-1). The density of *K. lanata* was the highest since 2007 and many, like *E. nevadensis*, showed good annual growth and had flowered and set seed.

Another indication of the stability of the plant community on the closure cover was the presence of several young plants of *A. confertifolia* and *K. lanata* (Figure 8-1). These young plants mostly likely established from seed dispersed by plants growing on the closure cover. None of the shrubs encountered on the closure cover showed signs of stress. Skeletons of plants, mainly *A. confertifolia*, are uncommon but not unexpected as the high densities experienced the first few years after revegetation have declined in recent years as perennial plants reach an equilibrium with the limited resources at this site.

Figure 8-1. Young plants of *E. nevadensis* (left) and *K. lanata* (right) established on CAU 110, U-3ax/bl closure cover

(Photos by D. C. Anderson, May 2013)

Spring rains this year were below normal, which resulted in a meager showing of annual forbs. In 2010, when spring rains were quite abundant, annual forb density was over 100 plants/m^2. This year forb density was 13 plants/m^2. Invasive weeds have never been a problem on the closure cover. This year *B. tectorum* was occasionally found, but no *Halogeton glomeratus* (halogeton) was observed, not even young seedlings.

The similarity of the plant community that has established on the U-3ax/bl closure cover to a comparable native plant community is quantified by comparing the amount of plant cover and plant density between the two sites. The plant community on the closure cover is considered to be similar to adjacent native plant communities when plant cover and density are at least 70% of what is recorded for the native plant community. Plant cover on the reference area, which represents a native plant community, is 18%; therefore, if cover on the U-3ax/bl closure cover meets or exceeds 12.6% (70% × 18.0% = 12.6%), it could be considered successfully revegetated. Plant cover on the closure cover this year is 23.8%, which exceeds the revegetation success standard. Shrubs are the major component of plant cover on both the closure cover and the native plant community and account for 75% and 80% of the total plant cover, respectively. Forb cover accounts for the balance of the cover because perennial grasses do not contribute to plant cover on either the reference area or U-3ax/bl closure cover.

Plant density on the U-3ax/bl closure cover this year is 14.5 plants/m^2 compared to the reclamation success standard of 13.6 plants/m^2. The reclamation success standard for shrubs is 0.5 shrubs/m^2 and grasses 0.1 grasses/m^2. The most common shrubs on the reference site are *L. andersonii*, *G. spinosa*, *K. lanata*, *A. canescens*, and *P. desertorum*. The most common shrubs on the U-3ax/bl closure cover are *A. confertifolia*, *E. nevadensis*, and *K. lanata*. *A. hymenoides* is the most common perennial grass on the reference site. There have been no perennial grasses on the U-3ax/bl closure cover for the last several years. Forbs make up the majority of the plant density on both the U-3ax/bl closure cover and the reference area. In 2013, there were 13.4 forbs/m^2 on the U-3ax/bl closure cover and 18.5 forbs/m^2 on the reference area.

Overall plant cover and density estimates for the U-3ax/bl closure cover exceeds the reclamation success standards. The plant community that has established on the CAU 110, U-3ax/bl closure cover, represents a stable plant community (Figure 8-2). Perennial plant cover and density have maintained at essentially the same levels over the last 5 years. No significant declines have been noted nor have there been significant increases in invasive annuals. Overall, there are no major concerns for the plant community that has established on the U-3ax/bl closure cover.

Figure 8-2. Plant community on the U-3ax/bl closure cover in May 2013
(Photo by D. C. Anderson, May 2013)

7.2 CAU 400, Five Points Landfill

Vegetation monitoring was conducted in June 2013 at CAU 400, referred to as Five Points Landfill, on the TTR. Five transects were sampled in the staging area that had not flooded and three in the area that was flooded and re-seeded in 2004. The reference area was sampled from 2000 to 2010. Data collected during that period were averaged to determine reclamation success standards.

7.2.1 Plant Cover – Staging Area

Plant cover on the staging area this year was 19% and included a mix of perennial shrubs and grasses and annual forbs (Table 8-5). *A. canescens* continues to be the dominant shrub and made up about half of the total plant cover. *A. hymenoides*, a perennial grass, made up about one-fourth of the plant cover, and *C. stevioides*, an annual forb, accounted for the remaining one-fourth.

The 19% plant cover this year represents an average year. Plant cover averaged 18% over the last 13 years. The lowest recorded was last year, which was just 9%. The highest plant cover recorded was 33% and occurred just a couple of years after the site was revegetated. Shrub cover alone for this same time period averaged 9%. This year's 10% shrub cover is the highest recorded since 2007 and 2006 and increased a couple of percentage points over the last 5 years. Grass cover this year was 4%, slightly below the 13-year average of 6%. However, the 4% is the second highest grass cover recorded over the last 10 years, only second to 6% recorded in 2006. Grass cover this year is about 3 times what it was last year. Forb cover fluctuates dramatically from year to year, which is inherent with annual plants. The 5% forb cover this year is equal to the long-term forb cover average for the site. Over the 10 years prior to 2013, there was no forb cover during 3 years, during 4 years there was less than 5%, and in 3 years forb cover was higher than 5%.

Table 8-5. Plant cover (percent) on CAU 400, Five Points Landfill

Lifeform		Staging	Re-Seeded	Reference	Standard
TOTALS	Shrubs	10.0	10.0	8.2	5.7
	Grasses	4.4	0.0	5.0	3.5
	Forbs	5.0	32.5	4.2	2.9
	Plant Cover*	19.4	42.5	17.4	12.1
	Bare Ground	57.5	47.5	68.2	
	Litter	23.1	10.0	14.5	
	Invasive Weed	0.0	0.0	0.3	

* Does not include invasive weeds

7.2.2 Plant Density – Staging Area

Plant density on the staging area was 7.4 plants/m^2 this year and included 0.8 shrubs/m^2, 0.2 grasses/m^2, and 6.4 forbs/m^2 (Table 8-6). Three perennial species were encountered and included one shrub, *A. canescens*, and two grasses, *A. hymenoides* and *Pleuraphis jamesii* (James' galleta grass). Forb density was made up primarily by *C. stevioides* with minor contributions from three other forbs. *Salsola tragus* (prickly Russian thistle), an invasive species, was present this year, but density was only 0.3 plants/m^2.

Shrub density this year is about what it has been for the last 5 years, but a little higher than it has been the last 3 years. It is slightly less than the 10-year average. Of note this year is the absence of *P. desertorum* for the first time in the last 8 years. The density of *P. desertorum* has never been high, but it has been present on the site since 2006. The dry spring and early summer may explain its absence this year. The density of grasses this year is below the 5-year average but the same as last year's. Grass density this year is about half of the highest grass densities recorded over the last 5 years. The density of forbs at this site ranges from 0 to almost 75 plants/m^2. This year's 6.4 plants/m^2 is about a third of the 5-year average.

Table 8-6. Plant density (plants/m^2) on CAU 400, Five Points Landfill

Lifeform		Staging	Re-Seeded	Reference	Standard
TOTALS	Shrubs	0.8	0.6	0.8	0.6
	Grasses	0.2	0.1	1.6	1.1
	Forbs	6.4	11.8	17.6	12.3
	Total Plant*	**7.4**	**12.6**	**20.0**	**14.0***
	Invasive Plants	0.3	0.0	1.6	

* Does not include invasive weed density

7.2.3 Species Richness – Staging Area

Species richness varies based on the timing and amount of precipitation. Precipitation was below average this year, resulting in fewer species per quadrat. The 1.8 species per quadrat (Table 8-7) this year included all three life forms (shrubs, perennial grasses, and forbs) and was below the 10-year average of 2.8 species/quadrat. Species richness was higher than last year, but below the previous 3 years. Shrub species richness of 0.4 shrubs/quadrat was the highest it has been since 2006 and just below the 10-year average of 0.5 shrubs/quadrat. This year *A. canescens* was the only shrub found on the site. In previous years *P. desertorum* was also present. Grass species richness of 0.2 grasses/quadrat was low this year compared to the 10-year average of 0.5 grasses/quadrat, but about what it has been 3 out of the last 5 years. Species richness of grasses is about half of the 10-year average. *A. hymenoides* and *Elymus elymoides* (squirreltail grass) are the only two perennial grasses found on the site. Forbs are occasionally common on the staging area but were relatively uncommon this year. Forb species richness was only 1.2 forbs/quadrat with the most common species being *C. stevioides*. Last year the most common forb was *Mentzelia albicaulis* (whitestem blazingstar). This year it was not present.

Table 8-7. Species richness (species/m^2) on CAU 400, Five Points Landfill

Lifeform	Staging	Re-Seeded	Reference	Standard
Shrubs	0.4	0.4	0.6	0.4
Grasses	0.2	0.1	0.9	0.6
Forbs	1.2	1.4	2.6	1.8
Total Species	**1.8**	**1.9**	**4.1**	**2.9**

7.2.4 Plant Cover – Re-seeded Area

Plant cover on the re-seeded area was 42.5% and was made up of one perennial shrub, *A. canescens*, and two forbs, *Descurainia sophia* (herb Sophia) and *D. pinnata* (western tansymustard) (Table 8-5). This is the highest plant cover recorded on the re-seeded area since the site was flooded and vegetation lost in 2006. Of the 42.5%, only 10% was perennial plant cover, specifically *A. canescens*. The other 32.5% was from the two annual forbs. There was 23% cover in 2010, but 20% was from annual forbs. Shrub cover has progressively increased over the last 5 years, even in times of relatively dry conditions.

7.2.5 Density

Plant density on the re-seeded area was 12.6 plants/m^2, the highest it has been since the site was flooded in 2006 (Table 8-6). Shrub density was 0.6 shrubs/m^2 this year, which is double what it was last year and 4 times the average shrub density since the area was flooded. Shrub density is composed of a single species, *A. canescens*. Although grass density was low (0.1 grasses/m^2), it is the highest it has been for the last 3 years. The perennial grasses present were *A. hymenoides* and *E. elymoides*. Grass density is still slightly below the average grass density since the area was flooded in 2006. Forb density on the re-seeded area was the highest it has ever been since the area was flooded in 2006. *D. pinnata* was the most common forb and, in fact, accounted for 82% of the forb density and 75% of the total plant density. There were three other forbs, but their contribution was relatively insignificant. The only invasive weed present was *S. tragus* at a density of 0.3 plants/m^2.

7.2.6 Species Richness

Species richness on the re-seeded area was 1.9 species/quadrat (Table 8-7), which is slightly higher than species richness on the staging area. As mentioned previously *A. canescens* is the only shrub on the re-seeded area. Perennial grass species richness was greater than zero this year after being absent last year with 0.1 grasses/quadrat in 2011. The number of forb species/quadrat was the highest it has been (1.4 species/quadrat) over the last 3 years and about 50% higher than it has been since the area was flooded.

7.2.7 Revegetation Success – Staging Area

The amount of plant cover on the staging area this year exceeded the revegetation success standards. Not only did total plant cover exceed standards, but each of the three plant life forms exceeded revegetation success standards. The standard for total plant cover is 12.1%, and there was a total of 19.4% plant cover on the staging area. The 10.0% shrub cover exceeded the standard for shrubs at 5.7%. Grasses were 4.4% compared to a standard of 3.5% grass cover. Forb cover this year was 5.0% and exceeded the standard of 2.9%. Non-invasive forbs and invasive weeds were represented by a single species this year, *S. tragus*, and total cover was only 0.3%.

The amount of shrub cover on the staging area has exceeded the revegetation success standard for shrub cover since 2002, just a couple years after it was revegetated. Grasses have not done quite as well. This year, for the first time since 2007, the amount of grass cover exceeded the success standard for grass cover. Grasses are more susceptible to drought conditions, whereas the shrubs are more persistent. Forbs fluctuate significantly from year to year and are not good indicators of revegetation success like shrubs and grasses are. When forbs are present, the amount of forb cover typically exceeds or comes close to meeting revegetation success standards.

Total plant density for 2013 was 7.4 plants/m^2, which is only about half of the density revegetation success standard. However, when density is evaluated by lifeform, the 7.4 plants/m^2 is more encouraging. For example, the density of shrubs this year was 0.8 shrubs/m^2, which exceeds the revegetation success standard of 0.6 shrubs/m^2. In fact, shrub density has exceeded the revegetation success standard every year since the site was first sampled in 1998. The density of grasses was not as good. Grass density this year was 0.2 grasses/m^2, well short of the revegetation success standard of 1.1 grasses/m^2. Grass density has not exceeded the revegetation success standard since 2007. The average grass density for the period since 2007 is 0.3 grasses/m^2. Forb density is about half the revegetation success standard and has only exceeded the standard twice since the second flood in 2006.

Species richness this year was 1.8 species/quadrat, which is about 60% of the revegetation standard. Shrub species richness actually meets the standard; however, grass species richness is about one-third of the standard, and forb species richness about two-thirds. The average species richness for perennial shrubs and grasses for the last 10 years is 1.0 species/quadrat, which meets the revegetation success standard for the same two lifeforms. Again, because forbs fluctuate so much from year to year, they are not as good of an indicator of revegetation success.

7.2.8 Revegetation Success – Re-seeded Area

Total plant cover on the re-seeded area was about 3.5 times the revegetation success standard for plant cover. Shrub cover was almost double the revegetation success standard, and forbs 10 times the success standard. Grasses are still not contributing to plant cover as has been the case the last 3 years. Shrub cover exceeded the success standard the last 3 years. Forb cover only contributed to plant cover in 2 of the last 5 years but exceeded success standards both years.

Although plant density on the re-seeded area was about double the density on the staging area, it was still just 90% of the success standard for plant density. Shrub density was equal to the success standard, but grass density was not quite 10% of the standard, and forb density was 96% of the standard. This is the first year since the second flooding in the summer of 2006 that shrub density has met revegetation success standards. This is the first year in the last 3 years that grasses were present, and forb density this year was the highest ever. All are good indications that, although success standards were not achieved this year, both grasses and forbs are beginning to establish on the site and with time will contribute more to both plant density and plant cover (Figure 8-3).

Figure 8-3. Plant community on CAU 400, Five Points Landfill site in May 2013
(Photo by D. C. Anderson, June 2013)

Species richness was nearly the same on the re-seeded area as the staging area and about 64% of the revegetation success standard. Shrub species richness equaled the success standard, grasses were about one-fifth of the standard, and forbs about three-fourths. Species richness was the third highest recorded for the re-seeded area since the site was flooded.

7.2.9 Summary

Average annual precipitation at the TTR has been below average the last several years. Some late summer and early winter storms recharged the soils this growing season, which appears to have favored increased growth more in perennial shrubs and grasses than in forbs. The plant community on the Five Points Landfill staging area appears stable and in fact meets revegetation success standards (Figure 8-3). The plant community on the re-seeded area has struggled becoming established with repeated setbacks from surface flooding. However, shrubs are becoming well established, and this year there are signs of perennial grasses moving back on to the area as well as native annual plants. With time this area appears to be on track to meet revegetation success standards. Flooding is always a concern at the Five Points Landfill because it is situated along a natural drainage. However, over time the area seems to rebound from the effects of flooding with or without remedial revegetation efforts.

7.3 CAU 407, Rollercoaster RADSAFE

Three transects were sampled in 2013 at the Rollercoaster RADSAFE site. Reclamation success standards were determined by averaging data collected at a reference site from 2000 to 2009. The reference site is located less than a mile north of CAU 407. Repairs to the Rollercoaster RADSAFE cover cap were made in 2004, which resulted in the loss of vegetation on the site and required remedial revegetation. The cover cap and side slopes were seeded, and a biodegradable erosion control blanket was installed in the fall of 2004 to minimize erosion on the side slopes.

Vegetation monitoring was conducted in June 2013 at the Rollercoaster RADSAFE site. This section documents the status of the vegetation community that has established on the site and identifies any concerns or issues related to its status.

7.3.1 Plant Cover

Plant cover at the Rollercoaster RADSAFE site was 14.2% (Table 8-8) in 2013, all from *A. confertifolia*. *A. canescens* and occasionally a few native forbs have commonly contributed to total plant cover, but not this year. The 14.2% plant cover is higher than last year and the same as it was in 2011 but below the 8-year high of 20.8% in 2010. Perennial grasses have never contributed significantly to plant cover at this site and have not been part of total plant cover since 2009. Annual forbs have contributed to plant cover on the Rollercoaster RADSAFE site cover 4 of the last 8 years. There has been no forb cover the last 2 years, as was the case in 2007 and 2009.

Table 8-8. Plant cover (percent) on the Rollercoaster RADSAFE site

Lifeform		Cover	Reference	Standard
TOTALS	**Shrubs**	14.2	9.4	6.6
	Grasses	0.0	1.8	1.3
	Forbs	0.0	1.9	1.3
	Plant Cover	**14.2**	**13.2**	**9.2***
	Invasive Plants	0.0	0.1	
	Bare Ground	71.6	69.6	
	Litter	14.2	17.2	

* Does not include invasive weeds

7.3.2 Plant Density

Plant density on the Rollercoaster RADSAFE site was 12.3 plants/m^2 this year and included three perennial shrubs (Table 8-9). The most abundant shrub was *A. confertifolia* with a density of

11.0 plants/m^2, which has been the average density for this species over the last 5 years. *A. canescens* was rarely encountered this year as was *K. lanata*. *A. canescens* was relatively abundant between 2005 and 2009 but has steadily declined the last 5 years, although density this year was higher than it has been the previously 2 years. *K. lanata* was never commonly encountered on the site. The 0.7 plants/ m^2 this year is the highest density recorded since 2007 and an improvement over the last 2 years.

Table 8-9. Plant density (plants/m^2) on the Rollercoaster RADSAFE site

Lifeform		Cover	Reference	Standard
TOTALS	Shrubs	12.3	4.0	2.8
	Grasses	0.0	1.7	1.2
	Forbs	0.0	9.8	6.9
	Total Plant*	**12.3**	**15.9**	**10.9***
	Invasive Plants	0.0	0.3	

* Does not include invasive weeds

7.3.3 Species Richness

There was an average of 0.9 species encountered per quadrat on the CAU 407 cover (Table 8-10) this year, which is what it has been the last 2 years. Also, like the last 3 years, there were no grasses or forbs.

Table 8-10. Species richness (species/m^2) on the Rollercoaster RADSAFE site

Lifeform	Cover	Reference	Standard
Shrubs	0.9	1.6	1.1
Grasses	0.0	0.5	0.4
Forbs	0.0	1.1	0.8
Total Species	**0.9**	**3.2**	**2.3**

7.3.4 Revegetation Success

Even with the relatively low plant cover and density this year, these two parameters met revegetation success standards (Tables 8-7 and 8-8). Although plant cover on the Rollercoaster RADSAFE site was about 50% higher than the revegetation success standard, there is still a concern because all of the plant cover is from shrubs. It is anticipated that under better growing conditions than have been experienced the last few years, grasses and forbs will become more common on the site. Plant density is the same. Total plant density is higher than the revegetation success standard of 10.9 plants/m^2, but again the only plants present were three perennial shrubs—no grasses or forbs. The third parameter measured reflects low species richness on the site. Species richness is 0.9 species/quadrat this year and has not been above that value the last 3 years. The revegetation success standard for species richness is 2.3 species/quadrat, a value that has not been achieved since 2006, just a couple of years after the site was re-seeded.

7.3.5 Summary

Corrective measures taken previously at the Rollercoaster RADSAFE site appear to be controlling severe erosion. The animal burrows, primarily along the southern slope, do not appear to be frequently used, and there are no signs of subsurface soils being carried to the surface.

Of minor concern is the lack of plant diversity at the CAU 407 site. Precipitation the last several years has been almost at drought levels. A few significant rains fell in the fall of 2012, which helped the shrubs, but the lack of spring and summer precipitation seems to perpetuate the absence of grasses and annual forbs.

Shrubs have established on the site, however, and seem to provide the site sufficient protection from erosion (Figure 8-4). As observed in previous years, plants that have established on the site appear smaller than would be expected and may be the result of subsurface compacted soils. As years of higher precipitation occur, the compacted soils may loosen and allow greater root penetration and better plant growth.

Figure 8-4. Plant community on the CAU 407, Rollercoaster RADSAFE site in June 2013
(Photo by D. C. Anderson, June 2013)

7.4 CAU 111, 92-Acre Site

CAU 111, the 92-Acre Site, encompasses the southern portion of the Area 5 RWMC and under closure operations was revegetated during the fall of 2011 (Hall et al. 2013). The objective of the revegetation efforts was to establish a native perennial plant community on the closure cover incorporating reclamation techniques used at other sites on the NNSS (Hall and Anderson 1999, Ostler et al. 2002, Anderson and Ostler 2002). The tasks this year included monitoring the vegetation that established on the 92-Acre Site and determining remediation actions that should be taken, if necessary.

7.4.1 Vegetation Monitoring

Monitoring of revegetation success was first completed in the spring of 2013. Permanent monitoring transects, each 100 m in length, were established on the four closure covers. There were 8 transects on the North-North Cover, 30 on the North-South Cover, 46 on the South Cover, and 46 on the West Cover. A representative number of transects were randomly selected to be sampled in 2013 for each cover. Four transects were selected to be sampled on the North-North Cover, 8 on the North-South Cover, 17 on the South Cover, and 11 on the West Cover. Only density was sampled this year and was accomplished by placing a 1 m^2 quadrat at 5 m intervals along each 100 m transect and recording the number of plants, by species, found within the quadrat. Plant density estimates were averaged over all quadrats and reported as number of plants per m^2.

In December 2012, several seedlings and established plants were observed on the 92-Acre Site. The most common shrubs encountered were *Larrea tridentata* (creosote bush), *A. canescens*, *E. nevadensis*, and *A. confertifolia* (Figure 8-5). *Ambrosia dumosa* (burrobush) was also observed but was uncommon. *A. hymenoides*, a perennial grass, was observed on the site as was *Baileya multiradiata* (desert marigold), a common perennial forb on the NNSS.

Vegetation monitoring was performed on May 7. Three different shrubs were encountered during sampling, *A. canescens*, *A. confertifolia*, and *E. nevadensis* (Table 8-11). *E. nevadensis* was the most common of the three, with an overall density of 0.041 plants/m^2. *A. canescens* density was 0.013 plants/m^2, and *A. confertifolia* density was the lowest at 0.004 plants/m^2. A few individuals of *A. hymenoides* were encountered but only on the North-North Cover. There were more dead plants encountered than live plants (Table 8-11) in approximately the same species ratios. Seedlings of *A. dumosa* and *L. tridentata* were frequently observed in December, but by May none were observed on any of the closure covers.

Table 8-11. Summary of vegetation monitoring and wildlife observations on 92-Acre Site in 2013

	Plant Density (plants/m^2)				
Plant Species	**North-North Cover**	**North-South Cover**	**South Cover**	**West Cover**	**Average**
Atriplex canescens	0.01	0.01	0.02	0.01	0.013
Ephedra nevadensis	0.08	0.06	0.01	0.02	0.041
Atriplex confertifolia		0.01		0.01	.0004
Achnatherum hymenoides	0.01				0.003
Atriplex canescens-dead	0.03	0.07	0.01		0.025
Ephedra nevadensis-dead	0.13	0.03	0.01	0.01	0.040
Atriplex confertifolia-dead	0.03	0.01	0.02		0.016
Larrea tridentata-dead		0.02			0.006
Animal Observations	**North-North Cover**	**North-South Cover**	**South Cover**	**West Cover**	
Small Mammal Burrow Complexes	0	0	12	13	
Average # Burrows/Complex	0	0	3	1	
Ant hills	0	0	2	2	

Figure 8-5. Young seedlings encountered on the 92-Acre Site in the fall of 2012. *L. tridentata* (upper left), *A. confertifolia* (upper center), *A. dumosa* (upper right), *E. nevadensis* (lower left), *A. hymenoides* (lower center), and *A. canescens* (lower right).

(Photos by D. C. Anderson, December 2012)

The cause of the low germination success and the subsequent low survival rate is unknown. One possible reason would be related to precipitation. The last 2 years have been the driest in the last decade. There was essentially no precipitation during the fall and early winter months immediately following seeding. Irrigation did not begin until January, and seeds may have needed more moisture in November and December to break dormancy and germinate. Previous successful re-seeding projects on the NNSS either included a fall irrigation or there was significant precipitation received in November and December immediately following seeding.

Two other factors may have played a role in the diminished germination and survival rates. The surface soils on the closure covers contained an unexpected high concentration of weeds, mainly *H. glomeratus* and *S. tragus*. Supplemental irrigation in the winter and spring months promoted seed germination and plant growth for both these species, which resulted in a dense cover of invasive weeds. High densities were experienced on the North-North Cover and the northern section of the West Cover. These invasive weedy species may have utilized the majority of the moisture in the soil thus decreasing the soil moisture needed for seed germination and plant establishment.

The other possible factor that may have led to the sudden and universal death of the young seedlings was a drop in temperatures for about a week in February 2013. Temperatures dropped into the single digits for 3 consecutive days and may have had a detrimental effect on the young seedlings, even though the species affected are native to the area and would be expected to be tolerant of such temperatures. There was no evidence that the plants had been browsed. Even the dead plants observed were intact plants, most with leaves still present (Figure 8-6).

Figure 8-6. A young *L. tridentata* seedling established on the 92-Acre Site in December 2012 (left) and a dead plant on site in May 2013 (right)

(Photos by D. C. Anderson, December 2012 and May 2013)

7.4.2 Remedial Revegetation

Based on the results of the vegetation monitoring conducted this year, remedial revegetation was recommended in order to establish a vegetative cover at the 92-Acre Site. The approach taken was to evaluate different methods of seeding and mulching rates at one of the four closure cover sites. Once a successful methodology is identified, then the other three sites will be revegetated. The North-North Cover was selected to be revegetated this year. The site was divided into four areas. Two areas were broadcast seeded at a rate of 23.0 kilograms (kg) of Pure Live Seed (PLS) per ha, and the other two sites were hydroseeded at a rate of 33.6 kg of PLS/ha. The seed mix used included native shrubs and grasses, including *A. hymenoides*, *A. dumosa*, *A. canescens*, *A. confertifolia*, *B. multiradiata*, *E. elymoides* (squirreltail), *Encelia farinosa* (brittlebush), *E. nevadensis*, *L. tridentata*, and *Sphaeralcea ambigua* (desert globemallow).

A renewable natural straw fiber mulch (Hydrostraw®) was used to mulch all four areas. One of the areas that was broadcast seeded and one that was hydroseeded was hydromulched at a rate of 2,240 kg/ha, and the other two sites were hydromulched at a rate of 3,360 kg/ha. The side slopes were hydroseeded and hydromulched at 33.6 kg/ha and 2,240 kg/ha, respectively. Seeding and mulching occurred between October 24 and October 30, 2013.

To provide the optimum opportunity for germination and eventual plant establishment, the four areas were irrigated. Irrigation lines were flushed and supplemental irrigation, equivalent to 5 mm of precipitation, was applied on November 13, and an additional 8 mm was applied on November 14. An additional 13 mm of supplemental irrigation was scheduled for December. However, during a relatively warm winter storm in late November, 22 mm of precipitation was recorded at the Area 5 RWMC, thus negating the need for any supplemental irrigation in December. Supplemental irrigation will continue in 2014.

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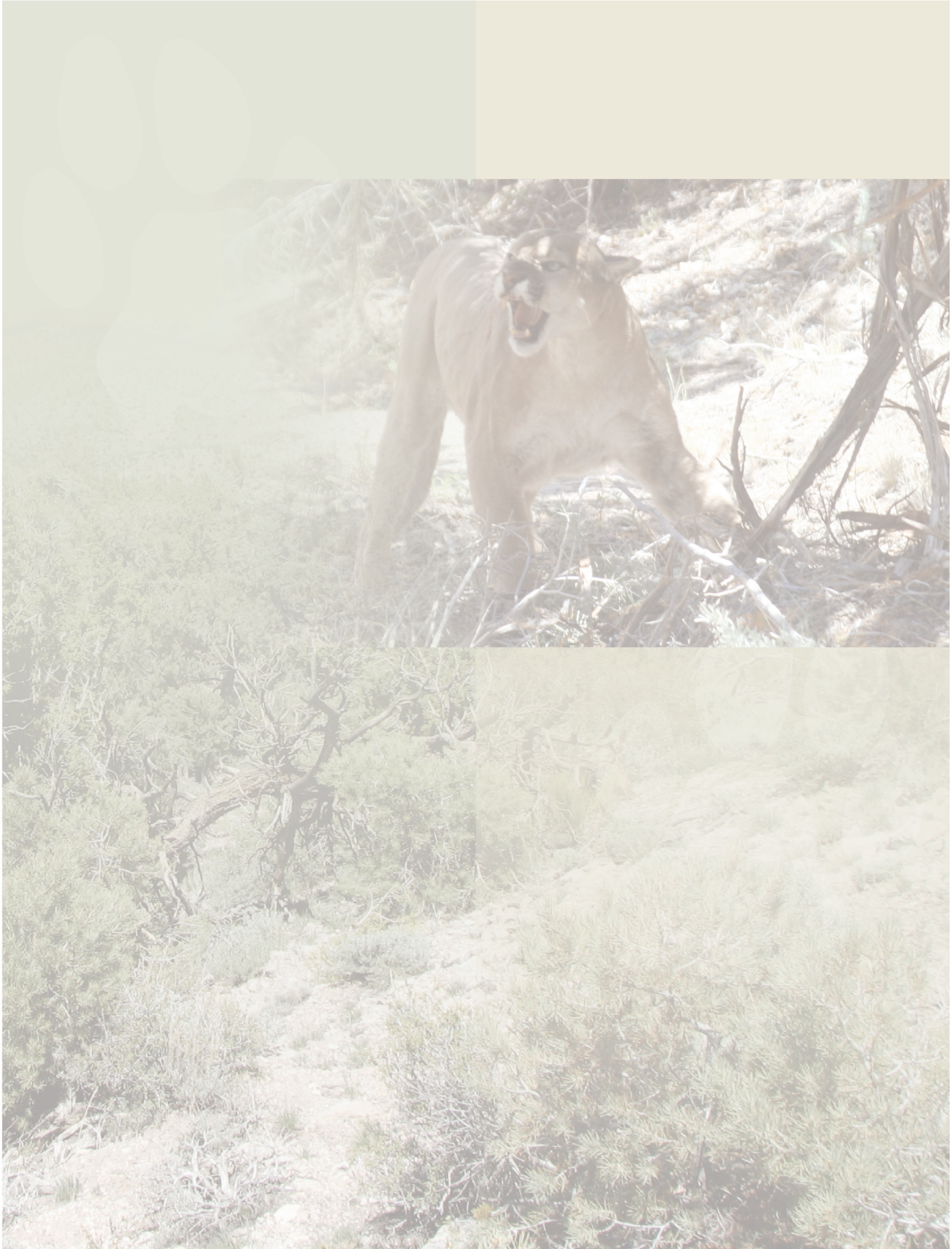

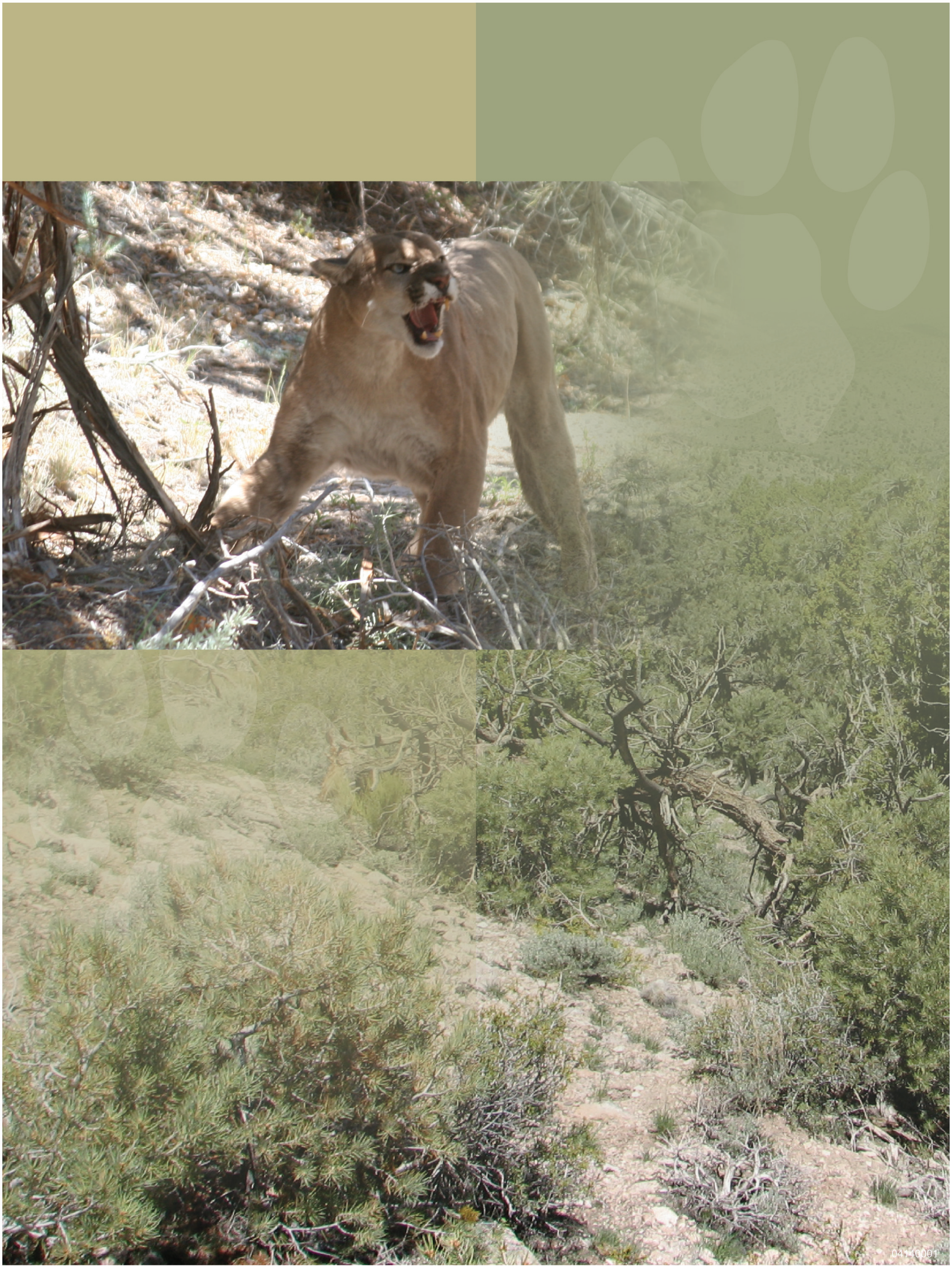

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