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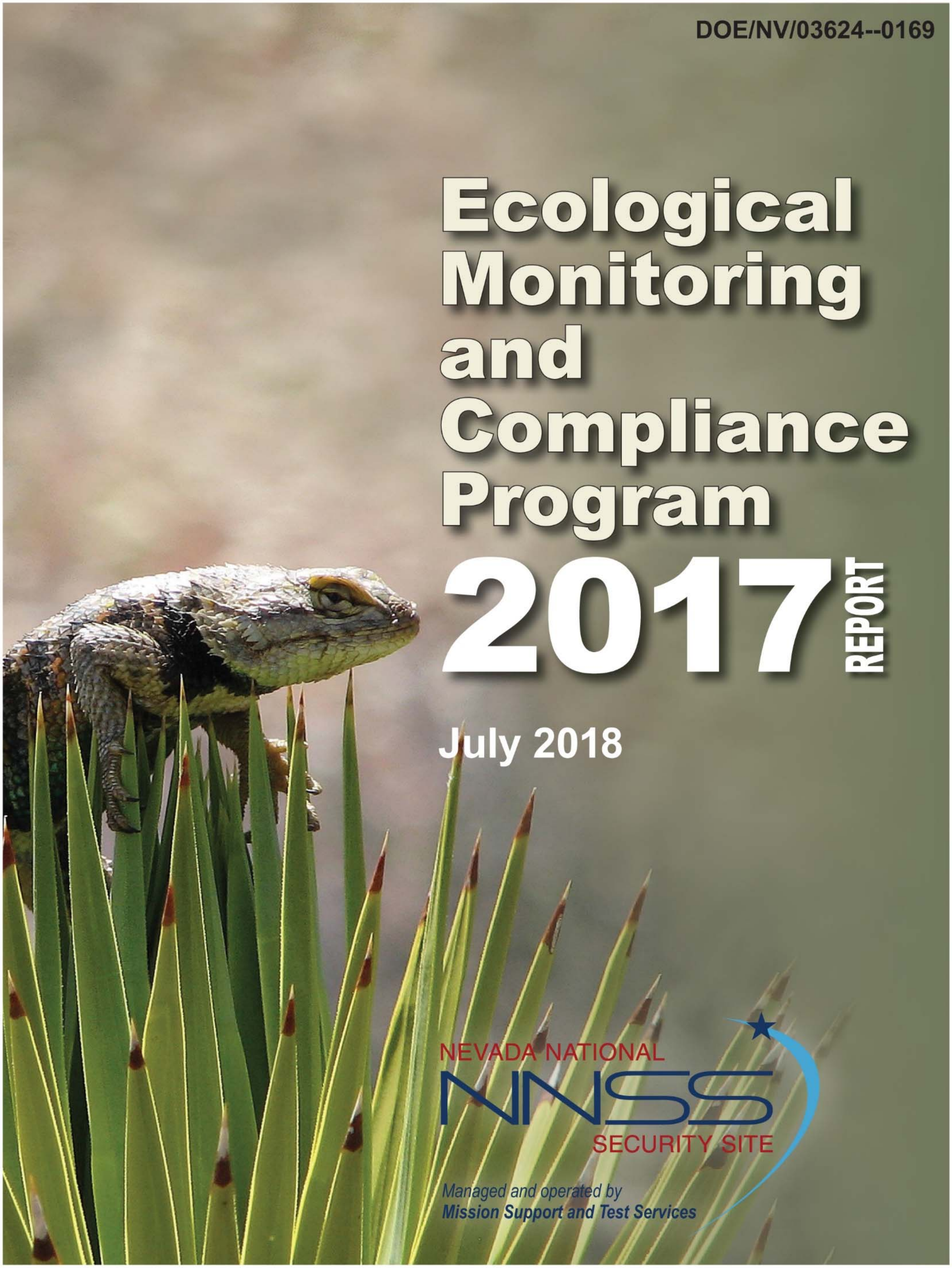

Ecological Monitoring and Compliance Program 2017 REPORT

July 2018

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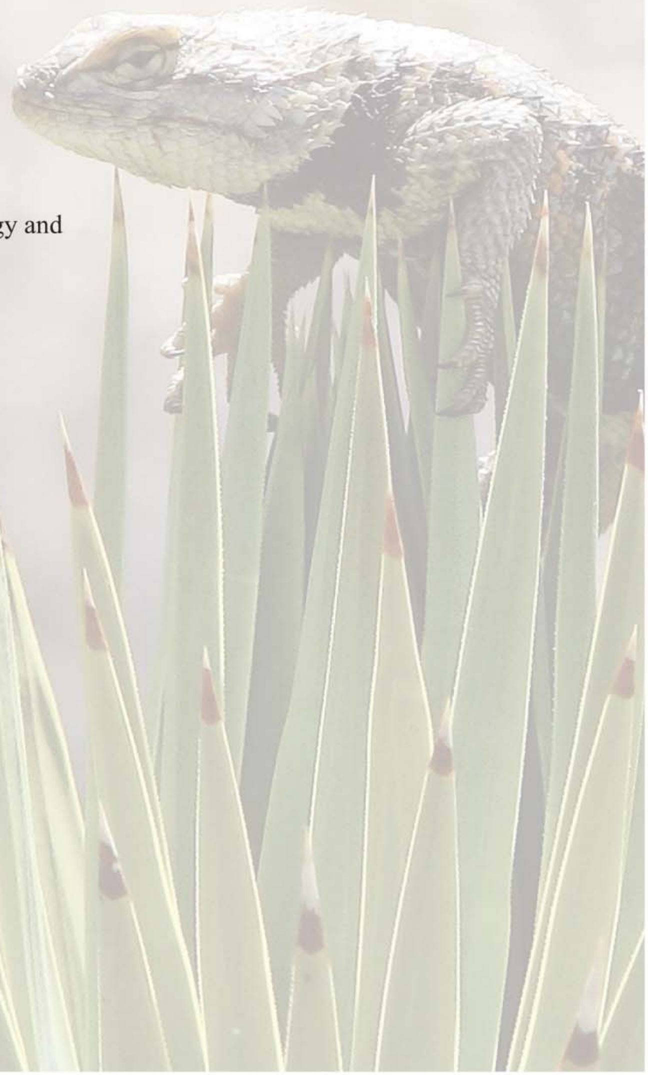

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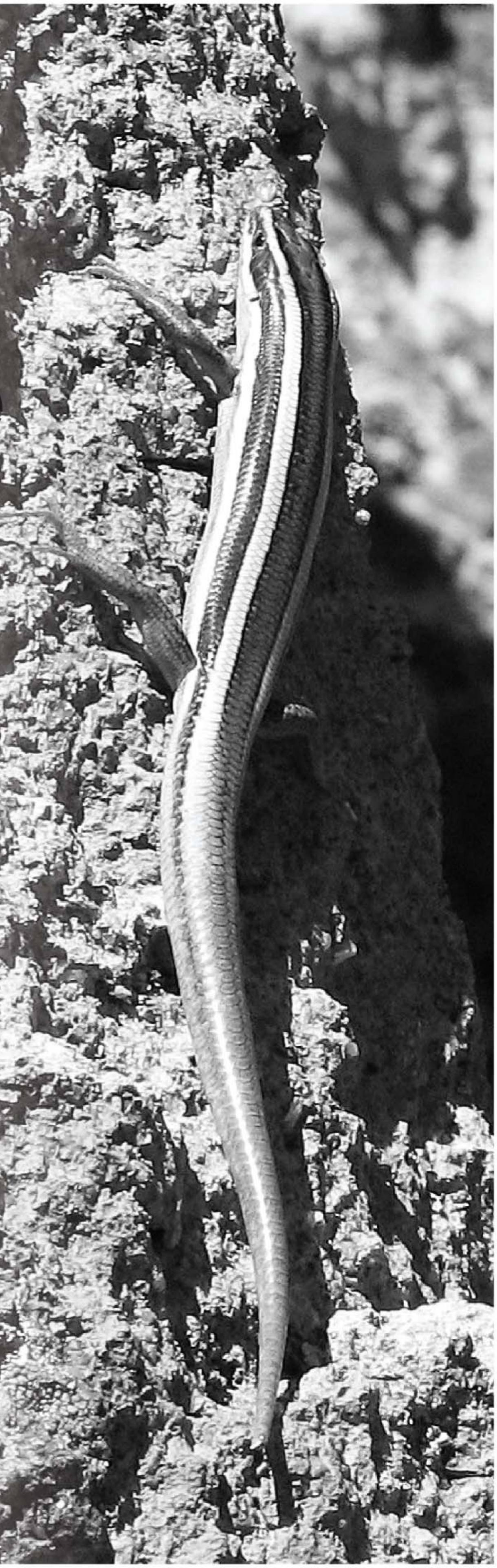
Ecological Monitoring and Compliance Program

2017 REPORT

Derek B. Hall and
Jeanette A. Perry

July 2018



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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), 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) and Mission Support and Test Services, LLC (MSTS), during calendar year 2017. 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 2017, all applicable laws, regulations, and most 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, 240 birds, and 23 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*) and the western yellow-billed cuckoo (*Coccyzus americanus*) are the only species on the NNSS protected under the *Endangered Species Act*, both listed as threatened. However, only one record of the cuckoo has been documented on the NNSS, and there is no good habitat for this species on the NNSS. It is considered an extremely rare migrant. Biological surveys for the presence of sensitive and protected/regulated species and important biological resources on which they depend were conducted for 19 projects. A total of 203.9 hectares (ha) were surveyed for these projects. Some of the sensitive and protected/regulated species and important biological resources found included western red-tailed skink (*Plestiodon gilberti rubricaudatus*) habitat, a burrowing owl (*Athene cunicularia*) site, predator burrows, one live desert tortoise (*Gopherus agassizii*), desert tortoise burrows, bird nests, Joshua trees (*Yucca brevifolia*), Mojave yucca (*Yucca schidigera*), and many cactus species. MSTS provided written summary reports to project managers of survey findings and mitigation recommendations, where applicable.

Ten of the 19 projects surveyed by biologists were within the range of the threatened desert tortoise. One project disturbed previously undisturbed desert tortoise habitat (0.53 ha) and no tortoises were injured or killed by any project activities. One tortoise was moved off a project site out of harm's way. There were 47 sightings of desert tortoises on roads on the NNSS with 41 of the tortoises determined to be in harm's way and moved off the road. Two of the sightings were accidental vehicular mortalities. One tortoise moved off a road out of harm's way was observed nearly four kilometers north of the northern boundary of their previously defined range. Resident adult tortoises continued to be tracked for the road study to determine how much time they spent around roads or how many times they crossed roads. Juvenile desert tortoises continued to be monitored as part of a collaborative effort to study survival of translocated animals.

From 1978 to 2017, there has been an average of 10.7 wildland fires per year on the NNSS with an average of about 96.0 ha burned per fire. During 2017, seven wildland fires occurred on the NNSS including one of the largest ever recorded. It burned approximately 6,070 ha in Area 30 and took NNSS Fire and Rescue personnel nearly a week to extinguish it. Another fire in Area 18 burned about 4 ha before it was extinguished. The other five wildland fires were small (<0.03 ha) and were extinguished by NNSS Fire and Rescue personnel or carefully monitored until they burned out.

Wildlife use at nine natural water sources, one well pond, five water troughs, and four radiologically contaminated sumps, was documented using motion-activated cameras. No field surveys for sensitive plants were conducted in 2017 on the NNSS.

Surveys of sensitive and protected/regulated animals in 2017 focused on birds, bats, feral horses (*Equus caballus*), mule deer (*Odocoileus hemionus*), desert bighorn sheep (*Ovis canadensis nelsoni*), and mountain lions (*Puma concolor*). Information about other noteworthy wildlife observations, southeast Nevada pyrg survey results, bird mortalities, and a summary of nuisance animals and their control on the NNSS is also presented.

A new bird species, the zone-tailed hawk (*Buteo albonotatus*), was observed in 2017, making a total of 244 confirmed bird species known to occur on the NNSS. Three golden eagle (*Aquila chrysaetos*) sightings were documented during winter raptor surveys; two on the Yucca Flat route during the January and February surveys and one on the southern NNSS route during the January survey. The red-tailed hawk (*Buteo jamaicensis*) was the most common species detected on both routes, comprising nearly three-fourths of all raptor sightings. Common ravens were more prevalent on the Yucca Flat route than the southern NNSS route.

Feral horse distribution was similar this year to last year with concentrated activity around Camp 17 Pond and Gold Meadows Spring especially during the hot, dry summer months. A total of 24 individuals were identified in four different bands and at least three foals were observed. Mule deer abundance measured with standardized deer surveys was nearly equivalent to last year but still lower than the long-term average. Thirteen radio-collared desert bighorn sheep were monitored during 2017. One ram died of natural causes in early April.

A total of 72 mountain lion images (i.e., photographs or video clips) were taken during 210,739 camera hours at 5 of 29 sites sampled, and another 11,164 images of at least 40 species other than mountain lions were documented. A minimum of four individuals (two radio-collared males [NNSS8 and NNSS9], one adult male, and one adult female) were known to occur on the NNSS in 2017, compared to a minimum of five individuals in 2016, three individuals in 2015 and four individuals in both 2014 and 2013. NNSS8 and NNSS9 were tracked until their deaths in May and February, respectively, and kill sites were documented.

Additional information is presented about bird mortalities, *Migratory Bird Treaty Act* compliance, nuisance animals and their control, and increasing populations of Rocky Mountain elk (*Cervus elaphus*) feral burros (*Equus asinus*) and pronghorn antelope (*Antilocapra americana*). Qualitative vegetation assessments were conducted on the revegetated cover caps at Corrective Action Unit (CAU) 110, U-3ax/bl and at CAU 111, “92-Acre Site.”

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ACRONYMS AND ABBREVIATIONS

α	statistical significance level
APP	Avian Protection Plan
CAU	Corrective Action Unit
cm	centimeter(s)
df	degrees of freedom
DOE	U.S. Department of Energy
DOE/NV	U.S. Department of Energy, Nevada Operations Office
EGIS	Ecological Geographic Information System
ELU	Ecological Landform Unit
EM	Environmental Monitor
EMAC	Ecological Monitoring and Compliance Program
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
kg	kilogram(s)
km	kilometer(s)
LANL	Los Alamos National Laboratory
m	meter(s)
MBTA	Migratory Bird Treaty Act
MCL	midline carapace length
mm	millimeter(s)
MOU	Memorandum of Understanding
MSTS	Mission Support and Test Services, LLC
n	Sample Size
NAC	Nevada Administrative Code
NAD	North American Datum
NDOW	Nevada Department of Wildlife
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
p	probability
pCi/L	picocuries per liter
r	correlation coefficient
r^2	coefficient of determination
sd	standard deviation
spp.	species
TCS	tortoise clearance survey
UGTA	Underground Test Area
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
UTM	Universal Transverse Mercator
VHF	very high frequency
χ^2	Chi-square statistic

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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) requires ecological monitoring and biological compliance support for activities and programs conducted at the Nevada National Security Site (NNSS). National Security Technologies, LLC (NSTec) was the Management and Operations contractor until December 1, after which the new Management and Operations contractor became Mission Support and Test Services, LLC (MSTS). MSTS Ecological and Environmental Monitoring has implemented the Ecological Monitoring and Compliance Program (EMAC) to provide the aforementioned biological compliance support and ecological monitoring. 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 2017, all applicable laws and regulations were followed, and most of the permit requirements were met (see Section 3.1 for exceptions), enabling EMAC to achieve its intended goals and objectives.

This report summarizes the EMAC activities conducted by NSTec and MSTS during calendar year 2017. For purposes of this report, MSTS will be referred to when discussing work accomplished by NNSS biologists. Monitoring tasks during 2017 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.

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) Plant and Animal At-Risk Tracking List (NNHP 2018). 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

In 2017, biological surveys were conducted for 19 projects on or near the NNSS (Figure 2-1 and Table 2-2). Scientists surveyed a total of 203.9 hectares (ha) for the projects (Table 2-2). The area surveyed included the project area and a buffer area extending 10-50 meters (m) beyond the project area. Ten projects were within the range of the threatened desert tortoise (*Gopherus agassizii*) (see Section 3.0), with project 17-27 within the Frenchman Flat desert tortoise exclusion zone (an area identified as having no tortoise presence). Sensitive and protected/regulated wildlife species and important biological resources found during the surveys included western red-tailed skink (*Plestiodon gilberti rubricaudatus*) habitat, 1 burrowing owl (*Athene cunicularia*) burrow, 17 predator burrows, 1 live desert tortoise, 5 desert tortoise burrows, 1 cottontail rabbit (*Sylvilagus audubonii*), 5 bird nests, many perched raptors, and horse (*Equus caballus*), pronghorn antelope (*Antilocapra americana*), mule deer (*Odocoileus hemionus*) and burro (*Equus asinus*) sign (Table 2-2). Sensitive and protected/regulated plant species found during surveys were Joshua tree (*Yucca brevifolia*), Mojave yucca (*Yucca schidigera*), Utah juniper (*Juniperus osteosperma*), singleleaf pinyon (*Pinus monophylla*), and many cactus species (Table 2-2). MSTS biologists communicated with ground crews and 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. These surveys are required whenever vegetation has re-colonized old disturbances and sensitive or protected/regulated species may 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 and tortoise clearance surveys are conducted to ensure that desert tortoises are not in harm's way. Burrowing owls frequently inhabit burrows, buried pipes with exposed openings, and culverts at disturbed sites, so surveys are conducted to ensure that adults, eggs, and nestlings are not harmed.

During vegetation mapping of the NNSS, delineated areas of homogeneous plant and wildlife communities were identified and referred to as Ecological Landform Units (ELUs) (Ostler et al. 2000). These ELUs were evaluated for importance with the intent that comparable ELUs would respond similarly to land management practices. This concept was later applied to categorizing groupings of ELUs into important habitat types as follow: *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

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
Sclerocactus polyancistrus	Redspined fishhook cactus	S, CY, Ma
Agavaceae	Yucca (3 species), Agave (1 species)	CY
Cactaceae	Cacti (17 species)	CY
Juniperus osteosperma	Utah juniper	CY
Pinus monophylla	Single-leaf 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, IA
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, A
Alectoris chukar	Chukar	G, IA
Aquila chrysaetos	Golden eagle	EA, NP, A
Buteo regalis	Ferruginous hawk	S, NP, A
Callipepla gambelii	Gambel's quail	G, IA
Coccyzus americanus	Western yellow-billed cuckoo	LT, S, NPS, IA
Corvus brachyrhynchos	American crow	G, IA
Falco peregrinus	Peregrine falcon	S, NPE, A
Haliaeetus leucocephalus	Bald eagle	EA, S, NPE, A
Ixobrychus exillis hesperis	Western least bittern	S, NP, IA
Lanius ludovicianus	Loggerhead shrike	NPS, A
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, A
Antrozous pallidus	Pallid bat	NP, A
Cervus elaphus	Rocky Mountain elk	G, IA
Corynorhinus townsendii	Townsend's big-eared bat	S, NPS, A
Equus asinus	Burro	H&B, A
Equus caballus	Horse	H&B, A
Euderma maculatum	Spotted bat	S, 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	S, A
Lasiurus blossevillii	Western red bat	S, NPS, A
Lasiurus cinereus	Hoary bat	S, A
Lynx rufus	Bobcat	F, IA
Microdipodops megacephalus	Dark kangaroo mouse	NP, A
Microdipodops pallidus	Pale kangaroo mouse	S, NP, A
Myotis thysanodes	Fringed myotis	S, NP, A
Ovis canadensis nelsoni	Desert bighorn sheep	G, A
Odocoileus hemionus	Mule deer	G, A
Puma concolor	Mountain lion	G, A
Sorex tenellus	Inyo shrew	S, IA
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 for Column 3**

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

LT	Listed Threatened

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
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 from unauthorized collection on public lands

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

NNSS Sensitive Plant Ranking

H	High
M	Moderate
W	Watch
Ma	Marginal

Long-term Animal Monitoring Status for the NNSS

A	Active
IA	Inactive

[b] All bird species on the NNSS are protected by the *Migratory Bird Treaty Act* except for chukar, Gambel's quail, English house sparrow (*Passer domesticus*), Rock dove (*Columba livia*), Eurasian collared dove (*Streptopelia decaocto*) and European starling (*Sturnus vulgaris*).

Sources used: NNHP 2018, Nevada Native Plant Society (NNPS) 2018, NAC 2018, U.S. Fish and Wildlife Service (FWS) 2018

Operations Office [DOE/NV] 1998). A single ELU could be classified as more than one type of these important habitats.

Two projects occurred in areas designated as sensitive habitat; 17-04 and 17-42 (Figure 2-1, Table 2-2). The total area disturbed in hectares of important habitat types since 1999 comprises 9.46 (Pristine), 17.46 (Unique), 376.11 (Sensitive), and 87.05 (Diverse). All projects surveyed in 2017 were within or adjacent to habitat previously disturbed (e.g., road shoulders, old building sites, utility corridors). Eight projects disturbed a total of 61.38 ha of habitat that was previously undisturbed (Table 2-2).

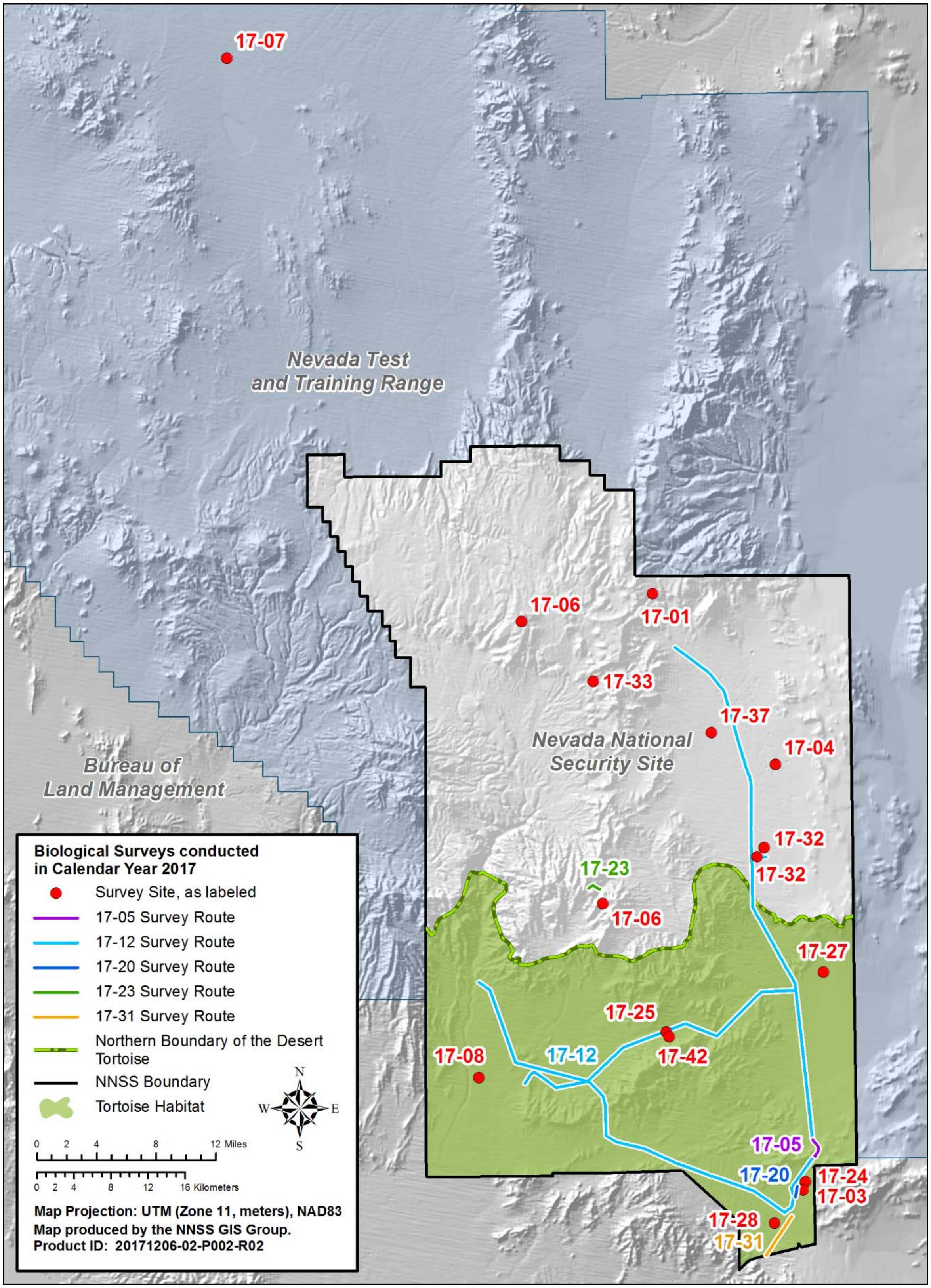

Figure 2-1. Biological surveys conducted on or near the NNSS during 2017. Surveys for project 17-06 and 17-32 had two locations per project.

Table 2-2. Summary of biological surveys conducted on or near the NNSS during 2017.

Project No.	Project Name	Important Species/Resources Found	Area Surveyed (ha)	Project area in Undisturbed Habitat (ha)	Mitigation Recommendations
17-01	UNESE P Tunnel	Western red-tailed skink habitat, cacti, juniper, pinyon, mule deer sign	14.16	Project not completed	Pre-activity survey, avoid skink habitat, avoid juniper and pinyon trees and cacti if possible
17-03	Mercury Fire Station Solar Demonstration	Antelope sign, yucca	0.69	0	TCS[a], EM[b], avoid yucca if possible, leave natural wash in tact
17-04	Frey II	Burrowing owl burrow, 2 predator burrows, yucca, cacti	42.04	33.63	Pre-activity survey, avoid yucca and cacti if possible, avoid flagged resources
17-05	Hill 200 Transmission Line	Tortoise burrow, cacti, yucca	2.83	0.53	Formal consultation, TCS[a], EM[b], avoid cacti and yucca if possible
17-06	Echo and Shoshone Turnarounds	Cacti, pinyon, juniper	0.29	0.01	Pre-activity survey, avoid cacti and pinyon and juniper trees if possible
17-07	Clean Slate III	Predator burrows, horned larks, antelope, horse sign, one cactus	16.76	12.57	Pre-activity survey, avoid cacti and flagged resources if possible
17-08	J-12 Broken Water Line	None	0.04	0	TCS[a], EM[b]
17-12	Power Pole Vegetation Abatement	4 tortoise burrows, 15 predator burrows, 5 bird nests, 1 live tortoise, yucca, cacti, antelope and burro sign, perched raptors	77.56	0	Formal consultation, TCS[a], EM[b], Pre-activity surveys, avoid all flagged resources
17-20	Install Fiber Cable	None	3.66	0	TCS[a], EM[b]
17-23	Motorola Power Line Road	Pinyon, juniper, cacti	1.46	0	Pre-activity survey, stay on access roads, avoid juniper and pinyon trees and cacti if possible
17-24	Reactivate Building 23-119	None	0.98	0	Pre-activity survey
17-25	Repair Underground Utility Line Port Gaston	Cottontail rabbit	0.12	0	TCS[a], EM[b]
17-27[c]	RWMS Expansion Haul Road and Spoils Laydown	Yucca, cacti	7.08	6.4	Pre-activity survey, avoid yucca and cacti if possible
17-28	Weed Abatement DRA	Burro sign	4.71	0	TCS[a], EM[b]
17-31	Grading Army Well Road	None	14	0	TCS[a], EM[b]
17-32	POD Center and Spoils Disposal	Antelope sign	11.98	7.53	Pre-activity survey
17-33	Replace Power Poles Area 18	Horse sign	1.39	0	Pre-activity survey
17-37	BEEF IST Fire break	Yucca, horse sign	1.58	0.18	Pre-activity survey, avoid yucca if possible
17-42	Launch Pad Port Gaston	Yucca, cacti	2.57	0.53	TCS[a], EM[b], avoid yucca if possible
		Total ha	**203.9**	**61.38**	

[a]TCS – Tortoise Clearance Survey; [b]EM – Environmental Monitor; [c]Within a tortoise exclusion zone

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*. 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 the FWS in August 1996 (FWS 1996). On July 2, 2008, NNSA/NFO provided the FWS with a Biological Assessment of anticipated activities on the NNSS for the next 10 years and entered into formal consultation with the 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 MSTS staff biologists in 2017, including (a) conducting 100% coverage tortoise clearance surveys (TCS) at project sites within 24 hours from the start of project construction, (b) ensuring that project managers have an environmental monitor (EM) 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

In 2017, biologists reviewed 21 projects or activities occurring within the range of the desert tortoise on the NNSS. Full coverage tortoise clearance surveys were required for two projects; 17-05 and 17-12 (Table 3-1, Figure 3-1). Tortoise clearance surveys and/or pre-activity surveys were conducted on an additional eight projects as biologists deemed prudent (Table 3-1, Figure 3-1). Project 17-27 was within one of the desert tortoise exclusion zones in Frenchman Flat (zones identified as having no tortoise presence) and did not require a tortoise clearance survey. Clearance surveys were conducted within twenty-four hours of project start time, typically hours before land-disturbing activities. All of the projects were in, or immediately adjacent to, roads, existing facilities, or other disturbances. One adult desert tortoise was observed within project site 17-12 and was relocated off the project site, out of harm’s way. No desert tortoises were reported injured or killed by project activities in 2017.

Post activity surveys were completed on five of the projects to ensure construction activities remained within the surveyed area and to quantify the amount of tortoise habitat disturbed (Table 3-1). All surveyed projects remained within proposed project boundaries with one project (17-05) disturbing 0.53 hectares of previously undisturbed desert tortoise habitat (Table 3-1).

In January 2018, the annual report summarizing tortoise compliance activities conducted on the NNSS from January 1 through December 31, 2017 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; (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 as well as vehicular mortalities; and (d) a summary of construction mitigation and monitoring efforts.

Table 3-1. Summary of biological surveys conducted in desert tortoise habitat on the NNSS during 2017.

Project No.	Project Name	Compliance Activities	Tortoise Habitat Disturbed (ha)
17-03	Mercury Fire Station Solar Demonstration	Tortoise Clearance Survey, Post Activity Survey	0
17-05	200 Hill Transmission Line	Tortoise Clearance Survey, Post Activity Survey	0.53
17-08	J12 Water Line Repair	Tortoise Clearance Survey, Post Activity Survey	0
17-12	Power Pole Weed Abatement	Tortoise Clearance Survey, Post Activity Survey	0
17-20	Fiber Cable Installation	Tortoise Clearance Survey	0
17-25	Port Gaston Utility Line Repair	Tortoise Clearance Survey	0
17-27	RWMS Haul Road and Spoils Area	Pre-activity Survey	0
17-28	Airport Weed Abatement	Tortoise Clearance Survey	0
17-31	Grade Army Well Road	Tortoise Clearance Survey	0
17-42	Port Gaston Launch Pad	Tortoise Clearance Survey, Post Activity Survey	0
		Total	**0.53**

Compliance with the Opinion ensures the desert tortoise is protected on the NNSS and the cumulative impacts on this species are minimized (DOE/NV 1998). In the Opinion, the FWS determined the "incidental take" ("take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct, and "incidental take" is a take that results from activities that are otherwise lawful) 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. In 2017, the threshold level established by the FWS for moving tortoises observed on NNSS roads out of harm's way was exceeded (Table 3-2). As the limit of incidental take under the Roads category was approached in June 2017, NNSA/NFO received concurrence from FWS to continue moving tortoises off roads when in harm's way. The take limit set by FWS for the 10-year term of the Opinion is 125 and the actual amount of take is currently 153 (Table 3-2).

There were 47 reported desert tortoise roadside sightings during 2017 (Figure 3-2). Forty-one of the encountered tortoises were determined to be in harm's way and moved off the road in accordance with FWS-approved tortoise handling procedures (Figure 3-2). Two of the sightings were accidental road mortalities; an adult tortoise on Jackass Flats Road and a juvenile tortoise on a utility access road (Figure 3-2). One noteworthy tortoise sighting was one of the furthest northern observations reported on the NNSS. The tortoise was moved off Tippipah Highway in Area 1, nearly four kilometers (km) north of the northern boundary of the desert tortoise range (Figure 3-2).

The number of reported desert tortoise roadside sightings along with the number of tortoises moved off NNSS roads has steadily increased since 2013. The number of tortoises moved off roads in 2016 was 19

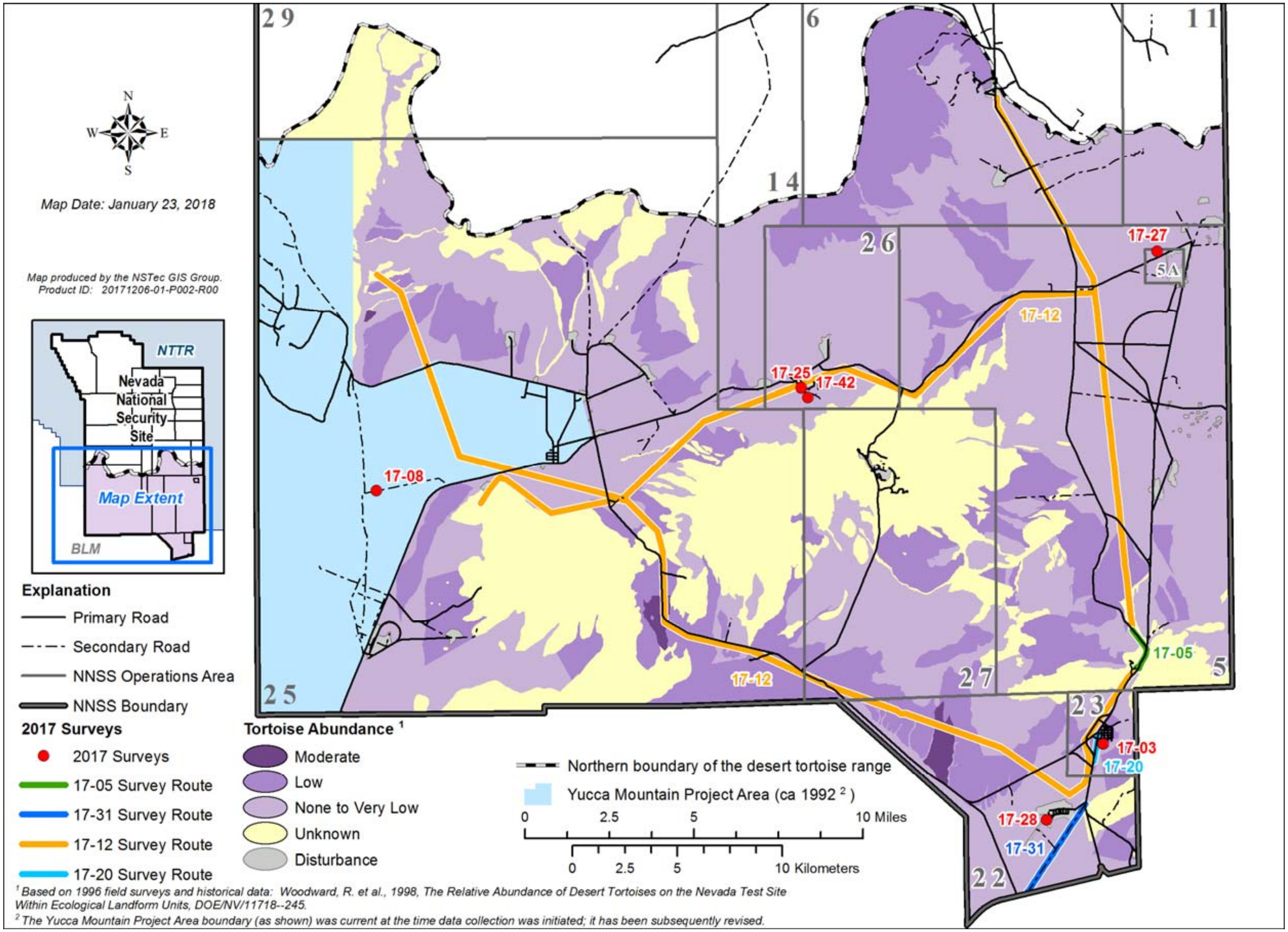

Figure 3-1. Biological surveys conducted in desert tortoise habitat on the NNSS during 2017.

Table 3-2. Cumulative incidental take (2009–2017) 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	14.50 (202)	0 (1)	0 (10)
Infrastructure Development	4.01 (40)	0 (1)	1 (10)
Roads	0 (0)	12 (15)[a]	153 (125)[b]
Totals	**20.78 (1,095)**	**12 (22)**	**154 (194)**

[a]No more than 4 desert tortoises killed on roads during any calendar year and no more than 15 killed on roads during the term of the Opinion.
[b]Take limit was exceeded during calendar year 2017. Requested concurrence to continue moving tortoises off roads when in harm's way was authorized by the Service on June 5, 2017.

and more than doubled to 41 in 2017. The NNSS is approaching their incidental take limit for road mortalities/injuries (15) which was set by the Service in 2009 for road mortalities or injuries with 11 mortalities and 1 reported injury through 2017 (Table 3-2). MSTS biologists suggested the following conservation recommendation to help minimize the adverse effects of vehicular traffic on the desert tortoise: increase road signage to increase awareness of tortoises on roads throughout desert tortoise habitat on the NNSS. Biologists installed 15 new caution tortoise road signs and replaced 10 old, faded signs in 2017 (Figure 3-2). New signs (Figure 3-3) were placed at locations that had considerable amounts of tortoise roadside sightings and where vehicular mortalities have occurred (Figure 3-2).

Two counts of non-compliance were noted. One was when a worker moved a tortoise from a project area (17-12). Additional training was done to help prevent this from occurring in the future. The other was a project (17-05) that was not appended to the Opinion. These issues were reported to the FWS and included in the annual FWS report.

3.1.1 Mitigation for Loss of Tortoise Habitat

Mitigation for the loss of tortoise habitat is required under Term and Condition 3c of the Opinion. This term and condition as amended in November 2013, requires NNSA/NFO to perform one of three mitigation options: (a) prepay funds into the Desert Tortoise Mitigation Fund for projects under the Work-for-Others Program, (b) apply the accrued costs to implement FWS-approved conservation studies on the NNSS as earned mitigation for the future loss of tortoise habitat by non-Work-for-Others projects, or c) prepay mitigation funds into the Desert Tortoise Mitigation Fund, then revegetate disturbed habitat following specified criteria; once the revegetation is successful, the money paid for mitigation will be refunded. There was one project under the Infrastructure Development program in 2017 (17-05) that disturbed desert tortoise habitat (Table 3-1). The project disturbed 0.53 ha of habitat and $1,127.10 for

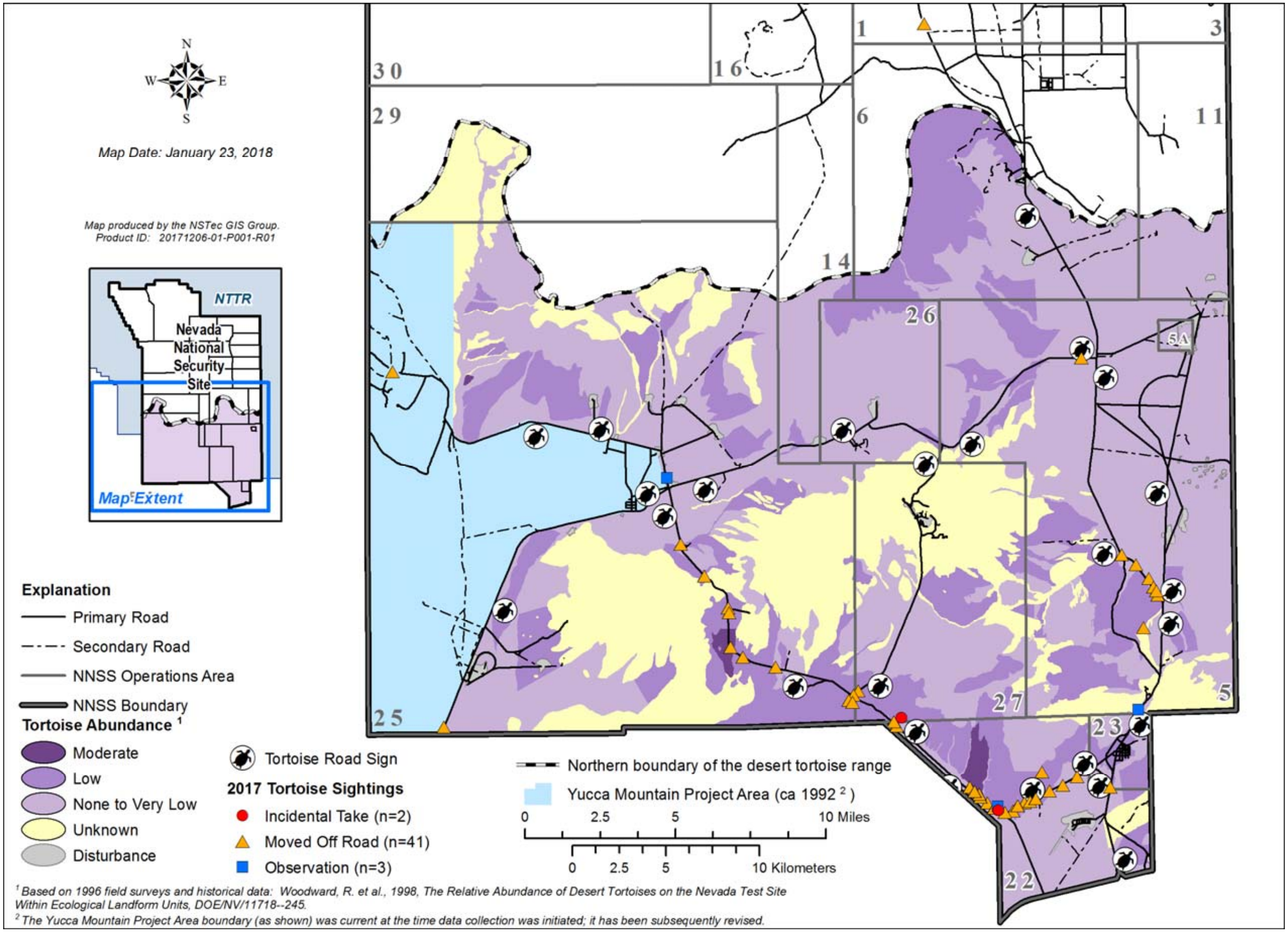

Figure 3-2. Location of tortoise roadside observations, mortalities, and tortoise caution signs installed during 2017.

Figure 3-3. New caution tortoise road sign (left) and old road sign (right).

mitigation was deducted from accrued funds earned from implementation of Service-approved conservation programs.

3.2 CONSERVATION RECOMMENDATION STUDIES

Two desert tortoise conservation research studies have been approved by the FWS and are being implemented by MSTS biologists; the desert tortoise road study and the juvenile translocation study. The following is a synopsis of activities conducted for each of these projects.

3.2.1 Desert Tortoise Road Study

Per the Opinion, NNSA/NFO developed a desert tortoise study which focuses on collecting fine-scale patterns of roadside habitat use by the desert tortoise for application in the future development and implementation of management practices in order to minimize road mortalities on the NNSS (FWS 2009).

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 the 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 km from road edges) on tortoise abundance (Boarman and Sazaki 2006).

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 stimulated plant growth from roadside maintenance activities such as mowing or blading. 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.

The desert tortoise road study was initiated in May 2012. The main objectives of this study are to (1) determine fine-scale patterns of habitat use of desert tortoises found near roads on the NNSS, and (2) 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. Originally the FWS approved a handling take limit of 20 adult tortoises for the study and later approved a sample size increase to 30 adult tortoises. Table 3-3 shows the current status of each animal including the date each animal was included in the study (capture date), the date the transmitter was removed from the animal (date removed from study), and brief health assessment information.

Starting in the 2012 tortoise active season (March through October), adult tortoises observed on or near NNSS roads were affixed with very high frequency (VHF) transmitters and Global Positioning System (GPS) data loggers to be included in the study (Figure 3-4). Eleven resident tortoises were included in the study in 2012. An additional seven tortoises were included in the study in 2013 and one tortoise (GOAG13) died from possible predation. Six additional tortoises were added to the study in 2014 with one tortoise (GOAG8) found dead, flipped on its back, with the assumption it was not able to right itself. In 2015, an additional six tortoises were affixed with transmitters and GPS loggers, making a total of 30 tortoises included in the study. One tortoise (GOAG29) was found dead from possible predation in 2015.

Tortoises included in the study were tracked via radio telemetry weekly during the active season and at least monthly during the hibernation period (November through February). Health assessments were conducted annually on all available tortoises. Oral, cloacal, and chin/forelimb swabs were obtained from all available tortoises during fall 2015 and 2017 for chemical analyses to investigate potential chemical signature differences between females and males. Each tortoise was monitored for at least three active seasons, then its transmitter and GPS logger removed (Table 3-3). A paper identification tag with the tortoise's identification number was affixed to the shell of each tortoise in the event it is encountered in the future.

In 2017, 13 tortoises continued to be tracked and affixed with GPS loggers (Figures 3-4 and 3-5). Health assessments were conducted on the animals in the spring, and GPS loggers were replaced every 4 weeks on each animal through the active season. The minimum 3-year duration of data collection for seven of the animals came to a completion in the fall (Figure 3-5). Transmitters and GPS loggers were removed from these animals in September and October. Health assessments were completed and new paper tags adhered to the animals when their transmitters were removed for future identification. Six animals currently remain in the study and will be tracked through 2018 (Figure 3-5). The study's completion date is set for fall 2018.

Data collected on the study animals while tracking includes GPS location, physical location (e.g. inside a burrow, under vegetation, on a road), foraging evidence, habitat and substrate use, and weather data. In 2017, study animals were observed 56% of the time in a burrow, 21% under vegetation, 20% in the open, 1% under rock shelters, and 1% inside culverts under paved roads. Tortoise habitat on the NNSS provides numerous refugia options for animals; caliche burrows, soil burrows, rock burrows and culverts. When a tortoise was observed inside refugia it was found 59% of the time in a soil burrow, 34% in a caliche burrow, 6% in a rock burrow, and 1% inside a culvert. The NNSS also provides a diverse plant

Table 3-3. Status of tortoises included in the desert tortoise road study (MCL = midline carapace length in millimeters [mm]; Body Condition Score = visual appraisal system that estimates average body energy reserves (1-3 [under condition], 4-6 [good condition], 7-9 [over condition]).

Tortoise ID	Sex	Capture Date	Date Removed From Study	Initial Body Condition Score	Final Body Condition Score	Size MCL (mm)
GOAG 1	F	5/10/2012	10/12/2015	4	4.5	285
GOAG 2	F	5/15/2012	10/06/2015	6	5	233
GOAG 3	M	5/17/2012	9/23/2015	5	5	288
GOAG 4	F	5/24/2012	10/24/2016	4	4.5	257
GOAG 5	F	5/29/2012	10/07/2015	4	5	243
GOAG 6	M	6/01/2012	10/08/2015	5	5	227
GOAG 7	F	6/11/2012	09/23/2015	5	5	238
GOAG 8	F	6/13/2012	09/17/2014	4	Dead	258
GOAG 9	F	6/26/2012	09/28/2016	4	5	251
GOAG10	M	7/12/2012	09/24/2015	5	5	230
GOAG11	M	9/27/2012	10/05/2016	5	4.5	257
GOAG12	F	4/30/2013	10/24/2016	4	4.5	277
GOAG13	M	5/14/2013	06/26/2013	3.5	Dead	206
GOAG14	F	6/12/2013	10/24/2016	4	4	214
GOAG15	M	8/14/2013	9/06/2017	4.5	5	280
GOAG16	M	9/04/2013	9/06/2017	4	5	307
GOAG17	M	9/05/2013	10/24/2016	4	4	282
GOAG18	M	9/11/2013	10/11/2016	4	4.5	277
GOAG19	F	5/14/2014	9/28/2017	4	4	232
GOAG20	U	6/11/2014	9/27/2017	3.5	4	180
GOAG21	M	7/01/2014	10/03/2017	5	5	286
GOAG22	M	8/27/2014	Currently Tracking	5	Currently Tracking	215
GOAG23	M	9/08/2014	9/26/2017	4.5	4	258
GOAG24	M	10/09/2014	9/26/2017	5	4	268
GOAG25	M	3/24/2015	Currently Tracking	5	Currently Tracking	241
GOAG26	F	5/04/2015	Currently Tracking	4	Currently Tracking	212

Table 3-3. Status of tortoises included in the desert tortoise road study (MCL = midline carapace length in millimeters [mm]; Body Condition Score = visual appraisal system that estimates average body energy reserves (1-3 [under condition], 4-6 [good condition], 7-9 [over condition]) (continued).

Tortoise ID	Sex	Capture Date	Date Removed From Study	Initial Body Condition Score	Final Body Condition Score	Size MCL (mm)
GOAG27	M	5/26/2015	Currently Tracking	5	Currently Tracking	250
GOAG28	M	7/21/2015	Currently Tracking	4.5	Currently Tracking	215
GOAG29	F	7/21/2015	8/10/2015	5	Dead	255
GOAG30	M	10/07/2015	Currently Tracking	4	Currently Tracking	279

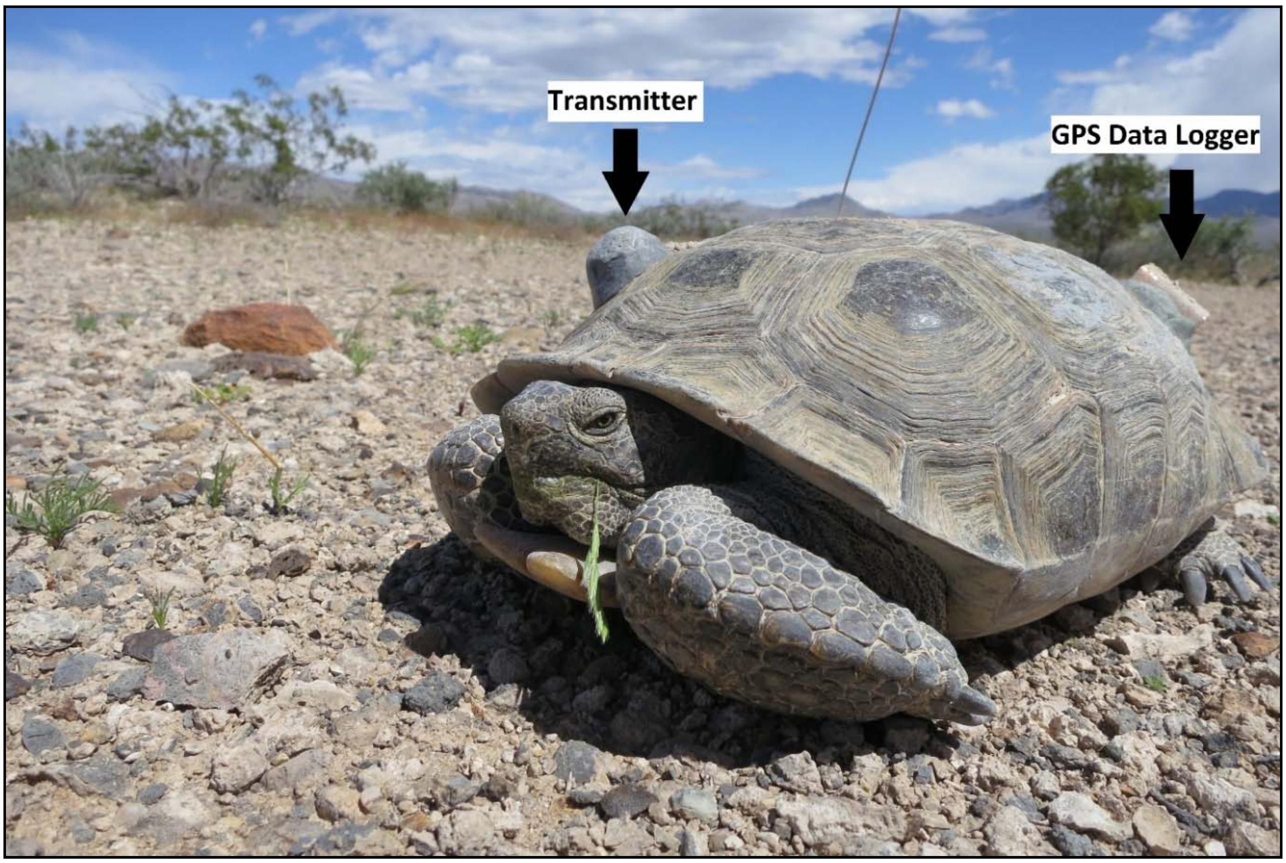

Figure 3-4. Adult tortoise (GOAG21) observed with evidence of foraging with a VHF transmitter (left) and GPS logger (right) affixed to its shell.

(Photo by J. Perry, April 3, 2017)

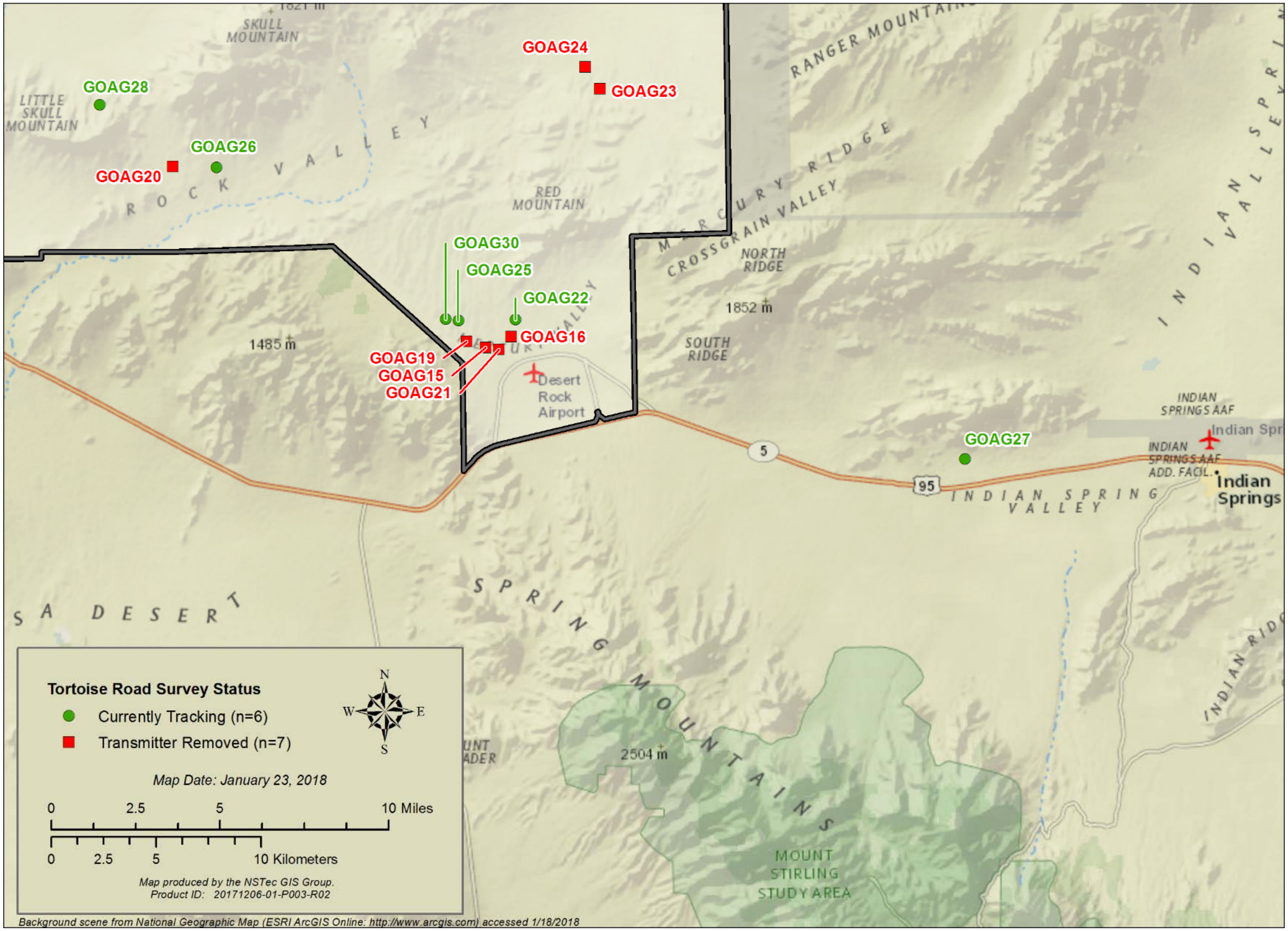

Figure 3-5. Tortoise road study status showing animals remaining in the study through 2018 (green dots) and animals removed from the study in 2017 (red squares).

community which tortoises utilize for shelter, shade and food. Tortoises were observed using 15 different species of plants as cover sites throughout the active season. White bursage (*Ambrosia dumosa*), water jacket (*Lycium andersonii*), pale desert thorn (*Lycium pallidum*), and blackbrush (*Coleogyne ramosissima*) were the plants utilized the most for cover.

Tortoises were observed foraging or showed evidence of foraging mainly during the spring in 2017 (Figure 3-4). Eighty-six foraging observations were recorded between March and May as opposed to six observations from August through October. This may have been due to the Mojave Desert receiving significant precipitation during the winter months in 2016 and very little during the summer months in 2017. Winter and summer rain storms allow seeds to germinate in the spring and fall, respectively. This was represented in the habitat data collected while tracking, which revealed the growing season in 2017 to be almost exclusively between March and June.

Several animals were observed by biologists on or near paved roads with several observations from site employees of study animals crossing Jackass Flats Road. One particular animal, GOAG19, had to be monitored several times during the active season while it foraged along Jackass Flats Road in order to make sure it would not be injured from vehicular traffic. Tortoises are utilizing roads on the NNSS for foraging and drinking opportunities, and shelter (e.g. culverts under roads, burrows in man-made roadside berms). Preliminary analysis of GPS logger data reveal tortoises living near roads are crossing roads more often than observed via tracking (Figure 3-6). GPS loggers affixed to the tortoises' shells allow for collection of fine-scale movement patterns that otherwise could not be collected via weekly tracking. Figure 3-6 shows the movement patterns of male adult tortoise GOAG25 during the active season in 2017 as well as its tracked locations. This tortoise's GPS logger documented him crossing Jackass Flats Road multiple times during the year, which would not have been documented with weekly tracking.

The processing and analysis of field and GPS logger data is ongoing. Movement data is in the process of being cleaned to prepare for analysis. When data is fully processed and summarized, it will be provided to FWS and the scientific community.

3.2.2 Juvenile Translocation Study

In September 2012, 60 captive juvenile tortoises were translocated from the Desert Tortoise Conservation Center in Las Vegas to the southern edge 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, MSTS, and the San Diego Zoo Institute for Conservation Research (ICR). Few studies have investigated translocated juvenile tortoise survival, so data obtained from this study will be valuable to assess translocation as a possible means of tortoise recovery.

Each tortoise was affixed with a VHF transmitter prior to release for post-release monitoring purposes. Regular monitoring of the animals occurred post-release from 2012 through 2017. During 2017, the monitoring schedule was as follows: once in January, once in February, weekly March through October, twice in November, and once in December. Tortoises were also monitored in mid-January 2018. In early 2017, the survival rate of the translocated juvenile tortoises was at 45% with 27 out of 60 tortoises observed alive. In April 2017, one tortoise (4018) died, and in May 2017, a tortoise (4009) that was thought to be dead was found and re-added to the study. Thus, 28 individual tortoises were monitored during 2017, with 27 known to be alive as of January 2018 (Table 3-4). Tortoise 4018 was found barely alive and half-eaten on April 24, 2017. FWS was notified, and the tortoise was taken to the North Las Vegas Animal Hospital for treatment. The damage was too severe and the tortoise died two days later. Figure 3-7 shows the release locations for all 60 translocated juveniles, the winter burrows for the surviving 27 tortoises, and the location of the dead tortoise (4018). Transmitters were changed on six

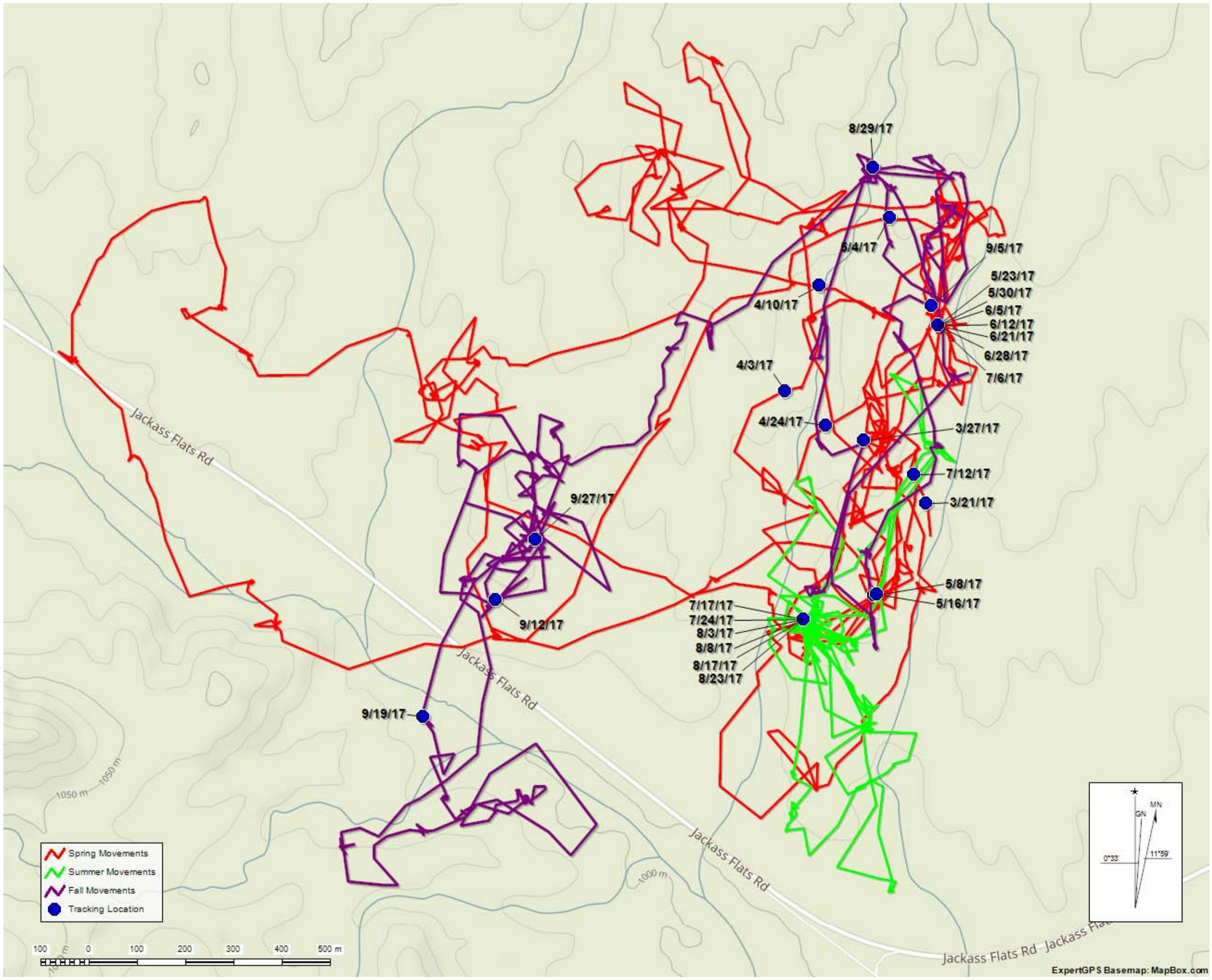

Figure 3-6. Movement patterns for male tortoise GOAG25 as recorded via GPS logger (color coded tracks) and tracking observations (blue dots).

tortoises in the spring, and on all 27 tortoises in the fall. Health assessments, including measuring and weighing were completed in the spring and fall. In addition, cloacal, oral, and chin/forelimb swabs were taken on all tortoises except 4044 in the fall. Swabs were sent to Bruce Kimball at the Monell Chemical Senses Center to be analyzed to determine chemical signatures of male and female juvenile tortoises.

After 64 months post-release, 27 of the 60 juveniles are still alive (45% survival). This is slightly higher but similar to an estimated 42% survival (25 of 60 tortoises alive) based on an annual survival rate of 0.85 that Turner et al. (1987) calculated in a natural population (Roy Averill-Murray, FWS, personal communication, February 7, 2017). There is a much higher survival rate for males (60% [18 of 30]) compared to females (31% [9 of 29]) with most of the mortalities suspected as coyote and kit fox predations. Given the importance of females surviving to adulthood to reproduce, this may be a critical life stage for females, and if female juveniles are not surviving to sexual maturity, this could lead to a decline in tortoise populations. The ratio of female to male adults captured in the wild for the road study is 12 females (40%) and 17 males (57%) with 1 of unknown gender (3%). Whether this is a result of differential mortality between sexes or an artifact of our opportunistic capture methodology is unknown. In contrast, a study by Turner et al. (1984) in Ivanpah Valley, CA showed a sex ratio of nearly 1:1. The ratio of females to males for adults and particularly juveniles as well as differential mortality between the sexes warrants further study in wild tortoise populations.

Table 3-4 contains information about the 28 juvenile tortoises monitored during 2017. On average, the distance between the release location and winter 2017-2018 burrow (i.e., the burrow a juvenile was in during the first part of January 2018) was 667 m (range 28–6,366 m; standard deviation [sd] 1,346 m). Nearly two-thirds (16 of 26) of the tortoises wintered in burrows within 100 m of their last year's winter burrow, and 19% (5 of 26) of them used the same winter burrow as the previous year.

The distance (m) between monitoring checks was calculated and is summarized in Table 3-4. This is not the total distance a tortoise moved during the year, but the summed distance between locations recorded during regular monitoring. Tortoises obviously moved on days between monitoring checks, which was not measured. For females the average distance was 1,846 m, and for males 2,236 m. A two-tailed, t-test was used to determine if this difference was statistically significant at α (alpha level) = 0.05. It was not significant (p [probability] = 0.42). The average distance by monitoring period between locations for all 27 surviving tortoises was also calculated and is shown in Figure 3-8 along with precipitation by monitoring period. The largest peaks in movement occurred in early May and early to mid-September. Movements don't appear to be correlated with precipitation as evidenced by the large spring movements of tortoises in the absence of precipitation.

During 2017, burrows were marked with unique numbers and data collected included Universal Transverse Mercator (UTM) coordinates (North American Datum [NAD] 83), burrow height, burrow width, burrow orientation, elevation, location, topographic position, vegetation cover and substrate. The number of unique burrows an individual used was calculated and is shown in Table 3-4. It is important to note that tortoise burrows were only documented during tracking checks, and therefore all burrows used may not have been documented. A total of 167 unique burrows were used by the 28 tortoises, and the number of new burrows marked and measured during 2017 was 115. The average height of burrows was 11.5 mm (range 6-29 mm; sd 4.7 mm) and average width of burrows was 22.0 mm (range 10-50 mm; sd 6.4 mm). Average elevation for burrow locations was 1,083 m (range 1,028–1,188 m; sd 19.0 m). It appears that tortoises do not have a preference for burrow orientation based on 2017 data (Chi-square [χ^2]= 4.5; p=0.21; degrees of freedom [df] = 3).

On average, tortoises used 6.2 unique burrows (range 1-12; sd = 2.7) (Table 3-4) with no significant difference between females (5.8 burrows) and males (6.4 burrows) (p = 0.57). Two burrows were used by

Table 3-4. Mortality, sex, distance in meters (m) between release site and January 2018 burrow, distance between January 2017 burrow and January 2018 burrow, total distance between monitored locations (January 2017 to January 2018), and number of used burrows and new burrows occupied by 28 juvenile desert tortoises monitored during 2017 (*=Found alive 5/8/17, **=Died 4/24/17, NA=Not Applicable).

Tortoise Number	Sex	Distance (m) Release to Jan. 2018 Burrow	Distance (m) Jan. 2017 Burrow to Jan. 2018 Burrow	Total Distance (m) between locations (Jan. 2017-Jan. 2018)	Number of Burrows Used (New Burrows)
4009*	Female	28	NA	196	2 (2)
4010	Female	1163	0	2252	3 (2)
4014	Female	515	51	545	5 (3)
4030	Female	2479	198	2669	7 (4)
4039	Female	243	150	1889	10 (6)
4044	Female	196	121	2537	11 (9)
4045	Female	188	0	2062	5 (3)
4046	Female	446	46	2630	5 (4)
4049	Female	1253	13	1834	4 (3)
4004	Male	36	27	2269	8 (5)
4005	Male	234	215	3202	8 (6)
4007	Male	156	45	743	6 (2)
4011	Male	140	0	4408	7 (6)
4018**	Male	NA	NA	NA	NA
4019	Male	343	156	4919	12 (9)
4024	Male	758	137	4046	6 (6)
4025	Male	1075	52	1535	11 (7)
4033	Male	125	0	1508	4 (2)
4034	Male	161	104	2033	7 (6)
4036	Male	518	175	2117	7 (4)
4037	Male	149	0	320	1 (0)
4038	Male	147	40	1763	5 (3)
4040	Male	705	42	1820	7 (6)
4041	Male	149	114	1643	8 (6)
4048	Male	52	62	3110	8 (4)
4050	Male	95	56	2245	5 (3)
4053	Male	280	50	751	3 (2)
4055	Male	6366	73	1824	3 (2)
	Average	667	74	2106	6 (4)

multiple tortoises. One was used by two different tortoises at different times, and one was occupied by two male tortoises (#4019 and #4033) on June 5, 2017.

All juveniles were at their winter 2017-2018 burrow by November 6, 2017 which is similar to last year. Eleven (41%) were at their winter burrow by October 1, 2017 compared to four (15%) in 2016, and 24 (89%) were at their winter burrow by October 23, 2017 compared to 7 (26%) in 2016. Only one (4%) was at its winter 2015-2016 burrow by October 1, 2015 and 10 (37%) were at their winter 2015-2016 burrow by October 23, 2015. Just over half of them were there by October 1, 2014 and all but three (90%) were at their 2014–2015 winter burrow by October 23, 2014. Timing of arrival at winter burrows appears to be influenced by temperature and moisture. If enough moisture is received in the fall to cause plant

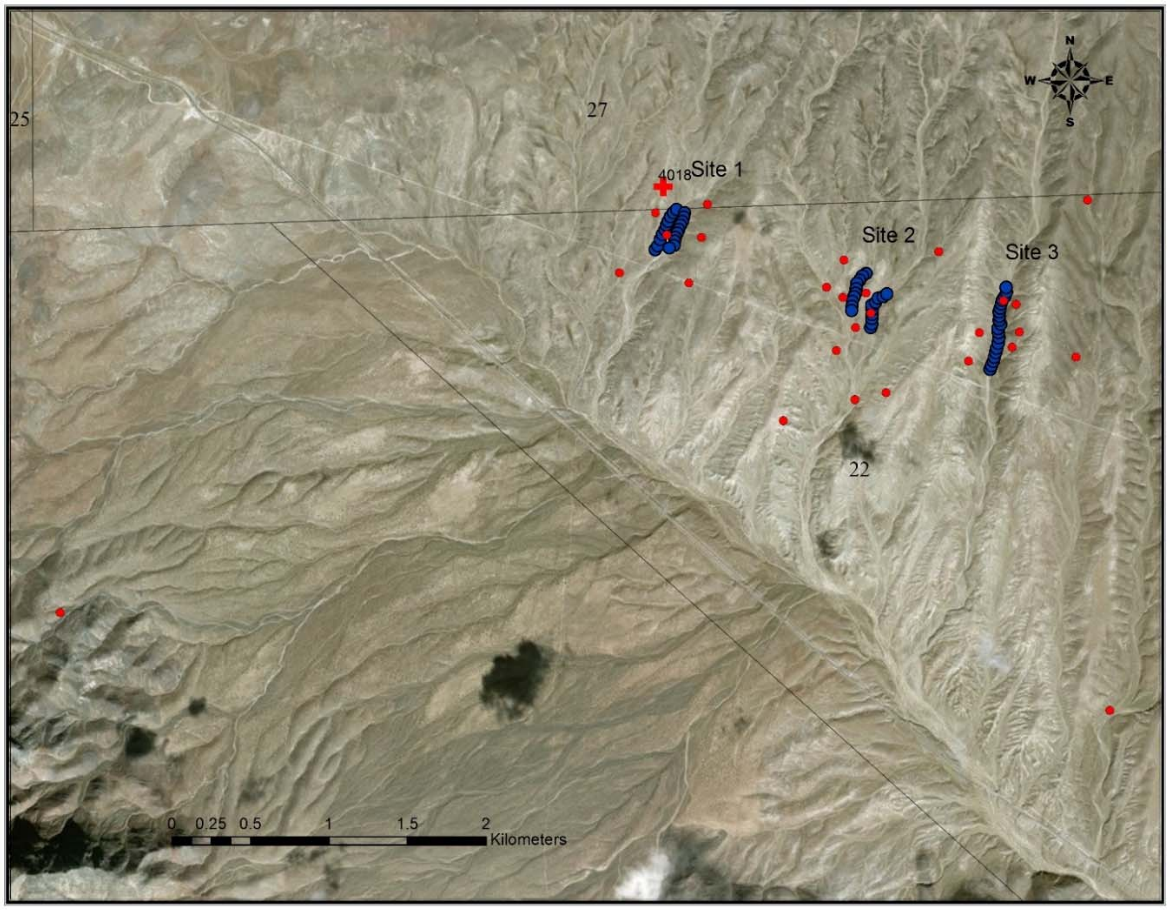

Figure 3-7. Release locations (blue dots) for all 60 translocated juvenile tortoises, mid-January 2018 locations (red dots) for surviving 27 tortoises, and location of dead tortoise #4018 (red cross).

germination and regrowth and temperatures are mild, tortoises continue to move around and forage into November (Hall et al. 2016).

Observations made while tracking from January 2017 to January 2018 on the 28 surviving juvenile tortoises totaled 1,105. Figure 3-9 illustrates the percentage of time tortoises were found in various locations. Two-thirds of the observations were of tortoises either inside their burrows, in their burrow entrance, or on the burrow apron. The remaining one-third of the observations found tortoises in the open or under vegetation. Tortoises were found under 17 different vegetation species and under mixed shrub clumps. Figure 3-10 depicts the percentage of observations tortoises were found under vegetation by species. Most noteworthy is the dominance of blackbrush and Nevada jointfir (*Ephedra nevadensis*) with nearly one-half of observations of tortoises found under these two species. Mixed shrub clumps were also important. The “Other” category included white bursage (3.3%), burrobrush (*Hymenoclea salsola*) (2.9%), spiny hopsage (*Grayia spinosa*) (1.1%), and water jacket, fourwing saltbush (*Atriplex canescens*), winterfat (*Krascheninnikovia lanata*), desert almond (*Prunus fasciculata*), desert prince’s plume (*Stanleya pinnata*), littleleaf ratany (*Krameria erecta*), Mexican bladdersage (*Salazaria mexicana*), and Shockley’s goldenhead (*Acamptopappus shockleyi*) at <1% each.

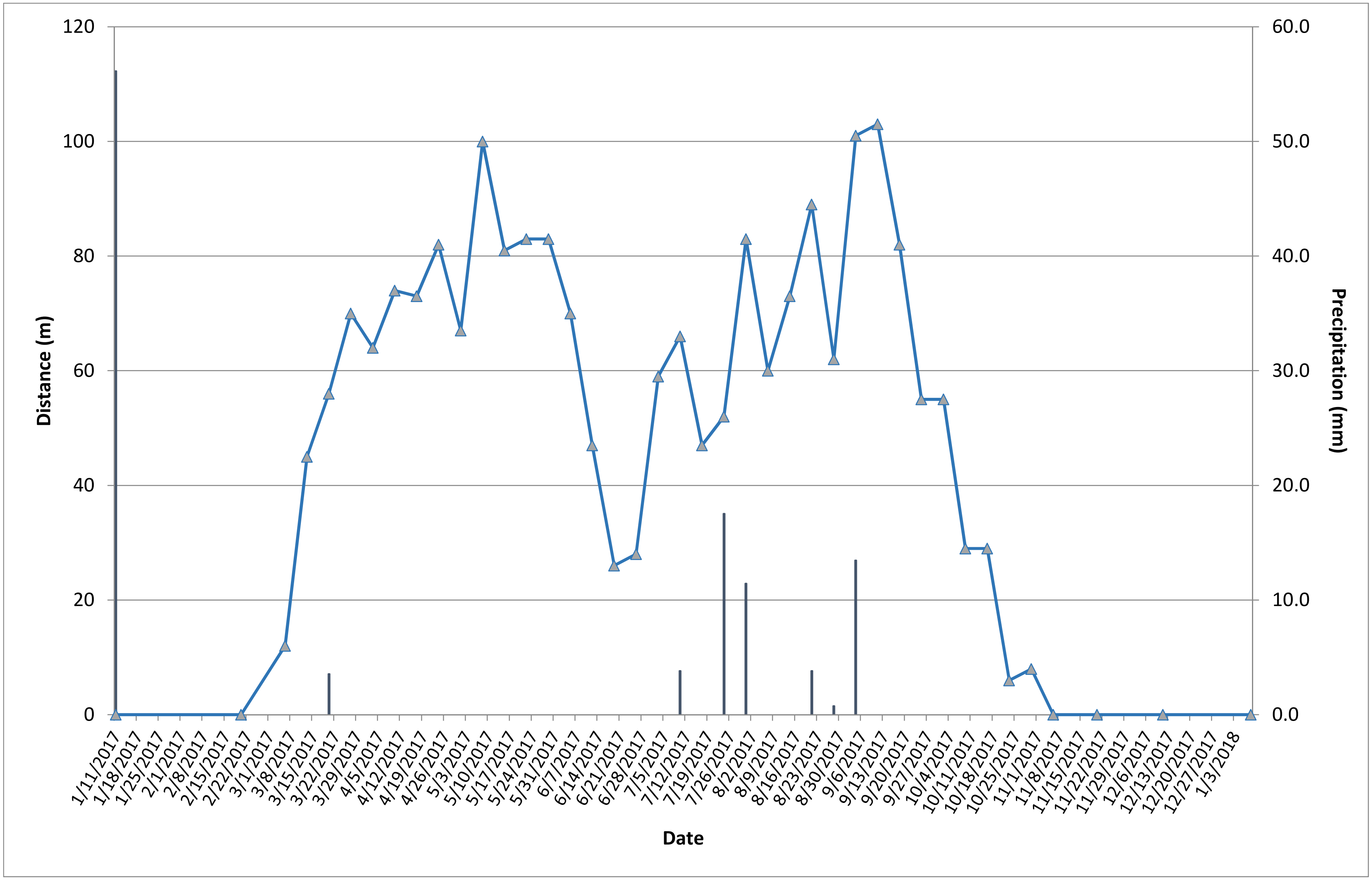

Figure 3-8. **Average distance (m) between locations (horizontal line) for 27 surviving juvenile tortoises and precipitation (mm) (vertical bars) received by monitoring period, January 2017–January 2018.**

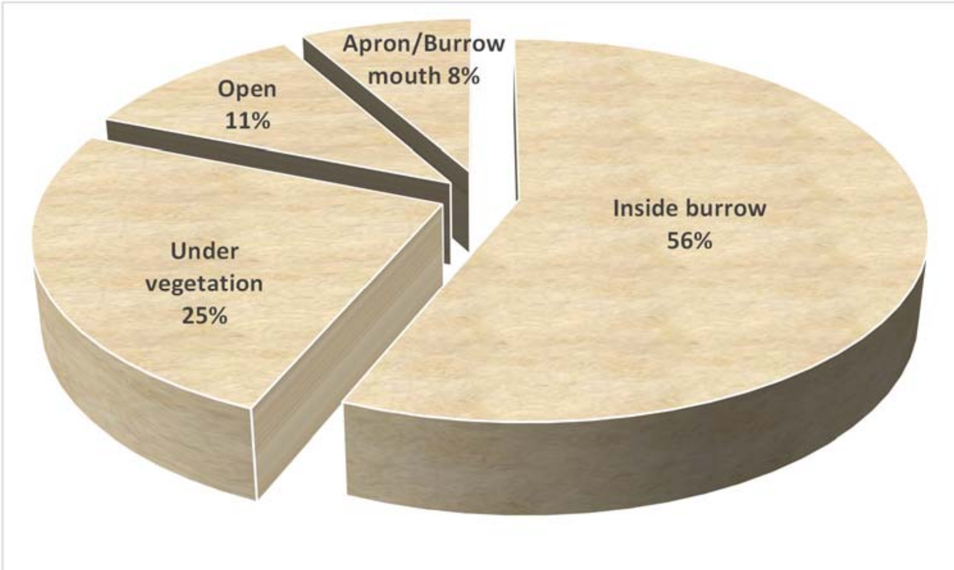

Figure 3-9. Percentage of observations (n=1,105) of 28 juvenile tortoises by location, January 2017–January 2018.

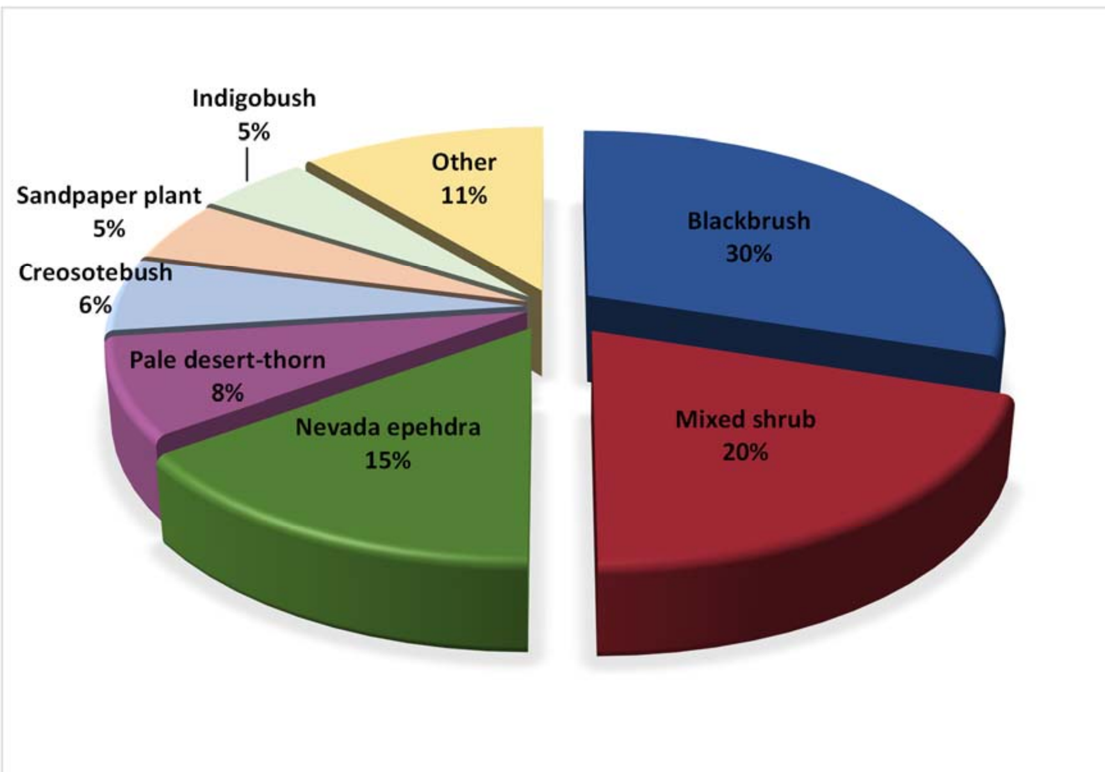

Figure 3-10. Percentage of observations (n=274) of 28 juvenile tortoises found under vegetation by species, January 2017–January 2018.

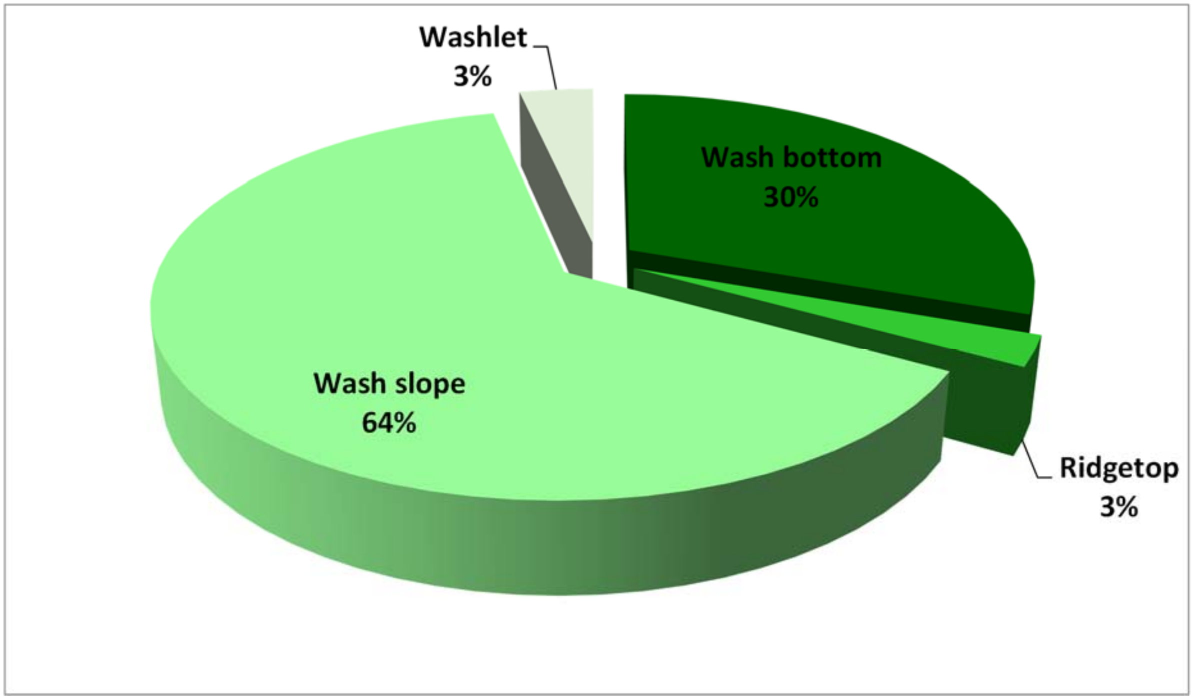

Figure 3-11. Percentage of juvenile tortoise burrows by topographic position, January 2017–January 2018 (n=115).

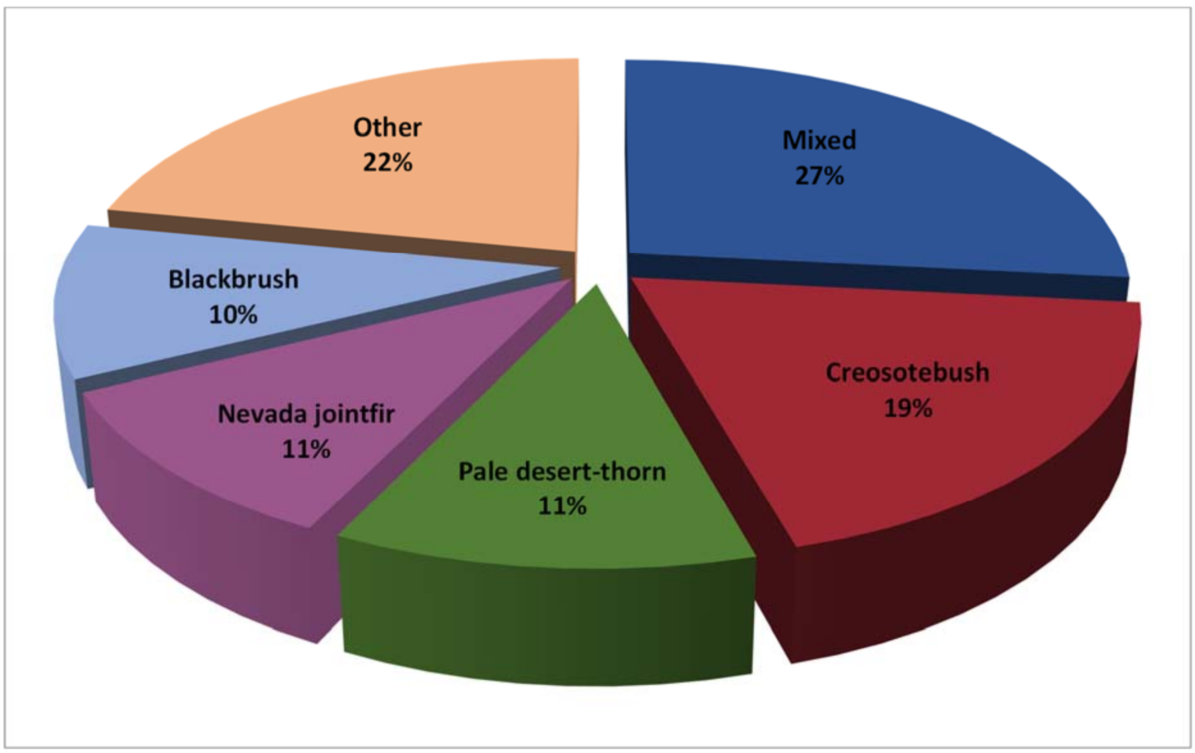

Figure 3-12. Percentage of juvenile tortoise burrows by vegetation cover at the burrow, January 2017–January 2018 (n=105).

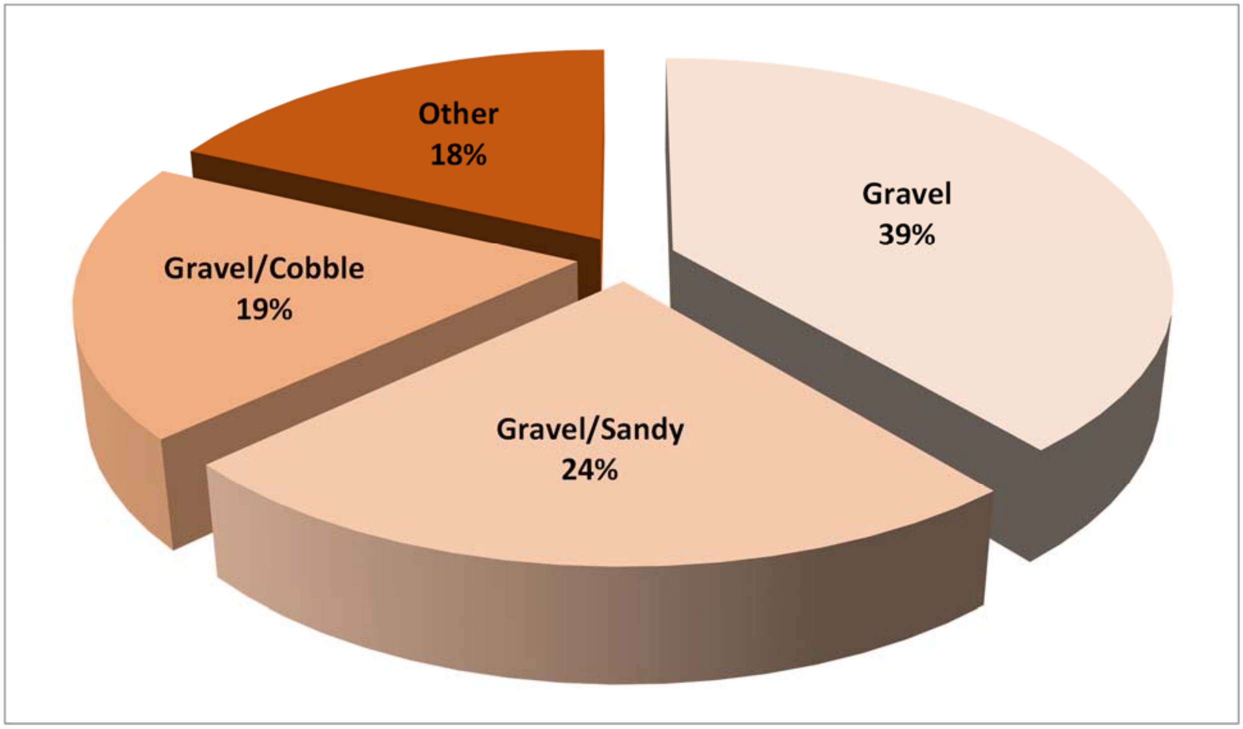

Figure 3-13. Percentage of juvenile tortoise burrows by substrate, January 2017–January 2018 (n=115).

Tortoises used burrows on wash slopes more than expected by chance ($\chi^2 = 117$; $p < 0.001$; df = 3) (Figure 3-11). Vegetation cover at burrows was found at 91% of the burrows, suggesting this is an important factor in burrow selection for these juveniles (Figure 3-12). Mixed shrub clumps seemed to be the dominant cover followed by creosote bush (*Larrea tridentata*), pale desert thorn, Nevada jointfir, and blackbrush. The other category was made up of dead vegetation (5%), water jacket (4%), burrobrush (4%), littleleaf ratany (2%), and white bursage, turpentinebroom (*Thamnosma montana*), spiny hopsage, Shockley's goldenhead, Mojave yucca, and fourwing saltbush <1% (Figure 3-12).

Gravel was the dominant substrate at juvenile tortoise burrows (Figure 3-13) with gravel/sandy and gravel/cobble also important. Gravel is defined as rocks <2.5 centimeters (cm) in size, cobble as rocks between 2.5 and 12.7 cm, and rock as >12.7 cm. The other category is made up of sandy (4%), cobble (4%), gravel/caliche (4%), cobble/caliche (2%), cobble/rock (2%), and sandy/caliche, sandy/cobble, and sandy/gravel/cobble <1%. Combined categories such as gravel/sandy means that both were equal in abundance.

Evidence of foraging was documented on all 28 tortoises, 196 times during 1,105 observations (18%) between March 7 and October 10, 2017 with foraging peaks in March (49 times), April (64 times), and May (30 times) and a smaller peak in September (21 times) (Figure 3-14). Similar to last year, annual plant production and diversity was high during the spring, due to abundant precipitation received during the previous fall and winter resulting in good spring foraging opportunities. There was also some plant growth in the fall as a result of some precipitation received during the summer which may explain the foraging peak in September. The most common species eaten was desert globemallow (*Sphaeralcea ambigua*) (4.1%). Other species eaten were bluedicks (*Dichelostemma capitatum*), brightwhite (*Prenanthella exigua*), red brome (*Bromus rubens*), Esteve's pincushion (*Chaenactis stevioides*), cushion cryptantha (*Cryptantha circumscissa*), Nevada cryptantha (*Cryptantha nevadensis*), Cooper's wild cabbage (*Caulanthus cooperi*), sixweeks fescue (*Vulpia octoflora*), *Camissonia* spp., and *Langloisia* spp. Most

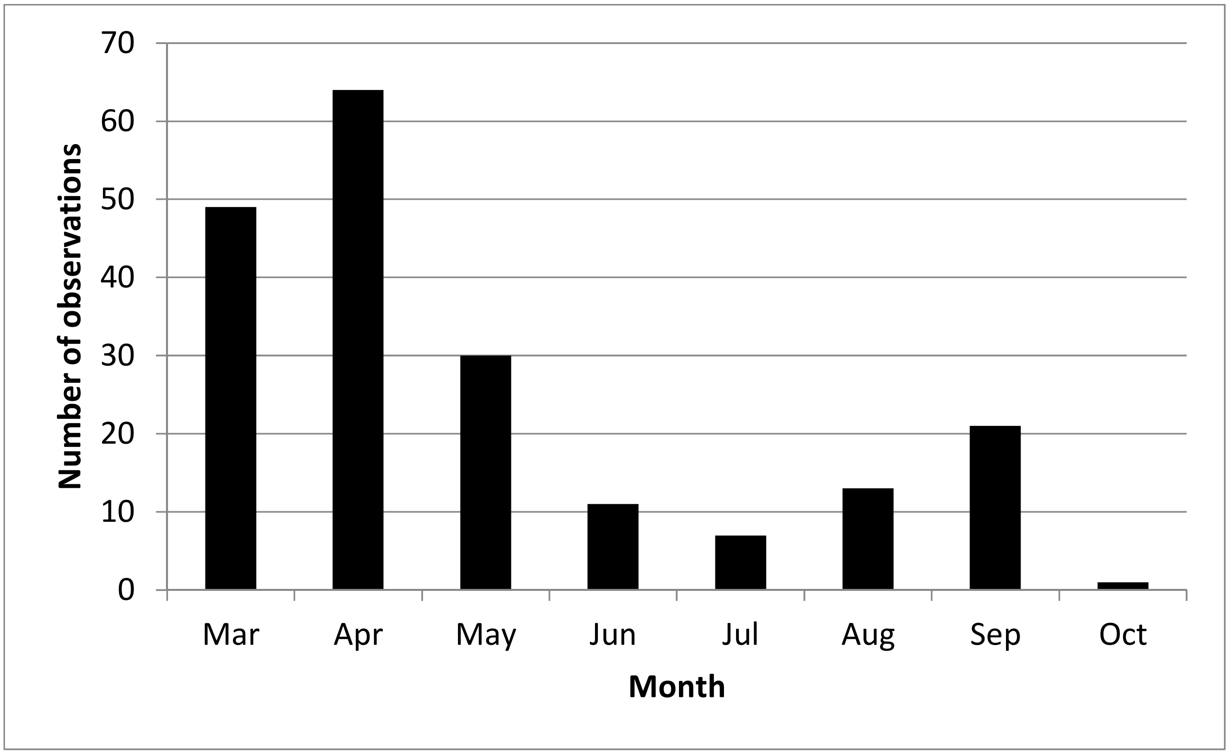

Figure 3-14. Number of times evidence of foraging was detected by month for 28 juvenile tortoises, January 2017–January 2018 (n = 196) (no evidence of foraging was detected in November, December, January, or February).

Figure 3-15. Juvenile female tortoise (#4046) eating soil.

(Photo by D.B. Hall April 10, 2017).

(88%) of the time, it was not possible to identify what the tortoises had eaten. On one occasion, a tortoise was observed eating soil (Figure 3-15) and on another a tortoise was eating fresh tortoise scat.

During September 2017, each tortoise was given a detailed health assessment. They were weighed, measured, and assigned a body condition score (1-3 = under condition, 4-6 = good condition, 7-9 = over condition) (Table 3-5). Tortoises were also assessed in March and April, 2017 (Table 3-5). Similar health assessments were performed pre-release in August and September 2012 (Table 3-5). This allows for comparison of growth rates, weight change and overall health and body condition score over time.

On average, the surviving 27 translocated juvenile desert tortoises increased 31 mm in MCL and 457 g in weight (without transmitters) from fall 2012 to fall 2017. Results from a two-tailed t-test showed there was no significant differences ($\alpha = 0.05$) in MCL growth between females (26 mm) and males (33 mm) ($p = 0.28$) or in weight gain between females (395 g) and males (489 g) ($p = 0.42$). Average growth in MCL from spring 2017 to fall 2017 was 10 mm with no significant difference between males and females ($p = 0.76$). Body condition scores indicated all tortoises were in good condition in 2017.

The main factor for survival appears to be gender with higher survival of males than females. This has been observed by other researchers as well (Melia Nafus, ICR, personal communication, December 4, 2014). Size, weight, overall health, and presence of *Mycoplasma* species (bacteria that causes upper respiratory disease in tortoises) do not seem to have any significant impact on survival. While it is impossible to determine if a tortoise was scavenged or preyed upon, a majority of dead tortoises have shown signs of being chewed on by mammalian predators. Given the presumed healthy status and low disease prevalence in the juveniles, it seems unlikely that they are dying and then being scavenged. This suggests that most of the mortality is due to predation. Coyote (*Canis latrans*) and kit fox (*Vulpes macrotis*) tracks have been observed on multiple occasions while conducting tortoise monitoring, and these canids appear to be the main predators killing juvenile tortoises. To better understand the predator community and visitation frequency, a camera trap was set up at Site 2 for 140 days from March to August. Results showed five coyote images which is about one every 28 days, three kit fox images which is about one every 45 days, and six badger (*Taxidea taxus*) images which is about one every 23 days (Table 6-4). Bobcats (*Felis rufus*) may also occur in this area.

Why predators seek out female tortoises more than males is a question yet to be answered. Given the fact that coyotes and kit foxes use olfaction as one of their dominant senses, it is possible that females are giving off scent that makes them easier to detect. Another possibility is females spend more time aboveground or travel farther, thus making them more susceptible to predation. An analysis conducted on March to October observations from 2012-2017 showed that females actually spend more time in their burrows ($p = 0.01$) and less time in the open ($p = 0.02$) than males and that females and males travel similar distances ($p = 0.76$).

More research is needed to help understand the interaction between tortoises and their predators. Oral, cloacal, and chin/forelimb swabs were collected from all 27 juvenile tortoises and 27 adult tortoises from the road study (10 females, 16 males, 1 unknown) during fall 2015. Additional samples were taken from 26 juveniles (18 males, 8 females) and 12 adults (9 males, 2 females, 1 unknown) during fall 2017. These samples were sent to Dr. Bruce Kimball at the Monell Chemical Senses Center in Philadelphia, Pennsylvania to be analyzed using headspace gas chromatography/mass spectrometry in an attempt to detect any chemical differences between males and females as well as between adults and juveniles that might cause increased canid predation. Preliminary results from the 2015 samples indicate significant differences in chemical signatures between female and male juveniles primarily in alkyl alcohols. It is anticipated that the 2017 samples will be analyzed in 2018 to better define chemical differences. Another possible study using captive coyotes at Utah State University may be conducted in 2018 or 2019 to investigate how coyotes respond to male and female tortoise scent.

Table 3-5. Midline carapace length (MCL) (mm), weight without transmitters (g), and body condition score in Fall 2012, Spring 2017, and Fall 2017 including MCL growth and weight gain from Fall 2012 to Fall 2017 (* = estimated weight).

Tortoise Number	Sex	Pre-release MCL (mm) (2012)	MCL (mm) (Spring 2017)	MCL (mm) (Fall 2017)	Change in MCL (mm) (2012-2017)	Pre-release Weight (g) (2012)	Weight (g) (Spring 2017)	Weight (g) (Fall 2017)	Change in Weight (g) (2012-2017)	Pre-release Body Condition (2012)	Body Condition (Spring 2017)	Body Condition (Fall 2017)
4009	Female	138	141	142	4	472	566*	528	56	4	4.5	4.5
4010	Female	Unknown	155	168	Unknown	590	812*	1045	455	4	4.5	5
4014	Female	136	148	153	17	485	580*	732	247	5	4	4.5
4030	Female	148	165	178	30	562	800*	1200	638	4	4	4
4039	Female	117	142	151	34	315	547*	748	433	5	4	4.5
4044	Female	146	162	169	23	484	811*	955	471	4	4.5	4.5
4045	Female	129	145	152	23	400	544*	742	342	4	4.5	4.5
4046	Female	126	152	169	43	476	797*	1100	624	4	4.5	4.5
4049	Female	106	125	137	31	238	409	523	285	4	4.5	4.5
4004	Male	117	131	143	26	303	413	602	299	4	4.5	4.5
4005	Male	140	156	165	25	564	804*	925	361	5	4.5	5
4007	Male	121	124	128	7	363	378	442	79	5	4	4.5
4011	Male	144	180	188	44	634	1100*	1200	566	4	4.5	4.5
4018	Male	105	113	Dead	Dead	213	257	Dead	Dead	4	4	Dead
4019	Male	150	182	196	46	654	1100*	1400	746	4	4.5	4.5
4024	Male	146	185	201	55	565	1250*	1600	1035	5	5	4.5
4025	Male	127	148	161	34	357	580*	873	516	5	4.5	4.5
4033	Male	126	132	139	13	430	508*	562	132	4	4	4
4034	Male	128	149	163	35	407	686*	840	433	4	4.5	4.5
4036	Male	132	161	171	39	455	833*	1002	547	4	4.5	4.5
4037	Male	105	115	117	12	223	280	308	85	4	4.5	4.5
4038	Male	132	174	190	58	457	974*	1300	843	4	4.5	5
4040	Male	140	154	162	22	493	750*	891	398	4	4.5	4.5
4041	Male	119	134	142	23	322	471	599	277	4	4.5	4.5
4048	Male	135	184	203	68	480	1200*	1650	1170	5	5	5
4050	Male	138	154	170	32	502	750*	940	438	4	4.5	5
4053	Male	150	160	162	12	681	712*	851	170	4	4	4.5
4055	Male	151	193	195	44	602	1200*	1300	698	4	4.5	4.5

MSTS will continue monitoring the remaining juveniles for an additional 5-10 years with monitoring every two weeks instead of weekly monitoring during most of the active season. Data analysis and publications will be a joint effort between NNSA/NFO and ICR.

3.2.3 USGS Rock Valley Study

USGS in collaboration with FWS, ICR, and Penn State University completed their epidemiology study in the Rock Valley pens in September 2017. All translocated tortoises were removed from the three pens and transported back to Las Vegas. An MSTS biologist assisted in this effort.

As a result of this study, some mating of translocated individuals occurred and a few juvenile tortoises were observed. FWS considers these resident tortoises now. It is currently undecided whether to leave the juveniles in the pens or to move them outside of the pens.

3.2.4 Coordination with Other Biologists and Wildlife Agencies

In January 2017, an MSTS biologist attended a desert tortoise recovery meeting in Las Vegas sponsored by the Desert Tortoise Council. Input was provided on issues regarding restoring Mojave Desert vegetation, threats to the desert tortoise, and current issues and possible solutions to desert tortoise recovery.

In February 2017, an MSTS biologist attended the Desert Tortoise Council's 42nd annual meeting and symposium. This meeting was held in Las Vegas, Nevada, and included numerous presentations on desert tortoise biology, ecology, and recovery efforts as well as a special session on desert mule deer.

An MSTS biologist met with Dr. Eric Gese at Utah State University and visited the captive coyote research facility in August 2017. A potential collaborative study was discussed to use captive coyotes to investigate their response to male and female juvenile tortoise scent.

4.0 ECOSYSTEM MONITORING

Biologists 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 ecological landform units (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 (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 2017 focused on wildland fire fuels surveys, natural water source monitoring, and constructed water source monitoring, including contaminated sumps.

4.1 VEGETATION SURVEY FOR WILDLAND FIRE HAZARD ASSESSMENT

Wildland fires on the NNSS require considerable financial resources for fire suppression and mitigation. For example, costs for fire suppression on or near the NNSS can cost as much as $198 per ha (Hansen and Ostler 2004). Costs incurred from the Egg Point Fire in August 2002 (121 ha) were well over $1 million to replace 1 mile of burned power poles, and more than $200,000 for soil stabilization and revegetation of the burned area.

4.1.1 Wildland Fires in 2017

From 1978 to 2017, an average of 10.7 wildland fires per year with about 96.0 ha per fire have occurred on the NNSS. 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., blackbrush and pinyon pine/Utah juniper/sagebrush [*Pinus monophylla/Juniperus osteosperma/Artemisia* spp.] 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).

Seven wildland fires occurred on the NNSS in 2017. The largest, and one of the largest ever recorded burned approximately 6,070 ha in Area 30. It took NNSS Fire and Rescue personnel nearly a week to extinguish the fire. Another fire in Area 18 burned about 4 ha before it was extinguished. The other five wildland fires were small (<0.03 ha) and were extinguished by NNSS Fire and Rescue personnel or carefully monitored until they burned out.

4.1.2 Fuel Survey Methods

Beginning in 2004, and in response to a request from NNSS Fire and Rescue Department, surveys were initiated on the NNSS to identify wildland fire hazards. Vegetation surveys were conducted in April and May 2017 at sites located along and adjacent to major NNSS corridors to estimate the abundance of fuels produced by native and invasive plants. 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.

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 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 one-half integer increments. The index ratings for fuels at survey sites were 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

Historically, 17 rain gauges were used to measure precipitation on the NNSS (Hansen and Ostler 2004). Data from these weather station gauges extend back more than 30 years (National Oceanic and Atmospheric Administration [NOAA] 2013). In the fall of 2011, in order to reduce costs and improve reliability, 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 having to manually retrieve and process the data (Rick Lantrip, Air Resources Laboratory, Special Operations Division, personal communication, May 4, 2012). In most cases, the new gauges were located near the previous gauge location. Of the original 17 locations, 14 remain. The Cane Spring, Tippipah Spring, and Rock Valley gauge stations were decommissioned; the Jackass Flats gauge was moved to Port Gaston in Area 26; and 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 2017 reflect the changes and attempt to match, as closely as possible, data collected historically. Mean values were calculated to account for periods when gauges were not functional.

In order to assess potential fuels, particularly fine fuels, a simple measure is needed. Precipitation for the months of December, January, February, March, and April was selected because of its simplicity and ease of calculation (Figure 4-1). While it is recognized that precipitation from other months is also important, as is the influence of temperature, winds, and relative humidity, precipitation during these months represents the period that most 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 allows for a prediction of the fuels that may be present. During the first 10 years of conducting fire fuel evaluations (2004-2013), the mean precipitation for these 5 months is correlated (R= 0.770) with our estimations of the combined fuel loads. During 2017, the average precipitation on the NNSS for December to April was 150.4 mm, well above the normal amount of 104.6 mm received on the NNSS and one of the highest values recorded since 2004.

4.1.3.2 Fuels

Due to the above-average precipitation received during winter/spring 2016-17, a lot of annual grasses and forbs germinated and grew. Perennial herbaceous grasses and forbs also had good production during the spring of 2017, except in a few locations.

The fine fuels index decreased slightly in 2017 (2.38) compared to 2016 (2.67), and was the fifth highest recorded since 2004 (Table 4-1). The fine fuels index reflected not only current year production but also

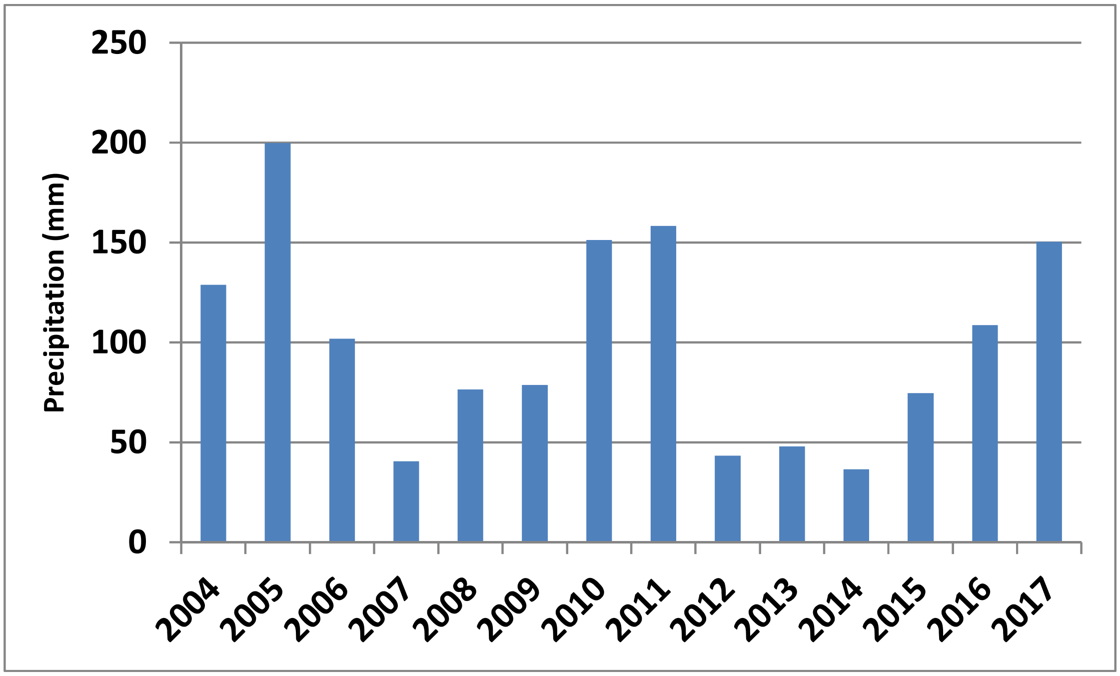

Figure 4-1. Average precipitation (mm) from December (previous year) through April for the years 2004 through 2017 (long-term average precipitation = 104.6 mm).

standing dead crop from last year, particularly in areas of high red brome and cheatgrass (*Bromus tectorum*) production from 2016. The woody fuels index value was slightly higher in 2017 (2.49) compared to 2016 (2.43), as foliar canopy cover increased slightly (Table 4-1). This was an average value in comparison to the other index values since 2004.

The combined index values (fine fuels plus woody fuels) for 2017 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 2017 was 4.87, which was an average value in comparison to previous years (Table 4-1), suggesting normal fuels for the NNSS. This is a little surprising because of the above-average precipitation received which should have produced more fine fuels.

The locations and results of the fine fuels, woody fuels and combined fuels surveys at 104 stations on the NNSS inspected during 2017 are shown in Figures 4-2, 4-3, and 4-4, respectively. The highest combined index values and thus the highest potential for wildland fires occurred in Fortymile Canyon, Mid Valley, southern Yucca Flat, and eastern Pahute Mesa. High amounts of fine fuels were found in Fortymile Canyon, Yucca Flat, and Mid Valley. Highest amounts of woody fuels are primarily found in the forested portions of Pahute Mesa.

Photographs were taken from permanent locations for all 104 sites over the past 14 years. Figure 4-5 shows photographs of Site 99 in Yucca Flat for the years 2011, 2015, 2016, and 2017. These photographs are valuable for 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. Fine fuels in 2015 were negligible when precipitation was below normal but abundant in 2016 and 2107 with normal to above-normal precipitation (Figure 4-1, Figure 4-5).

Table 4-1. Woody fuels, fine fuels, and combined fuels index values for 2004–2017

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
2014	2.44	1.39	3.83
2015	2.42	1.44	3.87
2016	2.43	2.67	5.10
2017	2.49	2.38	4.87

Overall, the hazards of residual fuels contributing to wildland fires on the NNSS in 2017 were about average and slightly lower than 2016, even though precipitation was higher in 2017, suggesting that factors other than total precipitation influence fire risk. The highest risk of wildland fires is found in previously burned areas where cheatgrass and/or red brome dominate the understory. Rapid response by NNSS Fire and Rescue after fires are ignited is a key factor in minimizing wildland fire spread and severity.

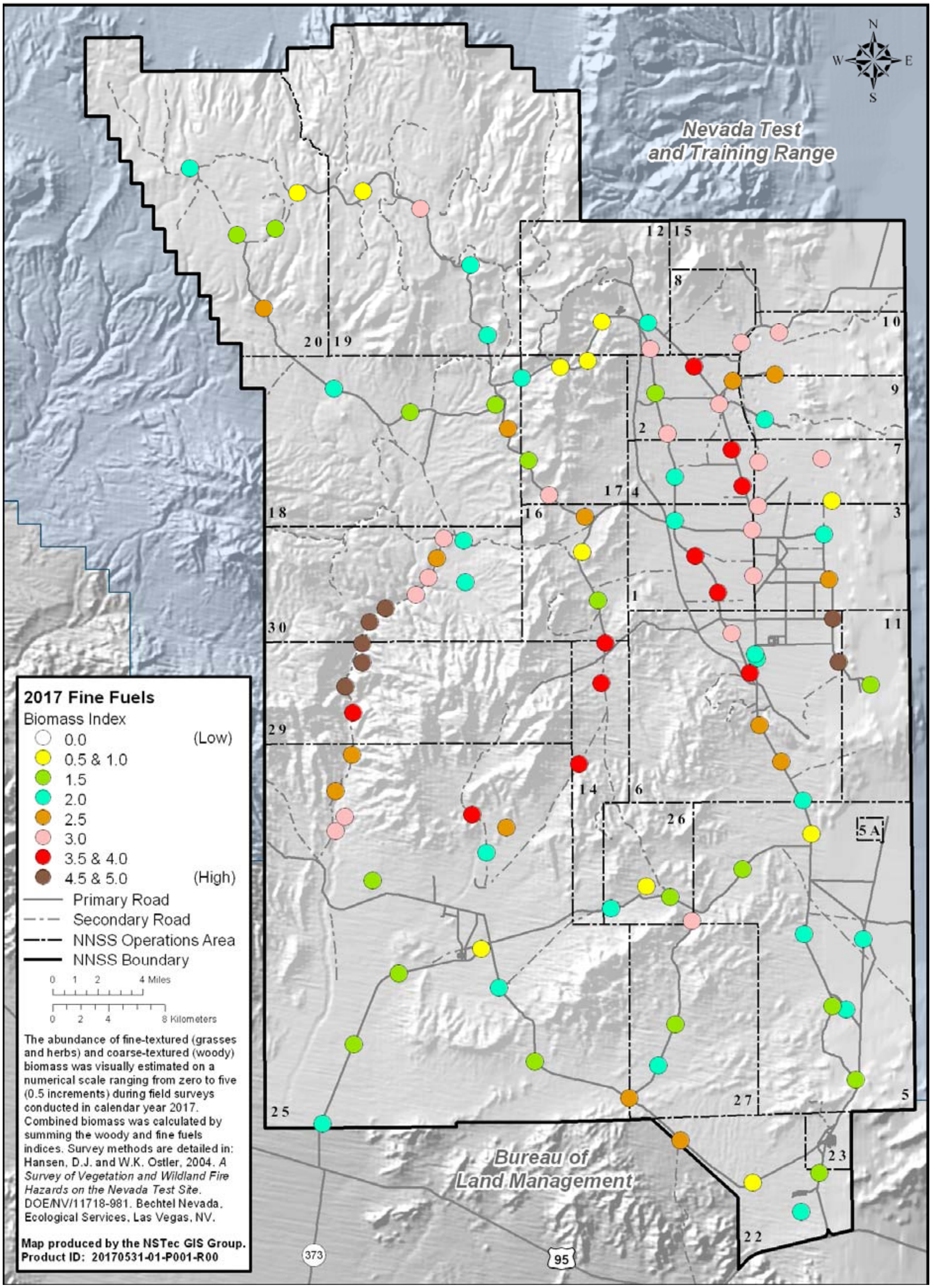

Figure 4-2. Index of fine fuels for 104 survey stations on the NNSS during 2017.

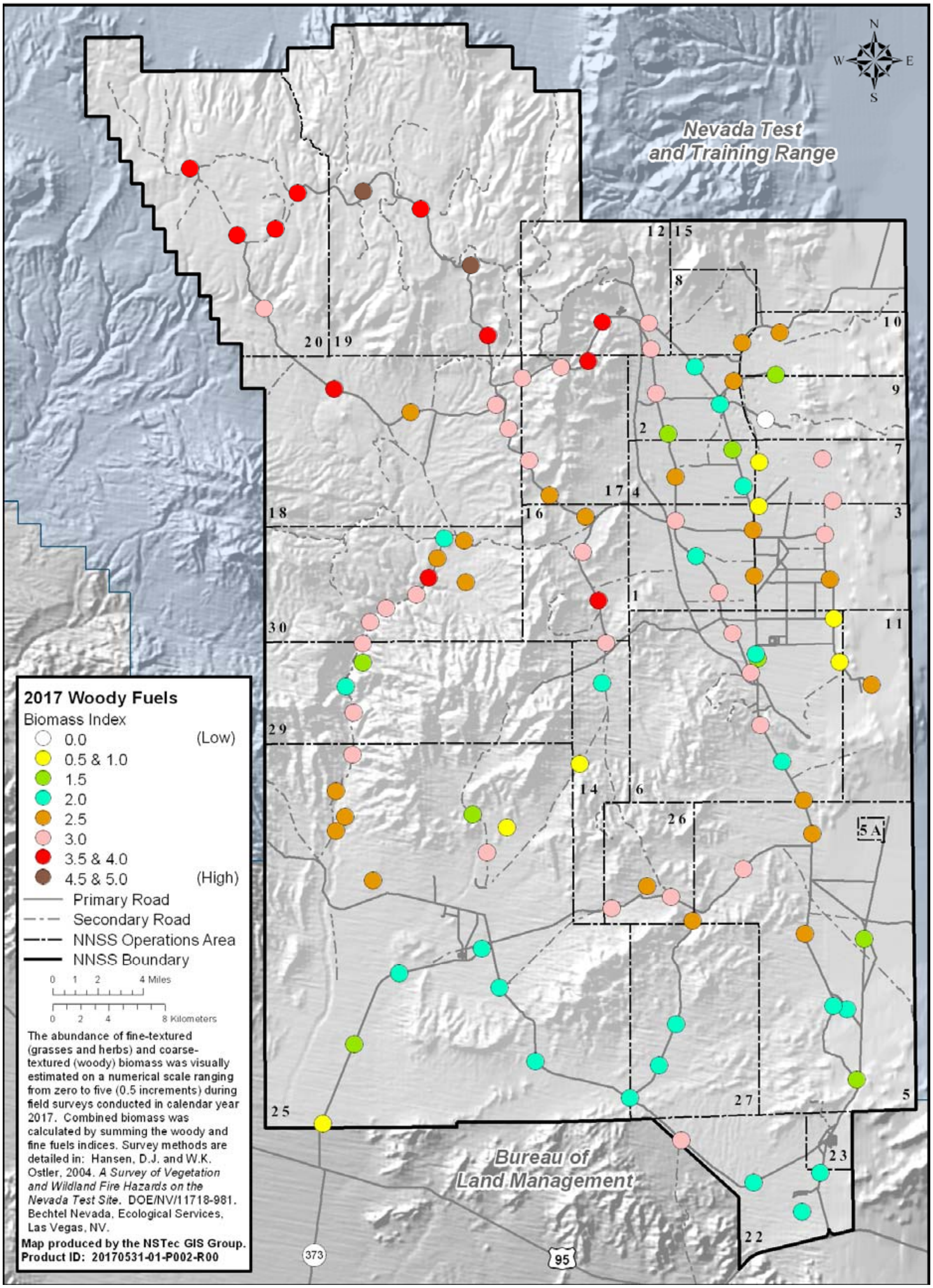

Figure 4-3. Index of woody fuels for 104 survey stations on the NNSS during 2017.

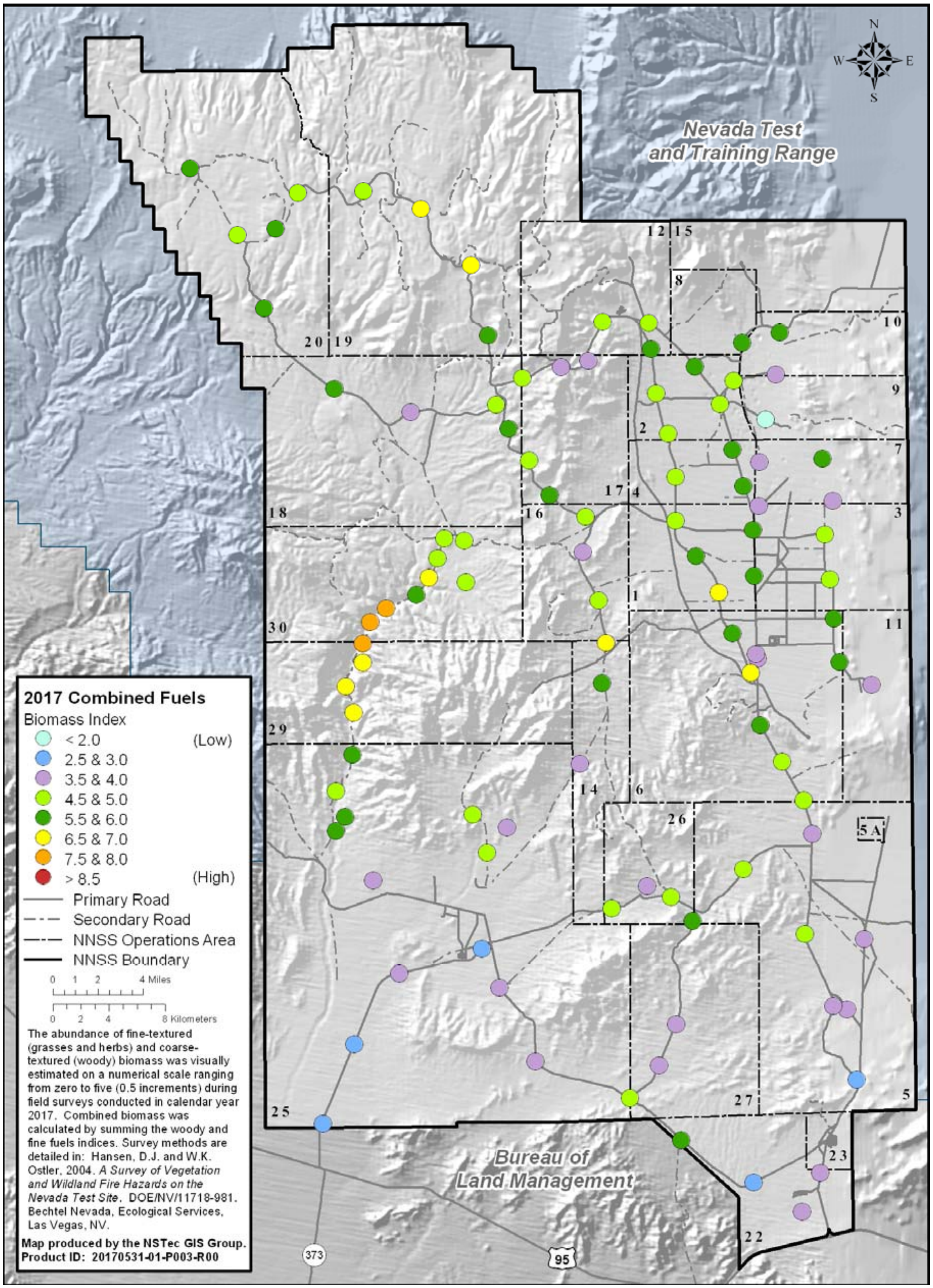

Figure 4-4. Index of combined fine and woody fuels for 104 survey stations on the NNSS during 2017.

Figure 4-5. Site 99 on the west side of Yucca Flat in 2011, 2015, 2016, and 2017.

(Photos by W. K. Ostler, April 26, 2011 [top left]; April 21, 2015 [top right]; April 20, 2016 [bottom left] and by J. Perry, April 26, 2017 [bottom right])

4.1.3.3 Invasive Plants

The three most commonly observed invasive annual plants to colonize burned areas on the NNSS are Arabian schismus (*Schismus arabicus*), found at low elevations; red brome, found at low to moderate elevations; and cheatgrass, found at middle to high elevations (Table 4-2).

Cheatgrass was the most common invasive plant occurring on 80% of the study sites. While it was predominantly found at middle to higher elevations it was also found at lower elevation sites as well. Both red brome (68%) and redstem stork's bill (*Erodium cicutarium*) (47%) had good germination over the NNSS. Precipitation history (Figure 4-1, 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 both in terms of plant abundance and biomass produced.

Colonization by invasive species such as cheatgrass, red brome, and Arabian schismus increases the likelihood of future wildland fires because they provide abundant fine fuels that are more closely spaced than native vegetation. Blackbrush vegetation types appear to be the most vulnerable plant communities to fire, followed by pinyon pine/Utah juniper/sagebrush species (*Pinus monophylla*/*Juniperus osteosperma/Artemisia* 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. Blackbrush, sagebrush, juniper and pinyon pine 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 cheatgrass and red brome) and other native annual species during 2017 was the fifth highest since 2004. Similar to last year, germination and growth of fine fuels during 2017 was greatest at the middle elevations and on previously burned sites.

4.2 REPTILE STUDIES

No formal trapping or roadkill studies took place in 2017. However, some opportunistic reptile observations were documented and one tissue sample from a gopher snake (*Pituophis catenifer*) was collected and given to the Nevada Department of Wildlife (NDOW) for future genetic analysis. The purpose of ongoing reptile sampling is to fill in data gaps for species that have not been documented recently or are rare on the NNSS.

A total of ten snakes including one speckled rattlesnake (*Crotalus mitchellii*), one juvenile gopher snake, one long-nosed snake (*Rhinocheilus lecontei*), one juvenile red racer (*Masticophis flagellum*), and six western ground snakes (*Sonora semiannulata*) were found in and around buildings around Mercury and were released back into the desert away from buildings. The long-nosed snake and western ground snakes were found alive on glue traps, extricated, and then released. One western ground snake was found dead on a glue trap in a building in Mercury. A hatchling sidewinder rattlesnake was found alive on a glue trap at the Canyon substation in Area 25, extricated and released back into the desert. A noteworthy observation was a road-kill western patch-nosed snake (*Salvadora hexalepis*) found in Area 25 on Jackass Flats Road on November 7.

Table 4-2. 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**	**2014**	**2015**	**2016**	**2017**
Mean Precipitation (mm) (December–April)	129.0	199.9	101.9	40.6	76.5	78.7	151.4	158.5	43.4	48.0	36.6	74.7	108.7	150.4
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	28.8	52.9	54.8	68.3
Bromus tectorum (cheatgrass)	40.3	54.0	60.7	0	59.2	66.0	67.0	79.2	17.0	70.2	61.5	36.5	69.2	79.8
Erodium cicutarium (redstem stork's bill)	5.2	6.2	24.6	0	21.3	27.4	33.0	42.4	0.9	37.5	33.7	25.0	43.3	47.1
Schismus arabicus (Arabian schismus)	4.7	2.8	5.2	0	11.4	9.4	3.8	11.3	0	9.6	6.7	10.6	15.4	15.4
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	26.0	47.1	66.4	54.8
Mentzelia albicaulis (whitestem blazingstar)	49.8	8.1	0	0	2.4	18.9	51.9	16.0	3.7	6.7	20.2	43.3	41.4	25.0
Chaenactis fremontii (pincushion flower)	27.0	8.0	0	0	1.4	11.3	13.2	0.5	0	6.7	2.9	7.7	32.7	38.5

4.3 NATURAL WATER SOURCE MONITORING

4.3.1 Existing Water Sources Monitored

Nine natural water sources (six springs, three rock tanks) were monitored with motion-activated cameras in 2017, primarily to document the presence of mountain lions (*Puma concolor*) and other wildlife (Figure 4-6). Results are found in Table 6-4 (see Section 6.7.1, Motion-Activated Cameras). General assessments were also made of each spring and surrounding area to document major disturbances or changes to these important water sources. Topopah Spring was nearly dry with just a small wet spot in the cave pool. Vegetation was heavily trampled by mule deer at Twin Spring and there was a small perennial pool of standing water. Vegetation at Captain Jack Spring is becoming pretty dense in the absence of wild horses using the perennial spring. Cottonwood Spring had more standing water than previously documented, and it persisted throughout the year when normally it dries up in the summer.

Cottonwood Spring had the greatest number of images (1,765) dominated by desert bighorn sheep (*Ovis canadensis nelsoni*) (941 images). Images of radio-collared sheep and unmarked sheep were observed (Figure 4-7). This was the first time sheep were photographed at this site since monitoring began in July 2013. Coyotes (311 images), bobcats (154 images), and common ravens (*Corvus corax*) (157 images) were also frequent visitors to the spring.

Captain Jack Spring had the second most images (1,618) but the greatest species richness with nine mammals and six birds detected. Mule deer dominated with 1,221 images recorded. Over 100 common raven images were taken this year versus 9 images last year. Gold Meadows Spring had the third most images (1,279). Most of these were mule deer (517 images) and horses (346 images). Other species detected were pronghorn antelope (173 images), elk (*Cervus elaphus*) (33 images), coyote (23 images), golden eagle (*Aquila chrysaetos*) *(*29 images), and common raven (158 images). Total images taken was similar to last year but there were half as many antelope images and a substantial increase in mule deer and horse images. As many as four bull elk were photographed using the spring during May and June (Figure 4-8). Although total number of golden eagle images was less than last year, large congregations of eagles were seen in images this year with some times as many as eight eagles in one image. Common raven images increased ten-fold with flocks of at least 50 seen in some images.

A total of 330 images were taken at Topopah Spring with most of these being coyotes (112 images) and desert bighorn sheep (87 images). Mule deer was the most common species photographed at Twin Spring (110 images). No animal species were photographed at Cane Spring. The camera only worked about half the time but it is still surprising that no animal photos were taken while it was operational.

Delirium Canyon Tank had water throughout the year, and a total of 141 images were taken. Eighty-seven of these were of marked and unmarked desert bighorn sheep. Four mesocarnivores were documented including bobcat (11 images), gray fox (*Urocyon cinereoargenteus*) (2 images), coyote (14 images), and ring-tailed cat (*Bassariscus astutus*). Fortymile Canyon Tanks, an ephemeral rock tank, was sampled for the first time this year, and a total of 106 images were taken. Species richness was high with five mammals, four birds, and two reptiles photographed. Another ephemeral rock tank, South Pah Canyon, was sampled again this year. A total of 24 images of seven species were photographed including two mammal species and five bird species.

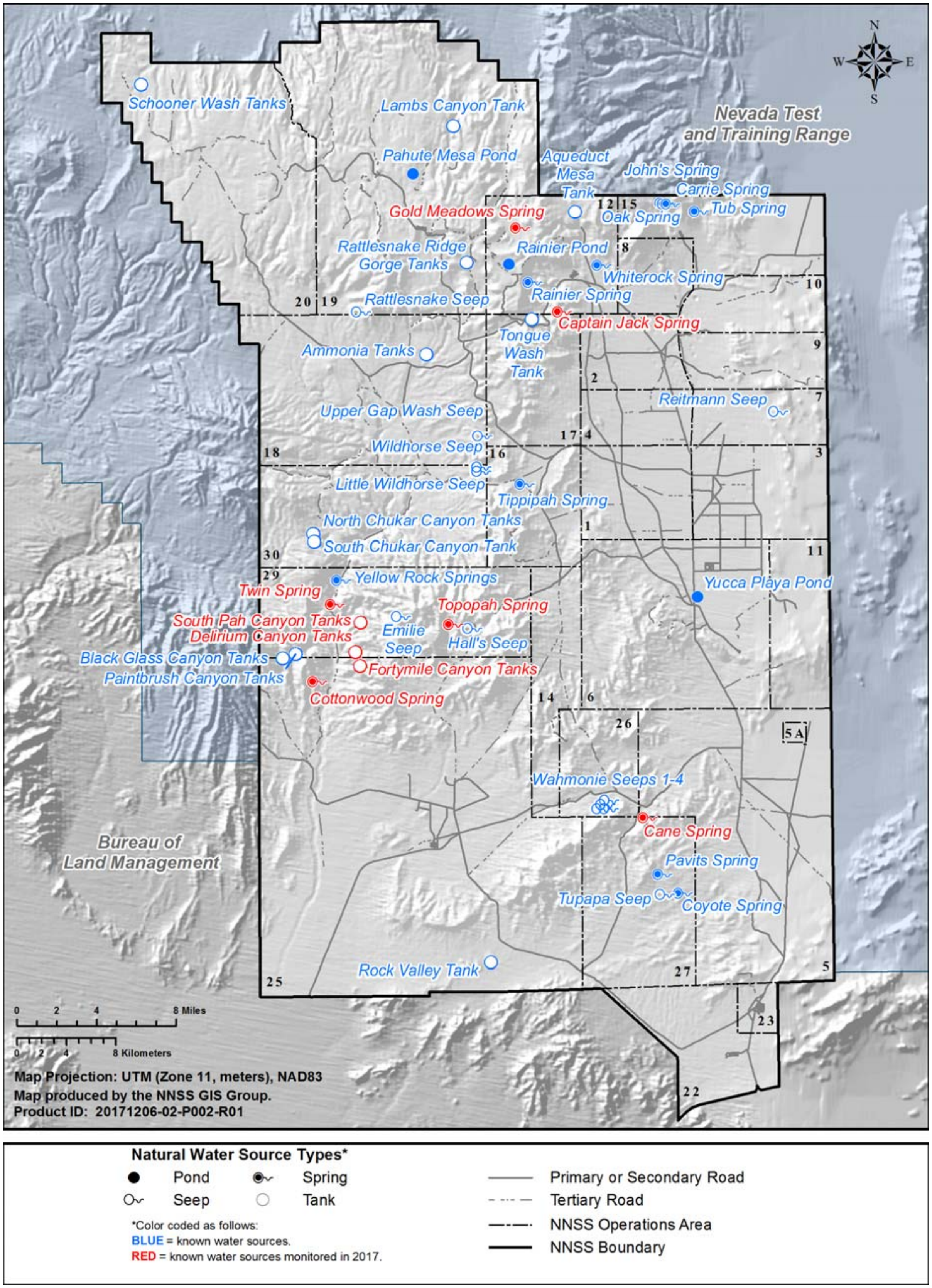

Figure 4-6. Natural water sources on the NNSS including those monitored in 2017.

Figure 4-7. Marked and unmarked desert bighorn sheep at Cottonwood Spring.

(Photo by motion-activated camera, June 23, 2017)

Figure 4-8. Four bull elk at Gold Meadows Spring.

(Photo by motion-activated camera, May 20, 2017)

4.4 CONSTRUCTED WATER SOURCE MONITORING

Ten constructed water sources were monitored with motion-activated cameras to document the presence of mountain lions and other wildlife during 2017. These included one well pond (Camp 17 Pond), five water troughs installed to mitigate the loss of well ponds, and four radiologically-contaminated sumps (Figure 4-9).

Camp 17 Pond had the greatest number of images (2,882) of any of the cameras in operation during 2017 with 15 species (7 mammal, 8 bird) being photographed (Table 6-4). Mule deer (1,280 images), horse (624 images), and red-tailed hawk (*Buteo jamaicensis*) (633 images) were the dominant species. Only half as many images of red-tailed hawks were taken in 2017 compared to 2016, and elk were documented for the first time at this water source.

4.4.1 Mitigating Water Loss for Wildlife

Water conservation measures were implemented on the NNSS in 2012 at four sites: Area 6 Construction Yard (Area 6 Los Alamos National Laboratory [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.

The drying of these ponds resulted in the loss of valuable wildlife habitat, so water troughs were installed to help mitigate the loss. 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 in Area 25. Motion-activated cameras were set up at each trough during the fall of 2012 and have been monitored since then to document wildlife use. These cameras were also added to the network of cameras used for monitoring mountain lions and results for 2017 are included in Table 6-4 (see Section 6.7.1, Motion-Activated Cameras).

Wildlife use at the Area 6 LANL Pond trough was moderate (372 images) and peaked during the dry, summer months. Nine species were detected including four mammals and five birds. Antelope continued to use this water source on a regular basis during the summer suggesting it is an important source of drinking water for them. Golden eagles were observed using this water source as well.

Use at Well C1 trough was moderate (220 images) with at least 15 species (8 mammals and 7 birds) documented at the trough. Use peaked during the dry, summer months. Number of images taken dropped ten-fold this year compared to 2016 with a major drop in common raven photos (70 in 2017 versus 1,501 in 2016) and mourning dove (*Zenaida macroura*) photos (3 in 2017 versus 623 in 2016). Noteworthy species documented included badger (Figure 4-10), golden eagle, and greater roadrunner (*Geococcyx californianus*).

Wildlife use at Well 5C trough was moderate (186 images) with at least 8 species (4 mammals and 4 birds) photographed. Black-tailed jackrabbits (*Lepus californicus*) (90 images) and antelope (45 images) were the most commonly photographed species.

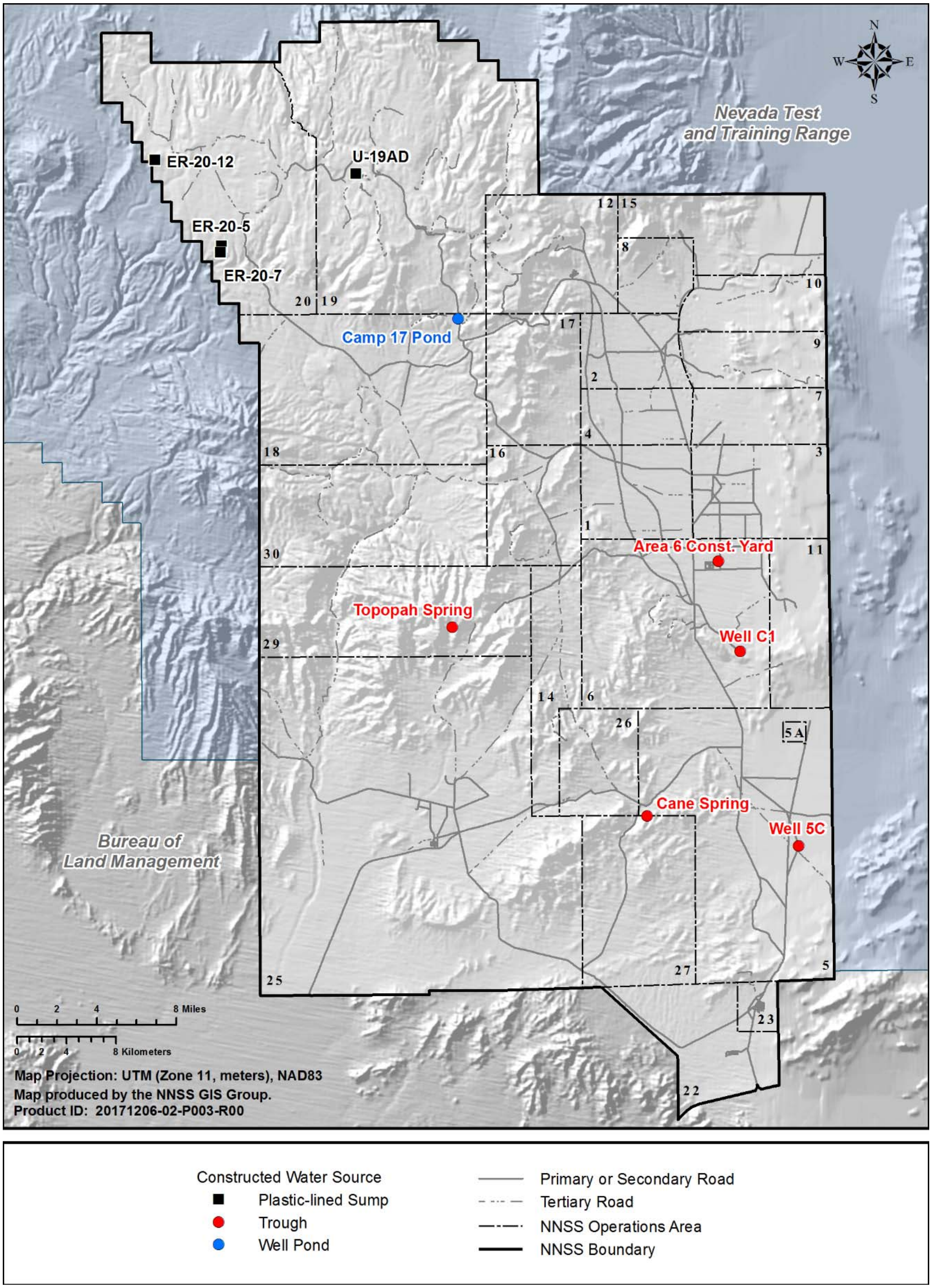

Figure 4-9. Constructed water sources monitored with motion-activated cameras for wildlife use during 2017.

Figure 4-10. Badger with turkey vulture in background at Well C1 trough.

(Photo by motion-activated camera, December 19, 2017)

Wildlife use at the trough at Cane Spring was very light with only three images taken, two red-tailed hawk photos and one mourning dove photo. Combined with the data from the spring, wildlife use was the lowest ever documented at this site for unexplained reasons.

Wildlife use at the Topopah Spring trough was light (71 images) with 4 species (3 mammals and 1 bird) documented. Similar to last year, most of the activity was from mule deer (66 images), and one image of a desert bighorn sheep was taken near the trough. The number of animal photographs taken at the Topopah Spring trough (71 images) was substantially less than at the spring (330 images) with five mammal species and four bird species detected at the spring. Differences in use may be a preference for the natural setting at the spring versus using the artificial trough or water availability/accessibility or a combination of both.

In summary, several wildlife species use the water troughs, indicating the troughs are benefiting many wildlife species on the NNSS, especially certain bird species, ungulates, and coyotes. Waterfowl and shorebirds do not appear to use the troughs 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, especially during the hot, dry summer.

4.4.2 Monitoring Wildlife Use at Potentially Contaminated Water Sources

During 2017, motion-activated cameras were set up at four contaminated water sources which are sumps constructed to retain groundwater and drilling fluids from Underground Test Area (UGTA) wells during drilling, well development, and groundwater testing. The sumps included those located at UGTA wells ER 20-7, ER 20-5, U19ad, and ER 20-12 (Figure 4-9). The cameras were also added to the network of cameras used for mountain lion monitoring (see Section 6.7.1, Motion-Activated Cameras) (Table 6-4). Typically, discharge water and drilling fluids having ≥400,000 picocuries/liter (pCi/L) of tritium are diverted to plastic-lined sumps to evaporate; otherwise, they are diverted to unlined sumps. Inactive well sumps can also retain precipitation, which can become contaminated from accumulated sediments. The cameras were set up to document which wildlife species were using the sumps and their frequency of use to assess the potential off-site transport of radionuclides by wildlife as well as the potential impact to the wildlife themselves.

Of the four sumps, ER 20-7 had the highest use with 223 images representing 7 species (3 mammals, 4 birds). This site was previously sampled in 2015 but was sampled again in 2017 because of its proximity to desert bighorn sheep habitat on the southern edge of Pahute Mesa. One un-collared ram was photographed six times at the sump on December 19th (Figure 4-11). Common raven was the most commonly photographed species (167 images) followed by horned lark (*Eremophila alpestris*) (23 images), coyote (15 images), turkey vulture (*Cathartes aura*) (10 images), mule deer (1 image), and mourning dove (1 image).

There are five, plastic-lined sumps at ER 20-5. A camera was set up at the sump in the northwest corner. Results showed minimal use with two images of coyotes, one image of mule deer, and one image of a common raven. Wildlife use at the U19ad plastic-lined sump was minimal also with one image of a coyote and three images of mule deer.

ER 20-12 was constructed in 2015 and because of its large size, two cameras (one in the northeast corner, one in the southeast corner by the sediment ramps) were installed in January 2016 to monitor wildlife use. Data from 2017, from both cameras combined showed minimal use with three images of mule deer, two images of northern harrier (*Circus cyaneus*), one image of common raven, two images of passerines, and ten images of unknown birds.

Overall, wildlife use at the contaminated sumps was moderate. Important species use them and are potentially uptaking radiological contaminants. Huntable species such as desert bighorn sheep, mule deer and mourning doves are a potential pathway of exposure to the general public. Protected birds such as hawks and ravens may also be impacted. UGTA sumps will continue to be monitored to determine their level of use by various wildlife species, calculate the potential dose someone eating contaminated wildlife may receive, and determine if the dose is harmful to the animal. More information about potential dose to humans and wildlife can be found in the annual Nevada National Security Site Environmental Reports (e.g., NSTec, 2017) available at http://www.nnss.gov/pages/resources/library/NNSSER.html.

Figure 4-11. Un-collared desert bighorn sheep ram at ER 20-7.

(Photo by motion-activated camera, December 19, 2017)

4.5 COORDINATION WITH SCIENTISTS AND ECOSYSTEM MANAGEMENT AGENCIES

Site biologists interfaced with other scientists and ecosystem management agencies in 2017 for the following activities:

- Collected specimens of California evening primrose (*Oenothera californica* ssp. *avita*) for Krissa Skogen at the Chicago Botanic Garden.
- Accompanied U.S. Forest Service personnel and took photos of their plots for the Interior West Forest Inventory and Analysis Program.
- Assisted Los Alamos National Lab personnel with plant identification and background information about potential radionuclide uptake by plants.
- Participated in multiple conference calls for the DOE Invasive Species Working Group
- Set up a display highlighting NNSS wildlife for the NNSS Safety Fair in Mercury.

5.0 SENSITIVE PLANT MONITORING

The list of sensitive plants on the NNSS (see Table 2-1) is reviewed annually to ensure the appropriate species are included in the NNSS Sensitive Plant Monitoring Program. There were no changes to the sensitive plant list in 2017. 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 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 on sensitive plants is disseminated to state and federal agencies and other interested entities. Sensitive plant monitoring surveys were not conducted in 2017 on the NNSS and no sensitive plant populations were observed during compliance surveys. Sanicle biscuitroot (*Cymopterus ripleyi* var. *saniculoides*) was observed in similar locations as in previous years in a few sandy washes in Area 22 while tracking translocated juvenile desert tortoises. Inyo hulsea (*Hulsea vestita spp. inyoensis*) was observed during fuel surveys at fuel survey site number 143 along Stockade Wash Road at the north side of Area 17. It was last observed at this location during fuel surveys in 2013.

6.0 SENSITIVE AND PROTECTED/REGULATED ANIMAL MONITORING

The NNHP Animal and Plant At-Risk Tracking List (NNHP 2018); NAC 503, "Hunting, Fishing and Trapping; Miscellaneous Protective Measures" (NAC 2018); the FWS Endangered Species home page (FWS 2018); 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. Substantive changes were made to the status of bats on the NNHP Animal and Plant At-Risk Tracking List. It was decided to consider bats found on the NNHP list as sensitive bat species and do away with designations found in the Revised Nevada Bat Conservation Plan (Bradley et al., 2006). Therefore, five bats including California myotis (*Myotis californicus*), small-footed myotis (*M. ciliolabrum*), long-eared myotis (*M. evotis*), Yuma myotis (*M. yumanensis*), and canyon bat (*Parastrellus hesperus*) were removed from the list and silver-haired (*Lasionycteris noctivagans*) and hoary bats (*Lasiurus cinereus*) are still considered sensitive species. In all, there are eight bat species now considered as sensitive and protected/regulated. The complete list with current designations is found in the Sensitive and Protected/Regulated Animal Species List (Table 2-1).

Surveys of sensitive and protected/regulated animals during 2017 focused on (a) birds, (b) bats (c) feral horses, (d) mule deer, (e) desert bighorn sheep, and (f) mountain lions. Information about other noteworthy wildlife observations, southeast Nevada pyrg survey results, bird mortalities, and a summary of nuisance animals and their control on the NNSS is also presented.

6.1 SOUTHEAST NEVADA PYRG

The southeast Nevada pyrg (*Pyrgulopsis turbatrix*) is a freshwater springsnail and is considered a sensitive species on the NNSS. It is only known to occur in Clark and Nye counties. On the NNSS, it is only known to occur at Cane Spring. It has been petitioned to become a listed species under the Endangered Species Act. This listing is currently under review by the FWS.

On May 5, 2016, FWS and other biologists collected 30 southeast Nevada pyrgs from Cane Spring as part of a range-wide genetic study of the species. Results validate that the species at Cane Spring is the southeast Nevada pyrg, and is most closely related to populations in the Spring Mountains, Nevada.

6.2 BIRDS

Bird monitoring on the NNSS during 2017 focused on Migratory Bird Treaty Act (MBTA) Compliance, documenting bird mortalities, implementing the NNSS Avian Protection Plan, and conducting winter raptor surveys. Additionally, a new bird species, the zone-tailed hawk (*Buteo albonotatus*) (Figure 6-1), was observed in Area 12 on May 3, 2017, near the Rainier Mesa Road/N Tunnel Road intersection. This makes a total of 244 confirmed bird species documented on the NNSS.

6.2.1 Migratory Bird Treaty Act Compliance

The MBTA is a federal law designed to protect most bird species. All but six birds known to occur on the NNSS are protected under the MBTA. Exceptions include the European starling (*Sturnus vulgaris*), English house sparrow (*Passer domesticus*), rock dove or pigeon (*Columba livia*), and the Eurasian collared dove (Federal Register, Volume 70, Number 49, March 15, 2005). The chukar (*Alectoris chukar*) and Gambel's quail (*Callipepla gambelii*) are also not protected under the MBTA but are regulated by

Figure 6-1. Zone-tailed hawk in flight, Area 12.

(Photo by R. Warren, May 3, 2017)

Nevada state law as gamebirds. A change in the way the MBTA has been interpreted was written in a FWS Memorandum M-37050 on December 22, 2017. Up until now the MBTA has prohibited the intentional and incidental take of migratory birds. M-37050 changes that interpretation to state, "the Migratory Bird Treaty Act does not prohibit incidental take." The impacts of this change are not known at this time but will be addressed as more information becomes available.

Executive Order (EO) 13186 *Responsibilities of Federal Agencies to Protect Migratory Birds* directs federal agencies to develop a Memorandum of Understanding (MOU) and work with the FWS to promote the conservation of migratory bird populations. An MOU was signed by U.S. Department of Energy and FWS in September 2013 regarding implementation of EO 13186.

Actions taken to comply with the MBTA and MOU during 2017 included the following: 1) conducted preactivity surveys for proposed projects before surface-disturbing work to avoid harming birds or their nests, 2) rescued and released four grounded birds including an eared grebe (*Podiceps nigricollis*), two barn owls (*Tyto alba*), and a cactus wren (*Campylorhynchus brunneicapillus*), 3) installed bird guard, protective covers and other retrofits on powerlines to reduce avian mortality, 4) submitted an application to FWS for a Special Purpose Utility permit, and 5) reported dead/injured birds to FWS.

6.2.2 Bird Mortalities

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. Other causes of death include predation and disease and in many instances the cause of death is unknown. Workers and biologists work together to observe and report mortalities.

A record number of 45 birds were found dead on the NNSS in 2017 (Figure 6-2). Thirty were electrocuted, including 14 golden eagles, 7 red-tailed hawks, 5 common ravens, 1 turkey vulture, 1 barn owl, and 2 unknown hawks. A western burrowing owl (*Athene cunicularia*), red-tailed hawk, and red-breasted merganser (*Mergus serrator*) were killed by vehicles; a barn owl was killed when it became entangled in razor wire; and 10 birds were found dead of unknown causes including 6 barn owls, 1 Cooper's hawk (*Accipiter cooperi*), 1 greater roadrunner (*Geococcyx californianus*), 1 California gull (*Larus californicus*), and 1 slate-colored race dark-eyed junco (*Junco hyemalis*). A golden eagle with severe wing tissue damage was found alive in north Yucca Flat (Area 2) and taken to the North Las Vegas Animal Hospital. It died within a day or two. It appeared to have been attacked by another bird but specific cause of death is unknown. One possible explanation for the high number of mortalities is the fact that bird activity, including breeding, was greater than normal in 2017 in response to the above-normal precipitation received during winter/spring 2016-2017.

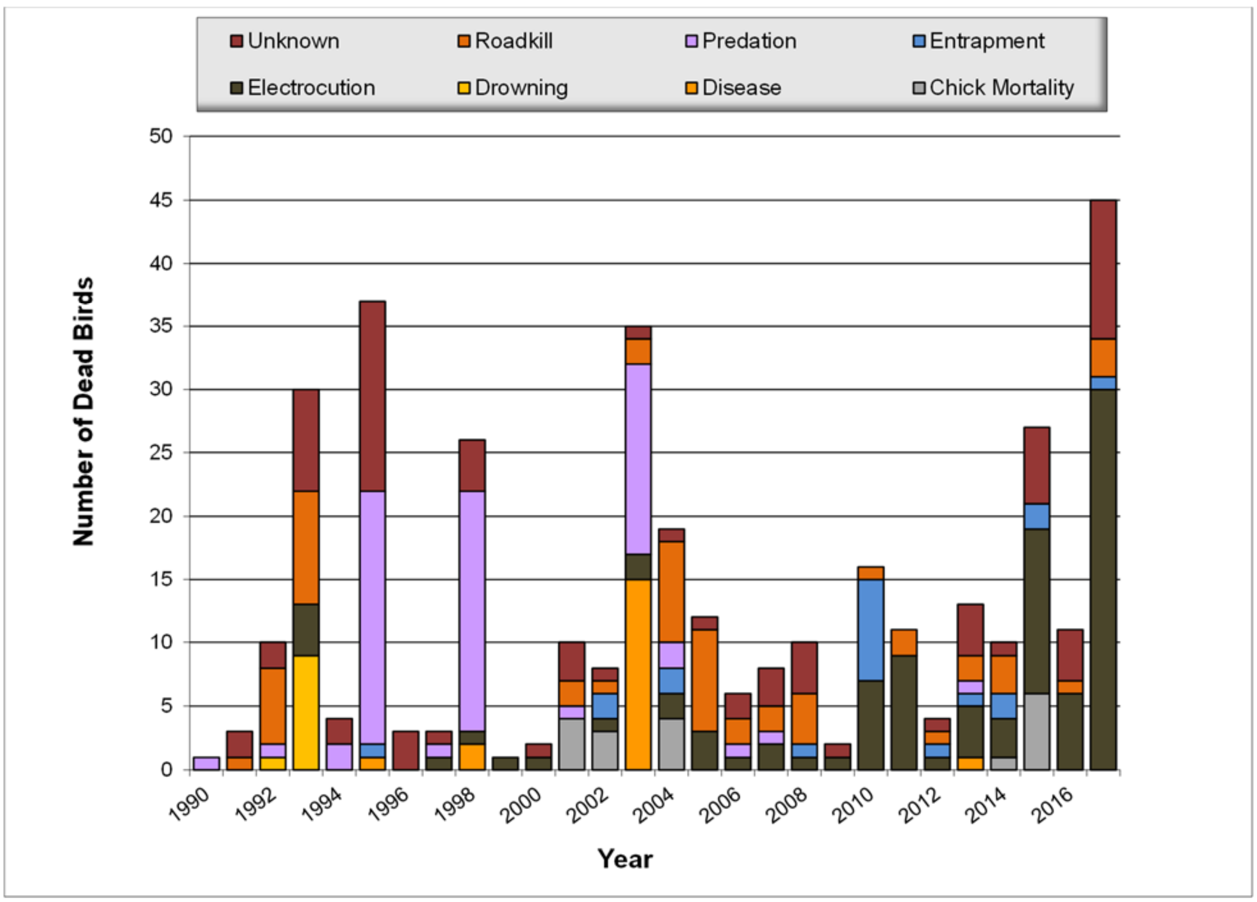

Figure 6-2. Records of reported bird deaths on the NNSS, 1990–2017.

The number of dead birds observed in 2017 is the most ever recorded in a single year on the NNSS. This total was comprised mainly of a record number of electrocutions with more than twice as many mortalities than the next highest year (13 in 2015). A staggering number of golden eagles were electrocuted this year with 14 being killed. This is nearly as many mortalities as has been recorded from 1971-2016 (n=15). The two main reasons for this are better reporting of bird electrocutions and a higher number of golden eagles on the NNSS during 2017. Anecdotally, there were more golden eagle sightings reported on the NNSS during 2017, possibly in response to high numbers of black-tailed jackrabbits. Additionally, results from the January 2018 winter raptor surveys confirmed the presence of at least seven golden eagles on the NNSS, two on the southern route and five on the Yucca Flat route. This is the most eagles ever recorded during these surveys since surveys began in 2014. The next highest number of eagles seen was two, one on the southern route and one on the Yucca Flat route in January 2017.

The golden eagle deaths were reported to FWS and the carcasses given to FWS law enforcement. Numerous poles were identified by MSTS biologists and the power group to install retrofits or reconfigure to make them avian friendly (Figure 6-3). A total of 64 poles were retrofitted during 2017 with additional poles planned to be retrofit during 2018 when power can be shut off to important NNSS facilities. A variety of retrofits were made including installing insulator covers and extenders, perch deterrents, conductor wire covers, and fuse covers.

Figure 6-3. Retrofit pole with conductor wire covers and insulator covers and extenders.

(Photo by D.B. Hall, April 5, 2017)

6.2.3 Implementing the NNSS Avian Protection Plan

The NNSS Avian Protection Plan (APP) was finalized during 2017. Its main purpose is to describe a program intended to reduce the operational and avian risks that result from avian interactions with electric transmission and distribution lines on the NNSS owned by NNSA/NFO as well as other non-electric sources of mortality (e.g., vehicle collisions, habitat disturbance).

At the end of each calendar year the APP should be reviewed and the following questions answered: 1) Is the reporting procedure effective at documenting avian mortalities, 2) Are reported mortalities/injuries addressed in a timely manner, 3) Are permit conditions being met, and 4) What mortality reduction measures were taken and are they effective. For 2017 answers to these questions are:

- The reporting procedure was effective at documenting avian mortalities. There is good communication between biologists, the power group, and the Operations Command Center to report avian issues.

- Reported mortalities/injuries were addressed in a timely manner and were usually investigated the same day or within a few days.

- Currently, the only permit we have regarding birds is MB008695-2 which allows the taking of up to 10 mourning doves each year for radiological analysis and the salvage of dead migratory birds (except species listed under the Endangered Species Act). All permit conditions were met and an annual report summarizing 2017 activities was submitted to FWS. No mourning doves were taken and no dead birds were salvaged. MSTS biologists prepared a permit application for NNSA/NFO to apply for a FWS Special Purpose Utility Permit that would enable biologists to remove active nests at project sites and possess and transport golden eagle carcasses. It is anticipated that this permit will be granted to NNSA/NFO in 2018.

- Several mortality reduction measures were taken including the aforementioned retrofits on 64 power poles, power was shut down to three poles that were not needed anymore, more than 100 poles were identified for future retrofits, four inactive nests were removed, 204 ha at 19 project sites were surveyed for active bird nests, and several dead rabbits were removed from roads to reduce the potential for vehicle mortalities. These measures were effective at reducing avian mortalities.

6.2.4 Winter Raptor Surveys

Winter raptor surveys were initiated during 2014, in an effort to better understand wintering raptors on the NNSS and as a collaborative effort to provide data to the U.S. Army Corps of Engineers' (USACE) nationwide mid-winter bald eagle survey and NDOW's statewide monitoring effort. Surveys continued in 2017, and were conducted by driving a standard route to identify all raptors observed (i.e., eagles, hawks, owls, and vultures). Two official routes were established on the NNSS: Southern NNSS, Route #60 (83 km), and Yucca Flat, Route #61 (75 km) (Figure 6-4). Data including common name, UTM coordinates (NAD 83), time, activity, age class, and perpendicular distance from the road were recorded, and climatic data (i.e., temperature, wind speed, and cloud cover) were taken at the beginning and end of each survey. Surveys were conducted January 10 (Southern NNSS) and January 11 (Yucca Flat) to coincide with the national bald and golden eagle survey and on February 13 (Southern NNSS) and February 15 (Yucca Flat).

The intent is for these surveys to be conducted each year for numerous years to look at long-term trends in winter raptor occurrence on the NNSS. Much is known about raptors on the NNSS in the summer, but

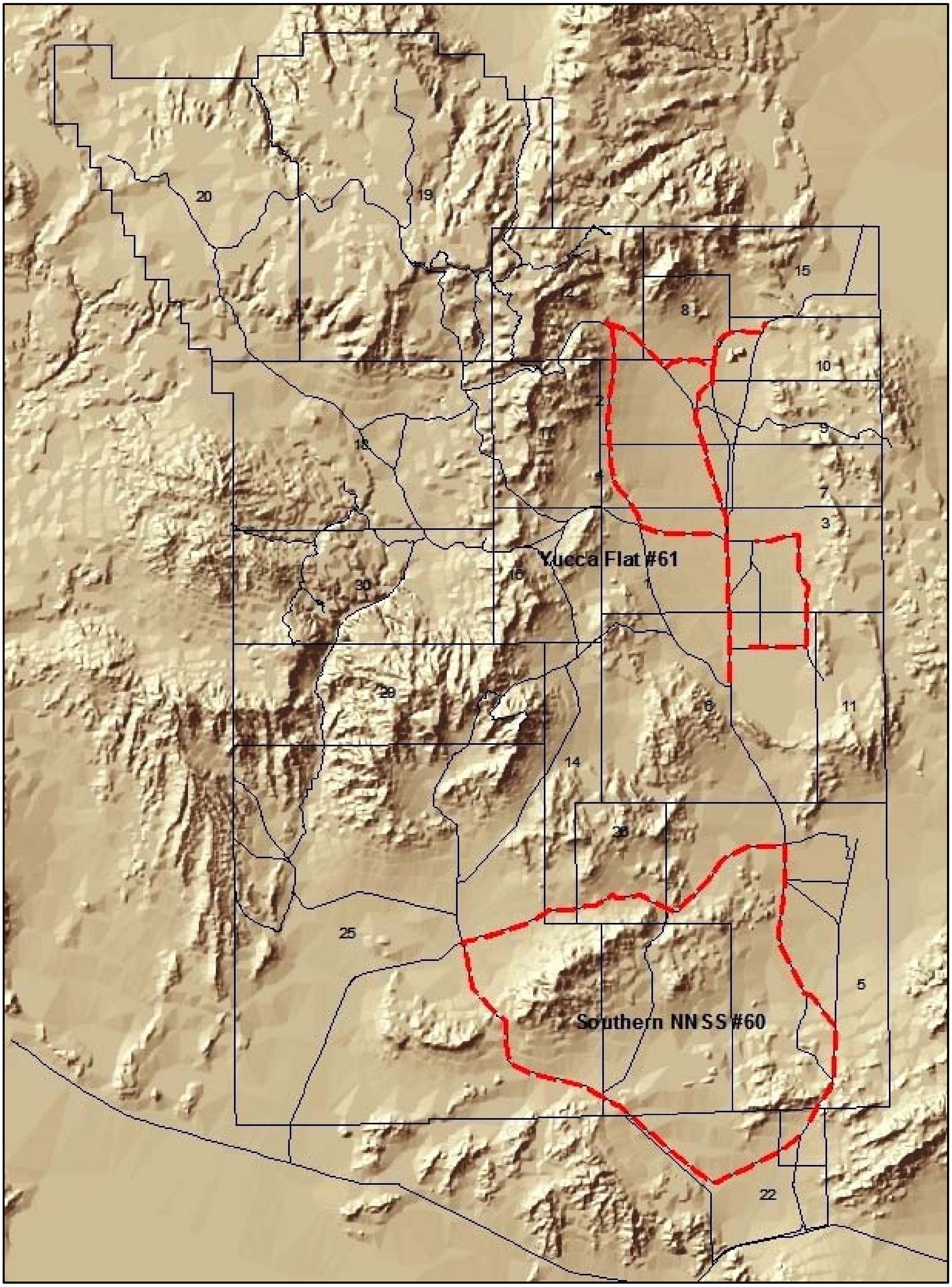

Figure 6-4. Winter raptor survey routes (red lines) on the NNSS.

winter data are lacking. Winter data may be important to detect changes in species composition related to climate change. Data on common ravens and loggerhead shrikes (*Lanius ludovicianus*) were also recorded because ravens are known desert tortoise predators, and the loggerhead shrike is a sensitive species. The southern route is located primarily in the Mojave Desert portion of the NNSS while the Yucca Flat route is located in the transition zone between the Mojave Desert and Great Basin Desert. Detailed driving directions for each route are found in the 2016 EMAC report (Hall et al., 2017).

Results are found in Table 6-1. Three golden eagle sightings were documented during the surveys; two on the Yucca Flat route during the January and February surveys and one on the southern NNSS route during the January survey. The red-tailed hawk was the most common species detected on both routes, comprising nearly three-fourths of all raptor sightings. Common ravens were more prevalent on the Yucca Flat route than the southern NNSS route. On the southern route, overall raptor abundance was higher in 2017 (n=21) than in the previous three years (12 in 2014, 3 in 2015, and 9 in 2016), and also higher in 2017 (n=23) on the Yucca Flat route than in the previous three years (16 in 2014, 17 in 2015, and 16 in 2016). Data were entered into the Ecological Geographic Information System (EGIS) faunal database, and given to NDOW and the USACE for inclusion in their analyses.

Table 6-1. Results of winter 2017 raptor surveys on the NNSS.

Species	Southern NNSS (1/10/17)	Southern NNSS (2/13/17)	Yucca Flat (1/11/17)	Yucca Flat (2/15/17)
Golden Eagle (*Aquila chrysaetos*)	1	0	1	1
Northern Harrier (*Circus cyaneus*)	1	0	2	1
Red-tailed Hawk (*Buteo jamaicensis*)	11	6	4	11
Praire Falcon (*Falco mexicanus*)	1	0	0	0
American Kestrel (*Falco sparverius*)	1	0	0	1
Burrowing owl (*Athene cunicularia*)	0	0	1	1
Total Raptors	**15**	**6**	**8**	**15**
Common Raven (*Corvus corax*)	3	1	7	4
Loggerhead Shrike (*Lanius ludovicianus*)	2	0	0	2

6.3 BAT SURVEYS

Bat monitoring in 2017 consisted of removing bats from buildings and documenting the roost sites. Two bats were found roosting in buildings in Mercury and were released away from populated areas. One was an adult, female pallid bat (*Antrozous pallidus*) and one was an adult, female California myotis (*Myotis californicus*). In addition, three bats were found dead in buildings. Two adult, female Brazilian free-tailed bats were found dead in a building in Mercury, and one adult California myotis or small-footed myotis (*M. ciliolabrum*) was found dead in a building in Yucca Flat (Area 11). Roost site locations at these buildings were entered in the EGIS faunal database.

6.4 WILD HORSE SURVEYS

An effort was made in 2017 to determine horse abundance and distribution on the NNSS. In order to allow for consistency in the identification of individuals, a rubric for horse color, body features, body markings, facial marking and leg markings was created based on previous monitoring techniques and common terminology. Surveys were conducted during the summer at several locations including Camp 17 Pond, Airport Road, and Pahute Mesa Road. A total of 24 individuals were identified in four different bands and at least three foals were observed (Joseph Casalino, MSTS, personal communication, August 15, 2017). Opportunistic sightings were noted and images from 30 motion-activated cameras (see Table 6-4 in Section 6.7.1, Motion-activated cameras) were also evaluated to document horse abundance and distribution.

Figure 6-5. Feral horses at Camp 17 Pond.

(Photo by motion-activated camera, August 20, 2017)

Based on opportunistic sightings and camera results, horses were observed using the same areas as in previous years. As a follow-up to 2016, no sightings were documented in Area 20 around Schooner Crater. No horses were documented using Captain Jack Spring for the fourth consecutive year. Numerous horse photos were taken at Camp 17 Pond (624 images) (Figure 6-5) and Gold Meadows Spring (364 images) (Table 6-4). These water sources are the core areas used by horses, especially during the hot, dry summer months.

6.5 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 during 1989–1994, 1999–2000, and 2006-2017. In past years, the monitoring effort has emphasized estimating relative abundance and density but 2016 and 2017 survey efforts focused solely on relative abundance.

6.5.1 Trends in Mule Deer Abundance

Mule deer abundance on the NNSS was measured by driving two standardized (59 km total length) road courses (Figure 6-6) to count and identify mule deer. One route (29 km) was centered around Rainier Mesa, and the second (30 km) was centered around the eastern portion of Pahute Mesa. Selection of the two routes was based on information from Giles and Cooper (1985) who determined there are two main deer herd components in these regions on the NNSS. Locations of mule deer were recorded with a GPS unit from the road centerline. Perpendicular distance from the road to each deer group was measured with a laser range finder.

During six surveys conducted September 18-20 and October 2-4, 2017, a total of 149 deer were observed on both routes combined, which equates to an average of 25 deer per night. This is nearly identical to 2016 results with 151 deer observed and an average of 25 deer per night. On average, this is about six deer per night lower than the long-term average since 1989. There has been a decreasing trend z($y = -2.4145x + 48.943$, $r^2 = 0.48$) the last 12 years with counts fluctuating widely (Figure 6-7). The trend for the entire study period (1989-2017, excluding 1995-1998 and 2001-2005) is nearly flat ($y = 0.0206x + 30.052$, $r^2 = 0.0002$). The standard deviation in 2017 for nightly counts was one of the highest recorded since 2006 (Figure 6-7), and deer counts ranged from 5 to 43 deer per night. Specific causes for the fluctuation in deer numbers is unknown and requires further investigation.

The number of deer per 10 km was higher on Rainier Mesa than Pahute Mesa this year (Figure 6-8). This is in contrast to the trend the last few years for deer numbers to be higher on Pahute Mesa than Rainier Mesa. In 2017, a total of 74 deer groups were detected. Group size varied from 1 to 11 animals. In contrast to 2016, where average group size was nearly equal between the Pahute Mesa and Rainier Mesa routes (1.7 and 1.9, respectively), average group size in 2017 was larger on the Rainier Mesa route than on the Pahute Mesa route (2.7 and 1.6 deer, respectively).

6.5.2 Sex and Fawn/Doe Ratios

The deer sex ratio (number of bucks per 100 does) greatly increased from 74 in 2016 to 124 in 2017, which is the third highest recorded since 2006 (Table 6-2). These sex ratios have varied greatly on the NNSS since 2006. Our values overall show some similarity to historical sex ratios noted by Giles and Cooper (1985), who attributed the higher number of males to a lack of hunting on the NNSS. Generally, deer populations in hunted areas in the western U.S. have significantly fewer males compared to females in the population than measured on the NNSS. The fawn/doe ratio (number of fawns per 100 does) in 2017 was 26 fawns per 100 does (Table 6-2) which is slightly above the average of 25 fawns per 100 does for the period 2006-2017. The largest percentage of individuals unclassified to sex since 2006 was documented this year with nearly 30% of individuals unclassified. When deer are observed at long distances (150-200 m) from the vehicle, it can be difficult to determine if individuals are bucks, does, or fawns due to spotlight limitations.

6.5.3 Fall Distribution Surveys

It is anticipated that 20 mule deer will be captured and radio-collared on the NNSS in the next year or two to better understand their habitat use and movements in support of studies regarding the potential radiological dose to the off-site public. Captures are planned for the November-December timeframe.

In order to facilitate captures, spotlight surveys were conducted on November 28-29 to evaluate the distribution of mule deer at this time of year. The Rainier Mesa route (Figure 6-6) was surveyed on November 28. A total of 11 deer were observed, all of which were on the eastern slope of Rainier Mesa at lower elevations. The Pahute Mesa route (Figure 6-6) was surveyed on November 29. Four deer were detected, three of which were found on the Echo Peak road and one on the Dead Horse Flats Road.

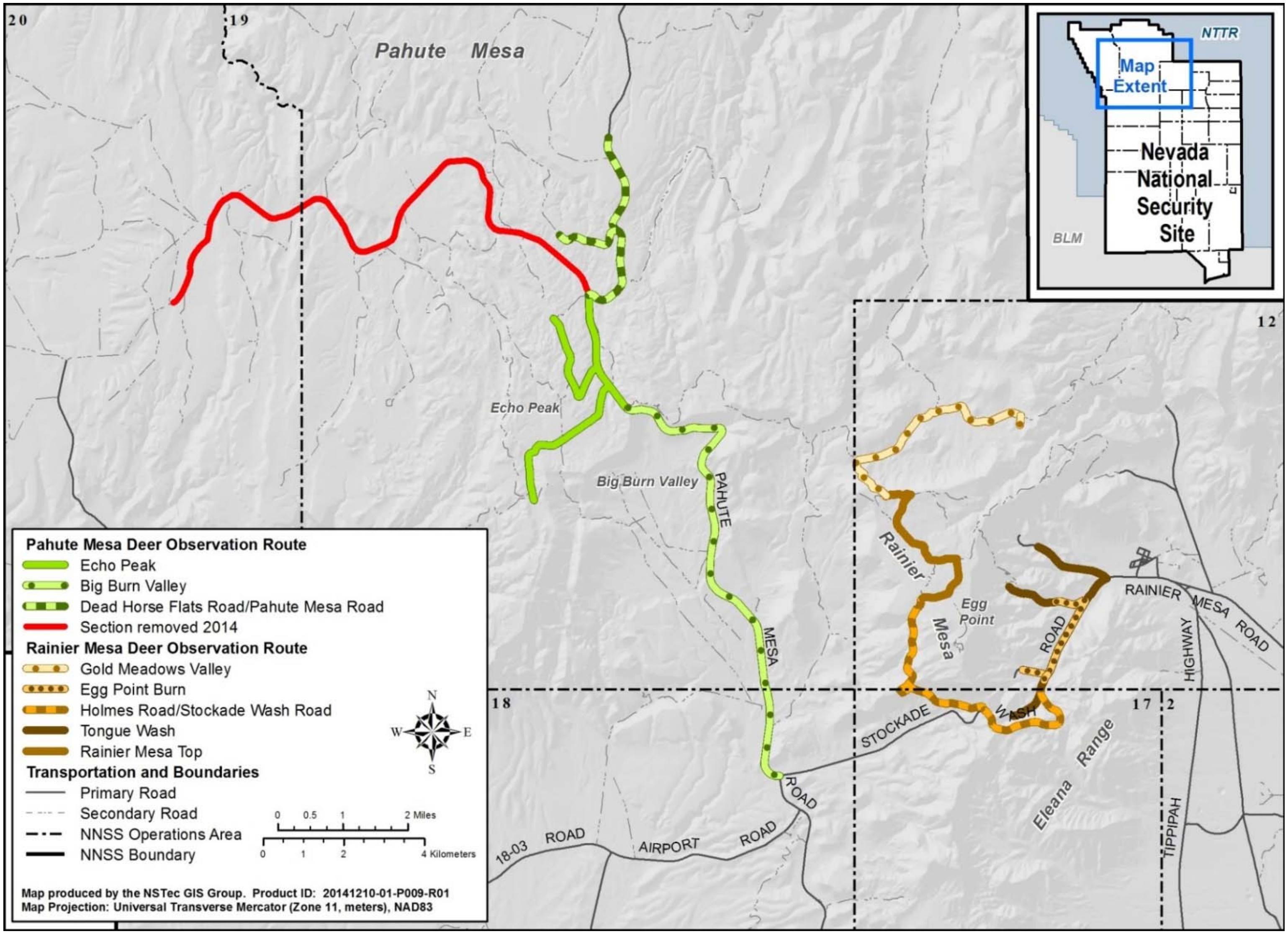

Figure 6-6. Road routes and sub-routes of two NNSS regions driven in 2017 to count deer and section removed due to road closure.

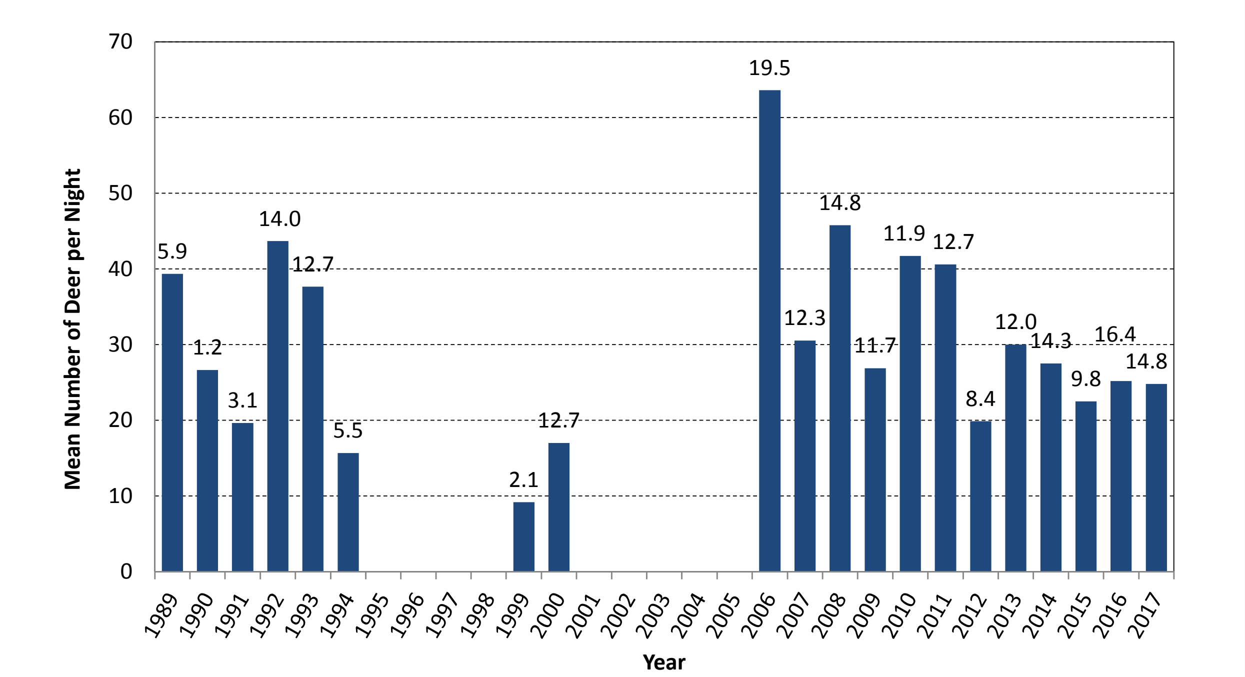

Figure 6-7. **Trends in total deer count per night from 1989 to 2017 on the NNSS (surveys were not conducted during 1995–1998 or 2001–2005). Standard deviation values above bars.**

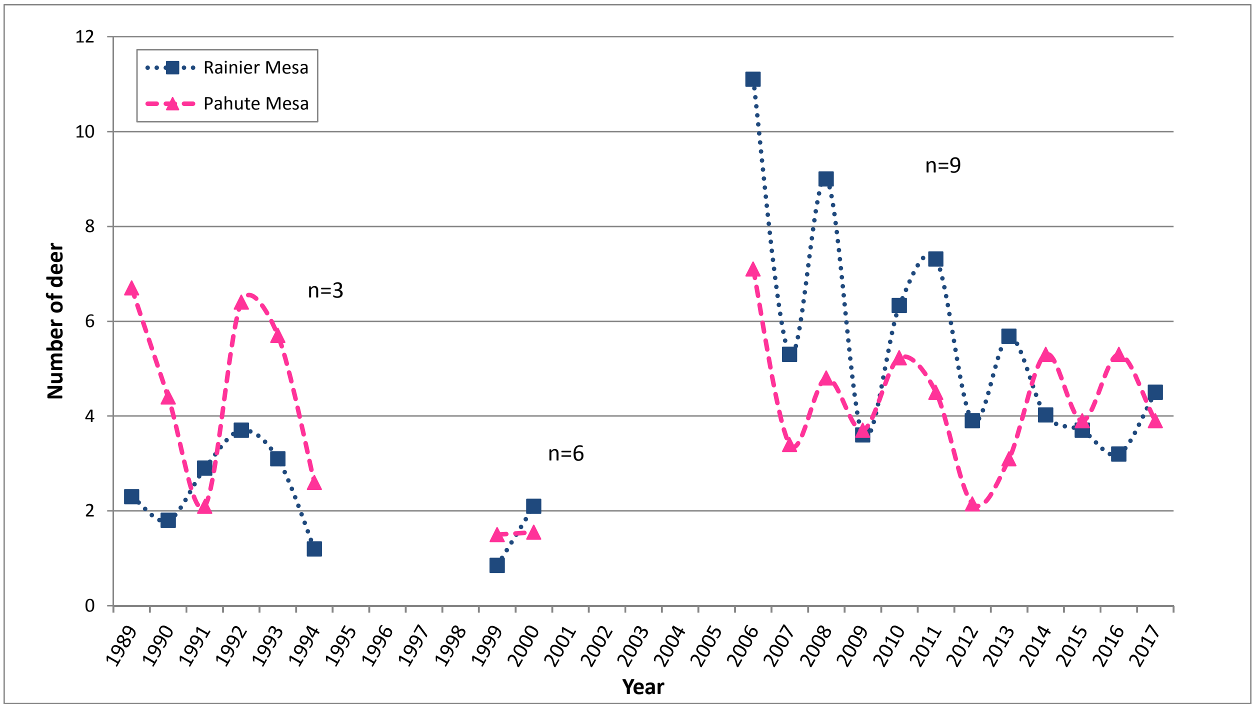

Figure 6-8. **Mean number of mule deer per 10 km per night, counted on two routes (n = number of survey nights; exceptions n = 12 for 2012, n = 8 for 2013, n = 6 for 2015-2017).**

Table 6-2. Mule deer classified by sex and age, with sex ratios, and fawn to doe ratios from 2006 to 2017 on the NNSS (12 survey nights for 2012, 8 for 2013, 6 for 2015-2017, 9 for all other years).

Year	Total Deer	Bucks	Does	Unclassified Sex	Bucks/100 does	Fawns	Fawns/100 does
2006	573	224	222	96	101	31	14
2007	275	148	68	59	218	0	0
2008	408	164	147	50	112	47	32
2009	242	98	102	35	96	7	7
2010	365	133	150	50	89	32	21
2011	477	189	184	67	103	37	19
2012	179	65	67	28	97	19	30
2013	243	106	68	38	156	31	45
2014	249	76	94	60	81	19	20
2015	135	33	58	19	57	25	43
2016	151	43	58	27	74	23	40
2017	149	52	42	44	124	11	26

6.6 DESERT BIGHORN SHEEP

Prior to 2009, desert bighorn sheep (sheep) were rare visitors on the NNSS (Saethre 1994, Hall et al. 2017). Since 2009, numerous observations of sheep and sheep sign (i.e., scat, beds, and remains) have been detected with motion-activated cameras and during the mountain lion study, including the discovery of ewes and lambs in the Yucca Mountain/Fortymile Canyon area and the southern flank of Pahute Mesa. These new data have expanded the known distribution of sheep on and near the NNSS and have prompted further study of these important animals including the capture, radio-collaring, and tracking of nearly 20 individuals over the last three years. This study is being led by Kathy Longshore (USGS) with NDOW and MSTS as collaborators. Camera traps at water sources are also being used to monitor sheep on the NNSS.

6.6.1 Capture Results

Five sheep (two ewes and three rams) were captured, radio-collared, and marked with ear tags on the NNSS on November 17, 2015. A sixth sheep (ram too young to be collared) was captured and marked with ear tags on November 18 (Table 6-3). Radio-collared sheep were tracked until their collars prematurely dropped off on May 1, 2016. Most of these stayed around Shoshone Mountain, Yucca Mountain, and Fortymile Canyon. Within a few days after being captured, one ram moved over 20 miles to the north and spent approximately three months on Quartz Mountain, Black Mountain, and in Thirsty Canyon. He moved back to Yucca Mountain in late February and spent the first two weeks of March on Bare Mountain and then moved back north around Black Mountain. Another ram was legally harvested by a hunter in the fall of 2016 in the hills north of Bare Mountain off the NNSS. This validated the supposition that bighorn sheep found on the NNSS are capable of moving off the NNSS and hunted.

On November 28-29, 2016, 15 desert bighorn sheep (7 ewes and 8 rams) (Table 6-3) were captured on or near the NNSS on Yucca Mountain, Shoshone Mountain and in Fortymile Canyon. Thirteen of these (6 ewes and 7 rams) were radio-collared with satellite transmitters to track their movements over the next

Table 6-3. Desert bighorn sheep capture information for 2015 and 2016.

Collar ID	Sex	Age (years)	Capture date	Left Ear Tag	Right Ear Tag	Capture Location	Comments
686329	Male	3	11/17/2015	Yellow124	Blue/Green124	Southeast Shoshone Mountain	Collar dropped 5/1/16
686326	Male	U	11/17/2015	GreenJ	OrangeJ	Cottonwood Spring Area	Collar dropped 5/1/16
No collar	Male	1.5	11/18/2015	OrangeD	BlueD	South Pah Canyon	Too young for collar
686327	Male	5	11/17/2015	Red121	Green121	Cottonwood Spring Area	Shot by hunter, fall 2016
686318	Female	U	11/17/2015	Blue125	Yellow125	Cottonwood Spring Area	Collar dropped 5/1/16
686317	Female	3	11/17/2015	Green126	Orange126	Cottonwood Spring Area	Collar dropped 5/1/16
686322	Male	4	11/28/2016	B -pink triangle	B -blue triangle	South Shoshone Mountain	
686315	Female	2	11/29/2016	I -yellow triangle	I-green triangle	South Shoshone Mountain	Good/fair condition
686316	Female	2	11/29/2016	118-green square	118-red square	South Shoshone Mountain	Location as of 11/20 0600
No collar	Male	0.8	11/29/2016	123-green square	123-yellow squ.	Shoshone Mountain	Too young for collar
No collar	Female	1	11/29/2016	A-green triangle	A-wht triangle	Shoshone Mountain	Too young for collar
686328	Male	3	11/29/2016	no tag	no tag	West Yucca Mountain	
686325	Male	5	11/29/2016	H-blue triangle	H-yellow triangle	West Yucca Mountain	Good/fair condition
686324	Male	4	11/29/2016	F-white triangle	F-pink triangle	West Yucca Mountain	
686314	Female	>2	11/29/2016	G-pink triangle	G-yellow triangle	Shoshone Mountain	
686319	Female	4	11/29/2016	120-blue square	120-green square	South Shoshone Mountain	Fair/good condition
686313	Female	>2	11/29/2016	E-yellow triangle	E-green triangle	Shoshone Mountain	
686320	Female	>2	11/29/2016	122-green square	122-yellow square	Shoshone Mountain	Good condition
686323	Male	>5	11/29/2016	112-blue	112-yellow	Shoshone Mountain	Great condition; No NDOW ear tag, used collar number for ID; Died of natural causes, early April 2017
686327	Male	3	11/29/2016	115-blue	115-yellow	West Yucca Mountain	No NDOW ear tag, used collar number for ID
686326	Male	3.5	11/29/2016	116-blue	116-blue	Shoshone Mountain	No NDOW ear tag, used collar number for ID

1.5 years. Collars were programmed to record locations four times a day (1800, 0000, 0600, and 1200), except for the first five days of each month when hourly locations were recorded. This was done to better understand diel movement patterns. A total of 35,301 GPS locations were successfully recorded for the 13 radio-collared animals from November 30, 2016 through December 31, 2017. Figures 6-9 and 6-10 show the locations of the six ewes from November 30, 2016 through December 31, 2017. All six ewes focused their activities around Yucca Mountain, Shoshone Mountain and Fortymile Canyon. Figures 6-11 and 6-12 show the locations of the seven rams from November 30, 2016 through December 31, 2017. Ram NNSS686323 died in early April, 2017. It was found at the base of a cliff about 8 meters tall (Figure 6-13). There was no evidence of predation or scavenging on the carcass and it apparently died of unknown natural causes. Rams 686322, 686323, 686326, and 686327 focused their activities around Yucca Mountain, Shoshone Mountain, and Fortymile Canyon similar to the ewes as did Ram 686324. However, he moved a moderate distance north into Thirsty Canyon, south of Black Mountain from late August to early October. Rams 686325 and 686328 focused their activities on Bare Mountain and the western portion of Yucca Mountain. Radio-collars are programmed to drop in early May 2018. More detailed analyses will be performed on the complete dataset.

6.6.2 Camera Trap Results

During 2017, motion-activated cameras detected sheep at Cottonwood Spring (941 images), Topopah Spring (87 images), Topopah Spring Trough (1 image), Delirium Canyon Tanks (87 images), South Pah Canyon Tanks (13 images), Twin Spring (21 images), and ER 20-7 (6 images). This was the first year sheep were documented at Cottonwood Spring although based on sign it is highly likely they used the spring during 2016. The camera was not operational for part of 2016 when sign was observed. This was also the first time sheep were detected at ER 20-7. It was an unmarked ram at the sump on December 19.

At Cottonwood Spring, seven ear-tagged animals (five from 2016 [Ewe 686314, Ewe 686315, Ewe 686316, Ewe 686319, and Ram 686327] and two from 2015 [Ewe 686317, Ewe 686318]) were documented along with at least two unmarked ewes and two unmarked rams. Ewe 686316 and Ewe 686319 appeared to have lambs accompanying them. At Topopah Spring, Ram 686326 (2015 capture), Ram 686322 (2016 capture), and at least two unmarked rams were documented between June 19 and August 1. Five marked sheep were detected at Delirium Canyon Tanks including Ewe 686319, Ewe 686313 and Ram 10180 (no collar) captured in 2016 and Ewe 686317 and Ewe 686318 captured in 2015. Three marked sheep (Ram 686329 [2015 capture], Ewe 686320 [2016 capture], and unknown ewe [green ear tag in left ear]) were photographed at South Pah Canyon Tanks along with at least one unmarked ram, one unmarked ewe, and one unmarked lamb. At least two unmarked rams were detected at Twin Spring. A total of 13 marked sheep (9 of 14 from 2016 captures and 4 of 5 still alive from 2015 captures) were documented with camera traps at water sources. This suggests that monitoring water sources in sheep habitat is a good technique for documenting marked sheep.

6.6.3 NTTR and Other Off-site Captures

NNSS sheep captures were part of a larger collaborative effort among NDOW, USGS, Nevada Test and Training Range (NTTR), FWS, and NNSA/NFO to get valuable data on 1) the prevalence of pneumonia responsible for killing large numbers of bighorn sheep in southern Nevada, 2) metapopulation structure (how different herds are related) of sheep populations in southern Nevada, and 3) movements and habitat use of sheep in areas never studied before. On October 20-21, 2017 an MSTS biologist assisted in the capture and processing of more than 10 sheep on Bare Mountain, near Beatty, and on the NTTR. Samples were collected for disease and genetic testing. One of these (27553) spent a lot of time on the NNSS along the southern escarpment of Pahute Mesa (Area 19 and 20) as well as in Thirsty Canyon and Ribbon Cliff area on the NTTR.

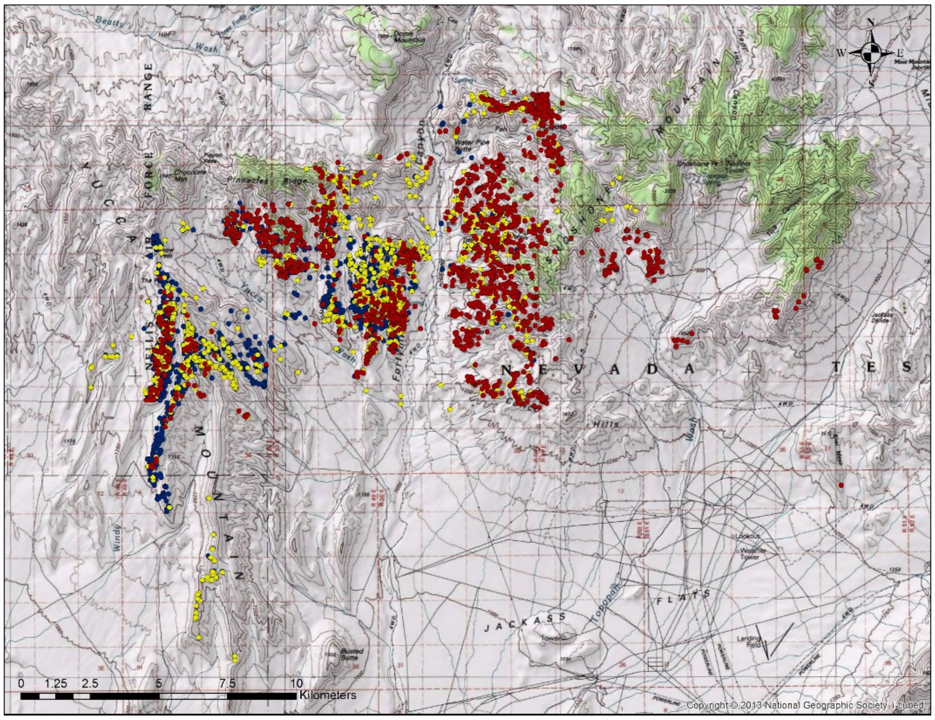

Figure 6-9. Locations of ewes 686313 (red dots), 686314 (yellow dots), and 686319 (blue dots) from November 30, 2016 through December 31, 2017.

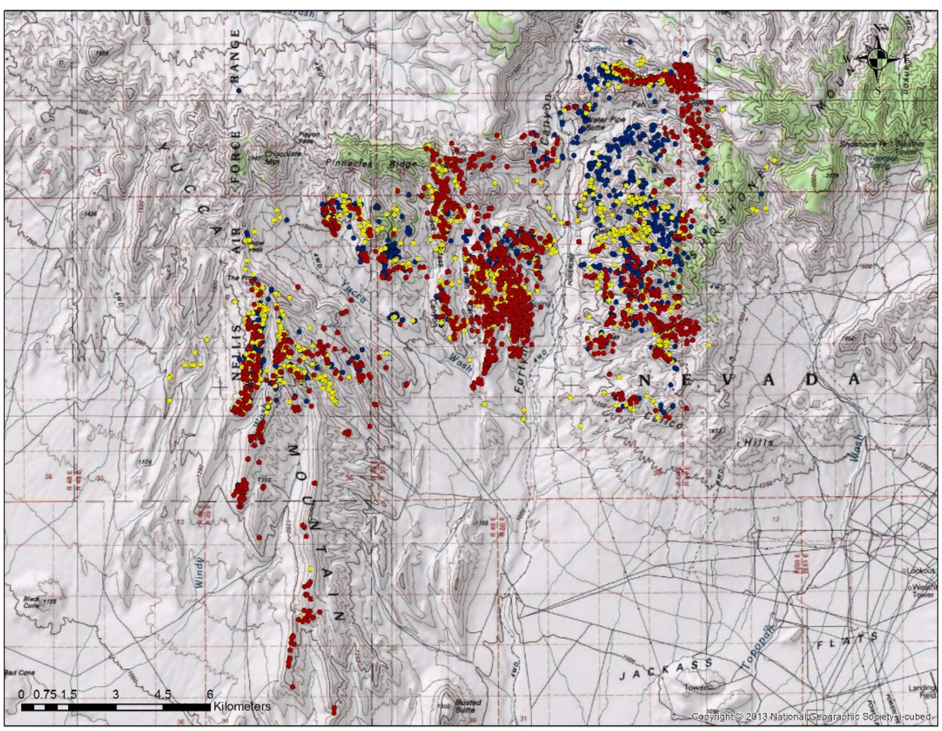

Figure 6-10. Locations of ewes 686315 (red dots), 686316 (yellow dots), and 686320 (blue dots) from November 30, 2016 through December 31, 2017.

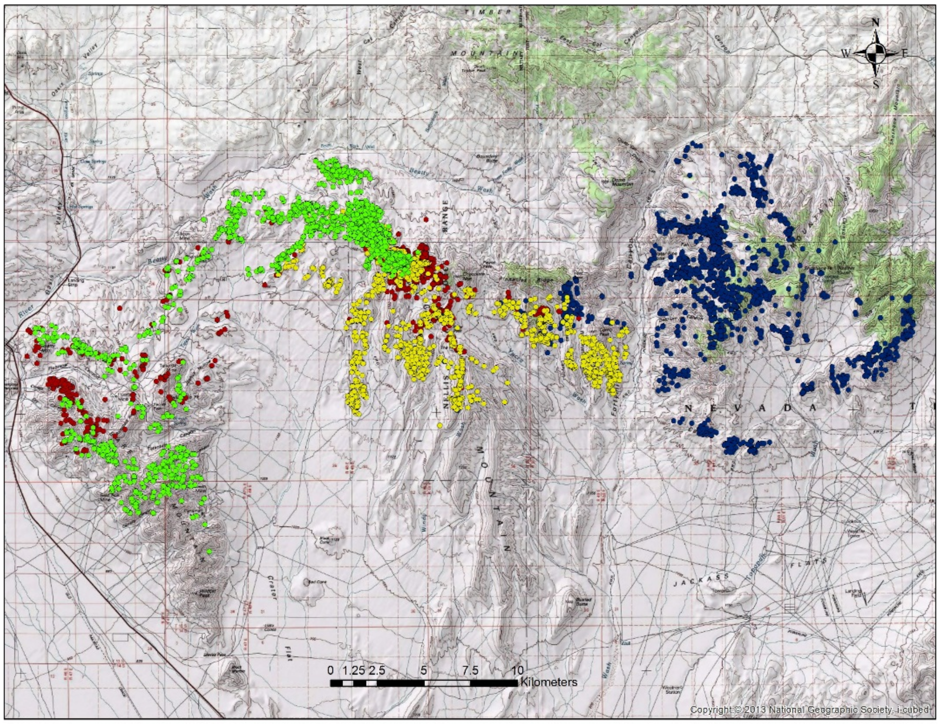

Figure 6-11. Locations of rams 686325 (red dots), 686326 (blue dots), 686327 (yellow dots), and 686328 (green dots) from November 30, 2016 through December 31, 2017.

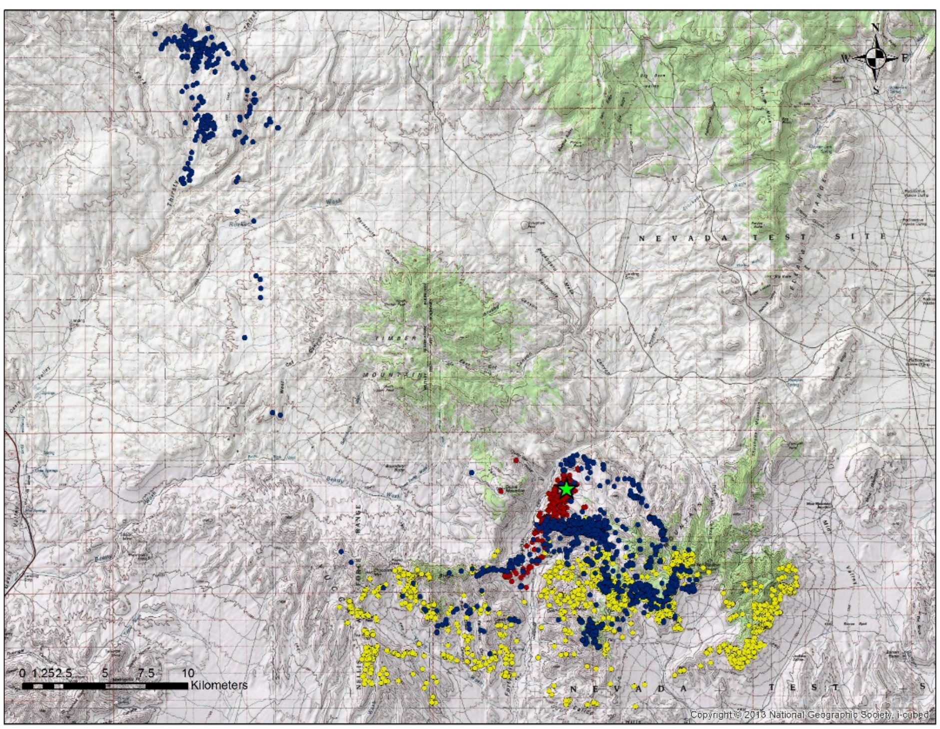

Figure 6-12. Locations of rams 686322 (yellow dots) and 686324 (blue dots) from November 30, 2016 through December 31, 2017. 686323 (red dots) died early April 2017 (green star).

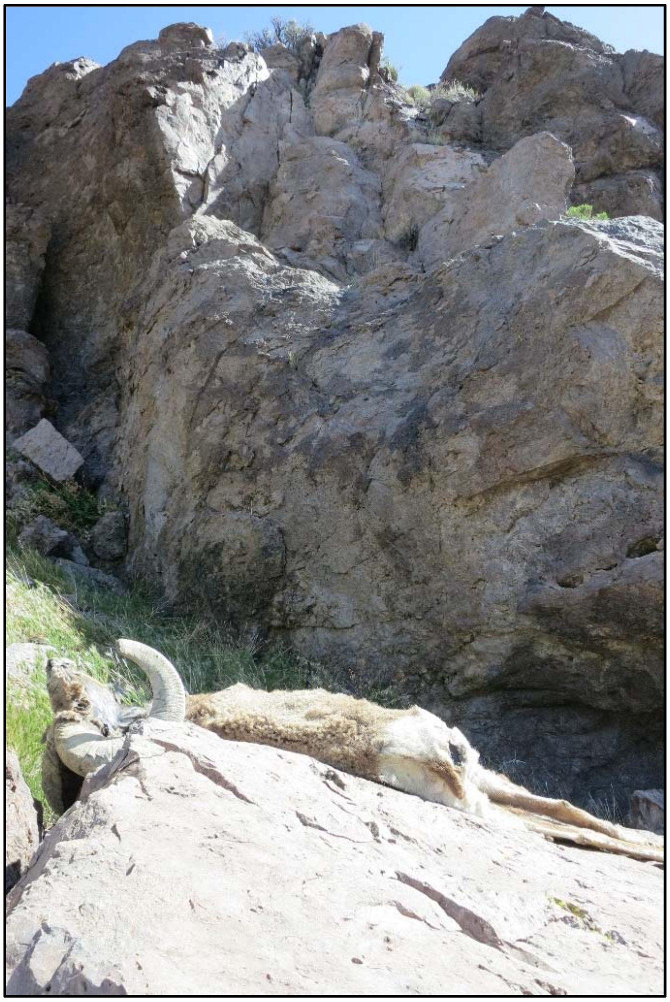

Figure 6-13. Mortality site for ram 686323, Fortymile Canyon.

(Photo by J.A. Perry, April 13, 2017)

Movements of other sheep captured in the Specter Range and Bare Mountains in the fall of 2015 by NDOW continued to be monitored during 2017. One ram (19479) stayed on Skull Mountain and Little Skull Mountain until mid-July when it moved south into the Specter Range. The collar stopped recording or the animal died on July 25, 2017 in the Specter Range. Ram 19482 moved from the Specter Range to Skull Mountain mid-November 2016 where it remained until July 31, 2017 when it moved back to the Specter Range. It remained here until the end of September before moving back to Skull Mountain where it remained until the collar stopped recording or the animal died on October 15, 2017. Ram 19484 captured on Bare Mountain stayed in the Shoshone Mountain and Yucca Mountain area until it moved back to Bare Mountain on August 24, 2017. The collar stopped working or the animal died on August 27, 2017.

In April and May, an MSTS biologist assisted NDOW biologists by investigating four sheep mortality events of collared sheep on NTTR and retrieving the radio collars. Two (Ewe 19747 and Ewe 19514) were on the south slope of Pahute Mesa south of Stonewall Mountain, one (Ram 19770) was near Black Mountain, and one (Ewe 19515) was on Quartz Mountain. All four appeared to have been killed by mountain lions.

6.6.4 Desert Bighorn Sheep Disease and Genetics

The collaborative capture effort from the Pintwater Range (southern NTTR) across the NNSS and NTTR to Stonewall Mountain and the Cactus Range (northern NTTR) has revealed valuable information on the movements of sheep among some of these areas and the potential for disease transmission over large areas. Disease testing results indicate that the bacteria that causes pneumonia in sheep (*Mycoplasma ovipneumoniae*) (Movi) is widespread from the Pintwater Range to the Cactus Range (Mike Cox, unpublished report). NDOW recommends continuing surveys to document lamb:ewe ratios and continuing captures to sample for the bacteria and evaluate the health of captured animals. One ewe captured near Quartz Mountain was in poor health and euthanized. A necropsy revealed severe lung damage from pneumonia and sinus tumor that nearly fully occluded the nasal passages.

Of 18 sheep sampled on the NNSS during 2015 and 2016, nearly 70% showed an immune response to Movi, meaning they had been exposed to the bacteria. More than half of the nine sheep sampled in 2016, had the bacteria present.

Samples for genetic testing were taken from mountain lion kills, scat collections, and blood drawn from captured animals. Of particular interest was to determine the origin for the relatively new sheep herd that is colonizing the NNSS. Scat samples have not been analyzed yet. Results from the blood and tissue from mountain lion kills indicate that the ancestry of the NNSS sheep is from the three closest re-introduced populations, namely Bare Mountain, Specter Range, and Stonewall Mountain (John Wehausen, unpublished report). However, the northern NNSS samples were actually collected from NTTR rather than the NNSS so further analysis is required. NTTR samples clustered most with Stonewall Mountain samples while NNSS samples clustered most with Bare Mountain and Specter Range samples. Based on movement data it is certainly possible for gene flow to occur between NNSS and NTTR. Samples from NNSS and NTTR were also compared with samples from the Pintwater Range and Desert National Wildlife Range (Sheep Mountains) and showed very little gene flow among these populations.

6.7 MOUNTAIN LION MONITORING

6.7.1 Motion-Activated Cameras

Few 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 and Dr. Kathy Longshore, USGS research scientists, 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. Remote, motion-activated cameras were used in 2017 at 29 sites (Figure 6-14 and Table 6-4). Sites were selected at locations with previous or new mountain lion sightings or sign, on roads or landform features 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). Some sites were also added based on other needs such as documenting the predator community in tortoise habitat or detecting animals potentially damaging runway lights. The number of images reported is based on a 1-minute interval between images taken during a single episode. Some images reported herein were taken during late 2016 and early 2018 due to the accessibility and scheduling of camera trap visits.

A total of 72 mountain lion images (i.e., photographs or video clips) were taken during 210,739 camera hours across all sites (Figure 6-14 and Table 6-4). This equates to about 0.3 mountain lion images per 1,000 camera hours. Mountain lions were detected at 5 of the 29 sites, including 2 water sources and 3 canyons (Figure 6-14). Table 6-5 contains the camera trap results by month and location. Figure 6-15 depicts an un-collared mountain lion in the snow at Camp 17 Pond.

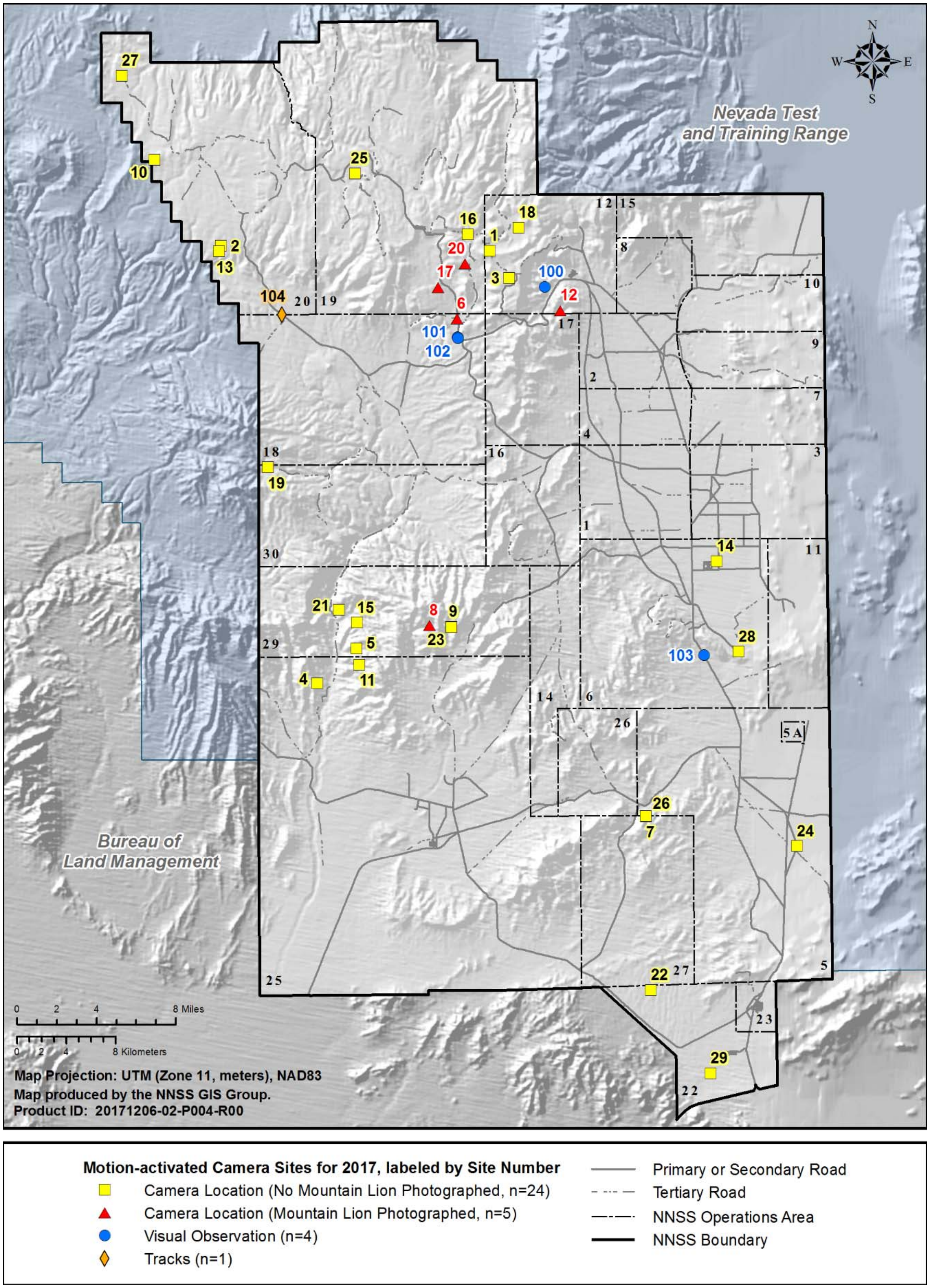

Figure 6-14. Locations of mountain lion photographic detections, camera traps, and visual observations on the NNSS during 2017.

Table 6-4. Results of mountain lion camera surveys during 2017.

Location (Site Number)	Dates Sampled	Camera Hours	Mountain Lion Images (Number of Images per 1,000 Camera Hours)	Other Observations (Number of Images)
Rattlesnake Ridge Gorge (#20)	12/14/16-12/19/17	8,875	47 (5.3)	Bobcat (1), gray fox (2), badger (1), coyote (7), desert cottontail (4), rock squirrel (5)
Captain Jack Spring (#12)	1/5-12/20/17	8,375	16 (1.9)	Bobcat (15), gray fox (21), badger (1), coyote (189), mule deer (1,221), desert cottontail (6), black-tailed jackrabbit (4), rock squirrel (1), golden eagle (3), greater roadrunner (2), chukar (10), mourning dove (13), common raven (117), scrub jay (15)
Camp 17 Pond (#6)	12/15/16-12/19/17[b]	7,102	6 (0.8)	Bobcat (1), coyote (130), elk (4), mule deer (1,280), horse (624), black-tailed jackrabbit (4), golden eagle (5), Cooper's hawk (9), red-tailed hawk (633), turkey vulture (93), mourning dove (5), chukar (13), common raven (65), brown-headed cowbird (16)
Water Bottle Canyon (#17)	12/15/16-12/19/17	8,855	2 (0.2)	Bobcat (1), elk (1), mule deer (2)
West Topopah Spring (#8)	1/10-12/20/17	8,228	1 (0.1)	Bobcat (8), coyote (1), mule deer (7), desert cottontail (2), rock squirrel (2), golden eagle (1), greater roadrunner (1)
12T-26, Rainier Mesa (#1)	12/14/16-12/19/17[b]	4,281	0 (0.0)	Mule deer (8)
Desert Rock Airport South (#29)	3/27-12/21/17	6,464	0 (0.0)	Coyote (2), pronghorn antelope (6), black-tailed jackrabbit (37), common raven (15)
Fortymile Canyon Tanks (#11)	4/27/17-1/4/18[b]	4,427	0 (0.0)	Bobcat (9), gray fox (2), coyote (3), rock squirrel (10), white-tailed antelope ground squirrel (41), golden eagle (2), chukar (15), mourning dove (7), rock wren (11), hummingbird (2), whiptail lizard (1), side-blotched lizard (5)

Table 6-4. Results of mountain lion camera surveys during 2017 (continued).

Location (Site Number)	Dates Sampled	Camera Hours	Mountain Lion Images (Number of Images per 1,000 Camera Hours)	Other Observations (Number of Images)
Gold Meadows Spring (#18)	12/14/16-12/19/17	8,876	0 (0.0)	Coyote (23), elk (33), pronghorn antelope (173), mule deer (517), horse (346), golden eagle (29), common raven (158)
Topopah Spring (#9)	1/10-12/20/17	8,228	0 (0.0)	Bobcat (2), coyote (112), desert bighorn sheep (87), mule deer (68), desert cottontail rabbit (21), turkey vulture (1), chukar (36), mourning dove (2), scrub jay (1)
Topopah Spring Trough (#23)	1/10-12/20/17	8,228	0 (0.0)	Coyote (2), desert bighorn sheep (1), mule deer (66), turkey vulture (2)
Dick Adams Cutoff Road, Rainier Mesa (#3)	12/14/16-12/19/17	8,876	0 (0.0)	Bobcat (1), mule deer (87)
South Pah Canyon (#15)	1/18/17-1/4/18[b]	8,423	0 (0.0)	Coyote (1), desert bighorn sheep (13), golden eagle (2), Cooper's hawk (1), red-tailed hawk (3), chukar (1), common raven (3)
East Cat Canyon (#19)	1/4-12/19/17[b]	8,170	0 (0.0)	Bobcat (1), coyote (3), mule deer (44)
East 19-01 Road (#16)	12/14/16-12/19/17[b]	8,451	0 (0.0)	Gray fox (2), coyote (7), mule deer (33), black-tailed jackrabbit (2)
Area 22, Juvenile GOAG Site 2 (#22)	3/27/17-1/8/18[b]	3,445	0 (0.0)	Coyote (5), kit fox (3), badger (10), black-tailed jackrabbit (107), kangaroo rat (24), white-tailed antelope ground squirrel (45), western burrowing owl (2), LeConte's thrasher (5), black-throated sparrow (6), red racer (1), leopard lizard (2), zebra-tailed lizard (5), western whiptail lizard (2)
Schooner Road (#27)	12/15/16-12/19/17[b]	6,252	0 (0.0)	Mule deer (1), black-tailed jackrabbit (1)

Table 6-4. Results of mountain lion camera surveys during 2017 (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)	1/18/17-1/4/18[b]	6,165	0 (0.0)	Bobcat (154), coyote (311), desert bighorn sheep (941), chukar (99), Cooper's hawk (1), red-tailed hawk (5), mourning dove (97), common raven (157)
Twin Spring (#21)	1/18/17-1/4/18[b]	6,355	0 (0.0)	Bobcat (1), coyote (3), desert bighorn sheep (21), mule deer (110), golden eagle (5)
Delirium Canyon (#5)	1/18-10/4/17[b]	4,109	0 (0.0)	Bobcat (11), gray fox (2), ring-tailed cat (1), coyote (14), desert bighorn sheep (87), mourning dove (26)
Cane Spring[a] (#7)	1/4-12/20/17[b]		0 (0.0)	None
Cane Spring Trough (#26)	1/4-12/20/17[b]	8,233	0 (0.0)	Red-tailed hawk (2), mourning dove (1)
Well 5C Trough[a] (#24)	1/4-12/20/17[b]	2,279	0 (0.0)	Coyote (24), pronghorn antelope (45), burro (1), black-tailed jackrabbit (90), red-tailed hawk (5), turkey vulture (5), mourning dove (3), common raven (13),
Area 6 LANL Pond Trough (#14)	1/4-12/20/17	8,403	0 (0.0)	Coyote (38), pronghorn antelope (53), mule deer (6), black-tailed jackrabbit (3), golden eagle (20), red-tailed hawk (13), great-horned owl (1), turkey vulture (160), common raven (82)
Well C1 Pond Trough (#28)	1/4-12/20/17[b]	7,192	0 (0.0)	Bobcat (4), coyote (23), badger (1), pronghorn antelope (9), mule deer (8), burro (13), desert cottontail rabbit (4), black-tailed jackrabbit (6), golden eagle (20), red-tailed hawk (7), great-horned owl (2), turkey vulture (49), mourning dove (3), greater roadrunner (1), common raven (70)
ER 20-5 Plastic-lined Sump (#2)	12/15/16-12/19/17	8,855	0 (0.0)	Coyote (2), mule deer (1), common raven (3)

Table 6-4. Results of mountain lion camera surveys during 2017 (continued).

Location (Site Number)	Dates Sampled	Camera Hours	Mountain Lion Images (Number of Images per 1,000 Camera Hours)	Other Observations (Number of Images)
U19ad Plastic-lined Sump (#25)	12/15/16-12/19/17[b]	7,830	0 (0.0)	Coyote (1), mule deer (3)
ER 20-12 Plastic-lined Sump NE Corner (#10)	12/15/16-12/19/17[b]	5,705	0 (0.0)	Unknown birds (10)
ER 20-12 Plastic-lined Sump SE Corner (#10)	12/15/16-12/19/17[b]	8,589	0 (0.0)	Mule deer (3), northern harrier (2), common raven (1), passerine (2)
ER 20-7 Plastic-lined Sump (#13)	3/16-12/19/17	6,675	0 (0.0)	Coyote (15), desert bighorn sheep (6), mule deer (1), mourning dove (1), turkey vulture (10), horned lark (23), common raven (167)

[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 and location (orange=number of mountain lion images; yellow=camera operational, no mountain lion images, green=camera not operational).

Camera Location (Site number)	Dec-16	Jan-17	Feb-17	Mar-17	Apr-17	May-16	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17
Rattlesnake Ridge Gorge (#20)	25	4	2	1				3	1	4	3	4	
Water Bottle Canyon (#17)				2									
Camp 17 Pond (#6)	2									1	3		
Captain Jack Spring (#12)		5	1	4				2			3	1	
Canyon West of Topopah Spring (#8)									1				

Figure 6-15. Un-collared mountain lion in the snow at Camp 17 Pond.

(Photo taken December 27, 2016, by motion-activated camera)

It is difficult to tell individual mountain lions apart from camera trap images and determine the exact number of mountain lions on the NNSS. Having radio-collared animals helps identify unique individuals. A minimum of four individuals (two radio-collared males [NNSS8 and NNSS9], one adult male, and one adult female were known to occur on the NNSS in 2017, compared to a minimum of five individuals in 2016, three individuals in 2015 and four individuals in both 2014 and 2013.

In order to investigate temporal activity of mountain lions, camera detection data from all 12 years (2006–2017) were combined. Mountain lions were detected every month with peak occurrences during June, (n = 99), August (n = 97) and November (n = 102) (Figure 6-16). The number of images taken during summer and fall (June–November) (n = 483) accounted for nearly three-fourths of all images compared with the number of images taken during winter and spring (December–May) (n = 272) (Figure 6-17). Nearly 80% of mountain lion images were taken between 1700 to 0500 hours (Figure 6-16). From 2011 to 2017, nearly 1.6 times as many images were taken when it was dark (n = 347) compared with when it was light (n = 218).

A secondary objective of the camera surveys is to detect other species using these areas and thus to better define species distributions on the NNSS. A total of 11,164 images of at least 40 species other than mountain lions were taken during 210,739 camera hours across all sites (Table 6-4) which is about 53 images per 1,000 camera hours. Of these, about 10% were not identifiable to species.

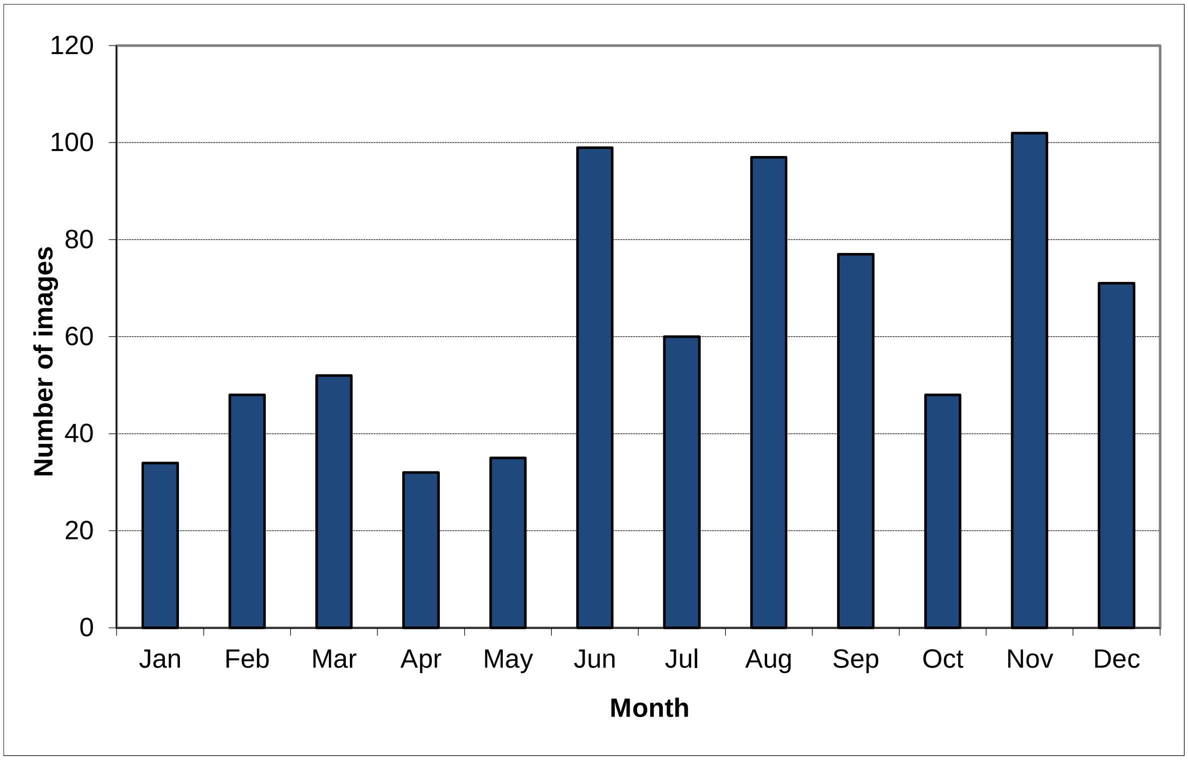

Figure 6-16. Number of mountain lion images by month for camera sites where mountain lions were detected from 2006 through 2017 (n = 755).

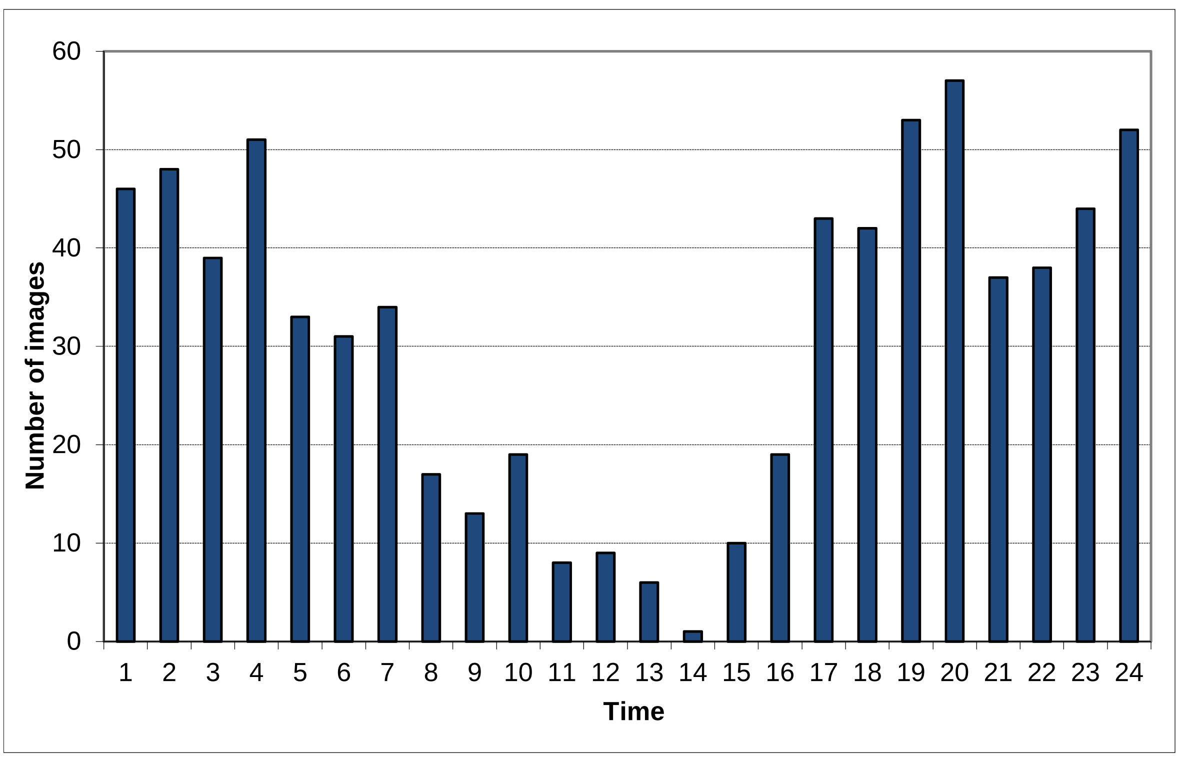

Figure 6-17. Number of mountain lion images by time of day (Pacific Standard Time) for camera sites where mountain lions were detected from 2006 through 2017 (n = 750).

The most prevalent species photographed (31% of all images) was mule deer (3,466 images at 19 of 29 sites). Captain Jack Spring (1,221 images), Camp 17 Pond (1,280 images), and Gold Meadows Spring (517 images) are very important water sources for mule deer. Some of the rarer, more elusive species documented from camera surveys were desert bighorn sheep (see Section 6.6.2), Rocky Mountain elk (see Section 6.10), bobcat (found at 13 of 29 sites), gray fox (found at 5 of 29 sites), golden eagle (found at 9 of 29 sites), and LeConte's thrasher (*Toxostoma lecontei*). A ring-tailed cat (*Bassariscus astutus*) was documented using the camera traps for the first time this year. Noteworthy observations of some of the more common species include 917 images of coyotes at 22 of 29 sites and 850 images of common ravens at 12 of 29 sites. Only 158 mourning dove images taken at 10 of 29 sites were recorded this year compared to 1,916 images at 17 of 28 sites during 2016. Greatest use and highest species richness was documented at water sources (both natural and constructed) especially during the summer and fall, which emphasizes the importance of these water sources for several wildlife species, particularly during the drier months.

6.7.2 Mountain Lion Telemetry Study

A collaborative effort between Kathy Longshore (USGS) and site biologists continued in 2017 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 provides information about their natural history and ecology as well. The NNSS and surrounding areas, encompassing the NTTR, Tonopah Test Range, and Desert National Wildlife Range, constitute one of the largest areas (over 15,540 square kilometers) 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 2017 was to continue to track the movements and diet of NNSS8 and NNSS9 with no plans to capture additional mountain lions. Radio collars were programmed to record locations every hour for the first five days of each month and every six hours the remaining days of each month.

6.7.2.1 NNSS8

NNSS8 was first captured in a snare trap on July 22, 2016 after 34 trap nights. It was estimated to be 5-6 years old and weigh 55.3 kilograms (kg). Due to radio-collar failure, NNSS8 was captured an additional two times in an attempt to get a functioning collar on the animal. The second capture occurred on July 28, 2016 in Mouse Meadow. This collar also malfunctioned most likely due to corrosion around the GPS antenna after being stored for a few years. NNSS8 was captured a third time on July 30, 2016, on the eastern edge of Rainier Mesa. A third radio-collar that was brand new from Telonics was attached to the animal and the animal was safely released. This collar also malfunctioned and only recorded approximately 10-20% of the points, leaving large gaps in the spatial data collection and kill-site analysis.

NNSS8 was tracked until its death which occurred around May 11, 2017. Figure 6-18 shows the documented locations of NNSS8 from July 30, 2016 to May 11, 2017. It spent the first couple of weeks on the eastern portion of Pahute Mesa and then moved to the Belted Range north of the NNSS until early November when it moved to the Oak Spring Butte area and the Gold Meadows area (Area 12) for a couple of weeks. On November 23, 2016 it was back in the Belted Range near Indian Spring. The next known point is on January 1, 2017 which is located east of Wheelbarrow Peak in the low elevation foothills of the Belted Range. It remained in this area until the middle of January when he made a significant move to the west into Thirsty Canyon and Pahute Mesa where it remained until early February. During most of February and March it moved back and forth along the lower elevation eastern slopes and canyons of Rainier Mesa and the Belted Range multiple times. In early April it crossed over the Belted Range and headed west. It remained in the Black Mountain, Quartz Mountain, and Thirsty

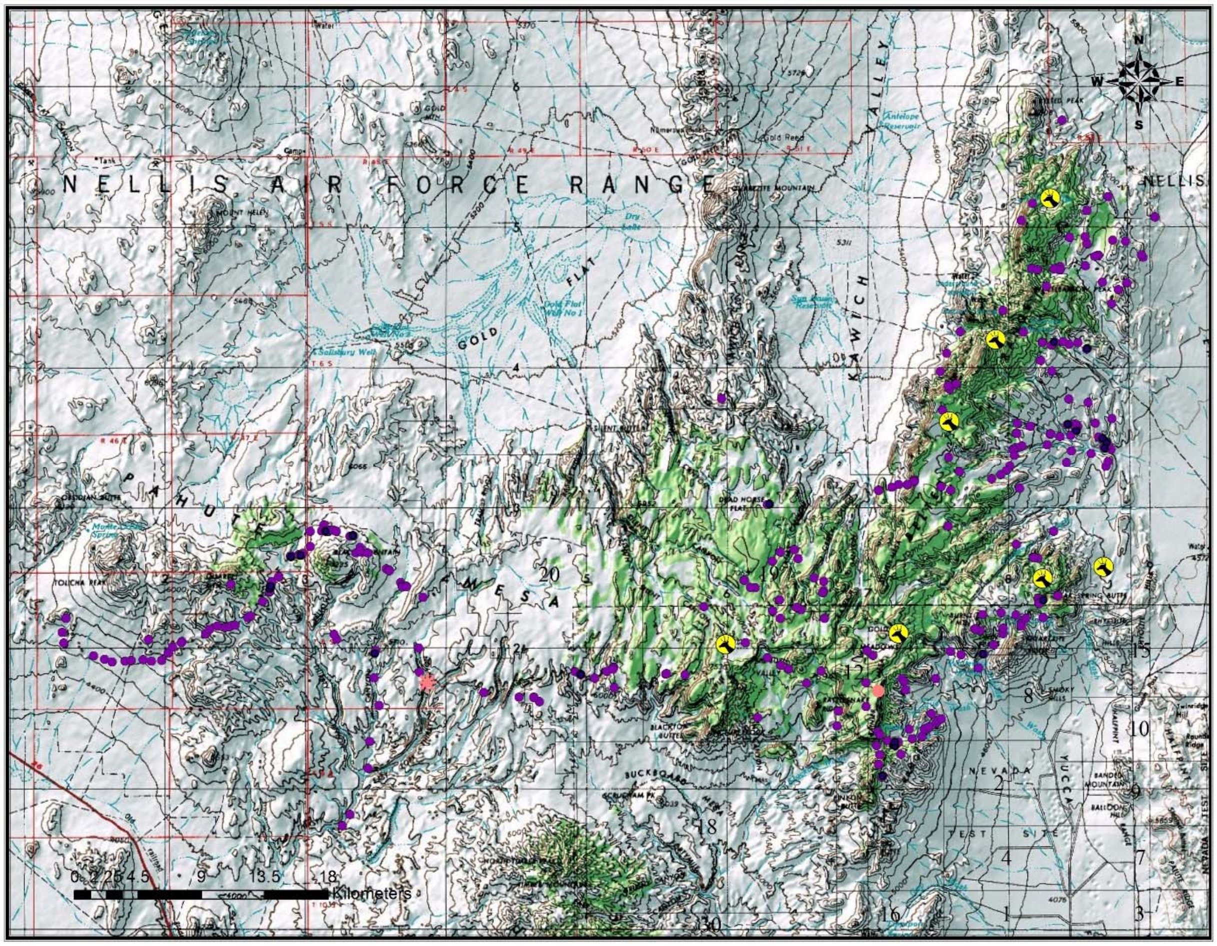

Figure 6-18. Locations (purple dots) of NNSS8 from July 30, 2016 (pink dot, capture site) to May 11, 2017 (pink asterisk, mortality site) and recorded mule deer kill locations (yellow dots).

Canyon area, travelling as far west as the southwestern slopes of Tolicha Peak, until it died in East Thirsty Canyon around May 11, 2017. A total of 30 clusters were checked. Only seven known kills were documented between August 10, 2016, and January 5, 2017. These included one around Echo Peak (August 10), three in the Belted Range (August 26, September 3, and September 30), one in east Gold Meadows (November 1), one north of Oak Spring Butte (November 14), and one west of Rhyolite Hills (January 5, 2017) (Figure 6-18). All kills were mule deer; five bucks, one doe, and one fawn.

6.7.2.2 NNSS9

NNSS9 was captured in a snare trap on the 19-01 road on August 3, 2016 after 145 trap nights. It was estimated to be 3-4 years old and weigh 58.5 kg. Figure 6-19 shows the documented locations of NNSS9 from August 3, 2016 to February 16, 2017. It spent most of its time around Rainier Mesa and the eastern portion of Pahute Mesa with movements into the southern Belted Range, Oak Springe Butte area, and northern Eleana Range. A total of 57 clusters were checked between capture and February 16, 2017 with 21 documented kill sites and one scavenged site (mule deer) which also happened to be the first kill site of NNSS8 (Figure 6-18). Twenty kills were mule deer; 13 bucks, 1 doe, 5 fawns, and one unknown adult. The last kill adjacent to the mortality site was a desert bighorn sheep ewe on February 10. NNSS9 was found dead on February 28, 2017 and the carcass retrieved on March 1, 2017. No external injuries or

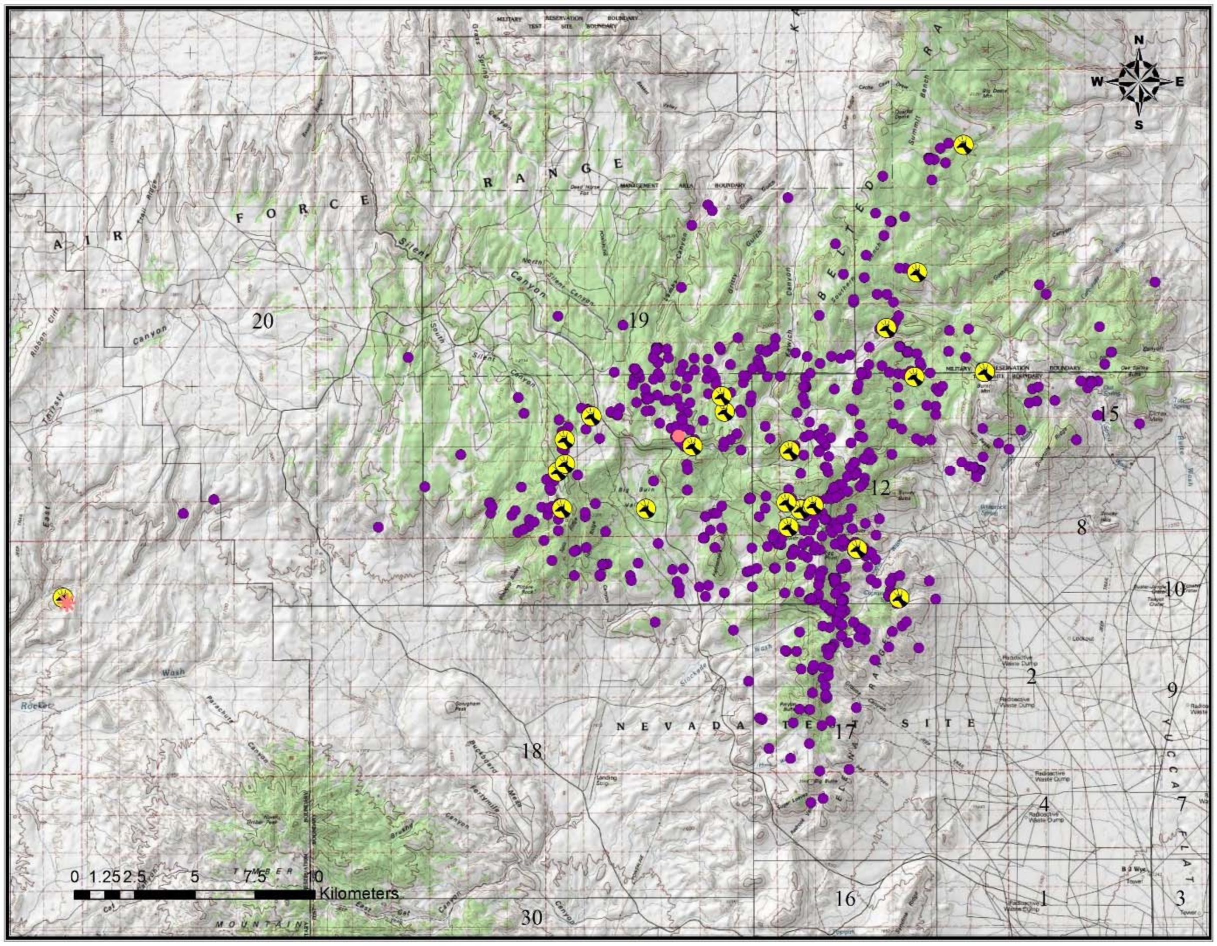

Figure 6-19. Locations (purple dots) of NNSS9 from August 3, 2016 (pink dot, capture site) to February 16, 2017 (pink asterisk, mortality site) and recorded kill locations (yellow dots).

signs of trauma were evident except for a little blood coming out of the mouth. The carcass was frozen and kept in Mercury until it was transported to NDOW in July. A full necropsy was performed by NDOW veterinarians and the animal tested positive for plague which was most likely the cause of death.

Home ranges of NNSS8 and NNSS9 overlapped spatially but rarely temporally based on recorded points. On only one documented occasion did the two come close to being at the same place at the same time. This occurred on August 3-4, 2017 within a day of NNSS9 being captured. Recorded points were only 110 meters and 5 hours apart north of the 19-01 Road.

6.7.3 Risk to Humans

Recorded observations of mountain lions or their sign in 2017 other than from camera traps included three un-collared lion sightings during mule deer surveys in the fall (one near E Tunnel Road on October 2, two within 100 meters of each other near the Pahute Mesa Road/Stockade Wash Road intersection on October 3 and 4), a reported sighting of a mountain lion crossing Mercury Highway south of Area 6 Control Point on March 28, and mountain lion tracks in the snow along Buckboard Mesa Road on January 25, 2017 (Figure 6-14). It is possible these tracks were made by NNSS8.

A few records from Frenchman Playa, Control Point Hills, and Yucca Flat have been recorded in the past but these sightings are extremely isolated and rare. Based on historic records and data obtained from nine radio-collared mountain lions, 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 low. Facilities in these areas include the Calico Hills firing range (Area 25), several tunnel complexes in Area 12 (e.g., E, 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 (e.g., 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. Furthermore, mountain lions occur more frequently around the tunnel complexes in winter and spring as they follow the deer off their high elevation summer range.

6.7.4 Mountain Lion Genetics

Blood samples were collected from mountain lions during capture for the purposes of genetic testing. DNA was extracted from 6 mountain lions captured on the NNSS and compared with DNA from 18 lions from the eastern Sierra Nevada mountains in Mono and Inyo counties, California and 5 from the Sheep Range, north of Las Vegas. Results from a variety of measures of genetic diversity (e.g., observed heterozygosity, allelic richness, and expected heterozygosity) indicate that NNSS mountain lions are more similar genetically to eastern Sierra lions than to lions from the Sheep Range even though the Sheep Range is substantially closer to the NNSS than the Sierra Mountains (John Wehausen, unpublished report). Also, NNSS lions did not exhibit the same inbred genetic structure that occurs in the Sheep Range lions, and there is considerably more gene flow between NNSS and eastern Sierra lions than NNSS lions and Sheep Range lions. Reasons for this are unclear although it may be caused by the low elevation, non-forested, non-mule deer habitat that exists between the Sheep Range and the NNSS whereas, there is forested, higher elevation mountains with mule deer that occur between the NNSS and eastern Sierras. Sampling from other areas around southern Nevada (e.g., Spring Mountains, Delamar Mountains) should be conducted and compared with these results.

6.8 RADIOLOGICAL SAMPLING

Sampling for radionuclides in mountain lions and their prey was performed in order to 1) determine uptake of radionuclides left over from previous nuclear testing on the NNSS, 2) estimate the potential dose to a human consuming a contaminated animal, and 3) estimate the dose to the animal. Sampling is to ensure dose limits, set to protect human and animal health, are not exceeded. Two opportunistic roadkill pronghorn antelope (both in Frenchman Flat) and two roadkill bobcats (one in Yucca Flat and one in Frenchman Flat) were also sampled for radionuclides. Mountain lions and their favored prey, mule deer and bighorn sheep, as well as pronghorn antelope are regulated as big game animals by NDOW and are hunted. These species are also known to have large home ranges and are likely to leave the NNSS and move into areas where hunting is allowed. This is a potential pathway for humans to receive a dose from radionuclides found on the NNSS and must be accounted for.

In 2017, seven samples were collected and analyzed. These included one mountain lion (NNSS9) found dead on the NTTR, one mule deer that died of unknown causes near E Tunnel Ponds, one radio-collared desert bighorn sheep that died of unknown causes in Area 30, two roadkill antelope, and two roadkill bobcats. Muscle tissue was collected from all animals and water was distilled from the samples and submitted to a laboratory for tritium (^{3}H) analysis. The remaining tissue samples from all animals except the mountain lion were submitted for Strontium-90 (^{90}Sr), Plutonium-238 (^{238}Pu), Plutonium-239+240 ($^{239+240}Pu$), Americium-241 (^{241}Am), and gamma spectroscopy analysis.

Man-made radionuclides were detected in five of the seven samples. Doses from these concentrations are overall very low and do not present a hazard to the animal or a person eating them. For a more detailed analysis of specific radionuclides and dose assessments see MSTS (2018).

6.9 NUISANCE AND POTENTIALLY DANGEROUS WILDLIFE

During 2017, NNSS biologists documented 93 calls regarding nuisance, injured, dead, or potentially dangerous wildlife in or around buildings, power lines, and work areas on the NNSS. This was a substantial increase from previous years. Problem, injured, or dead animals included birds (56 calls), bats (4 calls), other mammals (16 calls), reptiles (15 calls, including 3 rattlesnakes), and spiders (2 calls). Mitigation measures taken typically involved relocating the animals away from people, instructing workers to leave the animal in place, or disposing of dead animals.

6.10 ELK, PRONGHORN ANTELOPE, AND WILD BURROS

Historic studies on the NNSS do not mention the presence of either Rocky Mountain elk or pronghorn antelope (Jorgensen and Hayward 1965; Collins et al. 1982). Likewise, horses but not burros were mentioned by Jorgensen and Hayward (1965). Collins et al. (1982) conducted a biologic overview of the Yucca Mountain area and found that individual burros were occasionally observed near Cane and Topopah springs and documented numerous burro droppings in the central section of Yucca Mountain along the major ridges and in the eastern side canyons. They did not see any animals and concluded that burros used this area in winter and spring when ephemeral water and succulent plants were present. Site characterization studies at Yucca Mountain in the late 1980s and 1990s rarely if ever documented burros, and elk and antelope were not documented at all.

Saethre (1994) reported that Rocky Mountain elk are resident outside the NNSS and rarely observed on the NNSS but did not document any specific sightings. Since 2009, there have been a few transient bull elk seen and photographed around Rainier Mesa and Pahute Mesa. Young bull elk are known to disperse from their natal range, and it is likely that the source population for the young bulls is to the north, possibly in the Groom or Kawich Range. During 2017, bull elk were photographed at Gold Meadows Spring 33 times between April 13 and June 26. Four bull elk were seen in some photos (Figure 4-8), the largest group documented on the NNSS to date. Three elk (at least two bulls) were photographed at Camp 17 Pond on May 7, 2017, and one video clip was taken of three elk (at least two bulls) in Water Bottle Canyon on May 6, 2017. This was likely the same group observed at Camp 17 Pond given the close proximity of the two locations within a day of each other.

Pronghorn antelope appear to be increasing in number and expanding their range on the NNSS. During 2017, 286 images were taken of antelope at 5 sites with the majority recorded between June and August. Camera trap sites where antelope were documented included Gold Meadows Spring (173 images), the Area 6 LANL Pond water trough (53 images), the Well 5C water trough (45 images), and the Well C1 water trough (9 images). Six images were recorded at the southern end of the Desert Rock Airport in October and November. Antelope are regularly observed around Mercury, in Frenchman Flat and in Yucca Flat.

An MSTS biologist assisted NDOW in an antelope capture effort near Elko, Nevada in late October 2017 in preparation for anticipated antelope capture efforts on the NNSS. In order to understand movements and habitat use of antelope on the NNSS, MSTS biologists plan to capture and radio-collar up to 21 antelope and track them for a three-year period. Of particular interest is the radiological burden of antelope and the potential dose to the off-site public if a contaminated animal moves off-site and gets harvested and consumed.

Wild burros also appear to be increasing in number and expanding their range on the NNSS in recent years. A resident herd has been known to occupy Crater Flat, west of the NNSS for decades but sightings on the NNSS have been rare. During 2017, burros and their sign (e.g., scat, tracks) were documented with camera traps at the Well C1 trough (13 images) and the Well 5C trough (1 image). Additional records of burros and their sign were documented in Fortymile Canyon, along Jackass Flats Road, around Mercury, and in Frenchman Flat.

6.11 COORDINATION WITH BIOLOGISTS AND WILDLIFE AGENCIES

Site biologists interfaced with other biologists and wildlife agencies in 2017 for the following activities:

- Contributed to a film documentary that USGS produced entitled “Wildlife on the Nevada National Security Site” about desert bighorn sheep and mountain lions on the NNSS.
- Co-author on poster about mountain lion response to wildfire.
- Contributed data to USGS for the final report on radio-tracking mountain lions on the NNSS.
- Attended Nevada Bat Working Group Meeting and White Nose Syndrome workshop in Reno, Nevada, in December 2017.
- Assisted in conservation status review and ranking for all Nevada bat species.
- Participated in Nevada Bat Blitz in central Nevada.
- Coordinated with Bureau of Land Management for aerial surveys of feral horses and burros on and adjacent to the NNSS.

7.0 HABITAT RESTORATION MONITORING

MSTS biologists have conducted revegetation activities at disturbances on and off the NNSS in support of NNSA/NFO programs and continue to evaluate those efforts. Revegetation supports the intent of Executive Order EO 13112, "Invasive Species," to prevent the introduction and spread of non-native species and restore native species to disturbed sites. Revegetation also may qualify as mitigation for the loss of desert tortoise habitat under the current Opinion. Activities conducted in 2017 included visually assessing the vegetation at the U-3ax/bl closure cover and the "92-Acre Site".

7.1 CORRECTIVE ACTION UNIT (CAU) 110, U-3AX/BL, CLOSURE COVER

No quantitative sampling occurred at the U-3ax/bl closure cover in 2017. A visual assessment in July indicated that the vegetative cover continues to show signs of a stable plant community capable of removing water from the soil profile through evapotranspiration. The dominant plant species is shadscale (*Atriplex confertifolia*) with lesser amounts of Nevada jointfir and winterfat. Relatively low annual plant cover was observed despite the above-average precipitation received the prior winter and spring. A few ant mounds and some rodent burrows were observed but did not appear to negatively influence the integrity of the waste cover cap.

7.2 "CAU 111, "92-ACRE SITE," CLOSURE COVERS

No quantitative sampling occurred at the 92-Acre Site in 2017. A visual assessment in July found very few perennial plants on any of the cover caps. An abundance of annual plants, mostly saltlover (*Halogeton glomeratus*), prickly Russian thistle (*Salsola tragus*), Arabian schismus, and buckwheat species (*Eriogonum* spp.) were found on each cover cap. Some evidence of rabbit use and ant and rodent burrowing was detected. Burrowing activity was light and did not appear to negatively influence the integrity of the cover caps.

Seed production of creosote bush and white bursage during 2017 was good and the best in several years, so seed from both species was harvested for use in future revegetation efforts. Seed was sent to Comstock Seed for cleaning. A total of 10 bulk kg of cleaned white bursage and 8.4 bulk kg of creosote bush seed was harvested in Frenchman Flat within five miles of the Area 5 Radioactive Waste Management Complex.

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