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ECOLOGICAL MONITORING AND COMPLIANCE PROGRAM 2007 REPORT

March 2008

Prepared by
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Front Cover Picture: **Los Alamos National Laboratory (LANL) Pond in Area 6 with mule deer and mountain lion observed on Rainier Mesa during night surveys (Photos by D. Hall, August 29, 2001; September 13, 2006; and January 27, 2007)**

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EXECUTIVE SUMMARY

The Ecological Monitoring and Compliance Program, funded through the U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office (NNSA/NSO), monitors the ecosystem of the Nevada Test Site (NTS) and ensures compliance with laws and regulations pertaining to NTS biota. This report summarizes the program's activities conducted by National Security Technologies, LLC (NSTec), during the Calendar Year 2007. Program activities included (a) biological surveys at proposed construction sites, (b) desert tortoise compliance, (c) ecosystem mapping and data management, (d) sensitive plant species monitoring, (e) sensitive and protected/regulated animal monitoring, (f) habitat monitoring, (g) habitat restoration monitoring, and (h) monitoring of the Nonproliferation Test and Evaluation Complex (NPTEC).

Sensitive and protected/regulated species of the NTS include 44 plants, 1 mollusk, 2 reptiles, 238 birds, and 26 mammals protected, managed, or considered sensitive as per state or federal regulations and natural resource agencies and organizations. The threatened desert tortoise (*Gopherus agassizii*) is the only species on the NTS protected under the *Endangered Species Act*. Biological surveys for the presence of sensitive and protected/regulated species and important biological resources on which they depend were conducted for 22 projects. A total of 890.55 hectares (ha) (2,200.6 acres [ac]) was surveyed for these projects.

Sensitive and protected/regulated species and important biological resources found included inactive and potential tortoise burrows, active predator burrows, western burrowing owl (*Athene cunicularia hypugaea*) burrows, mature Joshua trees (*Yucca brevifolia*), yuccas, cacti, Beatley milkvetch (*Astragalus beatleyae*), Clokey buckwheat (*Astragalus oopherus* var. *clokeyanus*), two common raven (*Corvus corex*) nests (one chick and eight eggs), two barn owls (*Tyto alba*) and two great-horned owls (*Bubo virginianus*). NSTec provided a written summary report of all survey findings and mitigation recommendations, where applicable. All flagged burrows were avoided during construction activities.

Eleven of the 22 projects occurred within the distribution range of the threatened desert tortoise. NNSA/NSO must comply with the terms and conditions of a permit (called a Biological Opinion) from the U.S. Fish and Wildlife Service (FWS) when conducting work in tortoise habitat. No tortoises were found in project areas, nor were any accidentally injured, killed, captured, or displaced during project activities. One desert tortoise that was not located at a project was accidentally killed along a paved road. Several site-specific revegetation plans were prepared this year as required by the desert tortoise habitat revegetation plan approved in 2004 and will be submitted in 2008. This year 5.52 ha (13.64 ac) of tortoise habitat were disturbed. No revegetation of habitat was conducted in 2007 because of the severe drought.

In the spring of 2007, NNSA/NSO received a Biological Opinion from FWS for the security activities that are being conducted at the Device Assembly Facility.

Ecosystem mapping and data management in 2007 focused on a wildland fire fuels hazard survey. No ecological landform units were re-photographed or re-sampled in 2007 because of the poor condition of vegetation due to drought during the spring and summer of the year. There has been an average of 11 wildland fires per year on the NTS since 1978 with an average of about 93 ha (230 ac) burned per fire. In 2007 there were 15 wildland fires and a total of less than 6 ha (15 ac) burned. All fires in 2007 were small fires consisting of single shrubs or trees or small areas and were extinguished before they could spread. Precipitation in 2007 was about 58 percent below average for the winter months, which resulted in little or no germination from annual herbaceous plants and almost no production of fine fuels; however, a small amount of fine fuels still persisted from 2005 and 2006. A road survey to evaluate wildland fire fuel hazards was conducted, and maps showing indices for fine fuels, woody fuels, and combined fuels are presented in this report. A combined fuels index for the NTS in 2007 was 4.27 compared to 5.26, 5.64, and 4.88 in 2006, 2005, and 2004, respectively. A map is presented showing the historical location of wildland fires on the NTS for 2006, 2005, and prior years. Locations and acreage of wildland fires for 2007 are not shown because of their insignificant size.

Twenty plant species occur on the NTS that are considered sensitive and are listed by Nevada Natural Heritage Program as At-Risk plants. Currently none have been listed by the state of Nevada nor the FWS as endangered or threatened. The list of sensitive plant species for the NTS was reviewed and no changes to the list were made this year. *Penstemon fruticiformis* ssp. *amargosae* (Death Valley beardtongue), was added to the list of sensitive plant species for the NTS in 2006 and was the only species monitored in 2007. The distribution of *P. fruticiformis* ssp. *amargosae* encompasses less than a 161 kilometer (km) by 161 km (100 mile [mi] by 100 mi) area along the California-Nevada state line with a range of slightly more than 10,500 square km (4,000 square mi). Scientists conducting plant surveys in 1992 and 1994 described a location of *P. fruticiformis* ssp. *amargosae* as “on the NTS Boundary.” In May of this year, surveys were conducted along the north slopes of the Striped Hills in Area 25 of the NTS. Numerous plants of *P. fruticiformis* ssp. *amargosae* were found scattered over several acres. Three of the five groupings of *P. fruticiformis* ssp. *amargosae* were confirmed to be within the boundaries of the NTS. This site will be added to the long-term monitoring program conducted on the NTS for sensitive plant species and will be monitored at least once during a five-year period.

Surveys for the western red-tailed skink (*Eumeces gilberti rubricaudatus*), a sensitive species, were conducted this year. No western red-tailed skinks were captured over 4,517 trap days. Overall trap success for reptiles was 3.6 percent (162 captures/4,517 trap days) this year compared to 8.8 percent (538 captures/6,092 trap days) in 2006, suggesting a drought effect on reptile activity. Based on captures and observations, 11 of the 16 known lizards and 7 of the 17 known snake species on the NTS were detected. Of particular interest was the capture of three Great Basin skinks (*Eumeces skiltonianus utahensis*) at two locations on Pahute Mesa. This represents a range extension for this species on the NTS, as these animals were previously known to occur only on Rainier Mesa. Skink and reptile captures and observations increased during cool, wet periods of thunderstorm activity. Collaboration with Dr. Jonathan Richmond, a skink expert at Cornell University, resulted in genetic testing of seven skink samples. Results confirmed the presence of both the western red-tailed skink and Great Basin skink on the NTS and revealed that western red-tailed skinks and Great Basin skinks from the NTS are part of the Inyo clade (genetically related individuals) and Great Basin clade, respectively. Little to no genetic difference was found among the four western red-tailed skinks collected from across the western portion of the NTS that spanned a distance of nearly 40 km (24.9 mi). Genetic material from these specimens has been stored in hopes that future techniques will enable us to determine relatedness and patterns of dispersal at a much finer scale. Reptile captures in rectangular funnel traps (43 captures/901 trap days) were significantly higher than captures in triangular mesh traps (4 captures/908 trap days), and results from the bait trials showed no strong evidence for the efficacy of using canned pears or oatmeal as bait to increase reptile captures.

Western burrowing owl monitoring entailed documenting new burrowing owl locations and trapping owls as part of a collaborative effort with Dr. Courtney Conway, who is carrying out a Department of Defense Legacy Project to evaluate migratory linkages of burrowing owls in western North America. Six new burrow sites were found this year in the transition ecoregion, making a total of 138 known western burrowing owl locations (30 owl sightings and 108 burrow sites) on the NTS. Traps were set out at 20 burrow sites between April 3 and July 25 for a total of 70 “trap nights.” Seven owls (five adults and two juveniles) were captured, and one owl was captured twice for a total of eight captures. In addition, four 8 to 10 day old chicks were seen (not captured) inside a culvert burrow in Area 20, Pahute Mesa. This is the farthest north and highest elevation record (1,902 meters [6,240 feet]) of western burrowing owl breeding on the NTS. One of the adult owls captured this year was a recapture. She was captured about 1.2 km (0.7 mi) east of her natal burrow where she was originally captured as a juvenile on July 28, 2005. Radioisotopic analysis of the feathers from this adult female should provide information on where she spent the winter. Information learned from this cooperative effort will give NSTec biologists a greater understanding of western burrowing owl residency and migratory status on the NTS.

In 2007, small mammal sampling was conducted to assess the distribution of kangaroo mice (*Microdipodops* spp) and to investigate macro-habitat use by other small mammal species in forward areas of the NTS not previously sampled. A total of 530 captures were recorded in 4,800 trap nights at eight sites in 2007 (22 percent capture rate). The low capture rate is related to dry conditions during the year. No kangaroo mice were captured in 2007, although nine species of small mammals were captured overall.

Bat monitoring this year focused on passive acoustic monitoring of bat activity at Camp 17 Pond, post-closure monitoring at N Tunnel complex, and removing bats from buildings and documenting bat roosts. Data (minutes of activity per month by species) are presented for year-round bat activity at Camp 17 Pond during 2005 and for three winter periods (December through February, 2003–2004, 2004–2005, and 2005–2006). Activity of 14 species was documented during 2005, and activity of 11 species was documented during the winter periods. Silver-haired bats (*Lasionycteris noctivagans*), small-footed myotis (*Myotis ciliolabrum*), and long-legged myotis (*M. volans*) were previously not documented to be winter active in this region. Not only were these species active in the winter, but they were the most active species, accounting for 76 percent of total winter activity.

Bat-compatible closures (i.e., bat gates) were installed on the NTS for the first time during fall 2006/winter 2007. Two bat gates were installed during the closure of the N Tunnel Complex in Area 12: one in the main drift and one in the extension drift. Post-closure monitoring was conducted from February 8 to June 4 to investigate bat activity in the two tunnels. Passive acoustic monitoring using an Anabat II system was conducted in the main drift. The only bat species detected was California myotis (*Myotis californicus*), a species that typically uses underground features as roost sites. No bats were detected with a motion-activated camera during 2,783 hours of camera operation. Post-closure monitoring results suggest that bat activity is limited.

A few California or small-footed myotis bats were found roosting in and around two buildings in Mercury; one was removed from inside a building. A dead pallid bat was found in a building in Area 25 and bat guano observed at an elevator shaft of another building in the same complex. On May 21, during reptile trapping, a male pallid bat (*Antrozous pallidus*) was found day-roosting in a volcanic rock crevice.

The total number of wild horses (*Equus caballus*) estimated on the NTS has declined from about 53 individuals in 2006 to about 42 in 2007. Few to no foals appear to have survived through the summer months suggesting heavy losses due to predation. Mountain lion (*Puma concolor*) predation appears to cause the greatest horse mortality at NTS; however, one abandoned foal (whose mare died) was killed by one or more coyotes in summer of 2007, suggesting a potential but unknown impact of coyotes (*Canis latrans*) on horse mortality. Horse distribution range in 2007, estimated from water source visits, appeared to be reduced in size and shifted slightly to the west. Captain Jack Spring was not used by horses this year.

Deer numbers are monitored periodically on the NTS with spotlight surveys to estimate long-term population trends. This year there were no differences in the number of mule deer (*Odocoileus hemionus*) counted between Pahute and Rainier Mesa transects across all years (1989–1994, 1999–2000, 2006–2007). However, there were significantly higher numbers of deer counted per effort on the Rainier Mesa transect in 2006–2007 compared to counts from 1989–1994, suggesting that the Rainier Mesa area now supports higher numbers of deer than during some periods in the past. This may be due to increased food quality on the burn areas around Rainier Mesa or the recent construction of two new ponds on Rainier Mesa, which offer greater water availability. Deer numbers have also declined significantly (50 percent overall) from 2006 to 2007. These declines may be related to low precipitation levels early in the year, which resulted in poor forage conditions, low survival of young, and increased predation.

Mountain lions prey on wild horses, deer, antelope (*Antilocapra americana*), and desert tortoises, and pose a potential threat to humans on the NTS. In 2007, eight records of mountain lions or their sign were documented, excluding camera surveys. Five of these were in areas around human activity, and three were in forward areas away from human activity. In order to help evaluate the extent of risks to humans and other animals and to investigate mountain lion distribution and abundance, a collaborative effort between Erin Boydston, a research scientist with the U.S. Geological Survey, and NSTec biologists was continued again this year using remote, motion-activated cameras. A total of 58 mountain lion photographs were taken during 62,681 camera hours at 15 sites. This equates to 0.9 mountain lion photos per 1,000 camera hours. However, mountain lions were only detected at 6 of the 15 sites with nearly all (93 percent) of them detected at 3 sites located within 2.6 km (1.61 mi) of each other on Rainier Mesa.

Five of the six sites where mountain lions were photographed were in mule deer habitat on dirt roads with little to no vehicle traffic. Careful review of all the photographs suggests the presence of five to nine individuals including adult males and females, subadults, and a lactating female. Mountain lions were detected each month, except April, with peak occurrence during November. Mountain lions were photographed during most parts of the day with gaps during morning and early afternoon peaking between 2200 and 2300 hours. Only ten photos were taken during daylight hours: one in February, two in October, and seven in November. These data suggest that diurnal activity increases during fall and winter. A secondary objective of the camera surveys is to detect other species using these areas to better define species distributions on the NTS. Besides mountain lions, a total of 4,952 photographs of at least 21 species of mammals and birds were also taken during 62,681 camera hours across all sites. This is about 79 photos per 1,000 camera hours.

West Nile Virus (WNV) is a potentially serious illness that is spread to humans and other animals through mosquito bites. WNV surveillance continued in 2007 for the fourth consecutive year in cooperation with Southern Nevada Health District (SNHD) personnel to determine if mosquitoes on the NTS carry WNV. Nine sites were sampled during 15 surveys. Mosquitoes were taken to SNHD personnel for species identification and WNV testing. A total of 13 individuals representing two species were captured and analyzed. All specimens tested for WNV were negative including four mosquitoes captured at Well 3 Pond where mosquitoes in each of the past two years were determined to be suspect. This year, no new species were detected.

Shrimp monitoring was conducted at open water sources and wetlands (vegetated water sources) on Yucca and Frenchman Playas during 2007 following rainfall events in late September that stimulated hatching and development of several species of shrimp. Four species of shrimp were collected in playa habitats including the giant fairy shrimp, which is rarely observed. Two non-playa habitats (Pahute Pond and Gold Meadows Spring) where shrimp have never been collected before were also sampled in winter under the ice. Although unconfirmed, a new species of fairy shrimp (*Branchinecta* spp) may occur in these locations on the NTS. More specimens will be collected in 2008 to determine the species' taxonomic status.

The habitat restoration monitoring program on the NTS periodically monitors project sites, cover caps, or wildland fire areas that have been revegetated. The objective of monitoring these sites is to evaluate the different reclamation techniques that were used and to document the success of revegetation. The information is also used to refine revegetation procedures and techniques proposed for new restoration projects and to assess wildlife use.

Five project sites, three cover caps, and one wildland fire site were monitored this year. All five project sites are located on the Tonopah Test Range (TTR). One site, the Double Tracks remediation site, was revegetated in the fall of 1996; the other four sites, all Corrective Action Units, were revegetated in the fall of 1997. The Double Tracks site is located in the northwest section of Stonewall Flat on the western slopes of the Cactus Range. This site was the first of several safety shot sites scheduled for remediation in the late 1990s. Remediation included the removal of surface contaminated soils, followed by seeding and irrigation. Total plant cover on the site this year was less than on an adjacent reference area. Plant density was also lower. Diversity of plants has decreased over the years, but there are still several native shrubs and forbs common on the site. The other four project sites are located on the eastern slopes of the Cactus Range. Plant cover on the other four sites increased from previous years at two of the sites and decreased on the other two. The increases were attributable to increases in shrub cover. Grass cover decreased at all four sites as did shrub and grass density. Although density decreased, plant density on the revegetation sites is equal to the plant density on adjacent undisturbed areas.

Two of the three cover caps monitored this year are located on the TTR. Overall plant cover on these two vegetation cover caps was higher than on the adjacent reference areas. Plant density was mixed. It was higher on the Rollercoaster Sewage Lagoon site but lower on the Cactus Springs Waste Trench site. The other vegetation cover cap is located on the NTS at the Area 3 Radioactive Waste Management Area, closure site U-3ax/bl. As was typical of most other revegetation sites this year, plant cover and plant density were lower at this site than in previous years. There is no adjacent undisturbed area that is sampled at the U-3ax/bl cover cap; however, sites on the cover cap that were not seeded were completely devoid of any vegetation this year.

The Egg Point Fire burned approximately 121 ha (300 ac) in the late summer of 2002. The site was seeded that fall and transplants were planted the following spring. Periodic monitoring over the past five years indicated good establishment of native shrubs and grasses and several perennial forbs. The drought conditions the last few years in this area have affected the vegetation on the burn site. Although shrub cover increased this year in comparison to previous years, grass cover and both shrub and grass density decreased. Of special concern are the fifteen-fold increase in plant density of exotic or invasive plant species on the upper slopes of the site and the three-fold increase in the density of these same species on lower slopes.

Overall plant cover and plant density on the restoration sites monitored this year are less than in previous years. However, in many cases the amount of cover or density on the restoration site is equal to or higher than on adjacent reference areas.

NSTec scientists reviewed three chemical spill test plans in 2007. Chemicals were released at such low volumes or low toxicity that there was no need to monitor downwind transects for biological impacts. Baseline monitoring was only conducted at established control-treatment transects near the NPTEC in September and October.

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS xv
1.0 INTRODUCTION 1
2.0 BIOLOGICAL SURVEYS 3
2.1 Sites Surveyed and Sensitive and Protected/Regulated Species Observed 3
2.2 Potential Habitat Disturbance 3
3.0 DESERT TORTOISE COMPLIANCE 13
3.1 Project Surveys and Compliance Documentation 13
3.2 Habitat Revegetation Plan for Loss of Tortoise Habitat 16
3.3 Coordination with Other Biologists and Wildlife Agencies 17
3.4 Biological Opinion for Security Activities at the DAF 17
4.0 ECOSYSTEM MAPPING/DATA MANAGEMENT 19
4.1 No ELU Photography or Resampling of ELUs in 2007 19
4.2 Vegetation Survey for Determining Wildland Fire Hazards 19
4.2.1 Survey Methods 23
4.2.2 Survey Results 24
4.3 Coordination with Scientists and Ecosystem Management Agencies 34
5.0 SENSITIVE PLANT MONITORING 35
5.1 List of Sensitive Plant Species for the NTS 35
5.2 Long-term Monitoring 35
5.2.1 Penstemon fruticiformis ssp. amargosae 36
6.0 SENSITIVE AND PROTECTED/REGULATED ANIMAL MONITORING 39
6.1 Western Red-tailed Skink Surveys 39
6.2 Western Burrowing Owl 46
6.3 Raptor Observations 50
6.4 Small Mammal Surveys 51
6.5 Bat Surveys 54
6.5.1 Camp 17 Pond Passive Acoustic Monitoring System 54
6.5.2 N Tunnel Post-Closure Surveys 59
6.5.3 Bats at Buildings and Bat Roosts 61
6.6 Wild Horse Surveys 61
6.6.1 Abundance Survey 62
6.6.2 Horse Population Trends and Predation 62
6.6.3 Annual Range Survey 63
6.6.4 Horse Use of NTS Water Sources 64
6.7 Mule Deer Abundance on the NTS 65
6.7.1 General Abundance 65
6.7.2 Rainier Mesa Deer Counts Compared to Pahute Mesa Deer Counts 66
6.8 Mountain Lion Camera Surveys 67
6.9 Southeast Nevada Pyrg Monitoring 75
6.10 Coordination with Biologists and Wildlife Agencies 76
7.0 HABITAT MONITORING 77
7.1 West Nile Virus Surveillance 77
7.2 Wetlands and Wildlife Water Sources 78
7.3 Constructed Wetlands Monitoring 79

7.4 Natural Wetlands Monitoring 79
7.5 Fairy Shrimp Inventory on the NTS 84
7.5.1 Yucca and Frenchman Flat Playas 84
7.5.2 Non-Playa Shrimp Species on the NTS 90
7.6 Constructed Water Source Monitoring 90

8.0 HABITAT RESTORATION MONITORING 93
8.1 Methods 93
8.2 Monitoring Results: Project Sites 94
8.2.1 Double Tracks 94
8.2.2 CAU 400-Five Points Landfill 98
8.2.3 CAU 400-Bomblet Pit 100
8.2.4 CAU 426-Cactus Springs Waste Trenches: Project Area 101
8.2.5 CAU 404-Rollercoaster Sewage Lagoons 103
8.3 Monitoring Results: Cover Caps 104
8.3.1 CAU 426-Cactus Springs Waste Trenches: Cover Cap 104
8.3.2 CAU 404-Rollercoaster Sewage Lagoons: Cover Cap 107
8.3.3 CAU 110-Area U-3ax/bl: Cover Cap 109
8.4 Monitoring Results: Egg Point Fire Revegetation Site 113
8.4.1 Upper Slopes 114
8.4.2 Lower Slopes 115

9.0 MONITORING THE NPTEC 119
9.1 Task Description 119
9.2 Task Progress Summary 119

10.0 REFERENCES 121
DISTRIBUTION 125

LIST OF FIGURES

Figure 2-1. Biological surveys conducted on the NTS during 2007 8
Figure 2-2. Biological surveys conducted in important habitats of the NTS during 2007 12
Figure 3-1. Biological surveys conducted in desert tortoise habitat on the NTS during 2007 15
Figure 4-1. Number of wildland fires on the NTS by year 21
Figure 4-2. Distribution of wildland fires on the NTS by month from 1978 to 2002 21
Figure 4-3. Percent of average precipitation for January through April 2004 to 2007 23
Figure 4-4. Extended weather forecast for June, July, and August of 2007 for temperature and precipitation 26
Figure 4-5. National Wildland Fire Outlook, May 1 to August 31, 2007 27
Figure 4-6. Index of fine fuels for 211 survey stations on the NTS by operational area during 2007 28
Figure 4-7. Index of woody fuels for 211 survey stations on the NTS by operational area during 2007 29
Figure 4-8. Index of combined fine fuels and woody fuels for 211 survey stations on the NTS by operational area during 2007 30
Figure 4-9. Site 99 on the west side of Yucca Flat in 2004–2007 32
Figure 4-10. Location of large wildland fires on the NTS 33
Figure 5-1. Typical rocky habitat of *Penstemon fruticiformis* ssp. *amargosae* (Death Valley breardtongue--center of picture) in the Striped Hills of Area 25 37
Figure 5-2. Known locations (area in blue) of *P. fruticiformis* ssp. *amargosae* within and near the boundaries of the NTS (black line) along the southern edge of Area 25 38
Figure 6-1. Western red-tailed skink (*Eumeces gilberti rubricaudatus*) 40
Figure 6-2. Western red-tailed and Great Basin skink distribution on the NTS including all known locations, sites sampled during 2007, and 5-km sample grid 41
Figure 6-3. Rectangular, box-like funnel trap 42
Figure 6-4. Triangular wire-mesh funnel trap 42
Figure 6-5. Funnel trap baited with canned pears 44
Figure 6-6. Funnel trap baited with oatmeal 44
Figure 6-7. Great Basin skink (*Eumeces skiltonianus utahensis*) captured on Dead Horse Flat, Pahute Mesa 45
Figure 6-8. Known western burrowing owl distribution on the NTS and burrow sites where trapping occurred 48
Figure 6-9. Four 8–10 day old western burrowing owl chicks in culvert burrow in Area 20, Pahute Mesa 49
Figure 6-10. Capture female western burrowing owl with Acraft band on the left leg and aluminum FWS band on the right leg 49
Figure 6-11. Trapping locations for small mammals on the NTS in 2007 52

Figure 6-12. Passive acoustic monitoring system at Camp 17 Pond 55
Figure 6-13. Percent activity during 2005 by species excluding Yuma myotis, western red bat, and Townsend's big-eared bat, which each represent <0.1 percent of activity 56
Figure 6-14. Bat activity of five bat species with the highest activity through 2005 57
Figure 6-15. Winter (December through February) bat activity for six bat species 58
Figure 6-16. Overview of the N Tunnel Complex, Area 12 59
Figure 6-17. Completed bat gate in the main drift of N Tunnel 60
Figure 6-18. Completed bat gate in the extension drift of N Tunnel with plastic sheeting on ground below 60
Figure 6-19. Pallid bat roost, Reitmann Seep Ridge 61
Figure 6-20. Trends in the age structure of the horse population from 2000 to 2007 63
Figure 6-21. Feral horse sightings and horse sign observed on the NTS during 2007 64
Figure 6-22. Roads driven on the NTS to count deer from 1989–2007 65
Figure 6-23. Mule deer spotlighting counts from 1989–2007 66
Figure 6-24. Deer counts from two regions of the NTS expressed as mean counts per three-night session per distance surveyed 67
Figure 6-25. Locations of opportunistic mountain lion sightings, mountain lion photographic detections, and motion-activated cameras on the NTS during 2007 69
Figure 6-26. Lactating female mountain lion at 12T-26B camera site on Back Mesa Road in Area 12 72
Figure 6-27. Two mountain lions at 12T-26 camera site on Back Mesa Road in Area 12 73
Figure 6-28. Mature male mountain lion at 19-01 Road in Area 19 73
Figure 6-29. Numbers of mountain lion photographs (N=48) by month for camera sites where mountain lions were detected 74
Figure 6-30. Mountain lion circadian activity pattern based on photographic data 74
Figure 6-31. Southeast Nevada pyrg (1.5 mm [0.06 in.] shell length) from Cane Spring 75
Figure 7-1. Mosquito trap set at Well 5B in Frenchman Flat 77
Figure 7-2. Lush wetland plant growth observed at Captain Jack Spring pool during a period of horse absence 80
Figure 7-3. Water sources on the NTS, including those monitored in 2007 81
Figure 7-4. Locations on Yucca Playa where fairy shrimp were collected in 2007 85
Figure 7-5. Locations on Frenchman Playa sampled for fairy shrimp in 2007 86
Figure 7-6. Small human-made wetland on Yucca Playa where the giant fairy shrimp was collected 87
Figure 7-7. Long, narrow human-made channel on south Yucca Playa where alkali fairy shrimp were collected 87
Figure 7-8. Sample Site 1, a shallow pond site on Frenchman Playa where shrimp were collected in 2007 88

Figure 7-9. A human-made wetland (FMF-6) on Frenchman Playa where the paddletail shrimp was collected on October 17, 2007 88

Figure 7-10. Three species of shrimp collected from wetland YPW01 on Yucca Playa: (a) giant fairy shrimp, (b) tadpole shrimp, (c) alkali fairy shrimp 89

Figure 7-11. Constructed water sources monitored for wildlife use and mortality on the NTS during 2007........ 92

Figure 8-1. Double Tracks remediation site in 1996 prior to revegetation (top photo); in 1998, two years after revegetation was completed (middle photo); and in 2007 (bottom photo) 11 years after revegetation was complete. 96

Figure 8-2. A plant of *K. lanata* girdled by herbivores such as rabbits or small mammals........ 113

LIST OF TABLES

Table 2-1. List of sensitive and protected/regulated species known to occur on or adjacent to the NTS 4
Table 2-2. Summary of biological surveys conducted on the NTS during 2007 9
Table 2-3. Total area in hectares (acres in parentheses) proposed for disturbance within important habitats in 2007 and over the past 9 fiscal or calendar years 11
Table 3-1. Summary of tortoise compliance activities conducted by NSTec biologists during 2007..... 14
Table 3-2. Parameters and threshold values for desert tortoise monitoring on the NTS 16
Table 4-1. Number and acreage of wildland fires on the NTS 20
Table 4-2. Precipitation history and percent presence in surveyed sites (top species contributing to fine fuels) 22
Table 4-3. Inches of precipitation for meteorological recording stations on the NTS for January through April 2007 compared to long-term averages 25
Table 4-4. Comparison of combined fuel ratings on the NTS for 2004–2007 31
Table 6-1. Number of skinks and other reptiles captured by NTS area, site, and survey period 43
Table 6-2. Percent trap success for reptiles and total captures (reptiles plus small mammals) using two different kinds of bait and a no-bait control at two sites 46
Table 6-3. Western burrowing owl trapping results on the NTS, April–July 2007................................. 47
Table 6-4. Records of bird mortality on the NTS during 2007 51
Table 6-5. Numbers of individual small mammals captured on trap lines on the NTS in 2007[a] 53
Table 6-6. Minutes of activity by species and month for 2005 56
Table 6-7. Minutes of winter bat activity by species and month for 2003–2004, 2004–2005, and 2005–2006 57
Table 6-8. Number of horses observed on the NTS by age class, gender, and year................................ 62
Table 6-9. Results of mountain lion camera surveys during 2007 70
Table 7-1. Results of WNV surveillance on the NTS in 2007 78
Table 7-2. Hydrology and disturbance data recorded at natural water sources on the NTS 82
Table 7-3. Number of wildlife species observed or inferred at NTS natural water sources during 2007... 83
Table 7-4. Shrimp species collected on Yucca and Frenchman Playas in 2007...................................... 89
Table 7-5. Results of monitoring plastic-lined sumps for wildlife mortality at the NTS for 2007 91
Table 8-1. Percent plant cover on the Double Tracks remediation site and reference area in 2007........ 95
Table 8-2. Plant density on the Double Tracks remediation site and reference area in plants/m^2 with plants/ft^2 in parentheses... 98
Table 8-3. Percent plant cover on CAU 400-Five Points Landfill. Data reported for areas that were not flooded.. 99
Table 8-4. Plant density on CAU 400-Five Points Landfill in plants/m^2 with plants/ft^2 in parentheses .. 100

Table 8-5. Percent plant cover on CAU 400-Bomblet Pit 101
Table 8-6. Plant density at CAU 400-Bomblet Pit in plants/m^2 with plants/ft^2 in parentheses 102
Table 8-7. Percent plant cover on CAU 426-Cactus Springs Waste Trenches: Project area 102
Table 8-8. Plant density at CAU 426-Cactus Springs Waste Trenches: Project area in plants/m^2 with plants/ft^2 in parentheses 103
Table 8-9. Percent plant cover on CAU 404-Rollercoaster Sewage Lagoons—Project area 104
Table 8-10. Plant density at CAU 404-Rollercoaster Sewage Lagoons—Project area in plants/m^2 with plants/ft^2 in parentheses 105
Table 8-11. Percent plant cover at CAU 426-Cactus Springs Waste Trenches: Cover cap 106
Table 8-12. Plant density at CAU 426-Cactus Springs Waste Trenches: Cover cap in plants/m^2 with plants/ft^2 in parentheses 107
Table 8-13. Percent plant cover at CAU 404-Rollercoaster Sewage Lagoons: Cover cap 108
Table 8-14. Plant density at CAU 404-Rollercoaster Sewage Lagoons: Cover cap in plants/m^2 with plants/ft^2 in parentheses 109
Table 8-15. Percent plant cover at CAU 110 U-3ax/bl: Cover Cap 110
Table 8-16. Plant density on the Area 3 U-3axbl: Cover Cap in plants/m^2 with plants/ft^2 in parentheses 112
Table 8-17. Percent plant cover on upper slopes of the Egg Point Fire revegetation site 114
Table 8-18. Plant densities on upper slopes of the Egg Point Fire revegetation site in plants/m^2 with plants/ft^2 in parentheses 116
Table 8-19. Percent perennial plant cover on the lower slopes of the Egg Point Fire revegetation site 117
Table 8-20. Perennial plant densities on the lower slopes of the Egg Point Fire revegetation site in plants/m^2 with plants/ft^2 in parentheses 118
Table 9-1. Active small mammal burrows recorded on 1-km transects during October sampling 2005–2007 120

ACRONYMS AND ABBREVIATIONS

ac	acre
BN	Bechtel Nevada
CAU	Corrective Action Unit
cm	centimeter
CNTA	Central Nevada Test Area
CWA	*Clean Water Act*
DAF	Device Assembly Facility
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
ER	Environmental Restoration
ESA	*Endangered Species Act*
ft	feet
ft^2	square feet
FWS	U.S. Fish and Wildlife Service
FY	fiscal year
GIS	Geographic Information System
ha	hectare
in.	inch
kg/ha	kilograms per hectare
km	kilometer
LANL	Los Alamos National Laboratory
lb/ac	pounds per acre
m	meter
m^2	square meter
mi	mile
NAC	Nevada Administrative Code

ACRONYMS AND ABBREVIATIONS (Continued)

NSTec	National Security Technologies, LLC
NNHP	Nevada Natural Heritage Program
NNSA/NSO	U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office
NPTEC	Nonproliferation Test and Evaluation Complex
NTS	Nevada Test Site
RMP	Resource Management Plan
SNHD	Southern Nevada Health District
SOC	Special Operations Center
ssp	subspecies
spp	species
TTR	Tonopah Test Range
UNLV	University of Nevada, Las Vegas
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
var	variety
WNV	West Nile Virus

1.0 INTRODUCTION

In accordance with U.S. Department of Energy (DOE) Order 450.1, "Environmental Protection Program," the Office of the Assistant Manager for Environmental Management of the DOE, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) requires ecological monitoring and biological compliance support for activities and programs conducted at the Nevada Test Site (NTS). National Security Technologies, LLC (NSTec), Ecological Services has implemented the Ecological Monitoring and Compliance (EMAC) Program to provide this support. EMAC is designed to ensure compliance with applicable laws and regulations, delineate and define NTS ecosystems, and provide ecological information that can be used to predict and evaluate the potential impacts of proposed projects and programs on those ecosystems.

This report summarizes the EMAC activities conducted by NSTec during calendar year 2007. Monitoring tasks during 2007 included eight program areas: (a) biological surveys, (b) desert tortoise compliance, (c) ecosystem mapping and data management, (d) sensitive plant monitoring, (e) sensitive and protected/regulated animal monitoring, (f) habitat monitoring, (g) habitat restoration monitoring, and (h) biological monitoring at the Nonproliferation Test and Evaluation Complex (NPTEC). The following sections of this report describe work performed under these eight areas.

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2.0 BIOLOGICAL SURVEYS

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

2.1 Sites Surveyed and Sensitive and Protected/Regulated Species Observed

During 2007, biological surveys for 22 projects were conducted on or near the NTS (Figure 2-1, Table 2-2). For some of the projects, multiple sites were surveyed (Figure 2-1). A total of 890.55 hectares (ha) (2,200.60 acres [ac]) was surveyed for the projects (Table 2-2). Ten of the projects were within the range of the threatened desert tortoise (*Gopherus agassizii*). Sensitive and protected/regulated species and important biological resources found included inactive tortoise burrows, burrows being used by burrowing owls (*Athene cunicularia hypugaea*), active predator burrows, yuccas and cacti, Beatley milkvetch (*Astragalus beatleyae*), Clokey buckwheat (*Astragalus oopherus* var. *clokeyanus*), two common raven (*Corvus corax*) nests with one chick and eight eggs, two barn owls (*Tyto alba*), and two great-horned owls (*Bubo virginianus*) (Table 2-2). NSTec provided to each project manager a written summary report of all survey findings and mitigation recommendations, where applicable (Table 2-2). All burrows, except rodent burrows, were flagged and avoided during construction activities.

2.2 Potential Habitat Disturbance

Surveys are conducted at old industrial or nuclear weapons testing sites whenever vegetation has reinvaded a site or it is suspected that a sensitive or protected/regulated species may be found. For example, tortoises may move through revegetated earthen sumps and may be concealed under vegetation during activities where heavy equipment is used. Preactivity surveys are conducted at such revegetated sites to ensure that desert tortoises are not in harm’s way. Also, burrowing owls frequently inhabit burrows and culverts at disturbed sites, so preactivity surveys are conducted to ensure that adults, eggs, and nestlings in burrows are not harmed.

Eighteen of the projects for which surveys were conducted were entirely on sites previously disturbed (e.g., building sites, industrial waste sites, existing well pads, or road shoulders) (Table 2-2). Three projects were located either partially or entirely in areas that had not been previously disturbed. These projects have the potential to disturb 5.52 ha (13.64 ac). Two of the three projects occur in areas designated as important habitat (Table 2-3, Figure 2-2). During vegetation mapping of the NTS, Ecological Landform Units (ELUs) were evaluated and some were identified as Pristine (having few man-made disturbances), Unique (containing uncommon biological resources such as a natural wetland), Sensitive (containing vegetation associations that recover very slowly from direct disturbance), and Diverse (having high plant species diversity) (U.S. Department of Energy, Nevada Operations Office [DOE/NV], 1998). A single ELU could be classified as more than one type of these important habitats.

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

Plant Species	Common Names	Status[a]
Moss Species		
Entosthodon planoconvexus	Convex entosthodon moss	S, 5 years
Flowering Plant Species		
Arctomecon merriamii	White bearpoppy	S, 10 years
Astragalus beatleyae	Beatley milkvetch	S, 5 years
Astragalus funereus	Black woollypod	S, 5 years
Astragalus oophorus var. *clokeyanus*	Clokey eggvetch	S, 5 years
Camissonia megalantha	Cane Spring suncup	S, 10 years
Cymopterus ripleyi var. *saniculoides*	Sanicle biscuitroot	S, 10 years
Eriogonum concinnum	Darin buckwheat	S, 5 years
Eriogonum heermannii var. *clokeyi*	Clokey buckwheat	S, 5 years
Frasera pahutensis	Pahute green gentian	S, 10 years
Galium hilendiae ssp. *kingstonense*	Kingston Mountains bedstraw	S, 10 years
Hulsea vestita ssp. *inyoensis*	Inyo Hulsea	S, 10 years
Ivesia arizonica var. *saxosa*	Rock purpusia	S, 5 years
Lathyrus hitchcockianus	Bullfrog Mountain pea	S, 5 years
Phacelia beatleyae	Beatley scorpionflower	S, 10 years
Penstemon fruticiformis ssp. *amargosae*	Death Valley beardtongue	S, 5 years
Penstemon pahutensis	Pahute Mesa beardtongue	S, 10 years
Phacelia filiae	Clarke phacelia	S, 10 years
Phacelia mustelina	Weasel phacelia	S, 10 years
Phacelia parishii	Parish phacelia	S, 10 years
Agavaceae	Yucca (3 species), Agave (1 species)	CY
Cactaceae	Cacti (18 species)	CY
Juniperus osteosperma	Juniper	CY
Pinus monophylla	Pinyon	CY

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

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

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

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

[a]Status Codes:

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

- LT - Listed Threatened
- C - Candidate for listing

U.S. Department of Interior

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

State of Nevada-Animals

- S - Nevada Natural Heritage Program—Animal and Plant At Risk Tracking List
- NPE - Nevada Protected-Endangered, species protected under Nevada Administrative Code (NAC) 503
- NPT - Nevada Protected-Threatened, species protected under NAC 503
- NPS - Nevada Protected-Sensitive, species protected under NAC 503
- NP - Nevada Protected, species protected under NAC 503
- G - Regulated as game species
- F - Regulated as fur-bearer species

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

State of Nevada-Plants

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

Long-term Animal Monitoring Status for the Nevada Test Site (NTS)

A - Active
IA - Inactive
E - Evaluate

Long-term Plant Monitoring Status for the NTS

5 years - Monitor a minimum of once every 5 years
10 years - Monitor a minimum of once every 10 years

Nevada Bat Conservation Plan – Bat Species Risk Assessment

H - High
M - Moderate

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

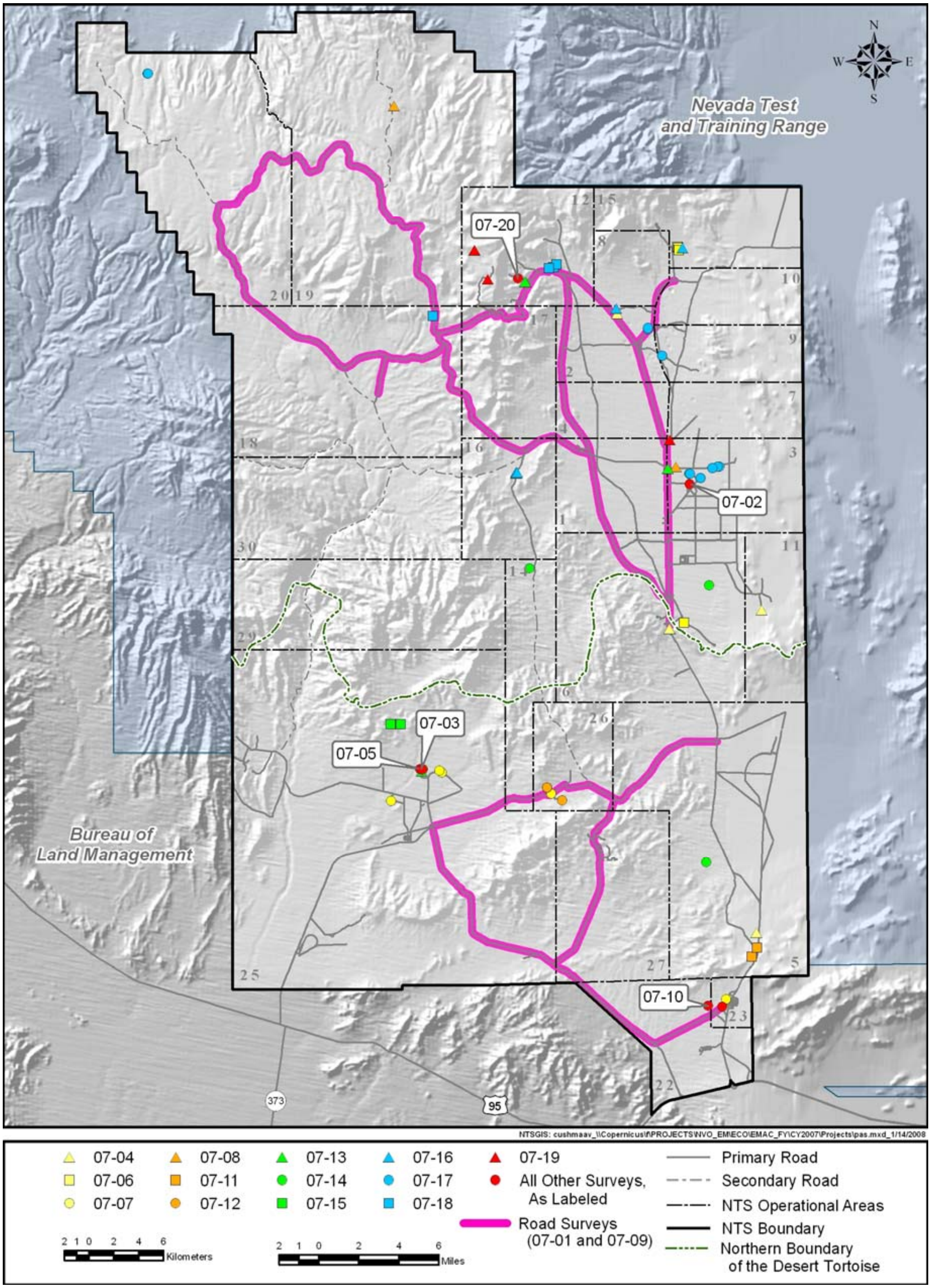

Figure 2-1. Biological surveys conducted on the NTS during 2007

Table 2-2. Summary of biological surveys conducted on the NTS during 2007

Project No.	Project	Important Species/ Resources Found	Area Surveyed in ha (ac)	Proposed Project Area in Undisturbed Habitat in ha (ac)	Mitigation Recommendations
07-01	Roadside Grading – Jackass Flats-Area 27	Burrows	10.19 (25.18)	0	Avoid burrows/Environmental Monitor (EM) needed
07-02	Corrective Action Unit (CAU) 536	None	0.24 (0.59)	0	None
07-03	CAU 127	None	0.50 (1.23)	0	EM needed
07-04	CAU 224	Yuccas and cacti	1.85 (4.57)	0.07 (0.17)	EM needed; Avoid yuccas/cacti if possible
07-05	CAU 116	None	0.28 (0.69)	0	EM needed
07-06	CAU 543	None	2.38 (5.88)	0	None
07-07	CAU 300	None	1.49 (3.68)	0	None
07-08	CAU 537	Beatley milkvetch	0.20 (0.49)	0	Avoid hill to east of Corrective Action Site 19-19-1
07-09	Roadside Grading/Mowing	Tortoise, owl and predator burrows	806.59 (1993.13)	0	Avoid burrows
07-10	Area 23 Landfill Borrow Pit extension	None	5.78 (14.28)	2.70 (6.70)	EM needed
07-11	Area 5 Transmission Line Maintenance/burrow pit.	Clokey buckwheat, tortoise burrow	8.53 (21.08)	0	EM needed; avoid Clokey buckwheat and tortoise burrow
07-12	CAU 127	None	1.43 (3.53)	0	EM needed
07-13	CAU 563	None	1.70 (4.20)	0	None
07-14	Geologic Characterization Study	None	6.90 (17.05)	0	EM needed at Frenchman sites
07-15	Project 300 Calico Hills	None	5.20 (12.85)	2.75 (6.80)	EM needed
07-16	CAU 124	None	0.80 (1.98)	0	None

Table 2-2. Summary of biological surveys conducted on the NTS during 2007 (Continued)

Project Number	Project	Important Species/ Resources Found	Area Surveyed in ha (ac)	Proposed Project Area in Undisturbed Habitat in ha (ac)	Mitigation Recommendations
07-17	CAU 545	None	15.40 (38.10)	0	None
07-18	CAU 151	None	1.82 (4.50)	0	None
07-19	CAU 234	None	5.73 (19.10)	0	None
07-20	Berm at E-Tunnel Ponds	None	1.04 (2.57)	0	None
07-21	Building Demolition	2 common raven nests with 1 chick and 8 eggs, two barn owls, 2 great-horned owls	0	0	Delay activities until nests are empty
07-22	Borehole Plugging	Burrowing owl burrows	12.5 (30.9)	0	Avoid burrowing owl culverts
		Totals in ha	**890.55**	**5.52**	
		(ac)	**(2,200.60)**	**(13.64)**	

Figure 2-2 shows the distribution of these important habitats, ranked so that pristine habitat overlays unique, which then overlays sensitive, which then overlays diverse habitat. The expected area to be disturbed in important habitat due to 2007 projects is 5.45 ha (13.47 ac) (Table 2-3). Since fiscal year (FY) 1999, a tally of all acreage proposed for disturbance within important habitats has been kept (Table 2-3). This tally may be used in the future to estimate the area and rate of establishment of invasive species into these habitats. Land-disturbing activities are known to cause the spread of invasive species such as *Bromus rubens* (red brome) into areas of the NTS where they have not previously occurred. Such nonnative weeds can degrade important habitats by decreasing plant biodiversity and increasing the risk and spread of wildfires. The monitoring and control of invasive plants on federal lands is encouraged under Executive Order 13112, "Invasive Species."

Table 2-3. Total area in hectares (acres in parentheses) proposed for disturbance within important habitats in 2007 and over the past 9 fiscal or calendar years

Project No.	Project Name	Pristine Habitat	Unique Habitat	Sensitive Habitat	Diverse Habitat
07-10	Area 23 Landfill Borrow Pit Extension	0	0	0	2.70 (6.70)
07-15	Project 300 Calico Hills	0	0	2.75 (6.80)	0
	Total ha 2007	**0**	**0**	**2.75**	**2.70**
	(ac)	**(0)**	**(0)**	**(6.80)**	**(6.70)**
	Grand Total ha 1999–2007	**9.20**	**11.85**	**184.61**	**82.17**
	(ac)	**(22.73)**	**(29.28)**	**(456.19)**	**(203.07)**

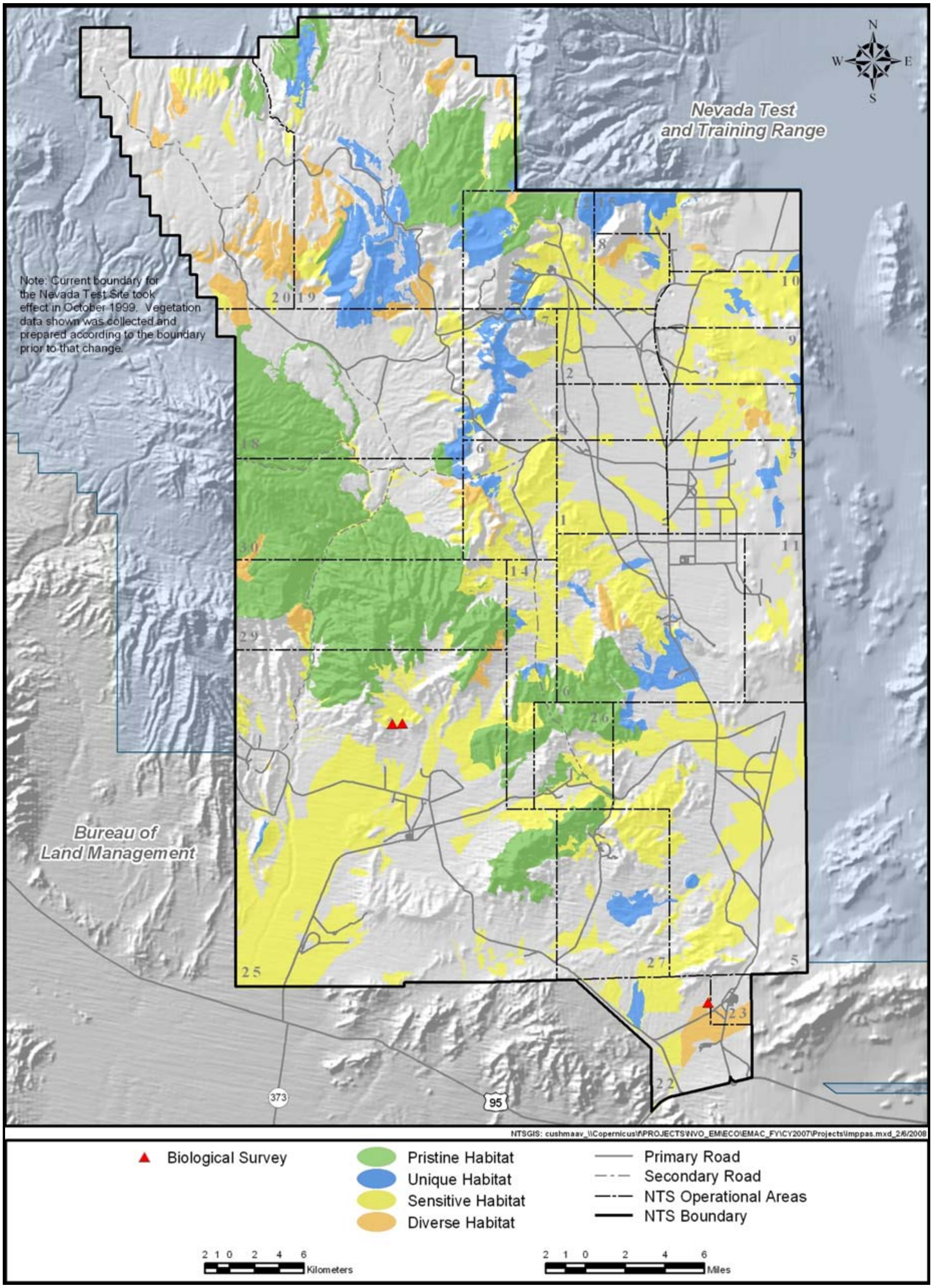

Figure 2-2. Biological surveys conducted in important habitats of the NTS during 2007

3.0 DESERT TORTOISE COMPLIANCE

Desert tortoises occur within the southern one-third of the NTS. This species is listed as threatened under the *Endangered Species Act* (ESA). In December 1995, NNSA/NSO completed consultation with the U.S. Fish and Wildlife Service (FWS) concerning the effects of NNSA/NSO 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. A final Biological Opinion (Opinion) (FWS, 1996) was received from FWS in August 1996. The Opinion concluded that the proposed activities on the NTS were not likely to jeopardize the continued existence of the Mojave population of the species and that no critical habitat would be destroyed or adversely modified. All terms and conditions listed in the Opinion must be followed when activities are conducted within the range of the desert tortoise on the NTS. On March 20, 2007, NNSA requested an extension of the August 1996 Opinion until the Supplement Analysis for the NTS Environmental Impact Statement was completed. That extension was granted by the FWS in a letter dated July 6, 2007. The extension of the Opinion is valid until December 31, 2008. All terms and conditions listed in the Opinion remain in effect until that date.

The Desert Tortoise Compliance task of EMAC was developed to implement the terms and conditions of the Opinion, document compliance actions taken by NNSA/NSO, and assist NNSA/NSO in FWS consultations. The terms and conditions that were implemented by NSTec staff biologists in 2007 included (a) conducting clearance surveys at project sites within one to seven days from the start of project construction, (b) ensuring that environmental monitors are onsite during heavy equipment operation, and (c) preparing an annual compliance report and submitting it to the FWS.

3.1 Project Surveys and Compliance Documentation

During 2007, biologists conducted biological and desert tortoise clearance surveys prior to ground-disturbing activities for 11 proposed projects (27 sites) within the range of the desert tortoise on the NTS (Table 3-1, Figure 3-1). Most of these projects were in, or immediately adjacent to, existing facilities and disturbances. Several inactive tortoise burrows were found during tortoise clearance surveys (Table 3-2). These inactive tortoise burrows (Project No. 07-09; 07-10) were flagged and avoided during project activities.

Three projects were initiated in previously undisturbed desert tortoise habitat. Project 07-04 did minor damage with very little loss of desert tortoise habitat (Table 3-2). This project is located just west of the Mercury Highway, north of 200 Hill, near the old abandoned camp in Area 5. Project 07-10 disturbed 2.70 ha (6.70 ac) of undisturbed habitat in northern Mercury Valley west of the Mercury Landfill in Area 23. Project 07-15 disturbed 2.75 ha (6.80 ac) of undisturbed habitat in northern Jackass Flats in the Calico Hills in Area 25. NSTec Ecological Services ensured that onsite construction monitoring was conducted by a designated environmental monitor at all sites where clearance surveys were performed.

Post-activity surveys to quantify the acreage of tortoise habitat actually disturbed were conducted for nine projects during this reporting period (Table 3-1). Post-activity surveys were not conducted if the projects were located within the tortoise exclusion zone or if viable tortoise habitat was not found within the project area boundaries (due to previous disturbance) during the clearance survey or if the environmental monitor documented that the project stayed within its proposed boundaries. This year a total of 5.52 ha (13.64 ac) of tortoise habitat was disturbed (Table 3-1).

Table 3-1. Summary of tortoise compliance activities conducted by NSTec biologists during 2007

Project Number	Project	Compliance Activities 100%-Coverage Clearance Survey	Tortoise Habitat Disturbed ha (ac)
07-01	Roadside Grading – Jackass Flats-Area 27	Yes*	0 (0)
07-03	CAU 127	Yes, post-activity survey completed	0 (0)
07-04	CAU 224	Yes, post-activity survey completed	0.07 (0.17)
07-05	CAU 116	Yes, post-activity survey completed	0 (0)
07-07	CAU 300	Yes*	0 (0)
07-09	Roadside Grading/Mowing	Yes*	0 (0)
07-10	Area 23 Landfill Borrow Pit extension	Yes, post-activity survey completed	2.70 (6.70)
07-11	Area 5 Transmission Line Maintenance/burrow pit	Yes, post-activity survey completed	0 (0)
07-12	CAU 127	Yes, post-activity survey completed	0 (0)
07-14	Geologic Characterization Study	Yes, post-activity survey completed	0 (0)
07-15	Project 300 Calico Hills	Yes, post-activity survey completed	2.75 (6.80)
		Total	**5.52 (13.64)**

*Post-activity survey was unnecessary because project was located within previously disturbed tortoise habitat.

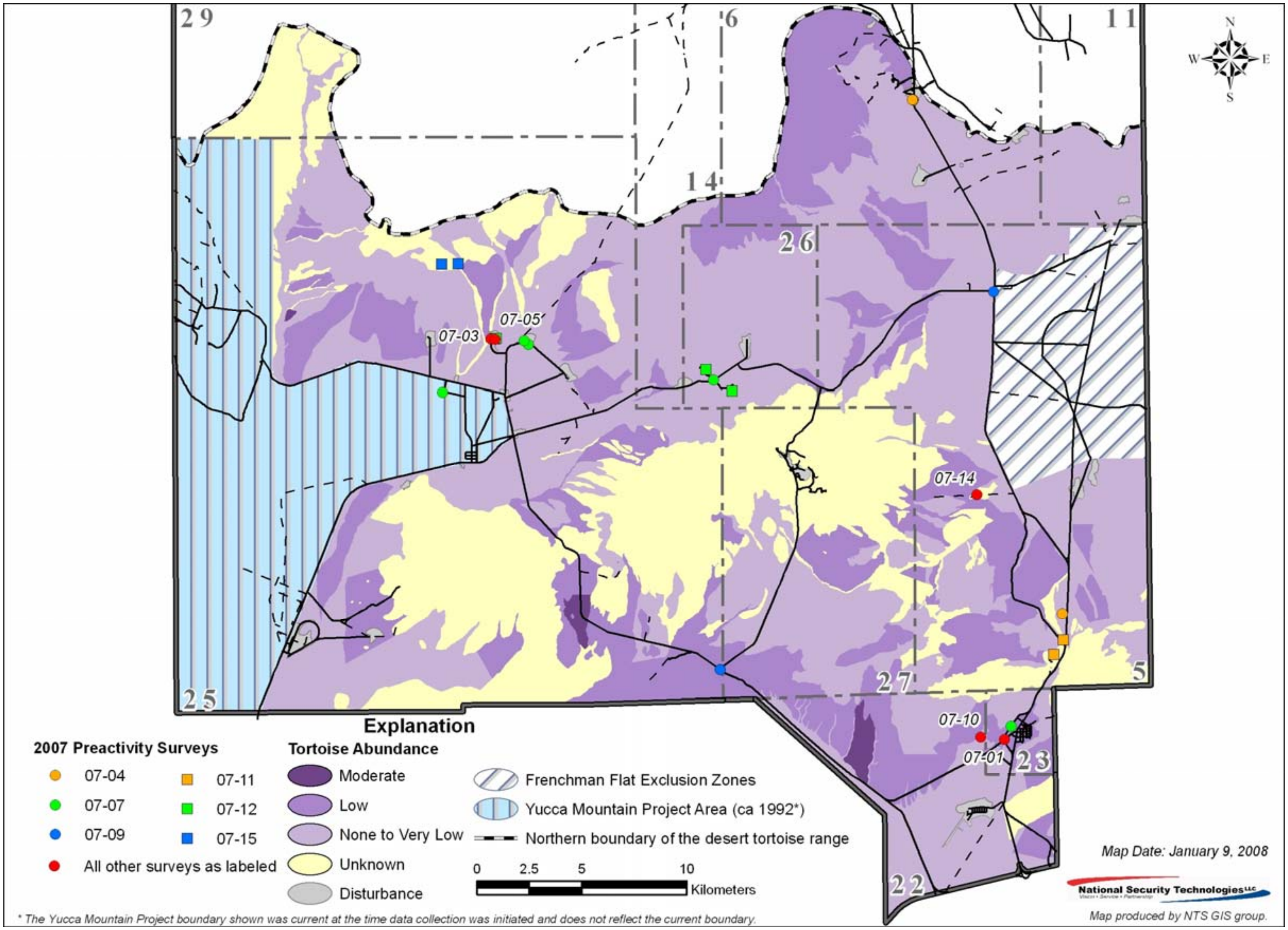

Figure 3-1. Biological surveys conducted in desert tortoise habitat on the NTS during 2007

In January 2007, NSTec submitted to NNSA/NSO the annual report that summarized tortoise compliance activities conducted on the NTS from January 1 through December 31, 2006. This report, required under the Opinion, contains (a) the location and size of land disturbances that occurred within the range of the desert tortoise during the reporting period; (b) the number of desert tortoises injured, killed, or removed from project sites; (c) a map showing the location of all tortoises sighted on or near roads on the NTS; and (d) a summary of construction mitigation and monitoring efforts.

Compliance with the Opinion will ensure that the two goals of the NNSA/NSO's Resource Management Plan (DOE/NV, 1998) are being met, namely, that the desert tortoise is protected on the NTS and that the cumulative impacts on this species are minimized. In the Opinion, the FWS has determined that the "incidental take"[1] of tortoises on the NTS and the cumulative acreage of tortoise habitat disturbed on the NTS are parameters to be measured and monitored annually. During this calendar year, the threshold levels established by the FWS for these parameters were not exceeded (Table 3-2). No desert tortoises were accidentally injured or killed by project activities, nor were any captured or displaced from project sites. One desert tortoise was killed along a roadway within the NTS.

Table 3-2. Parameters and threshold values for desert tortoise monitoring on the NTS

Monitored Parameter	Threshold Value	Adaptive Management Action	2007 Value of Monitored Parameter
Number of tortoises accidentally injured or killed as a result of NTS activities per year	3	Reinitiate consultation with FWS	0
Number of tortoises captured and displaced from NTS project sites per year	10	Reinitiate consultation with FWS	0
Number of tortoises taken in form of injury or mortality on paved roads on the NTS by vehicles other than those in use during a project	Unlimited	Supplemental employee education and bulletins	1
Number of total hectares (acres) of desert tortoise habitat disturbed during NTS project construction since 1992	**1,220 (3,015)**	Reinitiate consultation with FWS	**115.77 (286.07)**

3.2 Habitat Revegetation Plan for Loss of Tortoise Habitat

Mitigation for the loss of tortoise habitat is required under the terms and conditions of the Opinion. The Opinion requires NNSA/NSO to perform either of two mitigation options: (a) pre-pay Clark County $1,741 per each hectare ($705 for each acre) of habitat disturbed, or (b) revegetate disturbed habitat following specified criteria. Since 1992, NNSA/NSO has been using the balance of $81,000 that NNSA/NSO deposited into a Clark County fund to pre-pay for the future disturbance of 101 ha (250 ac) of tortoise habitat on the NTS. As of December 31, 2006, this fund was depleted and all new disturbances have to pay the required mitigation fee or revegetate the disturbances. NSTec biologists prepared several site-specific

[1] To "take" a threatened or endangered species, as defined by the ESA, is to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct.

plans to revegetate tortoise habitat as mitigation for projects. These plans will be sent to FWS in 2008 for approval. Revegetation of disturbed areas was not initiated in 2007 due to the severe drought.

3.3 Coordination with Other Biologists and Wildlife Agencies

Three 8.5-ha (21-ac) circular enclosures in Rock Valley were constructed during 1962–1963 to study the effects of chronic, low-level ionizing radiation on the desert flora and fauna. Over the past decades, at least 24 tortoises have been found, individually marked, and periodically measured. In 2002 there were approximately 18 adult tortoises remaining in the enclosures; however, in 2003, Phil Medica of the U.S. Geological Survey (USGS) Las Vegas Office, NSTec biologists, and a team of volunteer biologists found the remains of seven tortoises of known age. Two additional desert tortoises within the enclosures were lost in 2004 presumably to mountain lion predation. These plots were revisited once in the fall of 2007 with Phil Medica to observe desert tortoises in the fenced plots. Only one desert tortoise was found above ground. It was weighed, measured, and released back into the enclosures. One specimen was found dead and the bones/shell were salvaged. Areas around the enclosures were searched but no additional carcasses were observed.

3.4 Biological Opinion for Security Activities at the DAF

In spring of 2007, NNSA/NSO received a Biological Opinion from FWS on the security activities at the Device Assembly Facility (DAF). This concluded the formal consultation with FWS.

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4.0 ECOSYSTEM MAPPING/DATA MANAGEMENT

Ecological Services began comprehensive mapping of plant communities and wildlife habitat on the NTS in FY 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 types, slope, and hydrology. Boundaries of the ELUs were defined using aerial photographs, satellite imagery, and field confirmation. ELUs are considered by NTS 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 habitat types on the NTS were published and distributed (Ostler et al., 2000; Wills and Ostler, 2001). Ten vegetation alliances and 20 associations were recognized as occurring on the NTS.

In 2007, efforts continued to update and collect new habitat data when possible. Efforts focused on the following tasks in support of ecosystem mapping and data management of all NTS geospatial ecological data:

- Ecosystem mapping efforts were altered in 2007 due to drought conditions and the poor condition of vegetation, resulting in reductions in photography and sampling of ELUs
- A vegetation survey was conducted to determine wildland fire hazards
- Coordination was made with ecosystem management agencies and scientists

4.1 No ELU Photography or Resampling of ELUs in 2007

Because of below average precipitation during the early part of 2007 much of the herbaceous vegetation failed to grow, and growth of perennial shrubs and trees was poor. Because of these conditions no photographs of ELUs were taken in 2007 nor were any plots resampled.

4.2 Vegetation Survey for Determining Wildland Fire Hazards

Wildland fires on the NTS require considerable financial resources for fire suppression and mitigation. For example, costs for fire suppression on or near the NTS can cost as much as $198 per ha ($80 per ac). Additional costs are also incurred for replacement of burned structures. For example, the Egg Point Fire in August 2002 (121 ha [300 ac]) cost well over $1 million to replace burned power poles, while reclamation of the site cost more than $200,000 to stabilize and revegetate.

There has been an average of 11 wildland fires per year on the NTS since 1978 with an average of about 93 ha (230 ac) per fire (Table 4-1). These wildland fires do not occur randomly across the NTS, but occur more often in particular vegetation types that have sufficient fuels (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 unless the areas are revegetated with perennial native species.

Table 4-1. Number and acreage of wildland fires on the NTS

Year	Fires	Acres	Hectares
1978	10	7,901	3,197
1979	6	2	1
1980	26	13,504	5,465
1981	13	7	3
1982	6	2	1
1983	16	18,291	7,402
1984	17	1,132	458
1985	11	1,609	651
1986	12	236	96
1987	14	213	86
1988	23	821	332
1989	15	323	131
1990	7	7	3
1991	4	4	2
1992	12	239	97
1993	7	7	3
1994	8	15	6
1995	8	4,605	1,864
1996	2	1,700	688
1997	6	15	6
1998	9	2,580	1,044
1999	7	50	20
2000	11	151	61
2001	8	490	198
2002	7	360	146
2003	4	4	2
2004	8	8	3
2005	31	13,000	5,261
2006	16	8,615	3,486
2007	15	15	6
30-Year Total	**339**	**75,906**	**30,718**
Average Per Year	**11**	**2,530**	**1,024**
Average Per Fire		**230**	**93**

Source: Hansen, 2007

Figures 4-1 and 4-2 show the number of wildland fires on the NTS since 1978 and their distribution by month of the year (for the period of available records). The increase in the number of wildland fires on the NTS in 2005 and 2006 is due in large measure to the increase in winter precipitation during these years and the residual amounts of fine fuels. The reduced number of large fires in 2007 is probably due to reduced amount of fine fuels that resulted from the drought in 2007 and the low incidence of lightning during the summer months.

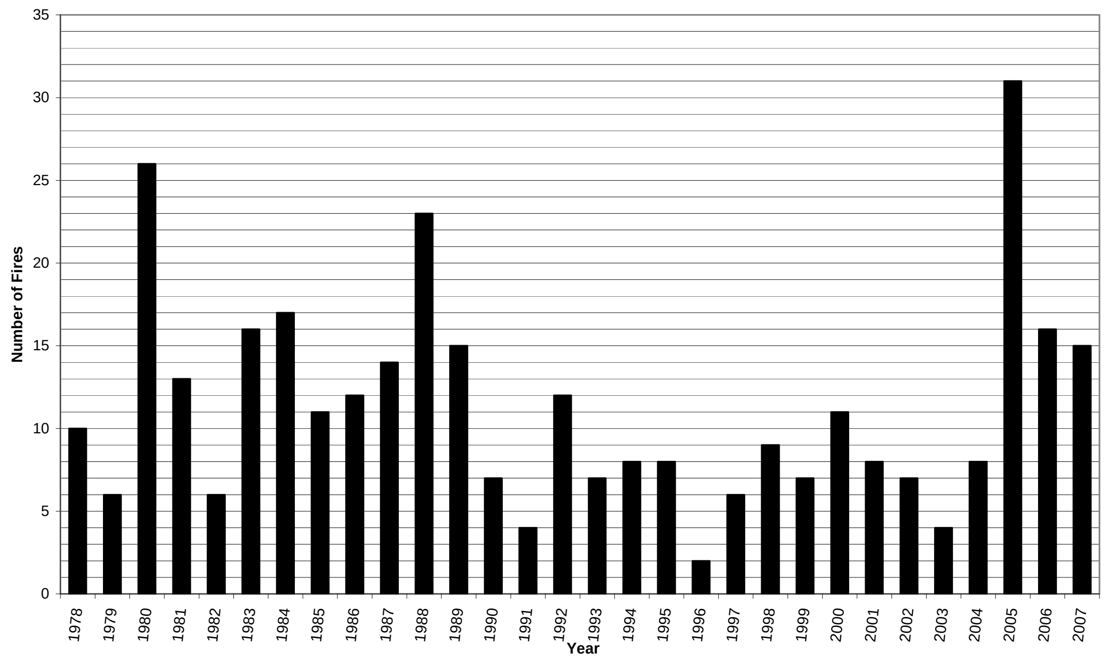

Figure 4-1. Number of wildland fires on the NTS by year

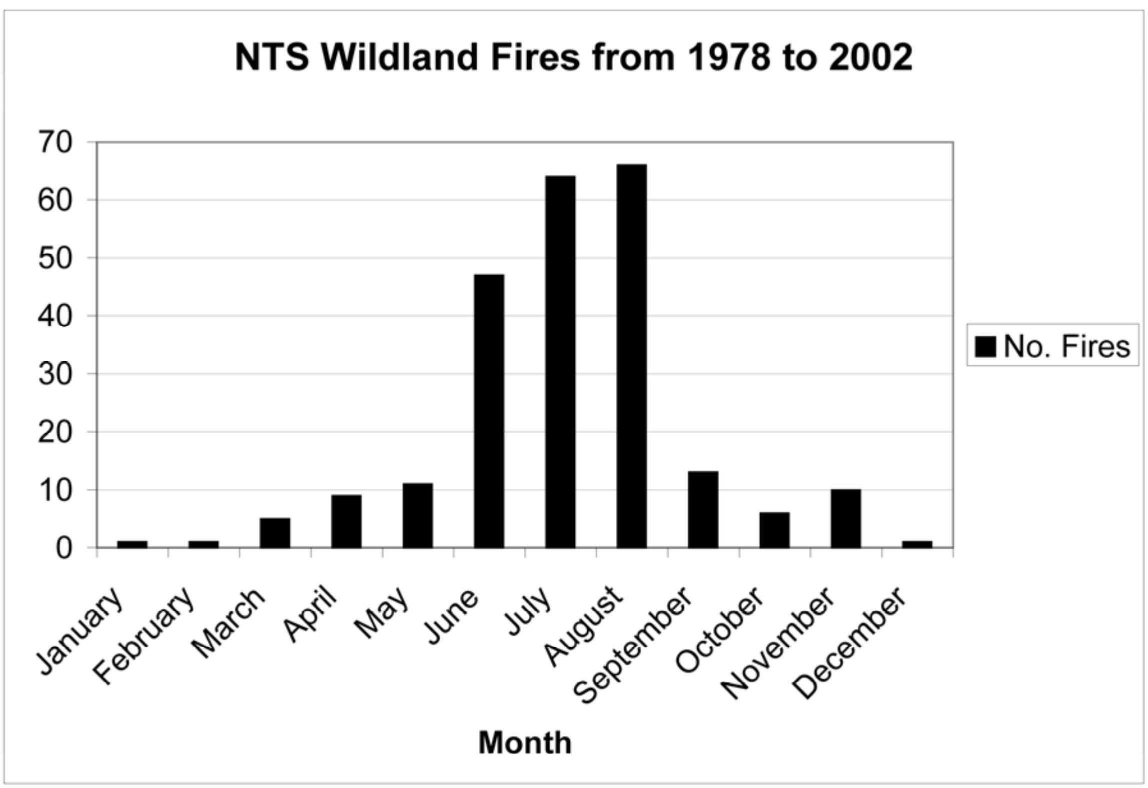

Figure 4-2. Distribution of wildland fires on the NTS by month from 1978 to 2002

The distribution of NTS wildland fires by month of occurrence indicates that most wildland fires occur during the months of June, July, and August, which also represents the active wildland fire season on the NTS (Figure 4-2). Significantly fewer wildland fires occurred during May and September, which represent the pre- and post-season months for NTS wildland fires.

The three most commonly observed invasive annual plants to colonize burned areas are *Schismus arabicus* (Arabian schismus), found at low elevations; *Bromus rubens*, found at lower to moderate elevations; and *Bromus tectorum* (cheat grass), found at moderate to higher elevations (Table 4-2). Colonization by invasive species increases the likelihood of future wildland fires because they provide abundant fine fuels that are more closely spaced than native vegetation. *Coleogyne ramosissima* (blackbrush) vegetation types appear to be the most vulnerable plant communities to fire followed by pinyon-juniper/sagebrush vegetation types. Wildland fires are costly to control and to mitigate once they occur. Revegetation of severely burned areas is very slow without reseeding or transplanting with native species and other rehabilitation efforts. Untreated areas become much more vulnerable to future fires once invasive species, rather than native species, colonize a burned area. Because of the low amount of winter precipitation during 2007 (Figure 4-3) invasive introduced annual species and native species failed to germinate and establish. This resulted in no observable annual and few perennial herbaceous plants at the sampling sites.

Table 4-2. Precipitation history and percent presence in surveyed sites (top species contributing to fine fuels)

Precipitation History	**2004**	**2005**	**2006**	**2007**
	Percent of average			
Precipitation (January - April)	104	167	120	42
Invasive Introduced Species	**2004**	**2005**	**2006**	**2007**
	percent presence			
Bromus rubens (red brome)	51.7	64.4	67.8	0
Bromus tectorum (cheatgrass)	40.3	54.0	60.7	0
Erodium cicutarium (redstem stork's bill)	5.2	6.2	24.6	0
Schismus arabicus (Arabian schismus)	4.7	2.8	5.2	0
Native Species	**2004**	**2005**	**2006**	**2007**
	percent presence			
Amsinkia tessellata (bristly fiddleneck)	34.0	62.0	16.1	0
Mentzelia albicaulis (whitestem blazingstar)	49.8	8.1	0.0	0
Chaenactis fremontii (pincushion flower)	27.0	8.0	0.0	0

Beginning in 2004, and in response to DOE Order 450.1, surveys were initiated on the NTS to identify wildland fire hazards by conducting a spring (April–May) road survey of vegetation at 211 sites located along and adjacent to major NTS corridors to estimate the abundance of fuels produced by native and invasive plants. Information about climate and wildland fire-related information reported by other government agencies were also identified and summarized as part of the wildland fire hazards assessment.

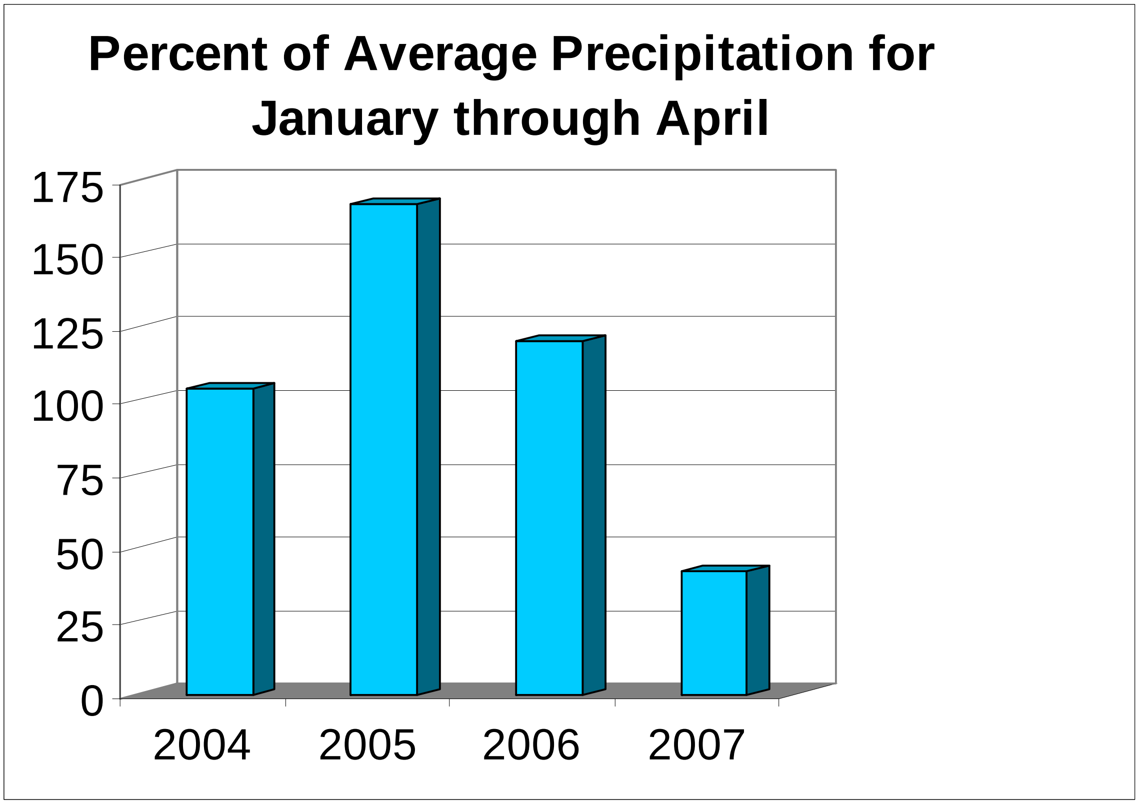

Figure 4-3. Percent of average precipitation for January through April 2004 to 2007

4.2.1 Survey Methods

The details of the spring survey to assess wildland fire hazards on the NTS are described in a 2004 report by Hansen and Ostler (2004). In short, the abundance of fine-textured (grasses and herbs) and coarse-textured (woody) fuels were visually estimated on numerical scales using the following 10-point potential scale: 0, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, and 5 (where 0 is barren and 5 is near maximum biomass encountered on the NTS).

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 [BN], 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 these survey sites were then plotted on a Geographic Information System (GIS) map and color coded for severity to indicate the hazards at various locations across the NTS.

4.2.2 Survey Results

Climate—There are 17 rain gauges on the NTS that are used to measure precipitation. Precipitation during the months of January, February, March, and April are most correlated with production of vegetation that produces fine fuels. The total accumulated precipitation appears to be highly correlated with biomass production during this spring period as reported by Hansen and Ostler (2004). Precipitation measurements at the 17 rain gauges show that when precipitation was averaged for all stations on the NTS, the amount received during the spring of 2007 was 58 percent below the average precipitation for this period (Table 4-3). This decreased precipitation was responsible for reducing or preventing plant germination and establishment. This is substantially less precipitation than that reported by Hansen and Ostler (2004) for this same period of the year in 2005 and 2006 (67 and 20 percent greater than average winter-spring precipitation, respectively).

At the beginning of the fire season, the extended weather forecast for the United States for the summer of 2007 (June, July, and August) indicated hotter than average temperatures and about normal precipitation through the fires season summer months (Figure 4-4). The National Wildland Fire Outlook for the months of June through September 2007 as it was reported at the beginning of the wildland fire season is shown in Figure 4-5. It identified southern Nevada as having “Normal” Fire Potential for the projected period of June 1 to September 30, 2007.

Fuels—Because of the decreased precipitation in early 2007 there were almost no new fine fuels. Fine fuel values shown in Figure 4-6 represent only a small amount of residual fine fuels from previous years. There was a slight decrease in woody fuels (Figure 4-7). Figure 4-8 shows the combined index values for fine fuels and woody fuels. Highest index values were reported for Fortymile Canyon, Pahute Mesa, and moderate slopes around Yucca Flat.

The average combined index values by NTS operational area are shown in Table 4-4. The NTS average combined index value for fine fuels and woody fuels for 2007 was 4.77 compared to 5.26 in 2006, 5.64 in 2005 (a very wet year) and 4.88 in 2004 (an average precipitation year). NTS areas having the highest combined fuels average index values were Areas 29 (8.1), 30 (6.14), 8 (5.75), and 12 (5.63).

Examples of the observable differences in fine fuels during the past four years are shown in Figures 4-9. Major fires (>100 acres) on the NTS in 2006, 2005, and previous years are shown in the Figure 4-10. There were no large fires in 2007, and small fires were extinguished soon after detection.

Table 4-3. Inches of precipitation for meteorological recording stations on the NTS for January through April 2007 compared to long-term averages

	YEAR	JAN	FEB	MAR	APR	Percent of AVG** January - April
		Inches of Precipitation				
	2007	0.120	0.400	0.320	0.810	
RAINIER MESA (A12)	LongTerm AVG*	1.610	1.690	1.920	0.880	
	Percent of AVG**	7.5	23.7	16.7	92.0	35
	2007	0.030	0.060	0.070	0.660	
BUSTER JANGLE (BJY)	LongTerm AVG*	0.820	0.950	0.730	0.380	
	Percent of AVG**	3.7	6.3	9.6	173.7	48
	2007	0.000	0.050	0.030	0.970	
CANE SPRINGS (CS)	LongTerm AVG*	1.130	1.360	0.950	0.490	
	Percent of AVG**	0.0	3.7	3.2	198.0	51
	2007	0.040	0.150	0.020	0.360	
DESERT ROCK (DRA)	LongTerm AVG*	0.660	0.900	0.660	0.350	
	Percent of AVG**	6.1	16.7	3.0	102.9	32
	2007	0.040	0.110	0.020	0.840	
AREA 06 (SOUTH)	LongTerm AVG*	0.470	1.350	0.410	0.600	
	Percent of AVG**	8.5	8.1	4.9	140.0	40
	2007	0.030	0.000	0.090	0.320	
JACKASS FLATS (4JA)	LongTerm AVG*	0.700	1.030	0.740	0.330	
	Percent of AVG**	4.3	0.0	12.2	97.0	28
	2007	0.060	0.280	0.340	0.780	
E TUNNEL (ETU)	LongTerm AVG*	1.100	2.550	1.070	1.010	
	Percent of AVG**	5.5	11.0	31.8	77.2	31
	2007	0.000	0.060	0.170	0.380	
LITTLE FELLER 2 (LF2)	LongTerm AVG*	1.010	1.170	1.200	0.540	
	Percent of AVG**	0.0	5.1	14.2	70.4	22
	2007	0.070	0.560	0.010	0.450	
MERCURY (MER)	LongTerm AVG*	0.690	0.860	0.650	0.330	
	Percent of AVG**	10.1	65.1	1.5	136.4	53
	2007	0.090	0.340	0.050	0.790	
MID VALLEY (MV)	LongTerm AVG*	1.360	1.640	1.090	0.510	
	Percent of AVG**	6.6	20.7	4.6	154.9	47
	2007	0.020	0.440	0.250	0.650	
40 MILE CANYON NORTH (40M)	LongTerm AVG*	0.830	1.120	1.060	0.530	
	Percent of AVG**	2.4	39.3	23.6	122.6	47
	2007	0.110	0.690	0.440	0.480	
PAHUTE MESA 1 (PM1)	LongTerm AVG*	0.620	0.830	0.880	0.640	
	Percent of AVG**	17.7	83.1	50.0	75.0	56
	2007	0.010	0.240	0.110	0.810	
PHS FARM (PHS)	LongTerm AVG*	0.930	1.190	0.960	0.510	
	Percent of AVG**	1.1	20.2	11.5	158.8	48
	2007	0.020	0.000	0.010	0.570	
ROCK VALLEY (RV)	LongTerm AVG*	0.830	1.140	0.840	0.340	
	Percent of AVG**	2.4	0.0	1.2	167.6	43
	2007	0.000	0.400	0.120	0.670	
TIPPIPAH SPRINGS (TS2)	LongTerm AVG*	1.080	1.430	1.060	0.530	
	Percent of AVG**	0.0	28.0	11.3	126.4	41
	2007	0.050	0.150	0.010	0.490	
WELL 5 B (W5B)	LongTerm AVG*	0.600	0.700	0.550	0.350	
	Percent of AVG**	8.3	21.4	1.8	140.0	43
	2007	0.040	0.070	0.040	0.640	
YUCCA DRY LAKE (UCC)	LongTerm AVG*	0.930	1.020	0.730	0.370	
	Percent of AVG**	4.3	6.9	5.5	173.0	47
	Percent of Average Precipitation for All Stations**					**42**

* Long-term average precipitation in inches for the month
** A value of 100 means precipitation equaled the mean of the long-term averages for all stations for January thru April
A value of 120 means precipitation exceed the mean by 20%
A value of 42 means that precipitation was less than the mean by 58%

Source: NOAAARL/SORD May 25, 2007: http://www.sord.nv.doe.gov/home_climate_rain.htm 2007MonthlyPecipData.xls

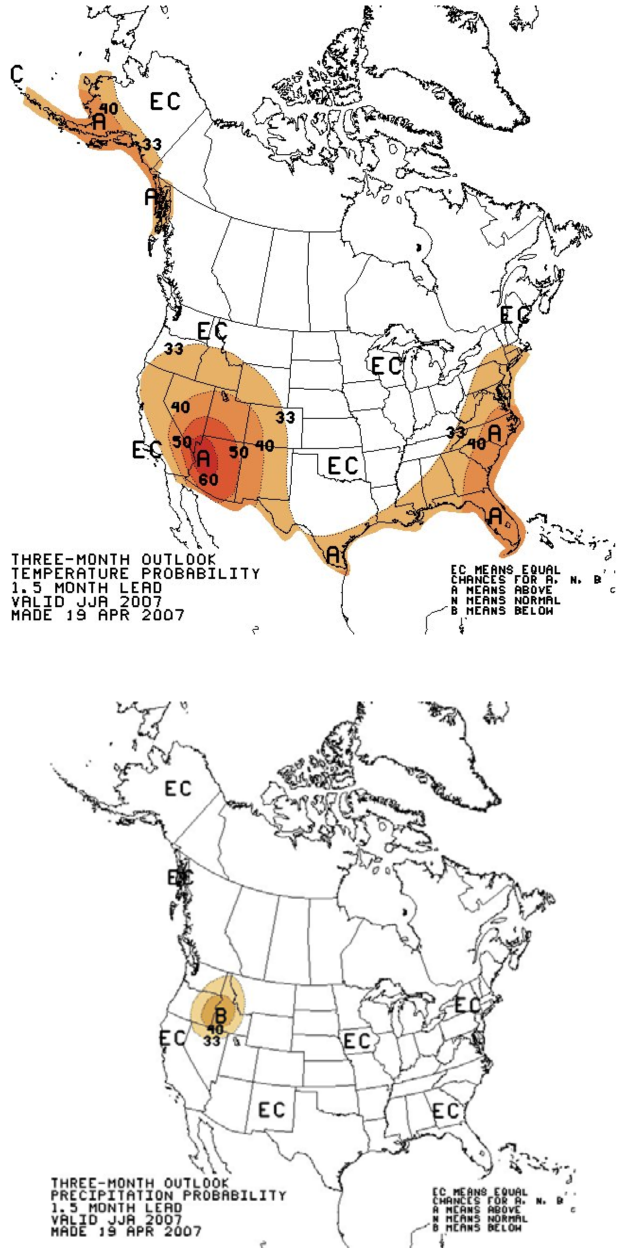

Figure 4-4. Extended weather forecast for June, July, and August of 2007 for temperature and precipitation (National Oceanic and Atmospheric Administration, 2007)

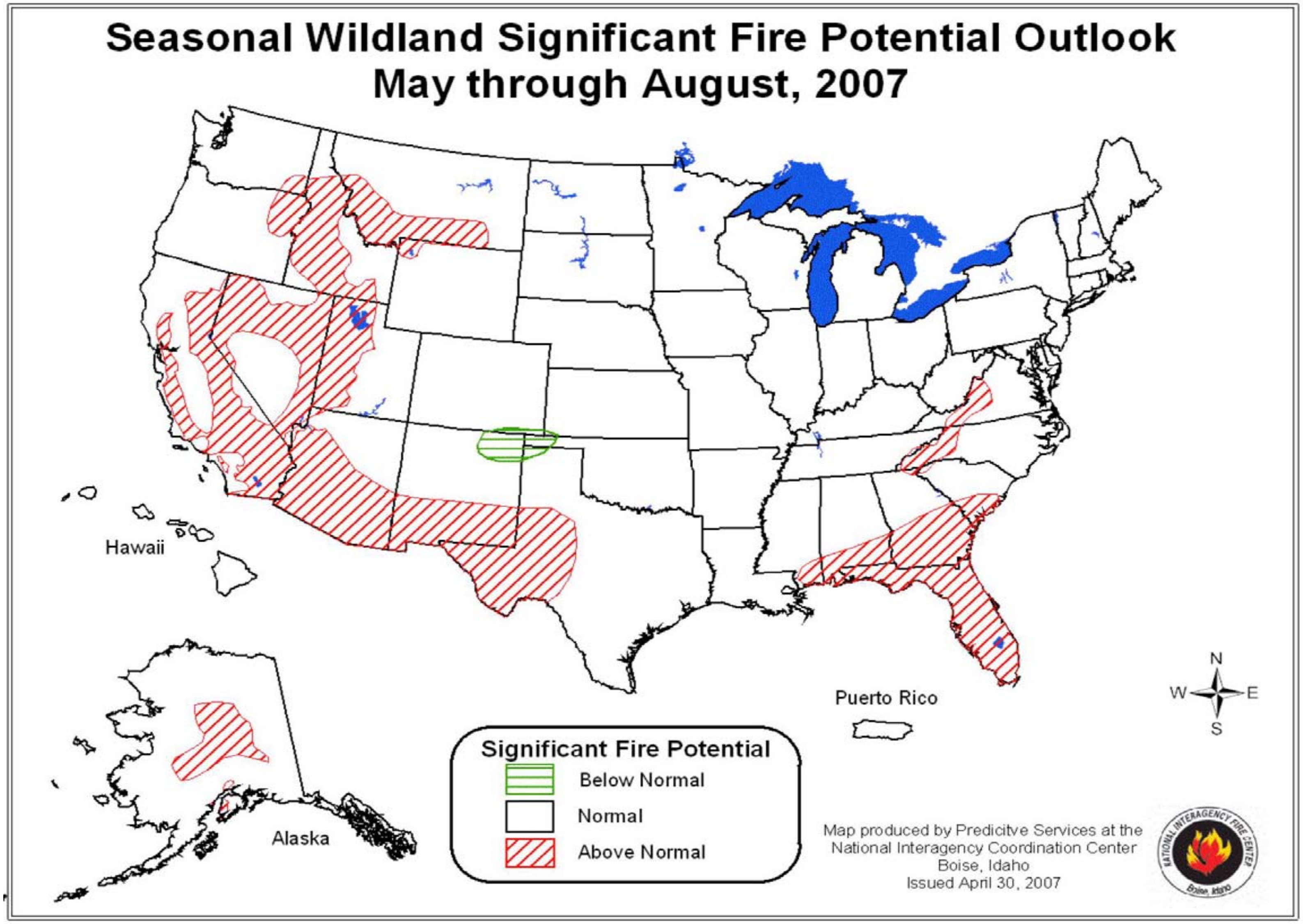

Figure 4-5. National Wildland Fire Outlook, May 1 to August 31, 2007 (U.S. Bureau of Land Management, 2007)

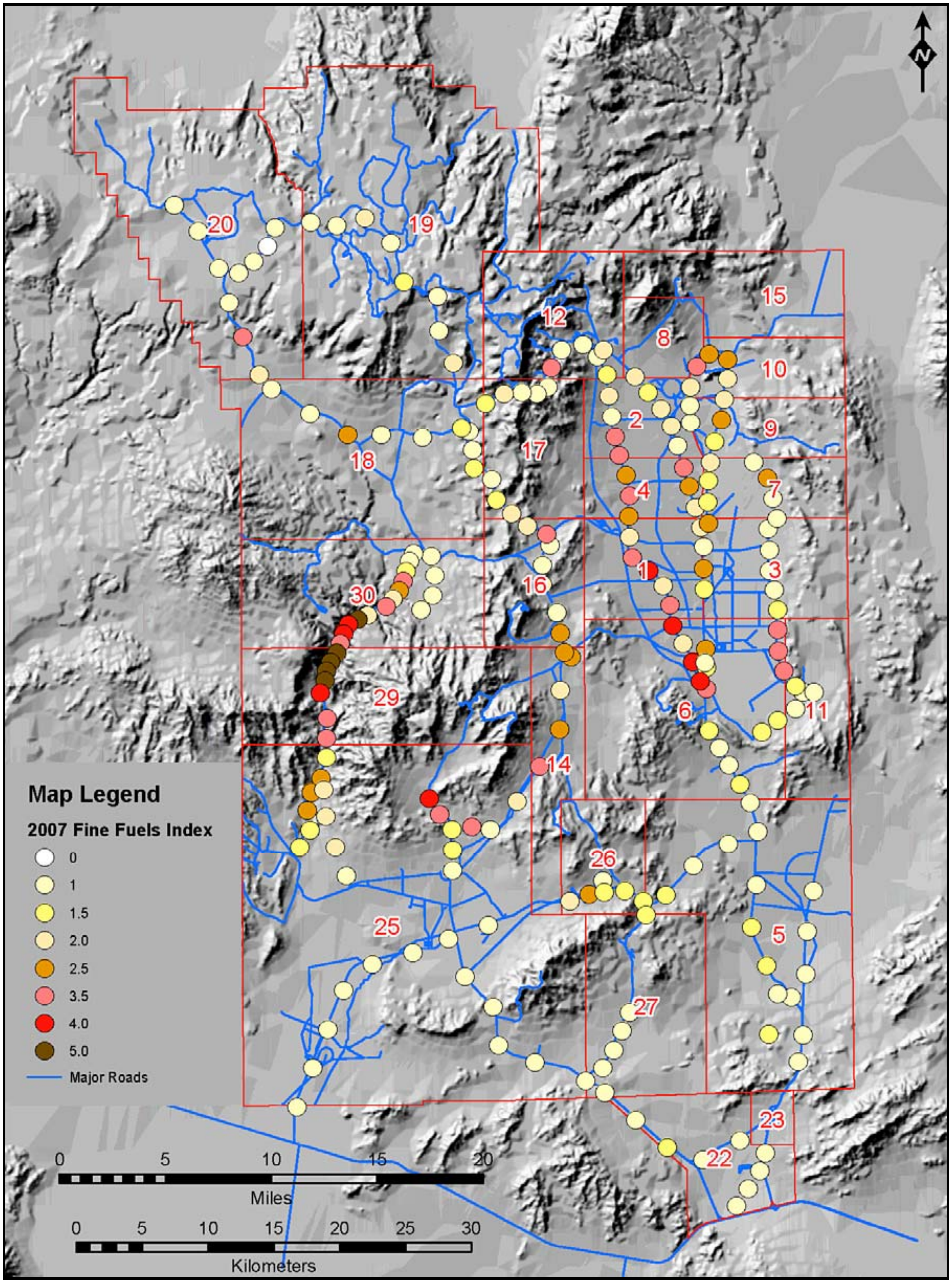

Figure 4-6. Index of fine fuels for 211 survey stations on the NTS by operational area during 2007

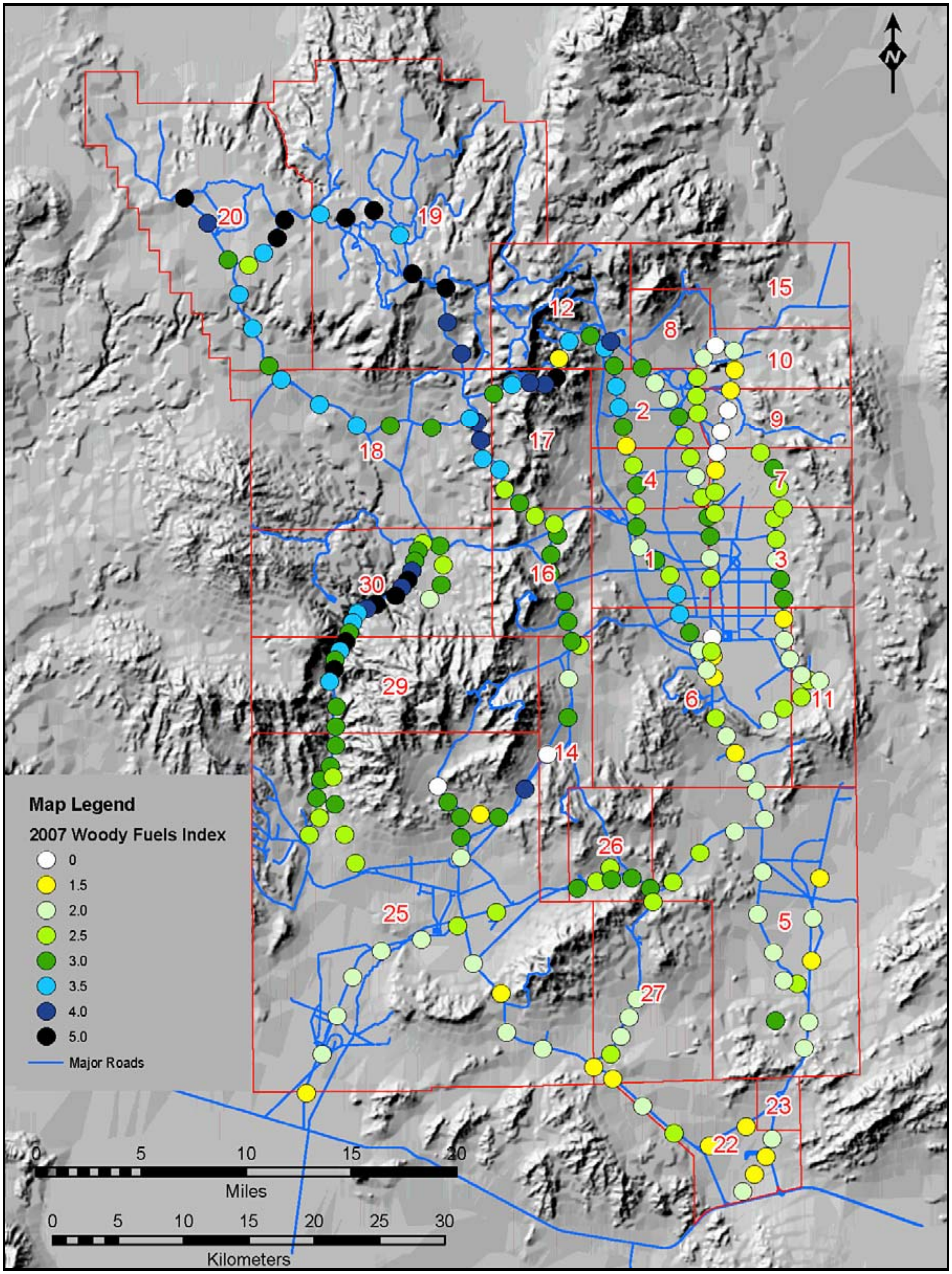

Figure 4-7. Index of woody fuels for 211 survey stations on the NTS by operational area during 2007

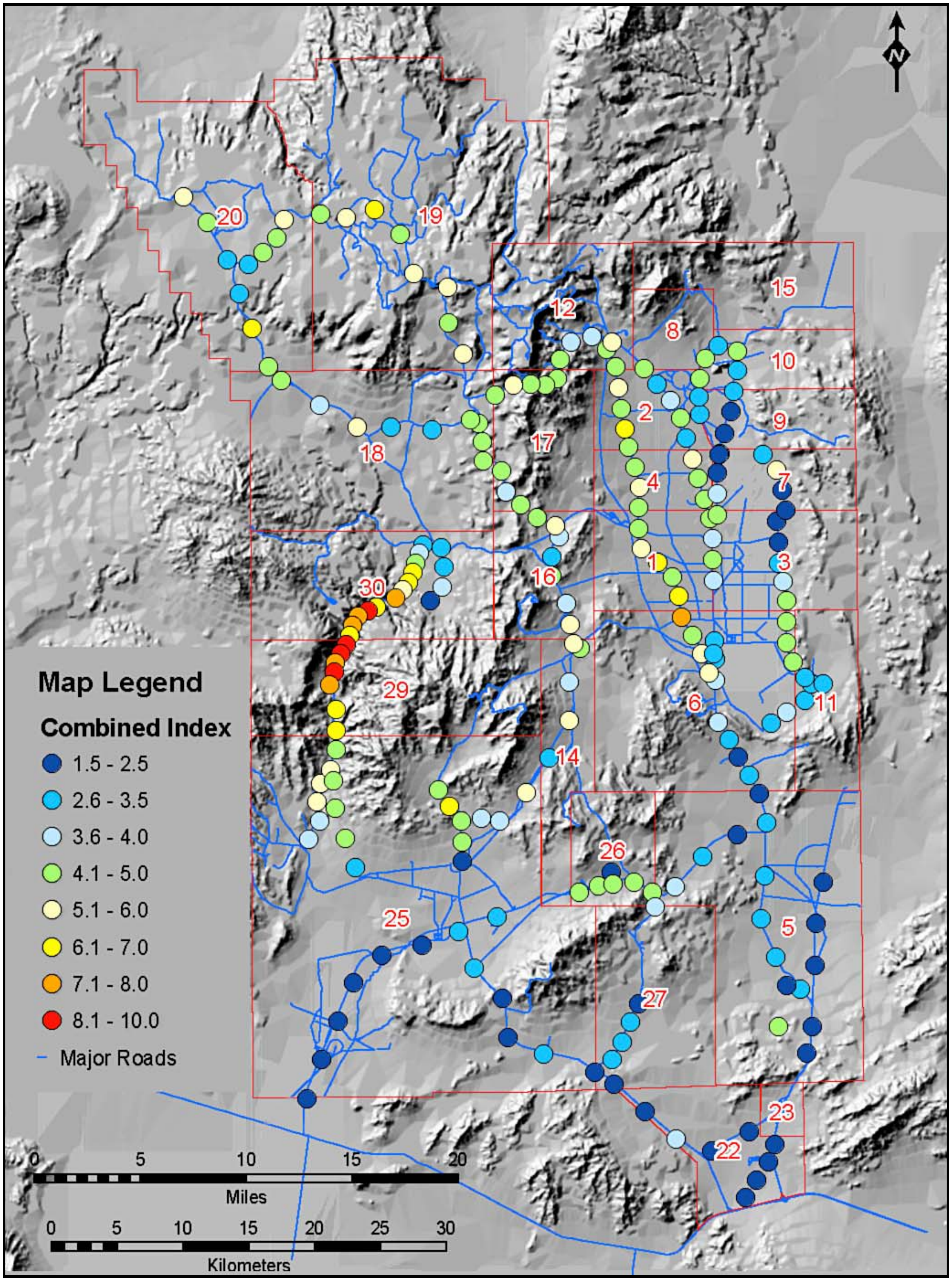

Figure 4-8. Index of combined fine fuels and woody fuels for 211 survey stations on the NTS by operational area during 2007

Table 4-4. Comparison of combined fuel ratings on the NTS for 2004–2007

Combined Fuels Average Index Value by NTS Area

NTS Area	2004 Data Average	2005 Data Average	2006 Data Average	2007 Data Average
1	4.28	5.72	5.56	5.06
2	4.19	5.69	5.19	4.34
3	4.58	5.25	4.67	4.13
4	4.58	6.00	5.83	5.00
5	3.41	4.56	3.97	2.97
6	4.59	5.88	5.71	4.73
7	4.00	5.36	4.64	3.82
8	5.50	7.00	6.50	5.75
9	2.75	4.88	4.88	3.75
10	5.75	6.17	6.17	5.08
11	3.63	5.25	4.75	4.06
12	5.00	5.67	6.67	5.63
14	5.90	6.50	6.00	5.35
16	5.93	6.43	6.43	5.50
17	5.25	5.69	5.50	5.13
18	5.22	5.94	5.39	4.94
19	6.44	6.56	5.63	5.53
20	5.25	5.20	4.65	4.43
22	3.19	3.88	3.38	2.25
25	4.85	5.19	4.65	4.16
26	4.71	5.50	5.07	4.29
27	2.80	3.60	3.40	2.70
29	8.30	7.86	8.30	8.10
30	6.78	6.94	6.72	6.14
NTS Average	**4.88**	**5.64**	**5.26**	**4.77**

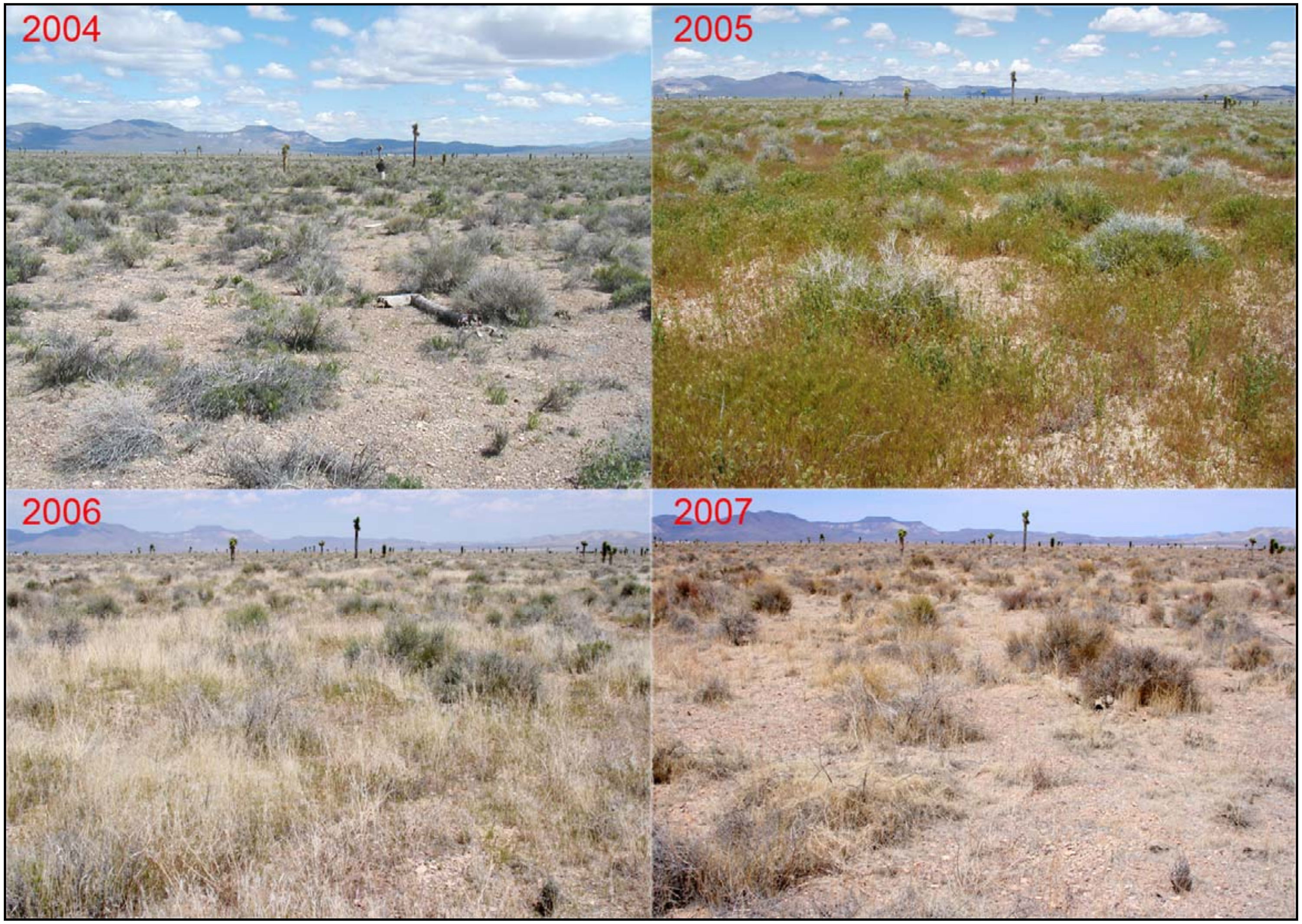

Figure 4-9. Site 99 on the west side of Yucca Flat in 2004–2007
(Photos by W. K. Ostler, April 29, 2004 [top left], April 20, 2005 [top right], May 4, 2006 [bottom left], and April 19, 2007 [bottom right])

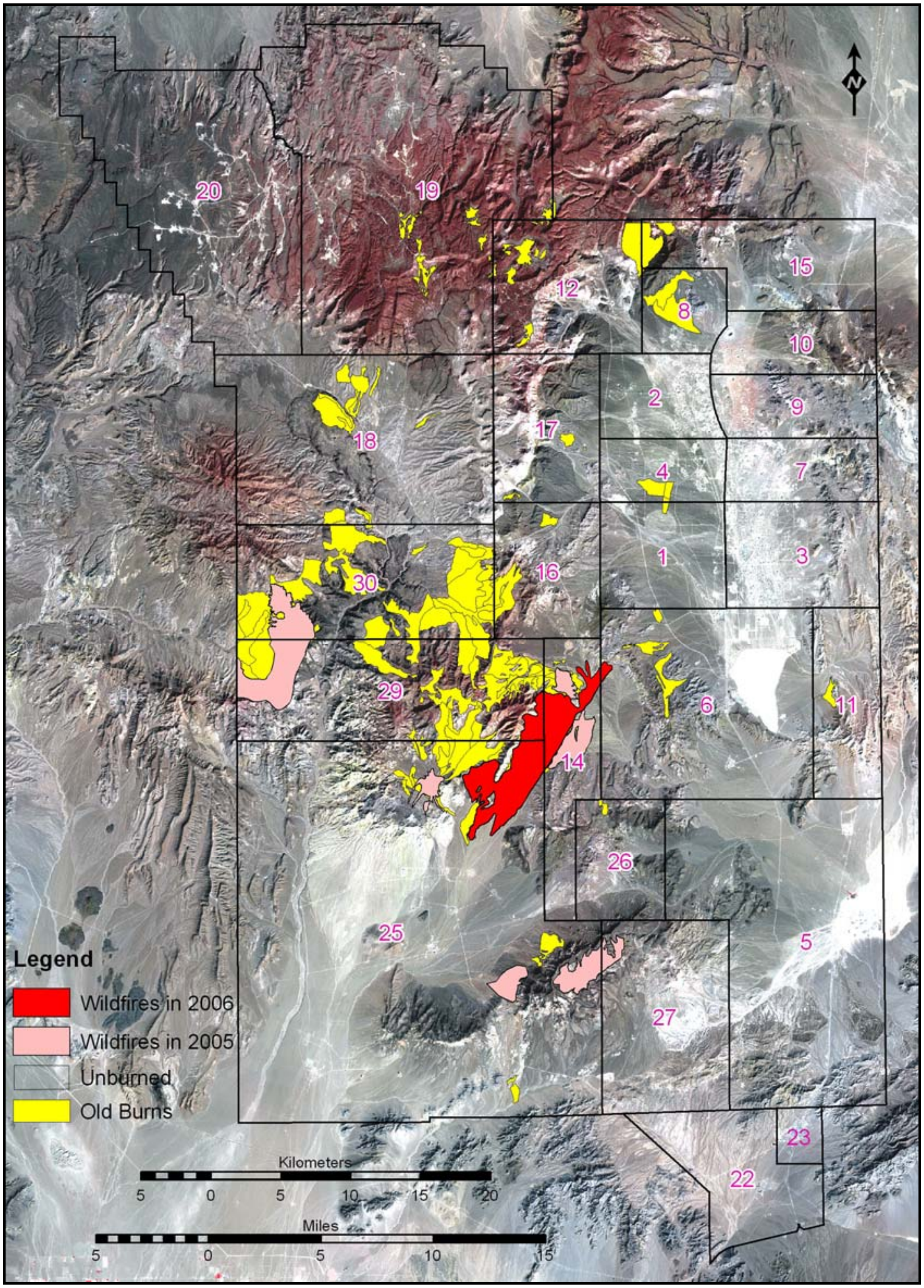

Figure 4-10. Location of large wildland fires on the NTS
(Note: All fires in 2007 were very small and are not shown on this map.)

4.3 Coordination with Scientists and Ecosystem Management Agencies

NSTec biologists interfaced with other scientists and ecosystem management agencies in 2007 for the following activities:

- Participated in a meeting sponsored by FWS to discuss their desert tortoise recovery plan. Included in the meeting were individuals from interested organizations such as homeowners associations, Clark County, the Bureau of Land Management, FWS, Nevada Division of Wildlife, and USGS. The meeting was held on November 8, 2007, in Las Vegas, Nevada.

5.0 SENSITIVE PLANT MONITORING

There are 20 plant species that occur on the NTS that are considered sensitive and are listed by NNHP as "At-Risk" plants (NNHP 2007) (Table 2-1). The goal of monitoring sensitive species is to ensure their continued occurrence on the NTS. A database containing information on each sensitive plant is maintained to evaluate long-term trends. The status of sensitive plants on the NTS is periodically evaluated to determine whether protection or management under state or federal law is necessary, or if the species should still be included on the NNHP list of at-risk plants.

Currently, there are no plants known to occur on the NTS that have been listed as endangered or threatened under the provisions of the ESA, nor are there any being considered for listing by the FWS. The state of Nevada has not listed any plants known to occur on the NTS as Critically Endangered either.

Management of sensitive plants on the NTS has changed over the years. In the 1970s and 1980s, the emphasis was on field inventories to determine the presence of such species on the NTS and also determine if NNSA/NSO activities were impacting any of them. Following those activities, DOE/NV prepared a Resource Management Plan (RMP), which included objectives to protect and conserve sensitive plant species found on the NTS and to minimize cumulative impacts to those species as a result of NNSA/NSO activities (DOE/NV, 1998). Pursuant to that document, BN published and distributed an *Adaptive Management Plan for Sensitive Plant Species on the Nevada Test Site* (BN, 2001). This document presents the procedures designed to ensure that the RMP goals are met by identifying parameters to be measured during long-term monitoring and outlining management actions that may be taken if significant threats to sensitive species are detected. Monitoring activities this year included a review of species on the list of sensitive plant species for the NTS, coordination with other agencies and professionals, and monitoring one of the 20 sensitive plant species.

5.1 List of Sensitive Plant Species for the NTS

The list of sensitive plant species for the NTS was reviewed in 2007. There are no changes to the list of sensitive plant species. NNHP along with Nevada Native Plant Society sponsors a Rare Plant Workshop annually. It was held in Las Vegas on April 3, 2007. Participants included state and federal agency representatives, academia, land resource managers, and private concerns. The workshop provides an opportunity for participants to coordinate their efforts in protecting at-risk plant species and to make recommendations regarding the protection of species under state or federal laws and regulations. During the 2007 workshop, no actions were taken by this group that affected the list of sensitive plant species for the NTS.

5.2 Long-term Monitoring

As described in the Adaptive Management Plan (BN, 2001) for sensitive plants on the NTS, the goal of long-term monitoring is to maintain an accurate assessment of the distribution of sensitive plant species on the NTS and to periodically evaluate their status. In an effort to maximize monitoring efforts, the 20 sensitive plant species on the NTS are monitored at either 5-year or 10-year intervals. Currently, nine of the 20 sensitive plant species on the NTS (see Table 2-1, shown previously) are monitored once during a 5-year period. The remaining 11 species are monitored once during a 10-year period. Those species to be monitored in a given year are selected at the beginning of the year. The selection is largely based on current year growing conditions (precipitation and temperature), although susceptibility to impacts and other such criteria are also considered. During field monitoring the status of each population is assessed, which may include estimates or observations of plant density, plant vigor, herbivory, disease, or documentation of direct or indirect impacts to the plant or its habitat. *Penstemon fruticiformis* ssp. *amargosae*, Death Valley beardtongue, was selected for long-term monitoring in 2007. Because of the continuing poor growing conditions in this region, no other species were considered.

5.2.1 Penstemon fruticiformis ssp. amargosae

In the early 1990s, *P. fruticiformis* ssp. *amargosae* was considered for listing by FWS as a Category 2 species, which is defined as a "Taxa for which existing information suggests listing may be warranted, but for which substantial biological information to support a proposed rule is lacking." Blomquist et al. (1995) conducted numerous surveys for this species from 1992 to 1994 and concluded that unless a threat from human activity could be shown for the Death Valley and Spring Mountain locations, this species did not warrant listing as a threatened or endangered species under the provisions of the ESA. In December 2007, *P. fruticiformis* ssp. *amargosae* was listed as an at-risk plant by the NNHP (NNHP, 2007).

The distribution of *P. fruticiformis* ssp. *amargosae* encompasses less than a 161 km x 161 km (100 mi x 100 mi) area in Nye and Clark Counties on the Nevada side of the California-Nevada state line, and Inyo and San Bernardino Counties on the California side. The southern-most and eastern-most population is recorded from the Kingston Mountains, specifically the Crystal Springs and Silver Rule mine areas. The northern-most populations include those along the northern slopes of the Striped Hills on the NTS and in Titus Canyon of the southern Grapevine Mountains in the Death Valley National Park. The Titus Canyon population and a population recorded from Pleasant Canyon in the Panamint Range represents the furthest west that *P. fruticiformis* ssp. *amargosae* has been found. Overall the range of *P. fruticiformis* ssp. *amargosae* is slightly more than 4,000 square miles (10,500 square kilometers) (Blomquist et al., 1995).

The occurrence of *P. fruticiformis* ssp. *amargosae* on the NTS has been questionable. Surveys for the species were conducted in 1992 and 1994 along the southern border of the NTS in Area 25. The areas where specimens were found were described as "on the NTS Boundary" (Blomquist et al., 1995), but it was uncertain whether it was within the boundaries of the NTS or outside. If within the boundaries this location would represent the only place *P. fruticiformis* spp. *amargosae* is found on the NTS.

The objective of this year's field monitoring was to document whether *P. fruticiformis* ssp. *amargosae* occurs on the NTS. In May of 2007 surveys were conducted along the north slopes of the Striped Hills in Area 25 of the NTS. A geographical positioning system, accurate to within 2–3 meters (m) (6.6–9.8 feet [ft]), was used to record the locations of all plants encountered. Approximately 71 plants were found. Only two of the plants were seedlings. All others were mature, semi-dormant plants, with no signs of flowering, and only a small percentage showed signs of current annual growth. Plants were scattered over several acres with heaviest concentrations on mid to upper talus slopes (Figure 5-1). The area is characterized by limestone outcrops and minimal well developed soils. Plants were found primarily on the slopes, although a few individuals were encountered along the lower stream channels.

Figure 5-1. Typical rocky habitat of *Penstemon fruticiformis* ssp. *amargosae* (Death Valley breardtongue--center of picture) in the Striped Hills of Area 25
(Photograph by D.C. Anderson, May 2007)

After plotting the locations of the plants on NTS site maps, it was confirmed that the population of *P. fruticiformis* ssp. *amargosae* in the Striped Hills occurs both within the boundaries of the NTS and south of the boundary (Figure 5-2). The highest density of plants was found on a location on the NTS with only scattered plants at the other locations. This population will be added to the long-term monitoring program conducted on the NTS for sensitive plant species and will be monitored at least once during a five-year period.

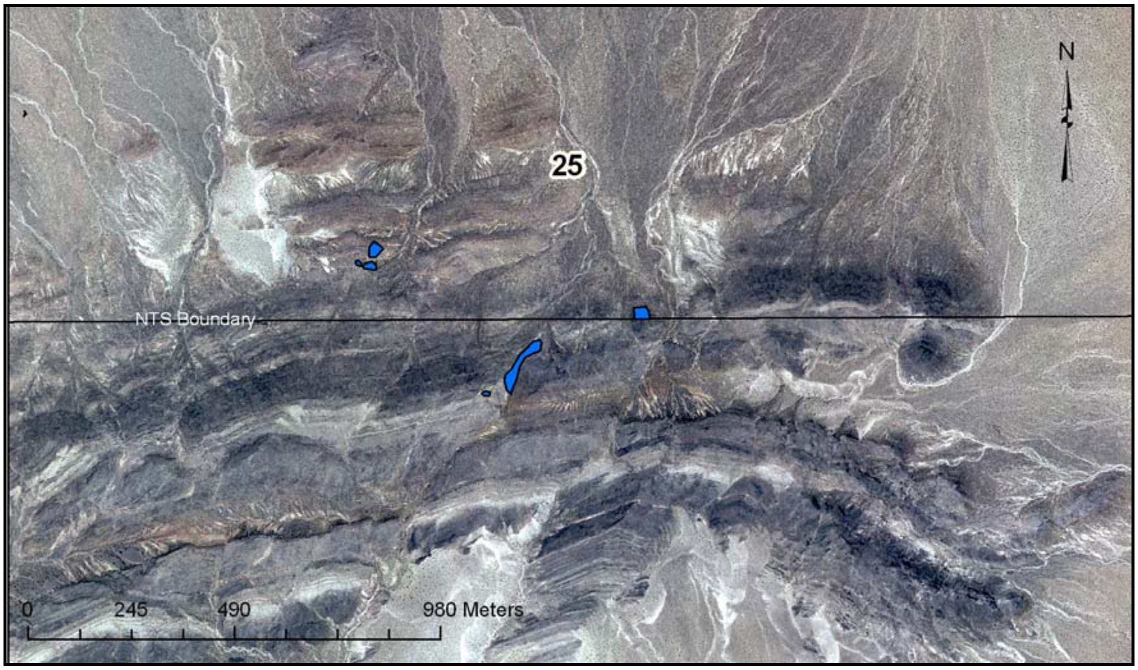

Figure 5-2. Known locations (area in blue) of *P. fruticiformis* ssp. *amargosae* within and near the boundaries of the NTS (black line) along the southern edge of Area 25

6.0 SENSITIVE AND PROTECTED/REGULATED ANIMAL MONITORING

The NNHP At-Risk Tracking List; Nevada Administrative Code (NAC) 503, "Hunting, Fishing and Trapping; Miscellaneous Protective Measures"; and other sources were reviewed to determine if any changes had been made to the status of species known to occur on the NTS. No changes were made to the NAC 503 measures, but several changes were made to the NNHP list. Noteworthy changes include:

- Removal of the bald eagle (*Haliaeetus leucocephalus*) from the Threatened Species List
- Moving the western burrowing owl (*Athene cunicularia hypugaea*), Swainson's hawk (*Buteo swainsoni*), black tern (*Chlidonias niger*), common loon (*Gavia immer*), and white-faced ibis (*Plegadis chihi*) from the At-Risk Tracking List to the Watch List
- Adding Bendire's thrasher (*Toxostoma bendirei*), LeConte's thrasher (*Toxostoma lecontei*), and pale kangaroo mouse (*Microdipodops pallidus*) to the At-Risk Tracking List.

The complete list with current designations is found in the Sensitive and Protected/Regulated Animal Species List (see Table 2-1, shown previously).

Surveys of sensitive and protected/regulated animals during 2007 focused on western red-tailed skink (*Eumeces gilberti rubricaudatus*), western burrowing owl (*Athene cunicularia hypugaea*), kangaroo mice (*Microdipodops* spp.), bats, feral horse (*Equus caballus*), mule deer (*Odocoileus hemionus*), mountain lion (*Puma concolor*), and the southeast Nevada pyrg (*Pyrgulopsis turbatrix*). Opportunistic sightings of pronghorn antelope (*Antilocapra americana*) were also recorded. Groups of antelope are commonly observed along the Mercury Highway from Mercury to Frenchman Flat and along the 5-01 Road. Year-round observations suggest this population has become resident during the last five years or more. Anecdotal evidence suggests that group size declined during 2007. This may be due to drought conditions or some other factor. Fourteen antelope road-kills were recorded in this region from 2001 to 2007, with two being killed during 2007. Sightings during 2007 were also recorded in Area 20 on the west side of Pahute Mesa and in Yucca Flat (Area 1 [three individuals] and Area 6 [five individuals]).

6.1 Western Red-tailed Skink Surveys

The western red-tailed skink (Figure 6-1) is considered a sensitive species by the NNHP and has an "Evaluate" status for monitoring on the NTS. This means that there is insufficient information on its distribution and abundance to determine if it is threatened and, therefore, whether it warrants protection and monitoring or not. Sampling was conducted in 2006 to obtain information on the distribution, abundance, and habitat types where this species occurs as well as to evaluate techniques for capturing this species. Prior to 2006, the western red-tailed skink was only known from four locations on the NTS. Nine western red-tailed skinks were captured in 2007 at six new locations and one historic location for a total of 10 documented locations (Figure 6-2). Tissue samples were taken from four of these individuals for genetic testing.

Surveys for this species continued during 2007 with the same objectives as in 2006, including the evaluation of two different trap designs, bait trials, and genetic testing. In order to more systematically sample for western red-tailed skinks, a 5-km by 5-km grid was overlaid on the NTS beginning at a point approximately 8 km (5 mi) northwest of the northwest corner of the NTS to ensure that the grid encompassed the entire NTS (Figure 6-2). Each grid cell was assigned

Figure 6-1. Western red-tailed skink (*Eumeces gilberti rubricaudatus*)
(Photo by D. B. Hall, May 11, 2006)

an alphanumeric label (A1 to M17), and 25 cells were randomly selected for sampling during 2007.

Due to logistical considerations such as travel time into remote areas, proximity to selected grids, and concurrent sampling for other species, three grids were sampled that were not randomly selected. Cells not containing sufficient rocky habitat or only slightly overlapping the NTS boundary were excluded from sampling. Within each cell, two sampling sites were selected based on habitat features (i.e., rocky areas, mesic areas) that western red-tailed skinks are known to be associated with based on the literature and previous experience (Morrison and Hall, 1999; Stebbins, 2003; NSTec, 2007). At each site, 30 funnel traps were set near rocks or vegetation to funnel animals into the traps.

Trap success, based on reptile captures, was evaluated for two types of funnel traps.
A rectangular, box-type funnel trap (61.0 centimeters (cm) long x 21.0 cm wide x 21.0 cm tall [24.0 x 8.3 x 8.3 inches (in.)]) (Figure 6-3) and a triangular, wire-mesh trap (61.0 cm long x 21.0 cm wide x 21.0 cm tall [24.0 x 8.3 x 8.3 in.]) (Figure 6-4). At ten sites (Table 6-1), both rectangular and triangular funnel traps were set, usually 15 of each type.

Two types of bait were tested to see if reptile capture success increased: canned pears and oatmeal. Canned pears were selected because they were used by researchers in New Zealand to attract skinks (Hoare et al., 2007). Oatmeal was used to attract insects that might entice western red-tailed skinks and other reptiles into the trap to prey on the insects. Bait trials were run at two sites (Table 6-1) for six days using 30 rectangular funnel traps with 10 traps baited with canned pears (Figure 6-5), 10 traps with oatmeal (Figure 6-6), and 10 traps with no bait.

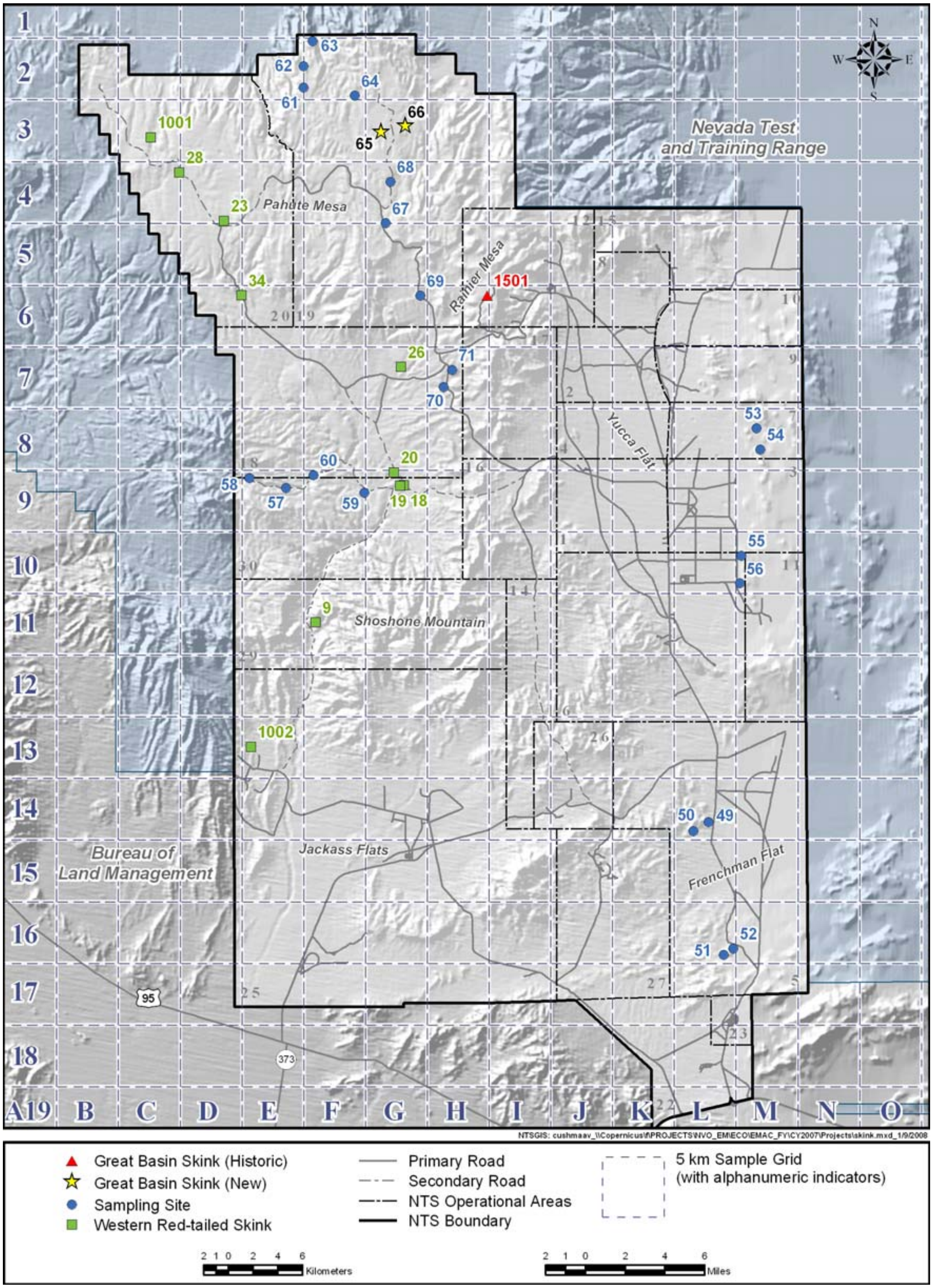

Figure 6-2. Western red-tailed and Great Basin skink distribution on the NTS including all known locations, sites sampled during 2007, and 5-km sample grid

Figure 6-3. Rectangular, box-like funnel trap
(Photo by D. B. Hall, May 30, 2007)

Figure 6-4. Triangular wire-mesh funnel trap
(Photo by D. B. Hall, June 14, 2007)

Table 6-1. Number of skinks and other reptiles captured by NTS area, site, and survey period
(P=species observed but not captured)

Site Number	NTS Area	Dates in 2007	Trap Days	Lizards: *Callisaurus draconoides*	*Cnemidophorus tigris*	*Coleonyx variegatus*	*Crotaphytus bicinctores*	*Eumeces skiltonianus*	*Gambelia wislizenii*	*Sauromalus obesus*	*Sceloporus graciosus*	*Sceloporus magister*	*Sceloporus occidentalis*	*Uta stansburiana*	Snakes: *Hypsiglena torquata*	*Masticophis flagellum*	*Masticophis taeniatus*	*Pituophis catenifer*	*Rhinocheilus lecontei*	*Salvadora hexalepis*	*Sonora semiannulata*	Total	Percent Trap Success
49[a]	5	4/30-5/3; 5/7-5/10	180		2							1										**3**	**1.7**
50[a]	5	4/30-5/3; 5/7-5/10	180	P	1		P			P				2								**3**	**1.7**
51	5	4/30-5/3; 5/7-5/10	180	P	2	1						2		1					1			**7**	**3.9**
52	5	4/30-5/3; 5/7-5/10	180		1							2		2		1						**6**	**3.3**
53[a]	7	5/21-5/24; 5/29-6/1	184		1		P		1			P		2								**4**	**2.2**
54[a]	7	5/21-5/24; 5/29-6/1	180									1		6								**7**	**3.9**
55	6	5/21-5/24; 5/29-6/1	180		2	2	P					1		P								**5**	**2.8**
56	6	5/21-5/24; 5/29-6/1	180		1		4					2		2		1				1		**11**	**6.1**
57	30	6/11-6/14; 6/18-6/21	180		3								2	4			1					**10**	**5.6**
58[a]	30	6/11-6/14; 6/18-6/21	180		2								1	2						1		**6**	**3.3**
59[a]	30	6/11-6/14; 6/18-6/21	184		P							3	1	1			2					**7**	**3.8**
60	30	6/11-6/14; 6/18-6/21	180		P								P	1							1	**2**	**1.1**
61	19	7/9-7/12; 7/16-7/24	205										5	1	1							**7**	**3.4**
62[a]	19	7/9-7/12; 7/16-7/19	177		P								3	P								**3**	**1.7**
63	19	7/9-7/12; 7/16-7/19	180										5	7								**12**	**6.7**
64[a]	19	7/9-7/12; 7/16-7/19	180										1	P								**1**	**0.6**
65[a]	19	7/23-7/26; 7/30-8/2	184					1			P		4									**5**	**2.7**
66	19	7/23-7/26; 7/30-8/2	180					2					6	2								**10**	**5.6**
67[a]	19	7/23-7/26; 7/30-8/2	180										8	P								**8**	**4.4**
68	19	7/23-8/2	300										17	6				3				**26**	**8.7**
69	19	8/6-8/8; 8/21-8/23; 8/27-8/30	403										3	1								**4**	**1.0**
70[b]	18	9/10-9/13; 9/17-9/20	180									2	1	3			3					**9**	**5.0**
71[b]	18	9/10-9/13; 9/17-9/20	180									1	2	2			1					**6**	**3.3**
		Total:	**4,517**	**0**	**15**	**3**	**4**	**3**	**1**	**0**	**0**	**15**	**59**	**45**	**1**	**2**	**7**	**3**	**1**	**2**	**1**	**162**	**3.6**
Number of sites species was found:				**2**	**12**	**2**	**4**	**2**	**1**	**1**	**1**	**10**	**15**	**21**	**1**	**2**	**4**	**1**	**1**	**2**	**1**		

[a]Site where trap design was tested

[b]Site where bait trial was conducted

Figure 6-5. Funnel trap baited with canned pears
(Photo by D. B. Hall, September 10, 2007)

Figure 6-6. Funnel trap baited with oatmeal
(Photo taken by D. B. Hall, September 10, 2007)

No western red-tailed skinks were captured over 4,517 trap days. This may be the result of (1) reduced western red-tailed skink activity due to drought conditions that persisted across the NTS for several months, (2) trapping at sites where western red-tailed skinks do not occur, (3) inability to capture western red-tailed skinks if they did occur at trapping locations, or (4) any or all combinations of the aforementioned reasons. Overall trap success for reptiles was only 3.6 percent this year (162 captures/4,517 trap days) compared to 8.8 percent (538 captures/6,092 trap days) in 2006, which suggests a drought effect on reptile activity. Based on captures and observations, 11 of the 16 known lizards and 7 of the 17 known snake species on the NTS were detected (Table 6-1).

Of particular interest was the capture of three Great Basin skinks (*Eumeces skiltonianus utahensis*) (Figure 6-7) at two locations on Pahute Mesa, Dead Horse Flat area (Figure 6-2). This represents a range extension for this species on the NTS. Prior to this it was only known from Rainier Mesa (Figure 6-2). Tissue samples were taken from all three skinks for genetic testing. Two of the three skinks were caught at two separate locations on July 25, and one skink was captured at one of the same sites the following day. These skinks were caught during a cool, wet period of thunderstorm activity. In fact, overall reptile captures peaked on July 25 or 26 at all four sites (Site #65 and #67, 0–4 captures; Site #66, 0–5 captures; and Site #68, 0–7 captures) sampled during a two-week period, suggesting an increase in reptile activity caused by higher humidity, higher cloud cover, cooler temperatures, and rain. At another site, Site #69, reptile captures did not increase, but observations doubled following a rainstorm (late August).

Figure 6-7. Great Basin skink (*Eumeces skiltonianus utahensis*) captured on Dead Horse Flat, Pahute Mesa

(Note the extension of the dark dorsolateral stripe well onto the tail) (Photo by D. B. Hall, July 25, 2007)

Trap success for reptiles captured in rectangular funnel traps was 4.8 percent (43 captures/901 trap days) compared to 0.4 percent (four captures/908 trap days) in triangular wire-mesh funnel traps. This difference is statistically significant using a paired t-Test ($t=5.8$, $P<0.001$). The advantages of the triangular wire-mesh traps are that they are cheaper to make and lighter than the rectangular traps, so fewer trips are required to set them at sites long distances from roads. The disadvantage is that they are less effective than rectangular traps at capturing reptiles. Therefore, we recommend not using this type of trap in the future. Overall trap success increased from 3.6 percent to 4.4 percent (158 captures/3,609 trap days) when data from triangular traps were excluded.

Results from the bait trials show no strong evidence for the efficacy of using canned pears or oatmeal as bait to increase reptile captures (Table 6-2). Small mammal captures did increase using oatmeal as bait at Site #70. These bait trials provide a limited dataset so additional trials may be conducted next year.

Table 6-2. Percent trap success for reptiles and total captures (reptiles plus small mammals) using two different kinds of bait and a no-bait control at two sites

Site Number	Reptiles			Reptiles plus Small Mammals		
	Pears	Oatmeal	No Bait	Pears	Oatmeal	No Bait
70	0.0 (0/60)	6.7 (4/60)	8.3 (5/60)	6.7 (4/60)	25.0 (15/60)	8.3 (5/60)
71	6.7 (4/60)	1.7 (1/60)	1.7 (1/60)	6.7 (4/60)	5.0 (3/60)	1.7 (1/60)
Total	**3.3 (4/120)**	**4.2 (5/120)**	**5.0 (6/120)**	**6.7 (8/120)**	**15.0 (18/120)**	**5.0 (6/120)**

Tissue samples from four western red-tailed skinks (captured last year) and three Great Basin skinks caught this year were sent to Dr. Jonathan Richmond at Cornell University. Dr. Richmond is an expert on these two species and has been studying their evolutionary history using DNA for several years (Richmond and Reeder, 2002; Richmond and Jockusch, 2007). Genetic material from Nevada is sparse in his studies and he was eager to analyze our samples to fill in data gaps from his sampling. Results verify that both the western red-tailed skink and Great Basin skink do occur on the NTS. Western red-tailed skinks from the NTS are part of the Inyo clade and are most closely related to skinks from slightly further north in Esmeralda County, Nevada, and west into the Panamint and Inyo/White Mountains in California. Great Basin skinks from the NTS are part of the Great Basin clade, and their closest relatives are from White Pine County, Nevada, and east into Utah (Richmond, 2007). Little to no genetic difference was found among the four western red-tailed skinks collected from across the western portion of the NTS that spanned a distance of nearly 40 km (25 mi). Genetic material from these specimens has been stored in hopes that future techniques will enable the determination of relatedness and patterns of dispersal at a much finer scale.

During skink trapping, the presence of other species such as mammals and birds was also documented by capture or observation. These data expand the knowledge of the distribution of wildlife across the NTS, especially in areas that have never been sampled before. A total of 38 captures of nine small mammal species was recorded, and observations of seven mammal species or their sign (e.g., scat, antlers) were noted. Two rock wrens (*Salpinctes obsoletus*) were captured and seven bird species were observed during trapping efforts.

6.2 Western Burrowing Owl

Western burrowing owl monitoring entailed recording new burrowing owl locations opportunistically and trapping owls at their burrows. Six new burrow sites were found this year in the transition ecoregion. This makes a total of 138 known western burrowing owl locations (30 owl sightings and 108 burrow sites) on the NTS (Figure 6-8).

Burrowing owl trapping was conducted for the third consecutive year. This is a collaborative effort with Dr. Courtney Conway from the University of Arizona. Dr. Conway is working on a Department of Defense Legacy funded project evaluating migratory linkages of western burrowing owls in western North America. This involves trapping and banding burrowing owls and taking feather and blood samples. An NSTec biologist was trained by Vicki Garcia, an associate of Dr. Conway, to band owls and collect the required samples. Trapping and banding was conducted under authority of Federal Bird Banding Permit #22524 and Nevada Scientific Collection Permit #S27477.

Traps were set out at 20 burrow sites (Figure 6-8) between April 3 and July 25 for a total of 70 "trap nights" (traps are usually set for three to six hours per night and checked regularly). Seven owls (five adults and two juveniles) were captured, and one owl was captured twice for a total of eight captures (Table 6-3). In addition, four 8–10 day old chicks were seen (not captured) inside a culvert burrow in Area 20, Pahute Mesa (Figure 6-9). This is the farthest north and highest elevation record (1,902 m) of western burrowing owl breeding on the NTS. Colored Acraft bands and FWS aluminum bands were placed on the left and right legs of adult females, respectively (Figure 6-10). For adult males, bands were reversed to facilitate identification of females and males in future years. The two juveniles were banded with brown colored Acraft bands on their left legs and FWS bands on their right legs.

Table 6-3. Western burrowing owl trapping results on the NTS, April–July 2007

Site number/ Burrow	Date	Sex[a]	Weight (grams)	Juvenile Age (days)	Acraft band #	FWS band #	Feathers collected	Blood collected
38/B	5/1	F	153	Adult[b]	Re-DD	934-26781	Yes	Yes
38/B	5/1	M	143	Ádult	Re-DE	934-26782	Yes	Yes
9/C	5/1	F	169	Adult[c]	Re-7U	844-69935	Yes	No
9/D	6/20	J	82	13	BR-M3	934-26783	Yes	No
9/D	6/20	J	80	13	BR-P3	934-26784	Yes	No
70/C	6/20	F	136	Adult	Re-DH	934-26785	Yes	Yes
37/A	6/20	F	134	Adult	Re-EA	934-26786	Yes	Yes

[a]J=juvenile, F=Female, M=Male; [b]Recapture same year; [c]Recapture from previous year

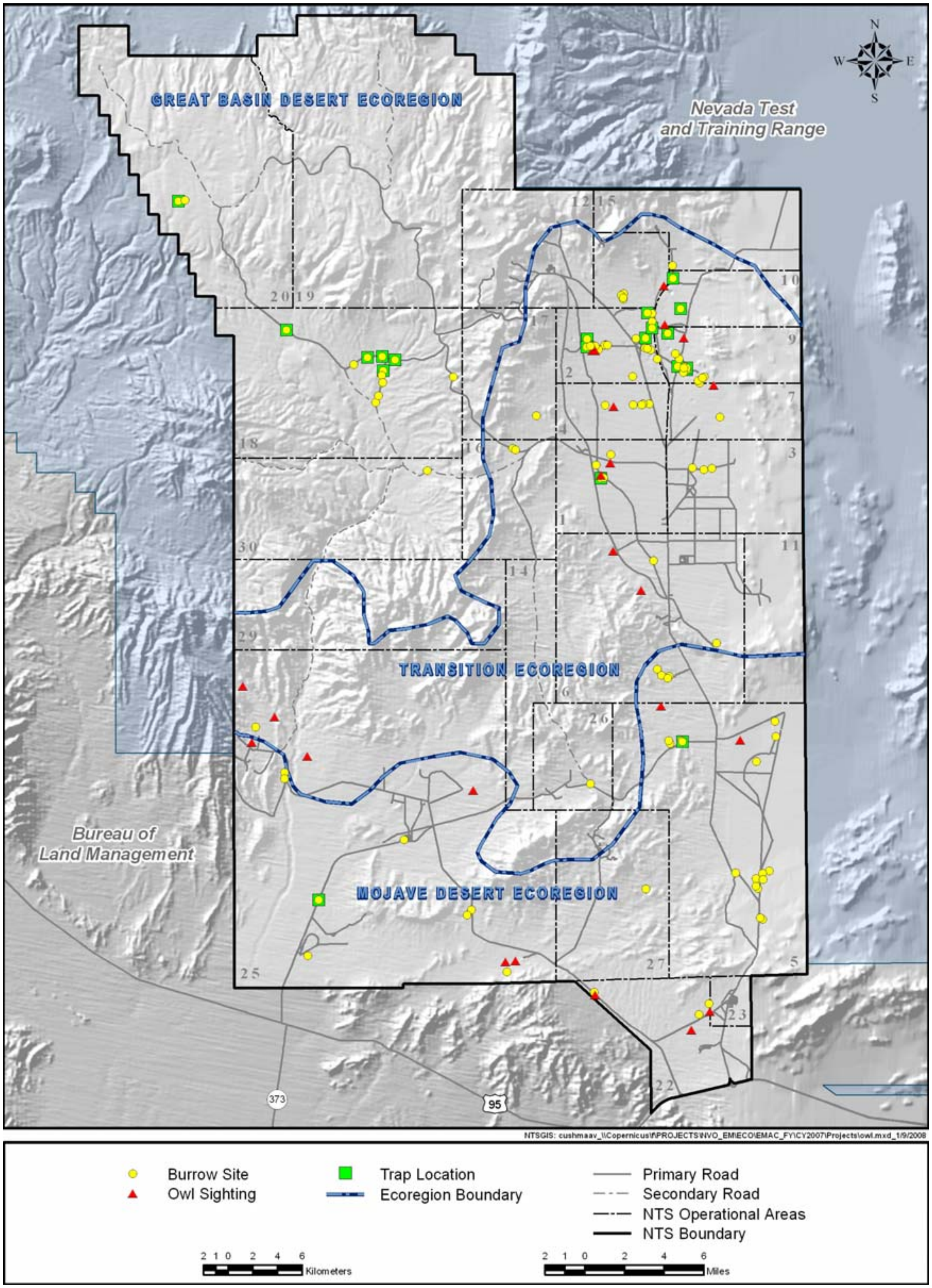

Figure 6-8. Known western burrowing owl distribution on the NTS and burrow sites where trapping occurred

Figure 6-9. Four 8–10 day old western burrowing owl chicks in culvert burrow in Area 20, Pahute Mesa
(Photo by D. B. Hall, June 20, 2007)

Figure 6-10. Capture female western burrowing owl with Acraft band on the left leg and aluminum FWS band on the right leg
(Photo by W. K. Ostler, June 20, 2007)

Feather samples were taken from all seven owls, and blood samples were taken from four of the five adult owls. One of the adult owls captured this year was a recapture. She was captured at Site #9, Area 18, about 1.2 km (0.7 mi) east of her natal burrow (Site #37, Area 18) where she was originally captured as a juvenile on July 28, 2005. She had a brood patch and later was confirmed to be raising two chicks. Radioisotopic analysis of the feathers from this adult female should provide information on where she spent the winter. Feather and blood samples will be analyzed at a future date by Dr. Conway and his colleagues. Information learned from this cooperative effort will give NSTec biologists a greater understanding of western burrowing owl residency and migratory status on the NTS. It may also help determine where owls from the NTS are wintering and potential threats to them at their wintering areas, which may help explain any potential future declines of this species on the NTS.

The number of owls captured this year (seven) was the lowest recorded in the three years of trapping (22 in 2005, 34 in 2006). Also, only two breeding pairs were documented this year compared with five to eleven breeding pairs in previous years (1999–2001, 2005–2006), even though numerous owl sightings were recorded during trapping activities. Reproduction was also delayed with the first juveniles (very young, 8–13 days old) not being detected until mid-June. The effects of the drought (i.e., reduced insect and small mammal populations) are most likely the reason for the low and delayed reproduction. Researchers in Arizona noticed a similar pattern this year with late breeding and numerous failures (Garcia, 2007).

6.3 Raptor Observations

Several raptors occur and breed on the NTS. Some are sensitive species and all are protected/regulated under the *Migratory Bird Treaty Act* and/or Nevada State law. Raptors include all vultures, hawks, kites, eagles, ospreys, falcons, and owls. Because these birds occupy the higher trophic levels of the food chain, they are regarded as indicators of ecosystem stability and health. Including the western burrowing owl, there are nine raptor species known to breed on the NTS (Hunter, 1994). Two active red-tailed hawk nests (*Buteo jamaicensis*) were found this year. One had three young and was located on a power pole in Area 26. The other nest had two young and was on a tower in Area 7.

Opportunistic sightings of raptors were observed this year and included red-tailed hawks, turkey vultures (*Cathartes aura*), golden eagles (*Aquila chrysaetos*), American kestrels (*Falco sparverius*), and prairie falcons (*Falco mexicanus*). Many of these raptors are seen perching on utility poles on Frenchman and Yucca Flat. Great horned owls (*Bubo virginianus*) were recorded around buildings on the NTS this year. Cooper’s hawk (*Accipiter cooperii*) and sharp-shinned hawks (*Accipiter striatus*) have been observed around water sources on and near Rainier Mesa.

Bird Mortality--Bird mortality is recorded as a measure of potential impacts that NNSA/NSO activities may have on protected bird species. Only seven bird mortalities were recorded in 2007. Two known causes of bird mortality were road kill and electrocution (Table 6-4). The Great horned owl examined was found directly below a power pole in late November suggesting it was electrocuted. During 2007 few impacts to birds were observed or reported by biologists from project activities. Therefore, impacts to bird populations from NNSA/NSO activities at the NTS appear to be very low.

Table 6-4. Records of bird mortality on the NTS during 2007

Species	Cause of Death		
	Electrocution	**Roadkill**	**Unknown**
Common raven (*Corvus corax*)			1
Eared grebe (*Podiceps nigricollis*)			1
Great horned owl (*Bubo virginianus*)	1		
Long-eared owl (*Asio otus*)		1	
Grey flycatcher (*Empidonax wrightii*)			1
Red-tailed hawk (*Buteo jamaicensis*		1	
Red-winged blackbird (*Agelaius phoeniceus*)			1
Total:	**1**	**2**	**4**

6.4 Small Mammal Surveys

Small mammal surveys were conducted to provide information on species distribution on the NTS. The objectives were to (a) investigate potential new habitats for the dark kangaroo mouse (*Microdipodops megacephalus*) and the pale kangaroo mouse (*M.. pallidus*), (b) collect data on small mammals that could fill spatial data gaps needed for a better understanding of species distribution on the NTS, and (c) learn more about species occupancy at selected macro-habitats on NTS. For example, macro-habitats sampled in 2007 were subjectively classified as wash, upland, valley, hill slope, etc.

Small mammal sampling was conducted by setting baited trap lines of 100 Sherman live traps for three consecutive nights. Trap lines were opened and baited between 3 and 6 p.m. and checked the following morning between 6 and 10 a.m. Animals were identified and marked with a unique indelible color on the first two days of trapping so total numbers of individuals could be tallied. Trapping design included two trap lines that were set, one in each comparative macro-habitat, such as a wash and an upland habitat. A Z-test was used to test for differences in total numbers of individuals caught between each matched macro-habitat pair. Chi-square tests were also performed across similar macro-habitat pairs to determine if species proportions varied significantly between sites. Cell totals (<8) were lumped into an "other species category" before conducting tests. Exclusive of paired comparisons, no statistical comparisons were made for species across sites. Statistical significance was set at P=0.05 for all tests. It is recognized that these macro-habitat categories are crude distinctions in relation to the overall complexity of habitats sampled. These preliminary results should be viewed with caution. The intent of making these comparisons was to learn more about species occupancy of different habitats throughout the NTS.

Five hundred and thirty captures were recorded representing 11 species at eight sites on the NTS (Figure 6-11). Three hundred and twelve individual nocturnal small mammals were caught (Table 6-5). This represents nine species. No kangaroo mice were captured during 2007. Trap success averaged 22 percent and varied from 8 to 37 percent across sites, much lower than was recorded in 2006. The reduced success may be attributed to drought conditions during 2007.

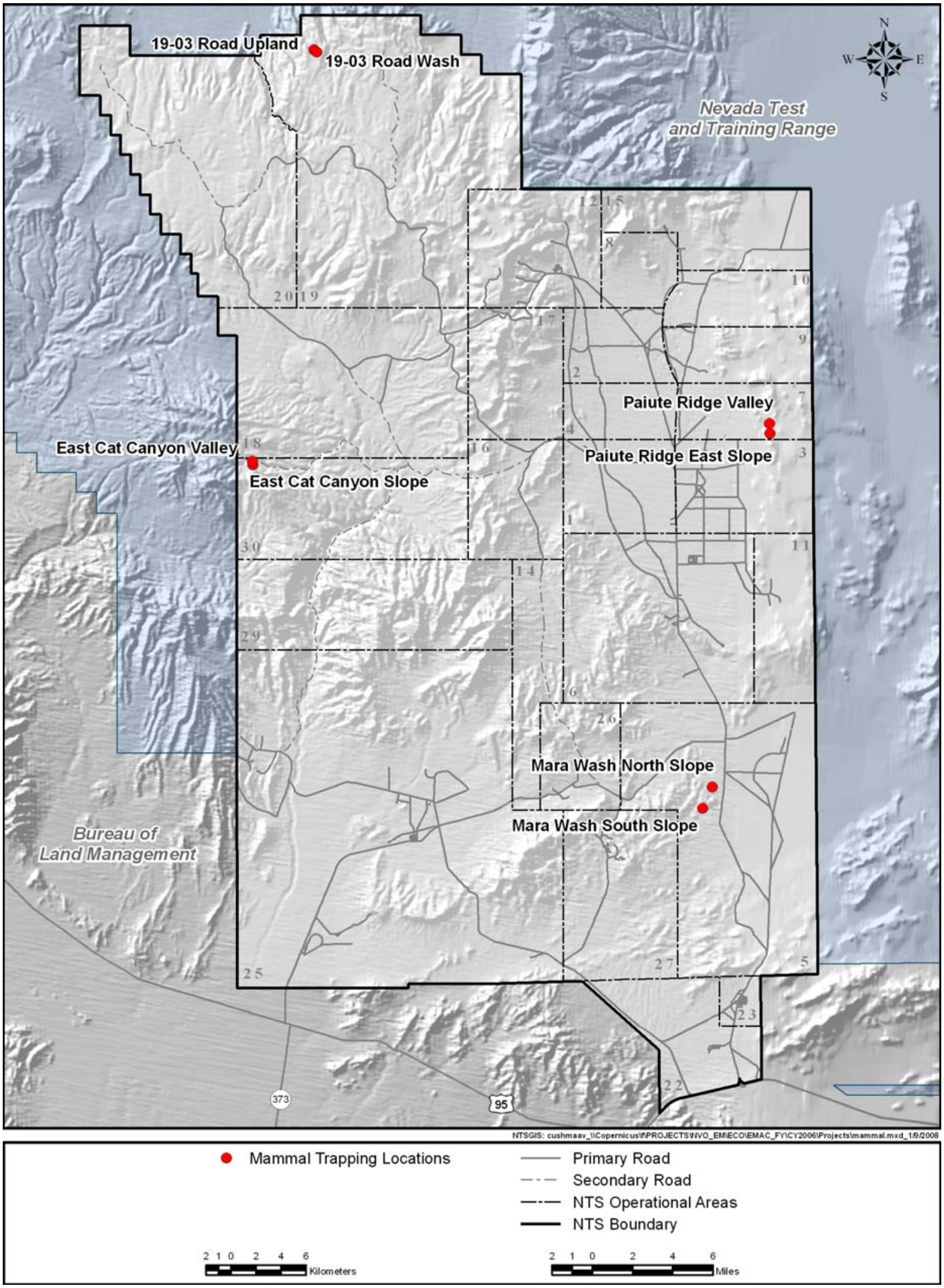

Figure 6-11. Trapping locations for small mammals on the NTS in 2007

Table 6-5. Numbers of individual small mammals captured on trap lines on the NTS in 2007[a]
(Codes for the first two letters of the genus and first two letters of the species are provided as species codes below the common name to help simplify the table.)

Species			Merriam's kangaroo rat	Chisel-toothed kangaroo rat	Lontail pocket mouse	Desert woodrat	Southern grasshopper mouse	Canyon mouse	Great Basin pocket mouse	Deer mouse	Pinyon mouse					
Sampling Sites	**Area**	**Dates**	**DIME**	**DIMI**	**CHFO**	**NELE**	**ONTO**	**PECR**	**PEPA**	**PEMA**	**PETR**	**Total Individuals**	**% Capture[b]**	**z and p for difference in total individuals for paired locations**	**chi-square and p for test of parallel patterns among species**	**Other species lumped into "other species" category**
Mara Wash South Slope	5	5/8-5/10	0	0	40	16	0	2	0	0	0	**58**	34.6	-0.802	10.011	DIME ONTO
Mara Wash North Slope			1	0	57	5	1	4	0	0	0	**68**	37.0	0.422	**0.007**	PECR
Paiute Ridge East Slope	7	5/22-5/24	0	1	7	18	0	3	0	2	0	**31**	20.3	-0.369	32.369	DIME ONTO
Paiute Ridge Valley			6	21	4	2	1	0	0	1	0	**35**	19.6	0.712	**0.000**	PECR PEMA
East Cat Canyon Slope	30	6/12-6/14	0	0	0	7	0	2	6	11	10	**36**	18.7	-1.599	25.275	DIME ONTO
East Cat Canyon Valley			5	0	0	1	5	0	20	20	1	**52**	28.0	0.110	**0.000**	PECR
19-03 Road Upland	19	7/10-7/12	2	2	0	0	0	0	6	7	0	**17**	8.3	0.177	3.348	DIME DIMI
19-03 Road Wash			0	0	0	3	0	1	0	11	0	**15**	10.0	0.860	**0.067**	NELE PECR PEPA
Totals			**14**	**24**	**108**	**52**	**7**	**12**	**32**	**52**	**11**	**312**				

Species with minor contributions to the chi-square statistic

Species with substantial contributions to the chi-square statistic

[a]100 traps per night/site

[b]Percent capture success = total caught/total trap nights x 100

Significant differences in species composition were found in three of four macro-habitat comparisons (Table 6-5). Overall, the species that contributed most to chi-Square test differences at our four paired mammal transect sites were the desert woodrat (*Neotoma lepida)*, pinyon mouse (*Peromyscus truei),* Great Basin pocket mouse (*Perognathus parvus*), and the chisel-toothed kangaroo rat, (*Dipodomys microps*). Similar to 2006, species such as the desert packrat were shown to be more abundant in rocky habitats typified by hillsides in 2007 as opposed to valley bottoms, which had fewer rocky areas. In one comparison of the south versus north slopes in Frenchman Flat, the main difference was also shown by the higher abundance of the packrat from the south slope habitat (Table 6-5). The pinyon mouse showed a proclivity for hillsides also, but this is likely because of the abundance of pinyon trees at one site as opposed to valley bottoms, which had few trees. The chisel-toothed kangaroo rat and the Great Basin pocket mouse showed an opposite pattern, or increased abundance for valley bottoms versus steep hillsides (Table 6-5). The 19-03 road sites (wash compared to upland) were not quite significant at p=0.07 and had low numbers caught, which probably affected significance. No significant differences were found in total numbers of individuals captured (Table 6-5).

6.5 Bat Surveys

In 2007 bat monitoring focused on (a) passive acoustic monitoring of bat activity at Camp 17 Pond, (b) post-closure monitoring at N Tunnel complex, and (c) removing bats from buildings and documenting bat roosts.

6.5.1 Camp 17 Pond Passive Acoustic Monitoring System

In order to learn more about long-term bat activity through different seasons and years, a passive acoustic monitoring system (Anabat II, Titley Electronics, Ballina, Australia) was installed at Camp 17 Pond (Figure 6-12) on September 22, 2003. Hundreds of thousands of electronic files containing bat calls have been recorded and are in the process of being analyzed by O'Farrell Biological Consulting. No comparable dataset exists. To date, data for November and December 2003; January, February, March, November, and December 2004; all of 2005; and January and February 2006 have been analyzed. This includes more than 224,000 files containing more than 4.5 million individual bat calls. Reported here are data from 2005 and the winters (December through February) of 2003–2004, 2004–2005, and 2005–2006. Robert Peppard, an NSTec Senior Scientist, developed the "BAT Loader" utility to more easily summarize the large amounts of data and includes a utility that takes weather data collected from data loggers and manipulates these to correspond with acoustic data. This allows correlations to be made between bat activity and different climatic parameters such as temperature, wind speed, barometric pressure, humidity, etc.

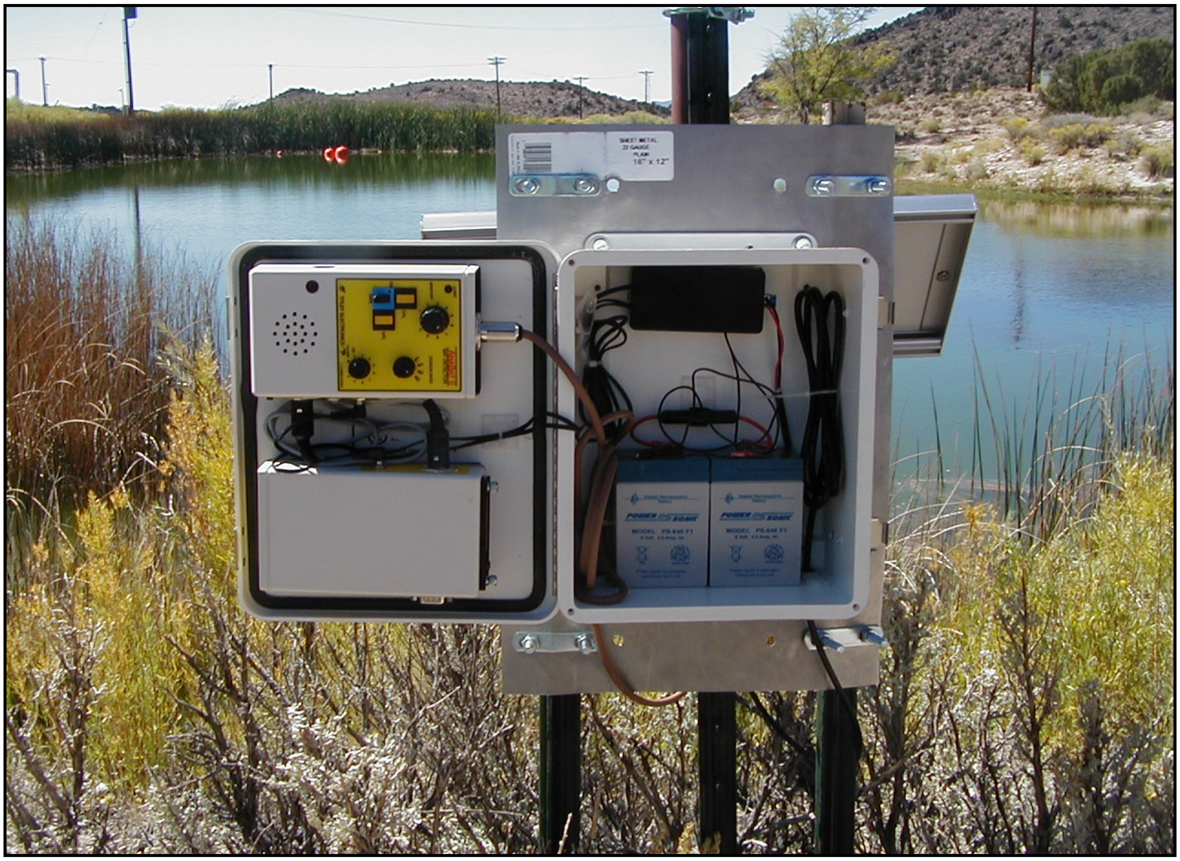

Figure 6-12. Passive acoustic monitoring system at Camp 17 Pond
(Photo by D. B. Hall, September 23, 2003)

Data were summarized into minutes of activity by species by month for 2005 (Table 6-6, Figure 6-13, Figure 6-14) and for the winters (December through February) of 2003–2004, 2004–2005, and 2005–2006 (Table 6-7, Figure 6-15). If one or more calls of a species were present during a minute, it was counted as one minute of activity.

Bat calls of 14 species were identified during 2005 (Table 6-6). Bat activity for all species combined was very low from January through March and began to increase in April. Activity peaked sharply in July with more than 32,000 minutes of activity and then dropped dramatically to just below 13,000 minutes in August (Table 6-6). This peak corresponds with the time when young are becoming volant and flying with the adults, but the reason for the dramatic decrease in August is unknown. Small-footed myotis (*Myotis ciliolabrum*), western pipistrelle (*Pipistrellus hesperus*), and long-legged myotis (*M. volans*) accounted for about two-thirds of the activity (Figure 6-13). Yuma myotis (*M. yumanensis*), western red bat (*Lasiurus blossevillii*), and Townsend's big-eared bat (*Corynorhinus townsendii*) activity was minimal. Small-footed myotis, western pipistrelles, long-legged myotis, California myotis, and pallid bats were active year-round with small-footed and long-legged myotis most active April through December, western pipistrelles and California myotis most active June through September, and pallid bats most active May through August. Fringed and long-eared myotis were essentially inactive during January through March and November through December and were most active May through October. Big brown bats were not active January through February and were most active May through September.

Table 6-6. Minutes of activity by species and month for 2005

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Small-footed myotis	32	16	166	1,471	3,522	5,790	9,260	4,399	3,644	1,891	1,417	1,134	32,742
Western pipistrelle	14		94	64	420	2,590	10,244	3,504	1,122	113	112	79	18,356
Long-legged myotis	16	10	69	1,164	3,499	4,280	3,572	881	2,527	978	734	567	18,297
Brazilian free-tailed bat	4		158	564	1,318	1,499	2,087	1,397	1,656	1,841	191		10,715
California myotis	3		76	324	472	1,868	2,657	1,629	1,774	527	278	227	9,835
Big brown bat			10	56	527	1,803	3,062	528	366	103	44	64	6,563
Hoary bat				792	2,862	362	13	172	105	214	3		4,523
Pallid bat	17	2	6	84	261	488	800	117	62	40	18	27	1,922
Fringed myotis	2		1	6	80	174	303	185	446	161	1		1,359
Silver-haired bat	55	8		171	5	1			39	206	281	254	1,020
Long-eared myotis				12	42	159	166	100	219	72			770
Yuma myotis						10	1	1	34	17	3		66
Western red bat				1		6	33	14					54
Townsend's big-eared bat			2	6	1		3		4	2			18
All Species	**143**	**36**	**582**	**4,715**	**13,009**	**19,030**	**32,201**	**12,927**	**11,998**	**6,165**	**3,082**	**2,352**	**106,240**

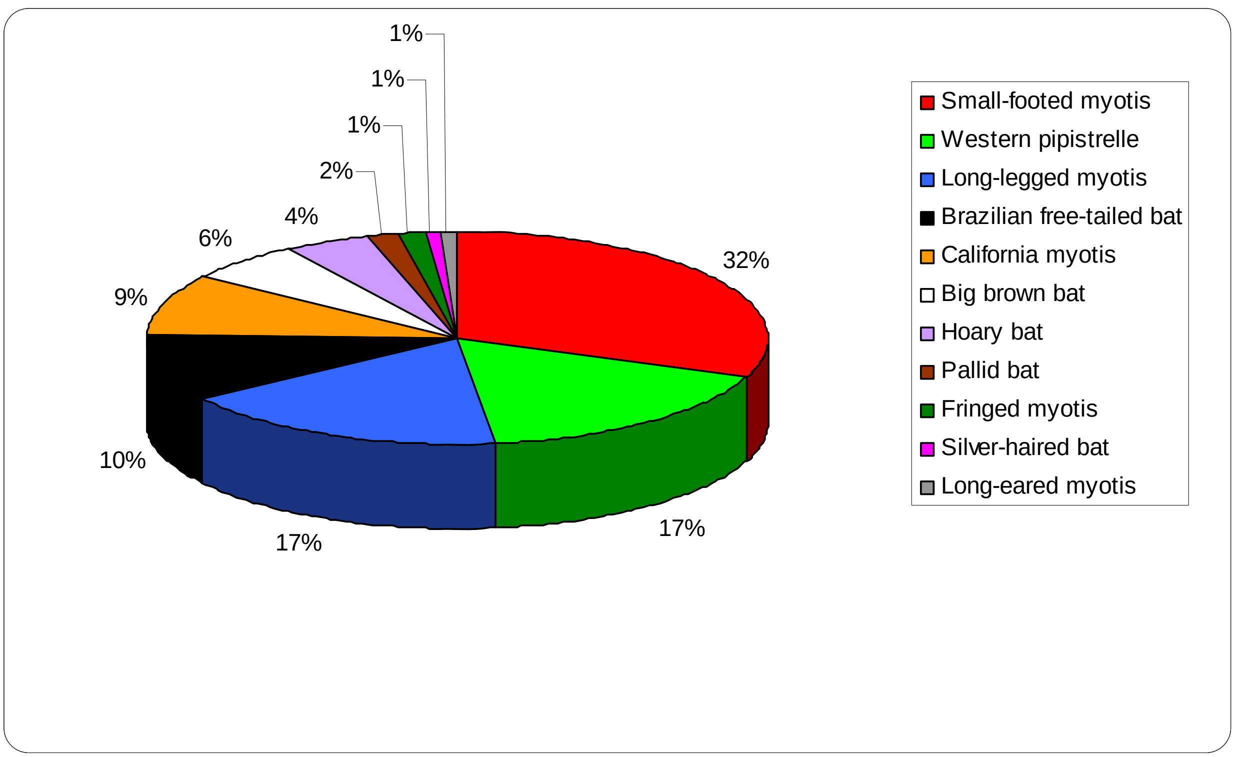

Figure 6-13. Percent activity during 2005 by species excluding Yuma myotis, western red bat, and Townsend's big-eared bat, which each represent <0.1 percent of activity

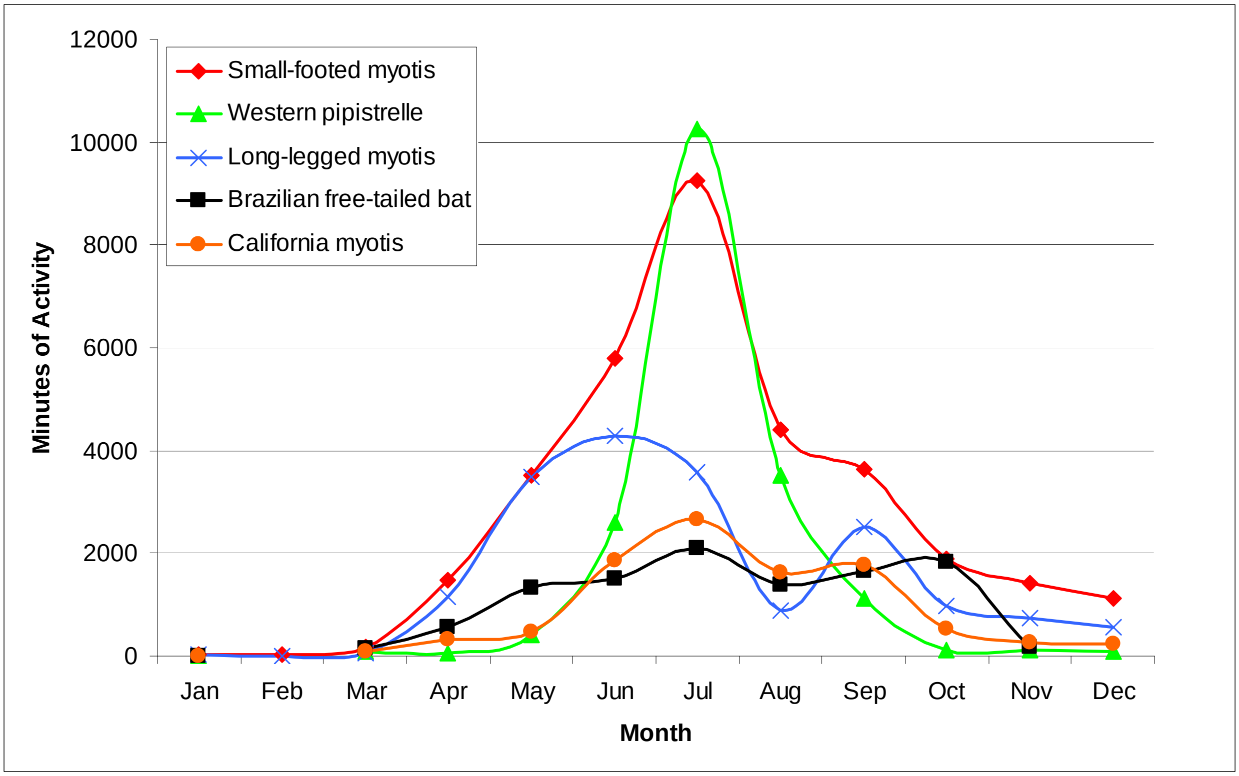

Figure 6-14. Bat activity of five bat species with the highest activity through 2005

Table 6-7. Minutes of winter bat activity by species and month for 2003–2004, 2004–2005, and 2005–2006

	2003-2004			2004-2005			2005-2006				
Species	**Dec**	**Jan**	**Feb**	**Dec**	**Jan**	**Feb**	**Dec**	**Jan**	**Feb**	**Total**	**%Total**
Small-footed myotis	947	515	83	936	32	16	1,134	384	1,075	5,122	45.31
Long-legged myotis	569	248	37	308	16	10	567	105	158	2,018	17.85
Silver-haired bat	345	146	77	140	55	8	254	153	269	1,447	12.80
California myotis	422	170	31	221	3		227	70	161	1,305	11.54
Western pipistrelle	168	173	52	119	14		79	27	78	710	6.28
Pallid bat	212	99	45	111	17	2	27	9	13	535	4.73
Big brown bat							64	10	43	117	1.03
Brazilian free-tailed bat	2			16	4					22	0.19
Fringed myotis	6	2		8	2				1	19	0.17
Townsend's big-eared bat		7								7	0.06
Long-eared myotis		3								3	0.03
All Species	**2,671**	**1,363**	**325**	**1,859**	**143**	**36**	**2,352**	**758**	**1,798**	**11,305**	**100.00**

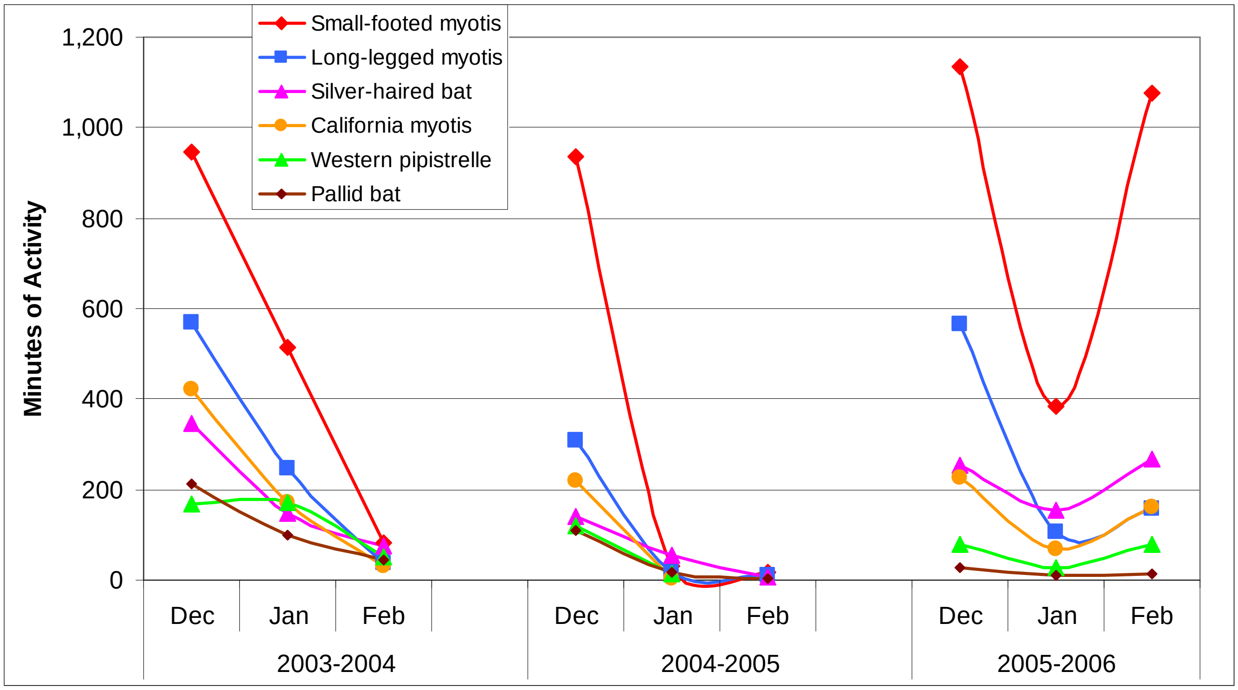

Figure 6-15. Winter (December through February) bat activity for six bat species

Known migratory species varied in their activity periods. Brazilian free-tailed bats were not active February and December and were most active May through October. Hoary bats were not active January through March or December but had a large pulse of activity in May and smaller pulses of activity in April and June and August through October, presumably due to migrating animals. Silver-haired bats were essentially not active during March and June through August and were most active in April (possible migration pulse) and October through December suggesting winter residency (Table 6-6). Lack of activity may be due to hibernation during the colder winter months, migration, or failure of the monitoring system to detect a species. Activity patterns may change from year to year for different species. As more data are analyzed, activity patterns across years will be evaluated.

A total of 11,305 minutes of activity of 11 species was recorded over the three winters with 6 species being present most consistently over the three winters (Table 6-7; Figure 6-15). Of particular interest is the fact that silver-haired bats (*Lasionycteris noctivagans*), small-footed myotis, and long-legged myotis were previously not documented to be winter active in this region, based on a large amount of capture data (O'Farrell et al., 1967; O'Farrell and Bradley, 1970; Ruffner et al., 1979). Not only were these species active in the winter, but they were the most active species, accounting for 76 percent of total winter activity. Bat activity for all species combined declined substantially from December to January all three winters. Activity during 2003–2004 declined again substantially from January to its lowest point in February. Activity during 2004–2005 declined slightly from January to its lowest point in February. Activity during 2005–2006 increased substantially from its lowest point in January to February. Activity of individual species tends to follow the overall pattern through the three winters although at different rates (Figure 6-15). Activity data for California myotis (*M. californicus*), western pipistrelles, and pallid bats (*Antrozous pallidus*) suggest a decline in activity over the three winters. Factors influencing winter activity include amount and duration of ice cover on water source, weather conditions (e.g., temperature, precipitation, storm patterns), suitable roosting sites near water source, insect activity, water balance, and physical condition of bats. Future analysis will investigate impacts of weather conditions on bat activity.

6.5.2 N Tunnel Post-Closure Surveys

Bat-compatible closures (i.e., bat gates) were installed for the first time on the NTS during fall 2006/winter 2007. Two bat gates were installed during the closure of the N Tunnel Complex in Area 12 (Figure 6-16), one in the main drift (Figure 6-17), and one in the extension drift (Figure 6-18). Post-closure monitoring was conducted from February 8 to June 4 to investigate bat activity in the two tunnels. Three techniques were used to monitor bat activity: passive acoustic monitoring, guano collection, and a motion-activated camera.

Passive acoustic monitoring using an Anabat II system was conducted in the main drift. A total of 35 identifiable files were recorded on six nights in early April. The only bat species detected was California myotis, a species that typically uses underground features as roost sites. A large sheet of plastic was placed on the ground under each bat gate to collect any guano dropped by bats flying through the gates (Figure 6-18). Plastic was put down on February 8 and then checked on April 3 and June 4. No guano was seen on either plastic sheet. A motion-activated camera (Sony Digital CamTrakker™ system, CamTrak South, Inc., Watkinsville, Georgia) was set to document bat activity at the bat gate in the main drift. No bats were detected with the camera during 2,783 hours of camera operation. Post-closure monitoring results suggest that bat activity is limited. Future monitoring, including exit surveys, will be performed to compare bat activity with pre-closure data.

Figure 6-16. Overview of the N Tunnel Complex, Area 12
(Photo taken by D. B. Hall, February 8, 2007)

Figure 6-17. Completed bat gate in the main drift of N Tunnel
(Photo taken by D. B. Hall, February 8, 2007)

Figure 6-18. Completed bat gate in the extension drift of N Tunnel with plastic sheeting on ground below
(Photo taken by D. B. Hall, February 8, 2007)

Figure 6-19. Pallid bat roost, Reitmann Seep Ridge
(Photo taken by D. B. Hall, May 24, 2007)

6.5.3 Bats at Buildings and Bat Roosts

A single bat was observed roosting in an alcove near the main entrance to Building 23-652 on several occasions during January and again in November and December. It is not known if it was the same individual each time. The one in November and December was a female California myotis and the one in January was either a California or small-footed myotis. Another California or small-footed myotis was removed from Building 23-726 and released west of Mercury in March. A dead pallid bat was found in a building at Test Cell C in Area 25, and large quantities of guano were observed in an elevator shaft of another building in the same complex. On May 21, during reptile trapping, a male pallid bat was found day roosting in a volcanic rock crevice (Figure 6-19). Roost site locations will continue to be documented and stored in the Ecological Geographic Information System (EGIS) faunal database to enable NSTec biologists to increase their knowledge about bat roosting sites on the NTS.

6.6 Wild Horse Surveys

Monitoring of horses (*Equus caballus*) on the NTS began in 1989 and provides information on the abundance, recruitment (i.e., survival of horses to reproductive age), and distribution of the horse population on the NTS. In 2007, horse abundance was estimated and horse sign recorded at various locations on the NTS. Selected natural and human-made water sources were visited in the summer to determine if they were being utilized by horses and to document the impact of horses on these wetlands and water sources. Information about abundance and recruitment during the period from 1990 to 1998 is summarized in Greger and Romney (1999).

6.6.1 *Abundance Survey*

A count of individual horses is used to estimate abundance. In 2007, a count of horses was conducted during non-consecutive days between May and November. A standard road course was driven to locate and identify horses. Motion/heat activated cameras at Camp 17 Pond were also used to photograph horses. Individuals were identified by their unique physical markings (facial blazes), and classified as foal, yearling, or older. The direct population count in 2007 was 42 individuals not including foals (Table 6-8). Numerous horse bands (composed of stallions, subordinate males, females, and their offspring) were detected this year.

Eight foals were observed with their mares from June to December. The population showed a moderate decrease in numbers over 2006, likely due to drought conditions and predation. The total absence of foals in numerous photographs taken at Camp 17 pond in September-October strongly suggests high foal losses among most bands.

Table 6-8. Number of horses observed on the NTS by age class, gender, and year

Age Class	*Years*													
	2001		**2002**		**2003**		**2004**		**2005**		**2006**		**2007**	
Foals	11		5		6		5		5		8		8	
Yearlings	2		0		9[a]		9		6		8		1	
Age Class	***Gender*[b]**													
	M	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
2-Year Olds	2	2	0	2	0	0	4	4	5	4	3	3	2	3
3-Year Olds	0	0	2	2	0	2	0	0	4	4	4	4	1	3
Adults (>3-Year Olds)	11	20	8	19	8	20	6	21	5	21	7	24	5	27
Total: (excluding foals and dead horses)	**37**		**33**		**38**		**44**		**49**		**53**		**42**	

[a] = 1 of the 9 was found dead; [b] M=Male, F=Female.

6.6.2 *Horse Population Trends and Predation*

Recent counts in the NTS horse population indicate a decline in numbers from 53 in 2006 to 42 in 2007 (Table 6-8, Figure 6-20), which represents about a 20 percent drop in the population. Most of this loss appears to be in the yearlings category where only one foal survived from 2006 to 2007. This population

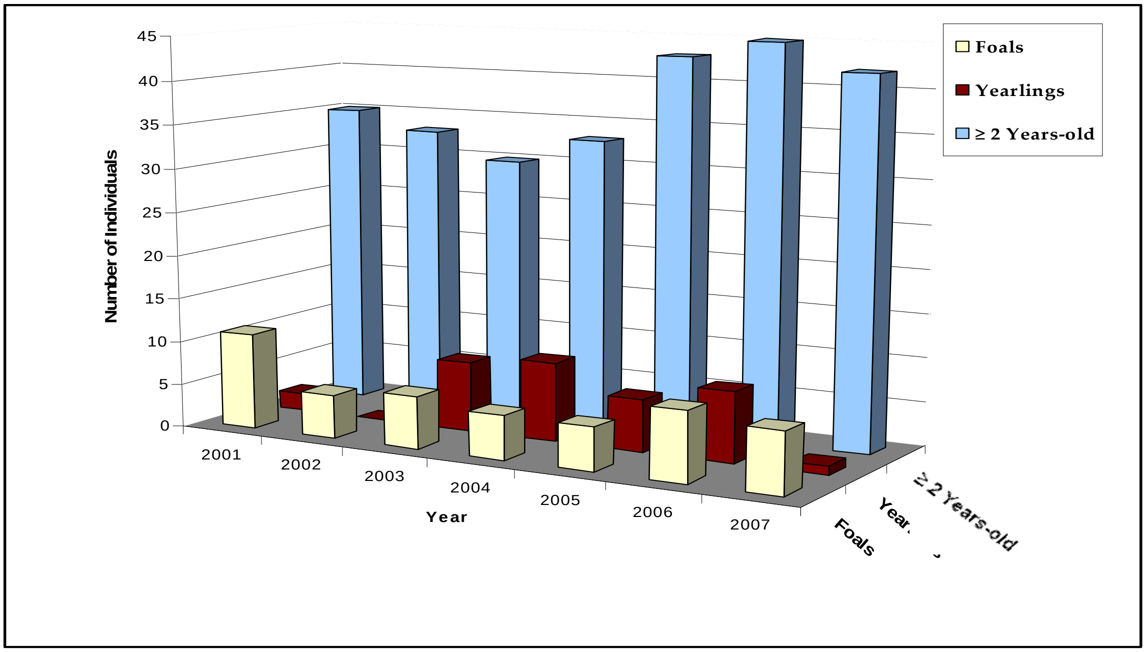

Figure 6-20. Trends in the age structure of the horse population from 2000 to 2007

reduction may have been caused by lower forage quality during this dry year as well as increased predation pressure from mountain lions and coyotes. Spotlighting counts in the fall of 2007 indicate that deer numbers declined about 51 percent from 2006 on the NTS. Therefore, if fewer deer are available as prey to cougars and other carnivores, this may lead to increased predation on horses, resulting in low survival of foals and yearlings. A black foal was found abandoned by her mare near Camp 17 Pond on July 7, 2007. The foal was killed by coyotes on the following morning. The mare's carcass was later located nearby; however, the cause of death of the mare was unknown. We sampled this foal's hind quarters by collecting a muscle sample that was analyzed for radioactivity (i.e., tritium, cesium, strontium, and transuranics). No radioactive isotopes were detected in the newborn foal.

6.6.3 Annual Range Survey

During 2007, selected roads were driven within and along the boundaries of the suspected annual horse range, and all fresh sign (estimated to be <1 year old) located on and adjacent to the roads were recorded. Six days of effort were expended for the road surveys. Horse sign data collected during the road surveys and horse use at natural and human-made water sources indicate that the 2007 NTS horse range (Figure 6-21) includes Gold Meadows, Eleana Range, southwest foothills of the Eleana Range, and the Echo Peak region of southeast Pahute Mesa. Overall, the estimated annual horse range appears to be reduced by about 35 percent this year (205 km^2 [79 mi^2]) compared to 2005/2006 (316 km^2 [122 mi^2]) due to reduced use of habitats east of the Eleana Range.

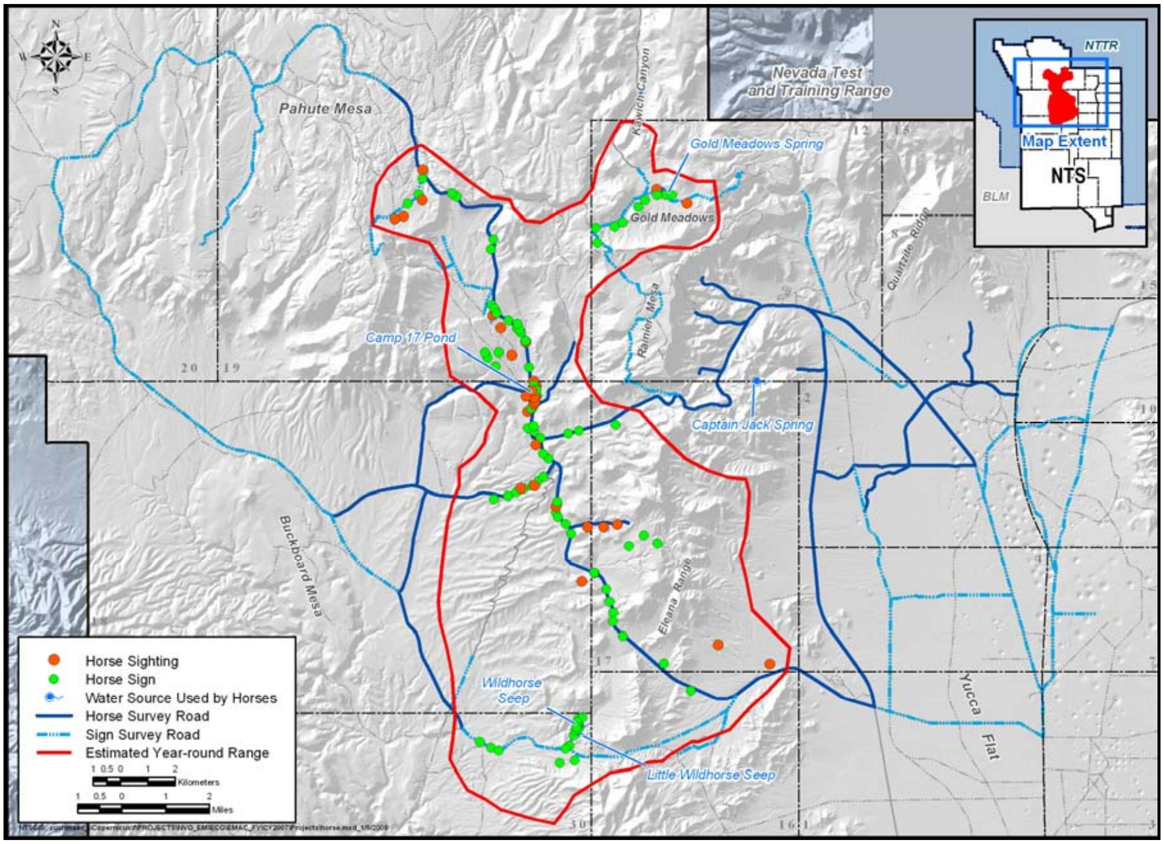

Figure 6-21. Feral horse sightings and horse sign observed on the NTS during 2007

6.6.4 Horse Use of NTS Water Sources

The NTS horse population is dependent on several natural and human-made water sources in Areas 18, 12, and 30 during different seasons of the year (Figure 6-21). One natural water source (Gold Meadows Spring in Area 12) and one human-made pond (Camp 17 Pond in Area 18) were used heavily as in past years; however, Captain Jack Springs, located in the eastern portion of their historic range, was not used by horses in 2007. This suggests that horses reduced the size of their range during the summer of 2007, moving to the central part of their historic range where forage and water were apparently more dependable.

Horses often use ephemeral water sources in winter such as rock tanks and natural pools that collect water from rain and snowmelt. In Area 30, two seeps (Wildhorse Seep and Little Wildhorse Seep) were used again by horses this year (Figure 6-21). Gold Meadows Spring was observed to be dry in May, June, and July (was not visited in August) and was observed to be refilled in September after a late rainstorm; it was used by horses during the fall. As in past years, none of the plastic-lined sumps within or near the horse range were used by horses this year.

6.7 Mule Deer Abundance on the NTS

6.7.1 General Abundance

Mule deer abundance on the NTS is estimated by counting deer while driving two standard road courses measuring 50 km [31 mi] long on the Pahute Mesa deer route and 27 km [17 mi] long on Rainier Mesa deer route. The total length of deer survey for both routes combined is 77 km [48 mi] (Figure 6-22). Both road surveys are run concurrently by two teams of observers at the same time and date. Counts are made by two observers with spotlights in each vehicle moving at speeds between 10 and 15 km per hour (6.2 and 9.3 mi per hour). The purpose of these counts is to estimate long-term trends in the deer population on the NTS.

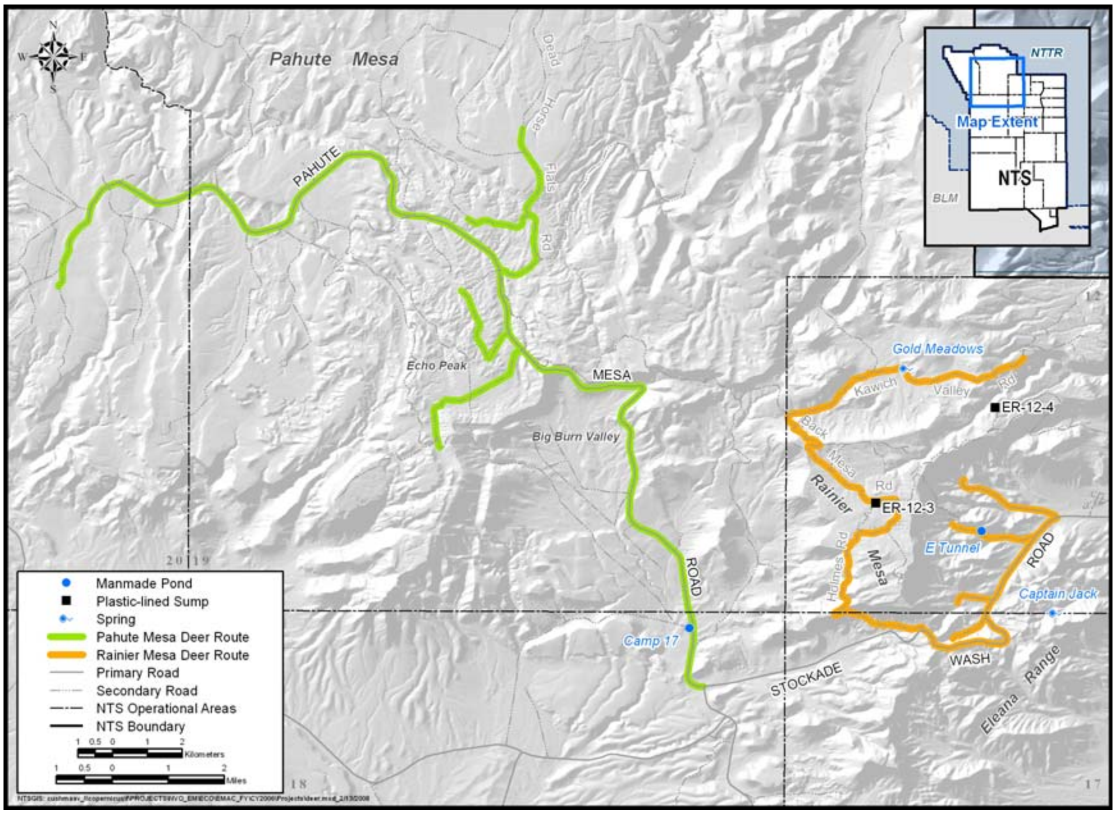

Figure 6-22. Roads driven on the NTS to count deer from 1989–2007

When deer are spotted, the vehicle is stopped and observers use binoculars to count and classify animals according to age (adult, spike, fawn, etc.) and sex, if possible. A spotlighting session involves three consecutive nights of work from August to October. Counts were made during a single session each year from 1989–1994. The numbers of survey sessions were increased over time to improve the overall estimate of counts. For example, two sessions a year were conducted during 1999 and 2000, and three sessions were completed in 2006 and 2007. In 2007 surveys were conducted on September 10, 11, 12, 24, 25, 26, and October 8, 9, and 10. Trends in the total counts (Pahute Mesa and Rainier Mesa routes combined) are examined in this section.

Mean nightly deer counts from 1989 to 1994 ranged from a high of 43 in 1992 to a low of 16 in 1994, showing a declining trend through a period of severe drought (1989–1991), followed by a small recovery in numbers in 1992–1993 (Figure 6-23). Deer surveys were not conducted from 1995–1998; however, when they resumed in 1999, the lowest mean nightly counts (9 and 13 deer in 1999 and 2000, respectively) were detected in the history of this study. Therefore, combined deer counts declined significantly from 1989 to 1994 to counts in 1999–2000 (ANOVA, F= 25.2, P>0.0002, Figure 6-23).

Deer counts increased significantly from the 1999–2000 period to a deer count of 62 during 2006, followed by a significant reduction to 31 per night in 2007 (F=15.5, P=0.03). This recent decline may be related to short-term drought effects on the deer population during fall–summer of 2006–2007. Few fawns were seen this year on the deer counts, and it was noticed from photographs that numerous deer appeared to be in poor condition. The dry period appears to have reduced forage quality and may have had an effect on the deer population size because of the reduced survival of fawns.

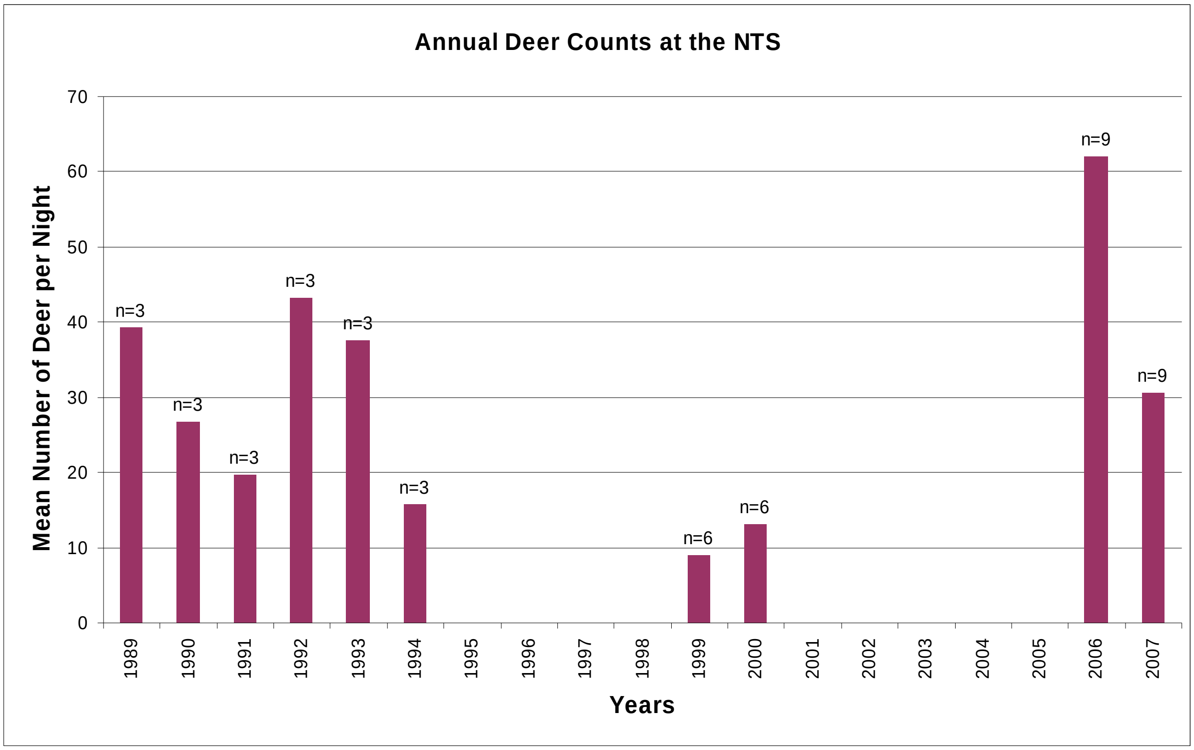

Figure 6-23. Mule deer spotlighting counts from 1989–2007
(Data were not collected in 1995–1998 and 2001–2005.)

6.7.2 Rainier Mesa Deer Counts Compared to Pahute Mesa Deer Counts

Previous studies of mule deer on the NTS were conducted by Giles and Cooper (1985). They conducted a mark and recapture study and reported a Lincoln Peterson population index for each herd segment. The Echo Peak herd located on Pahute Mesa was estimated to be much larger than the Rainier Mesa herd (a mean of 800 deer compared to about 125, respectively). From these data it was apparent that the Echo Peak area supported many more deer than the Rainier Mesa region in 1985.

More recent work on the NTS has relied on a relative abundance estimate (number of deer per 10 km [6.2 mi]) to evaluate the status of deer. Over all years, deer numbers are not significantly different between the Rainier and Pahute Mesa transects. Recently, however, deer were observed in higher numbers in the Rainier Mesa area per effort expended than during past times (Figure 6-24). For example, there were significantly higher numbers of deer sighted per effort (deer/10 km [deer/6.2 mi]) on the Rainier Mesa transect during 2006–2007 (Figure 6-24) than recorded during 1989–1994 (ANOVA, F =

27.7, P>0.0001). Furthermore, counts from Pahute Mesa from 1989–1994 compared to 2006–2007 showed no significant difference (F = 0.58, P = 0.45). These data suggest an overall change in deer distribution patterns with more deer being detected in the Rainier Mesa herd than the Pahute Mesa herd, a major difference compared to Giles and Cooper's (1985) previous assessment on herd sizes.

The apparent shift in deer distribution may be due to several factors including local water resources changing since 1985. First, the number of permanent man-made water locations on Pahute Mesa has decreased from three to zero since 1994, representing a major change since no permanent springs occur in this area. Two new plastic-lined water sources (ER 12-3 and 12-4) were constructed on Rainier Mesa in recent years and contain rainwater or snowmelt temporarily that may benefit the Rainier Mesa deer herd. There also may be improved forage regrowth from the Egg Point Fire burn area near Rainier Mesa since 2004 or later. Permanent water sources around Rainier Mesa have also declined but to a much lesser extent than Pahute Mesa (a decrease from four pond locations to two since 1994). The presence of two springs nearby may buffer the impact of the loss of these ponds to deer.

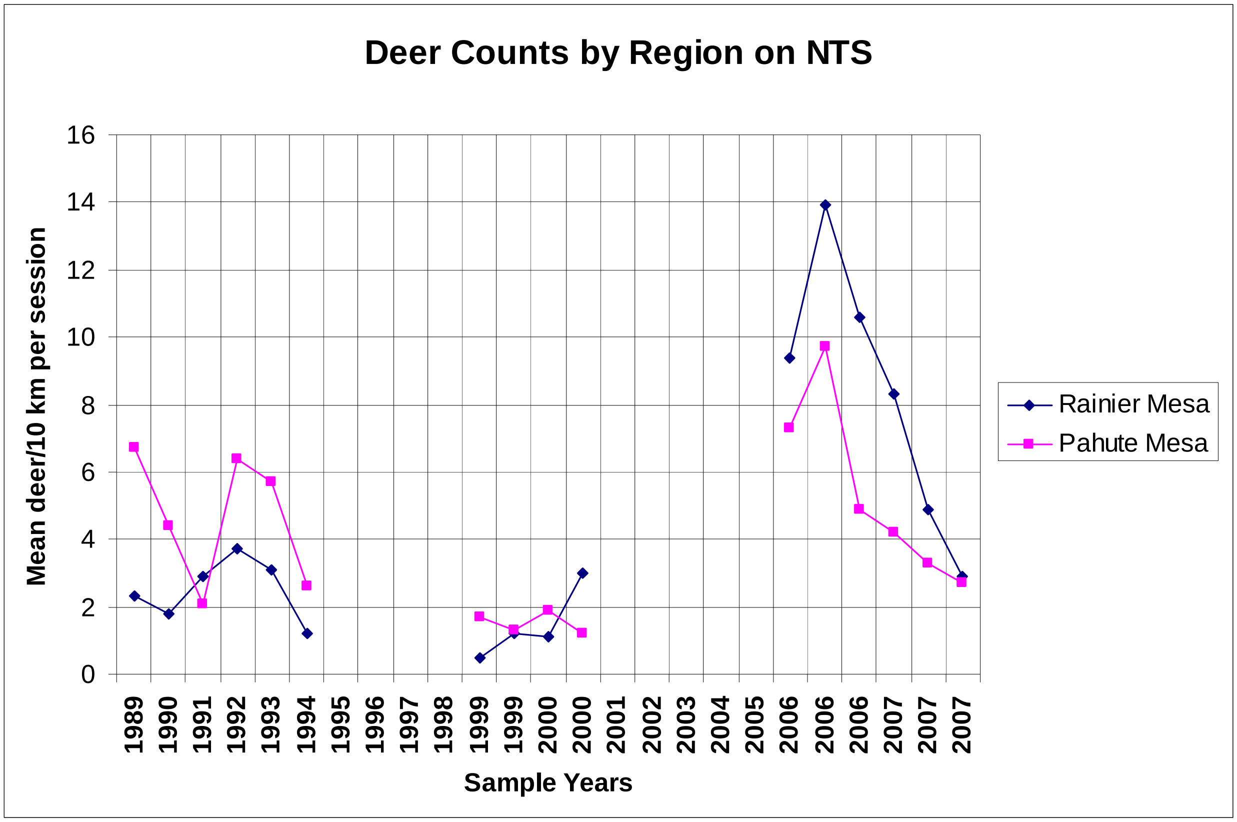

Figure 6-24. Deer counts from two regions of the NTS expressed as mean counts per three-night session per distance surveyed

6.8 Mountain Lion Camera Surveys

Little data exist for mountain lion (*Puma concolor*) numbers and distribution in southern Nevada. Erin Boydston, a research scientist with USGS, is investigating mountain lion distribution and abundance using remote, motion-activated cameras. NSTec biologists collaborated with Ms. Boydston in setting up several cameras on the NTS to help determine how many mountain lions are found here and where they occur. Knowing the number of mountain lions and their distribution on the NTS will enable a better assessment of the potential risk of mountain lions to NTS workers.

Historically, 87 records from opportunistic sightings of mountain lions or their sign have been recorded on the NTS (EGIS faunal database, 2007). In 2007, eight sightings of mountain lions or their sign were recorded (Figure 6-25). Five of these were in areas around human activity (Area 3 RWMC, Guard Station 560 in Area 27, 12-7E Barricade in Area 12, E Tunnel Ponds in Area 12, and Valley Substation in Area 2), and three were in forward areas away from human activity. One of these was seen during deer surveys. Biologists investigated the location of the sighting the next day and found a fresh deer kill buried under a tree. A motion-activated camera was set up to photograph the lion returning to consume the deer, but the lion pulled the deer out from the back side of the tree and went undetected by the camera.

During 2007, remote, motion-activated cameras were set up at 15 sites (Figure 6-25, Table 6-9). At four sites, two cameras were used simultaneously to document animal activity at different locations within a site. At six sites, cameras were moved within the site as resources changed (e.g., animal sign shifted, water sources fluctuated) (Table 6-9).

One camera was set up at the 12T-26B site (named after the 12T-26 Rad-Safe road sign in Area 12) on June 28, 50 m (164 ft) uphill from the camera at 12T-26, to allow both a front and rear view of the same animal passing through for better identification of individual lions. Sites were selected based on previous mountain lion sightings, infrequently traveled dirt roads, and areas known to be frequented by mule deer (e.g., deer trails, water sources), a primary prey species of the mountain lion.

Fifty eight mountain lion photographs were taken during 62,681 camera hours across all sites. This equates to 0.9 mountain lion photos per 1,000 camera hours (Table 6-9). However, mountain lions were only detected at six of the 15 sites with nearly all (93 percent) of them detected at three sites (12T-26, 12T-26B, and Dick Adams Cutoff) located within 2.6 km (1.6 mi) of each other on Rainier Mesa. Many of the mountain lion photos from these three sites appear to contain some of the same individuals based on the time the photographs were taken and physical characteristics of the photographed animals. Even though two cameras were set up within 50 m (164 ft) of each other (12T-26 and 12T-26B), they did not always yield the same results.

For comparable time periods (June 28, 2007, to January 2, 2008), a total of 18 mountain lion photographs was taken at 12T-26 versus 14 mountain lion photographs taken at 12T-26B. Results indicate that on nine occasions, photographs were matched between the two sites, nine photographs were unique to the 12T-26 site, and four photographs were unique to the 12T-26B site. Possible explanations for this may be due to differences in camera systems or mountain lion behavior (e.g., animals may be startled by the camera system and leave the road or start running and go undetected by the second camera). It is noteworthy that the camera was set up at 12T-26 on August 30, 2006, but the first mountain lion was not detected until January 27, 2007.

The 12T-26 and 12T-26B sites are located on a road (Back Mesa Road) going from the top of Rainier Mesa down into Gold Meadows in a remote area of the NTS that is infrequently traveled by vehicles.

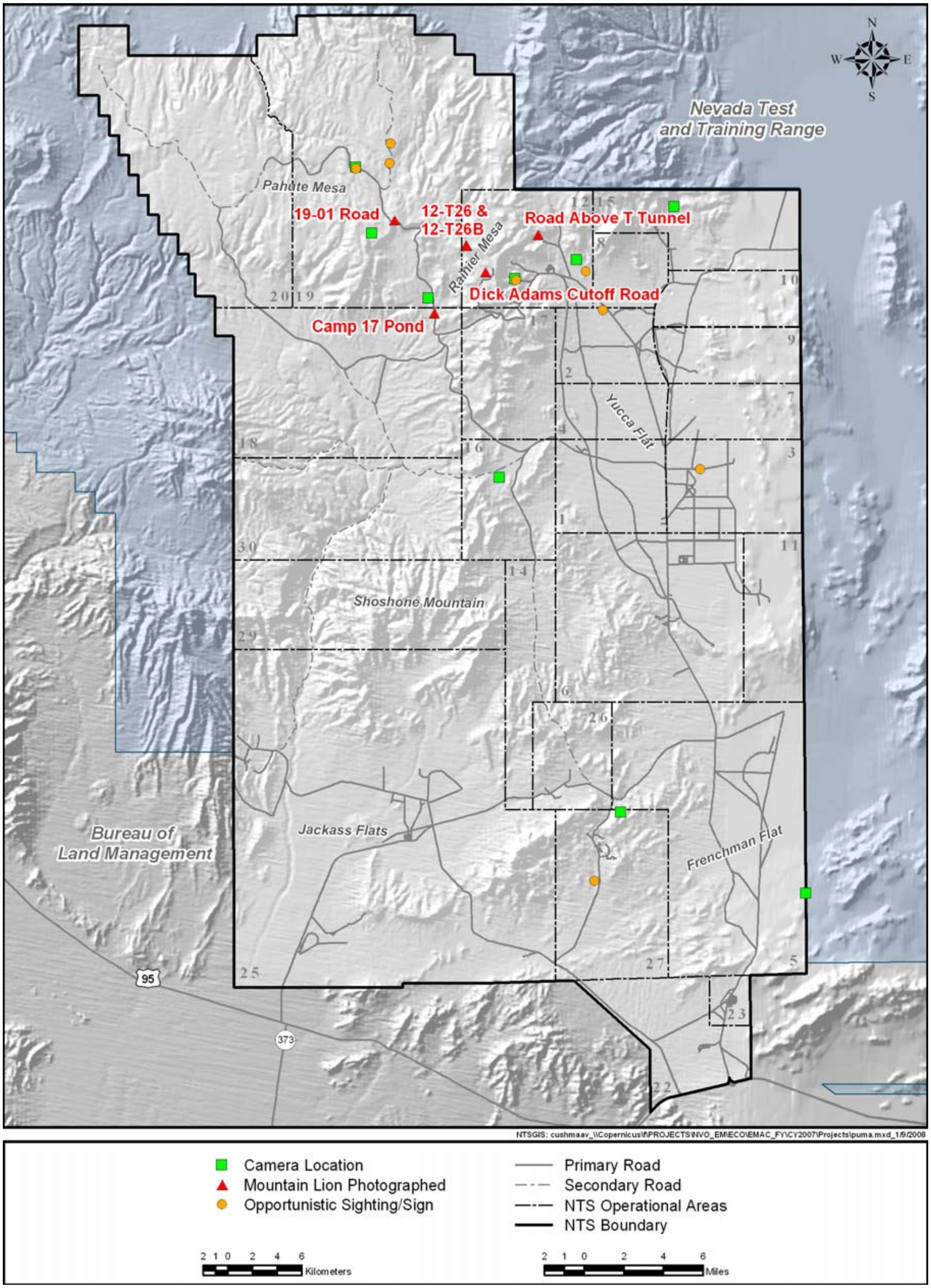

Figure 6-25. Locations of opportunistic mountain lion sightings, mountain lion photographic detections, and motion-activated cameras on the NTS during 2007

Table 6-9. Results of mountain lion camera surveys during 2007

Location	Dates Sampled	Camera Hours	Mountain Lion Photos (No. photos/1000 camera hours)	Other Animals (Number of photos)
12T-26, Rainier Mesa	1/10/07-1/2/08	8,544.75	27 (3.2)	Bobcat (8), coyote (44), gray fox (8), badger (1), mule deer (14), black-tailed jackrabbit (35)
12T-26B, Rainier Mesa	6/28/07-1/2/08	4,511.75	14 (3.1)	Coyote (6), mule deer (12)
Dick Adams Cutoff Road, Rainier Mesa	1/10/07-1/2/08	7420.25[c]	13 (1.8)	Bobcat (4), coyote (46), gray fox (26), mule deer (124), black-tailed jackrabbit (163), cliff chipmunk (3), unknown mammal (1)
Camp 17 Pond[a] (2 locations)	1/10/07-1/2/08	7,201.25	2 (0.3)	Coyote (23), horse (1,074), mule deer (939), desert cottontail (1), black-tailed jackrabbit (1), bat (3), unknown predator (2), golden eagle (2), red-tailed hawk (3), raven (189), turkey vulture (28), mourning dove (1), chukar (2), great blue heron (7), belted kingfisher (1), American coot (1), pinyon jay (11), brown-headed cowbird (4), unknown birds (30)
19-01 Road, Pahute Mesa	6/7/07-12/5/07	4,344.00	1 (0.2)	Mule deer (5)
Road above T Tunnel	12/12/07-1/2/08	502.00	1 (2.0)	Coyote (1)
Wash north of Camp 17 Pond[b] (2 locations)	4/10/07-7/31/07	2,687.00	0	Coyote (1), mule deer (37), raven (7), pinyon jay (11), unknown birds (3)
E Tunnel Ponds[a, b] (3 locations)	1/10/07-12/5/07	2,790.50	0	Coyote (1), mule deer (36), golden eagle (8), chukar (3)

Table 6-9. Results of mountain lion camera surveys during 2007 (Continued)

Location	Dates Sampled	Camera Hours	Mountain Lion Photos (No. photos/1000 camera hours)	Other Animals (Number of photos)
Echo Peak Road, Pahute Mesa	7/18/07-9/26/07	1,680.50	0	Coyote (11), horse (1), mule deer (6)
Pahute Mesa, cougar deer kill	9/26/07-10/1/07	119.00	0	Coyote (2), deer rumen (1)
Tub Spring and Cave Pool[a, b] (3 locations)	1/10/07-1/2/08	10,065.25	0	Bobcat (3), coyote (14), mule deer (104), desert cottontail (9), chukar (1)
Whiterock Spring[b] (2 locations)	1/10/07-10/16/07	4,840.25	0	Bobcat (2), coyote (21), mule deer (1,725), golden eagle (2), turkey vulture (4), raven (30), mourning dove (1)
Tippipah Spring[b] (2 locations)	1/10/07-7/26/07	3,828.25	0	Bobcat (1), coyote (6), mule deer (66), unknown bird (1)
Cane Spring[a, b] (3 locations)	2/22-5/17; 10/31/07-1/2/08	1,841.25[c]	0	Mule deer (1)
5-1P Barricade	2/26-3/26; 3/28-6/4	2,305.00	0	Coyote (9), black-tailed jackrabbit (1), unknown bird (1)

[a]Two cameras set up simultaneously for at least part of the year
[b]Cameras moved within a site
[c]Camera hours not known for some time periods

This road appears to be frequently used by mountain lions. In fact, five of the six sites where mountain lions were photographed were in mule deer habitat on dirt roads with little to no vehicle traffic.

Careful review of all the photographs suggest the presence of five to nine individuals including adult males and females, subadults, and a lactating female (Figure 6-26). This estimate is based on tail structure; dark pelage markings; ear, head, and body size; body condition; and gender differences. Several pictures contained no distinguishing characteristics.

Figure 6-26. Lactating female mountain lion at 12T-26B camera site on Back Mesa Road in Area 12
(Photo by motion-activated camera, October 11, 2007)

Two of the pictures taken in June contained two mountain lions, which may have been a mating pair or a mother with a subadult offspring (Figure 6 -27). A large adult male was photographed on the 19-01 Road in September (Figure 6-28). Mountain lions were detected each month, except April, with peak occurrence during November (Figure 6-29). This was due, in part, to a lactating female that was repeatedly photographed (at least eight times) at the Dick Adams (six photographs), 12T-26, and 12T-26B sites. She may have had a nursery site near the camera at Dick Adams and was thus frequently photographed. No young were ever detected.

Mountain lions were photographed during most parts of the day with gaps during morning and early afternoon peaking between 2200 and 2300 hours (Figure 6-30). Only ten photos were taken during daylight hours; one in February, two in October, and seven in November. These data suggest that during fall and winter, diurnal activity increases. Data from photographs taken at 12T-26B that were matched with photographs from 12T-26 were not included in the monthly (Figure 6-29) or circadian activity graphs (Figure 6-30) to avoid duplication.

Figure 6-27. Two mountain lions at 12T-26 camera site on Back Mesa Road in Area 12
(Photo by motion-activated camera, June 6, 2007)

Figure 6-28. Mature male mountain lion at 19-01 Road in Area 19
(Photo by motion-activated camera September 8, 2007)

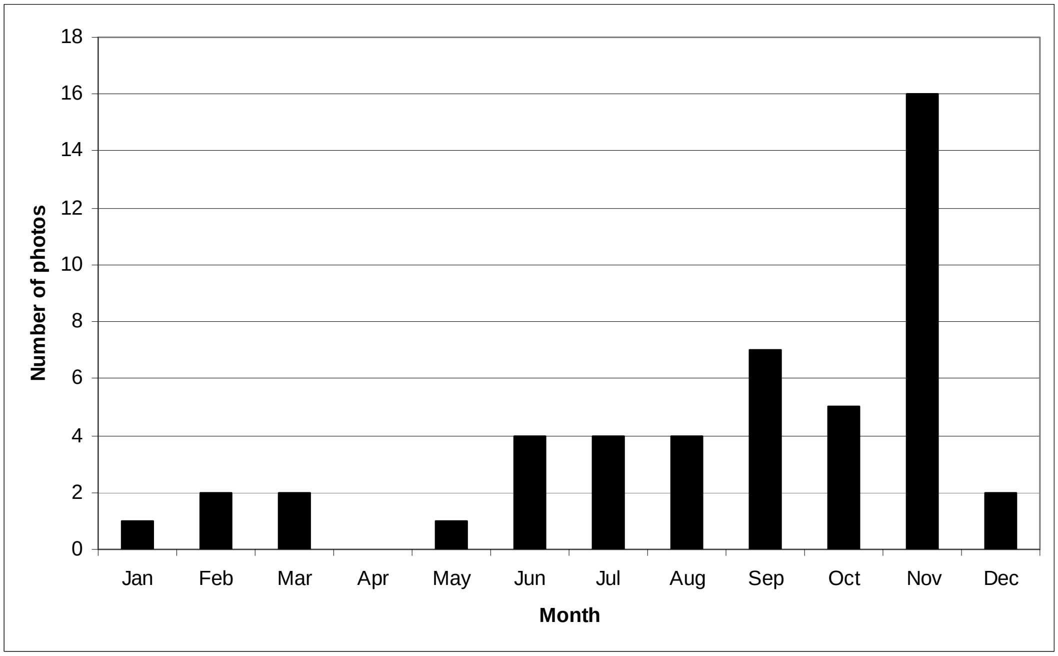

Figure 6-29. Numbers of mountain lion photographs (N=48) by month for camera sites where mountain lions were detected
(January 10, 2007 to January 2, 2008)

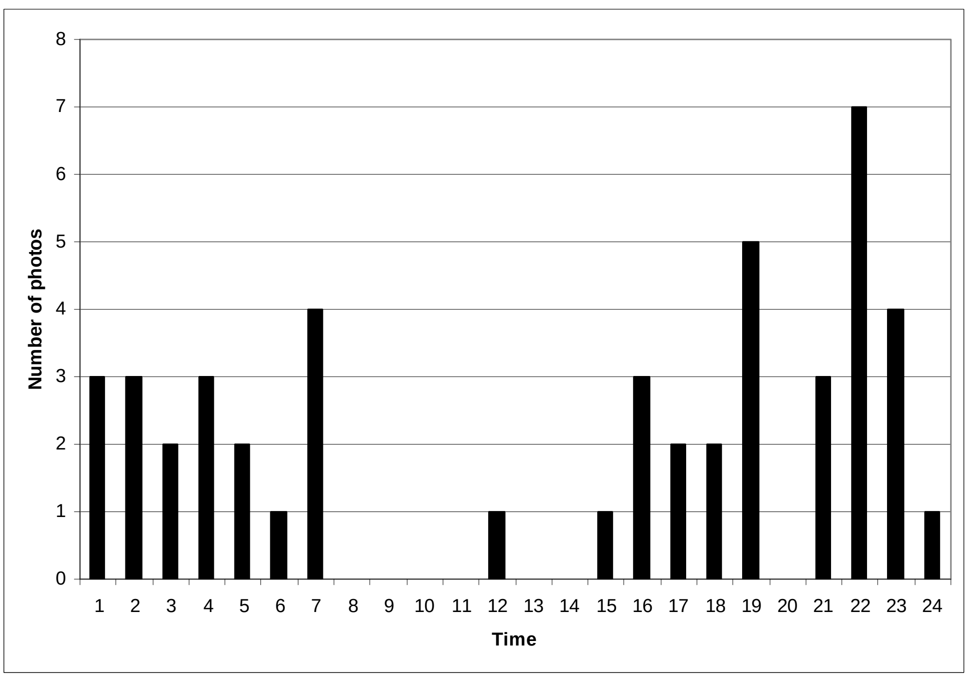

Figure 6-30. Mountain lion circadian activity pattern based on photographic data
(N=47, unknown time on one photo) (January 10, 2007 to January 2, 2008)

A secondary objective of the camera surveys is to detect other species using these areas to better define species distributions on the NTS. A total of 4,952 photographs of animals other than mountain lions were taken during 62,681 camera hours across all sites (Table 6-9). This is about 79 photos per 1,000 camera hours. A majority of these photographs (3,070 photographs) were of mule deer or about 49 mule deer photos per 1,000 camera hours (see Section 6.7 for trends in mule deer population). Water sources are important to sample because many species, including mountain lions, rely on these water sources for survival. Results show that a variety of wildlife (at least 21 species of mammals and birds) are using the different sites with the greatest activity at water sources, particularly during the dry, summer and fall months. Thunderstorm events in late August and early September dispersed the mule deer and horses away from Camp 17 Pond as evidenced by nearly a ten-fold decrease in number of photos taken of these species during September/early October compared to number of photos taken during the dry months of June and July.

6.9 Southeast Nevada Pyrg Monitoring

In the fall of 2007 the population status of the southeast Nevada pyrg (formerly called the southeast Nevada springsnail [*Pyrgulopsis turbatrix*]) (Figure 6-31) was investigated at Cane Spring located in Area 27. A detailed description of Cane Spring is provided elsewhere (Hansen et. al, 1997). An attempt was made to estimate density of the pyrg by placing two Petri dishes (9 cm diameter, 63.6 cm^2 [3.5 in. diameter, 9.86 $in.^2$]) in the habitat starting on October 31 and retrieving both vessels on December 5, 2007 (a five-week period). This provided a preliminary estimate of the population density as a fall-winter minimum. Another trial will be run in June 2008 to estimate the summer population maximum.

Figure 6-31. Southeast Nevada pyrg (1.5 mm [0.06 in.] shell length) from Cane Spring
(Photo by P. Greger, January 23, 2008)

The Petri dishes were submerged carefully in the habitat and soil added as a substrate for the pyrgs to colonize. The Petri dishes were carefully removed by hand after the colonization period, and all contents were washed into a vial for later sorting and counting of pyrgs. The number of pyrgs identified per dish was expressed as numbers per square meter (numbers/m^2). Petri dishes were placed downstream and in habitat free of southern cattail (*Typha domingensis*) growth.

Results from the first sample yielded a count of 30 pyrgs or approximately 4,710 pyrgs/m^2 (438 pyrgs/ft^2). The second sample contained only 8 pyrgs or a density estimate of 1,256/m^2 (117 pyrgs/ft^2) (average density of 2,978 pyrgs/m^2 [277 pyrgs/ft^2]). More samples (3–6) will be taken when this experiment is repeated in June 2008.

6.10 Coordination with Biologists and Wildlife Agencies

Skink tissue samples were sent to Dr. Jonathan Richmond at Cornell University for genetic testing. This is a collaborative effort that benefits Dr. Richmond by providing samples from an area where data were lacking, as well as NSTec biologists by providing genetic information for species identification and perhaps relatedness among skinks at locations across the NTS.

Dr. Courtney Conway from the University of Arizona is working on a Department of Defense Legacy-funded project evaluating migratory linkages of western burrowing owls in western North America. This involves trapping and banding burrowing owls and taking feather and blood samples. Feathers will be analyzed for specific stable isotopes to help determine migratory status and breeding and wintering locations. Dr. Conway contacted NSTec biologists to request their assistance in collecting samples on the NTS. Trapping results can be found in Section 6.2. This is the third year that trapping has been conducted on the NTS and will continue for at least one more year.

Three manuscripts about burrowing owl ecology were submitted for publication. Two manuscripts, “Regional and seasonal diet of the western burrowing owl in south-central Nevada,” and “Burrow use by the western burrowing owl at the Nevada Test Site in south-central Nevada,” were submitted to the *Western North American Naturalist*; the other manuscript, “Documenting western burrowing owl reproduction and activity patterns using motion-activated cameras,” was submitted to the *Journal of Raptor Research.*

Derek Hall, an NSTec biologist, attended the biennial meeting of the Western Bat Working Group in Tucson, Arizona, and presented a poster entitled, “Radionuclides in bats using a contaminated pond on the Nevada Test Site, USA.” Derek continued to serve as co-leader of the Nevada Bat Working Group; participated in the first Nevada Bat Working Group Bat Blitz during which dozens of abandoned mines near Lida, Nevada, were surveyed for bat use prior to being closed for human safety reasons; and attended a working group meeting in December. He also served as a board member of the Western Bat Working Group and participated in several conference calls throughout the year with other group members throughout the western United States. Affiliation with these groups is important to keep abreast of the latest techniques in bat monitoring and facilitates data exchange within the bat community.

A collaborative effort using remote, motion-activated cameras to investigate mountain lion distribution and abundance on the NTS continued this year in conjunction with Erin Boydston, a USGS research scientist. For details see Section 6.8.

Fairy shrimp were collected from numerous locations on the NTS and samples were sent to Dr. Christopher Rogers at EcoAnalysts, Inc. (Richmond, California) for identification. Dr. Rogers is one of the leading authorities in the world on fairy shrimp.

West Nile Virus surveillance continued this year in cooperation with Southern Nevada Health District (SNHD) personnel (see Section 7.1). Results from NTS sampling are included in SNHD’s annual report.

7.0 HABITAT MONITORING

7.1 West Nile Virus Surveillance

West Nile Virus (WNV) is a potentially serious illness that is spread to humans and other animals through mosquito bites. It was first discovered in Uganda in 1937 and was not detected in North America until 1999. In southern Nevada, it was not detected until the spring of 2004. WNV surveillance continued in 2007 for the fourth consecutive year to determine if mosquitoes on the NTS carry WNV. WNV surveillance entails setting mosquito traps baited with dry ice overnight at sites where standing water provides a potential breeding site for mosquitoes (Figure 7-1). As the dry ice sublimates, it produces carbon dioxide, which serves as an attractant for mosquitoes. Nine sites were sampled during 15 surveys (Table 7-1). Mosquitoes collected during the surveys were taken to SNHD for species identification and WNV testing. A total of 13 individuals representing two species were captured and analyzed in 2007 (Table 7-1). All specimens were negative for WNV including four mosquitoes captured at Well 3 Pond where one mosquito in each of the past two years was a suspect of carrying the WNV. Mosquito species identified will be entered into the EGIS faunal database to define mosquito distribution on the NTS. This year, no new species were detected.

Figure 7-1. Mosquito trap set at Well 5B in Frenchman Flat
(Photo by D. B. Hall, May 2, 2005)

Table 7-1. Results of WNV surveillance on the NTS in 2007

Location	Date	Number Captured	Species	WNV
Mercury SOC Park, Area 23	5/31/07	0	NA	NA
Well 3 Pond, Area 6	5/31/07	3	*Culex tarsalis*	Negative
LANL Pond, Area 6	5/31/07	2	*Culex tarsalis*	Negative
Camp 17 Pond, Area 18	6/20/07	0	NA	NA
Well 3 Pond, Area 6	6/20/07	0	NA	NA
Mercury Sewage Lagoons, Area 23	6/20/07	0	NA	NA
Shaker Plant Sumps, Area 1	7/5/07	0	NA	NA
Well 3 Pond, Area 6	7/5/07	0	NA	NA
Well 5B Pond, Area 5	7/5/07	3	*Culex tarsalis*	Negative
Well 3 Pond, Area 6	8/29/07	1	*Culex tarsalis*	Negative
J-11 Pond, Area 25	8/29/07	0	NA	NA
Mercury SOC Park, Area 23	8/29/07	0	NA	NA
Well 3 Pond, Area 6	9/17/07	0	NA	NA
Camp 17 Pond, Area 18	9/17/07	0	NA	NA
Well 5C, Area 5	9/17/07	2	*Culex tarsalis*	Negative
Well 5C, Area 5	9/17/07	2	*Culiseta inornata*	Negative

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

7.2 Wetlands and Wildlife Water Sources

Natural wetlands (e.g., vegetated seeps and springs) and human-made water sources (e.g., sumps and sewage lagoons) on the NTS provide unique habitats for vegetation and wildlife. In prior years, natural wetlands on the NTS were evaluated for their potential to qualify as "jurisdictional wetlands" under the *Clean Water Act* (CWA). The presence of three wetland field indicators (vegetation, hydrology, and soils) was the basis for determining whether individual wetlands might be considered jurisdictional wetlands (i.e., wetlands over which the U.S. Army Corps of Engineers [USACE] takes legal jurisdiction for the purposes of permitting, mitigation, and rehabilitation for site alterations).

Inherent in the concept of jurisdictional wetlands was the assumption that isolated wetlands were important for interstate commerce such as hunting, recreation, or for other related uses as defined by the CWA. In 2006, the Supreme Court issued rulings on a pair of related cases (Rapanos v. United States, and Carabell v. U.S. Army Corps of Engineers). The court ruled that the CWA does not extend jurisdiction to channels through which water flows intermittently or channels that provide drainage for rainfall. At issue were isolated wetlands typical of wetlands found on the NTS. From initial national and local reaction to the rulings, it appears that NTS wetlands will no longer be considered "jurisdictional wetlands." Although a formal request was initiated by BN in 2005 through NNSA/NSO to the USACE to clarify whether NTS wetlands were considered "jurisdictional" by USACE, to date no response has been issued formally. While the recent Supreme Court ruling will most likely alter the potential of NTS wetlands from being considered jurisdictional, the rulings will not alter the basic underlying principle of protecting wetlands as unique and important habitats for wildlife. Characterization of these important mesic habitats and periodic monitoring of their hydrologic and biotic parameters were started in 1997 as components of EMAC and will continue in the future. This monitoring will help identify annual fluctuations and ranges in measured parameters to help determine if these fluctuations and ranges are natural or are related to NNSA/NSO activities.

7.3 Constructed Wetlands Monitoring

During 2007, constructed wetlands on Frenchman Flat were visited in October to check on water availability and to sample several species of fairy shrimp. Results of the shrimp sampling are presented in Section 7.5.

7.4 Natural Wetlands Monitoring

Monitoring of numerous wetlands continued this year to characterize seasonal baselines and trends in physical and biological parameters. Ten wetlands were visited at least once during the year to record wildlife and horse use, the presence/absence of land disturbance, water flow rates when applicable, and surface area of standing water (Table 7-2). The sizes of wetlands monitored in 2007 varied greatly from very small areas of less than 1 m^2 (10.8 ft^2) to moderately sized springs of 180–500 m^2 (1,937–5,382 ft^2). Surface flow rates were low (<5 liters per minute [L/min] [<0.3 gallons per minute (gal/min)]) at most wetlands where flow was measurable (Table 7-2).

No horses were observed at Captain Jack Spring in 2007 permitting a partial recovery of wetland plants, which resulted in a very lush growth and high plant cover (approaching 100 percent) around the water source (Figure 7-2) unlike other years when most of the vegetation was removed.

Heavy growth of southern cattail (*Typha domingensis*) was observed at Cane Spring (canopy cover estimates of nearly 50 percent), which may adversely impact pyrgs (invertebrate snails) in this habitat (see Section 6.9). Density estimates of pyrgs in the cattail region will continue in 2008 to evaluate possible impacts from the southern cattail. Eradication of the southern cattail may be considered to open up the habitat to benefit invertebrates found in the wetland.

Wildlife use data recorded at water sources during daytime sampling are summarized in Table 7-3. Overall, few wildlife species and individuals were observed in 2007 compared to 2006. Only 5 species and 49 individuals of birds were observed in 2007 at nine wetlands visited compared to 16 species and 236 individuals seen in 2006 at 12 wetlands. Very low numbers of chukar *(Alectoris chukar)* and mourning doves *(Zenaida macroura)* were observed at springs throughout the NTS (Table 7-3), undoubtedly an impact of climatic drought. Two Guzzlers were constructed as a benefit to wildlife over 2006–2007 and were maintained to help photograph wildlife (Table 7-2). See Section 6.8 for additional records of wildlife use at selected springs/habitats. Fairy shrimp were also sampled at several springs during the winter (see Section 7.5).

Figure 7-2. Lush wetland plant growth observed at Captain Jack Spring pool during a period of horse absence
(Photo by P. Greger, September 9, 2007)

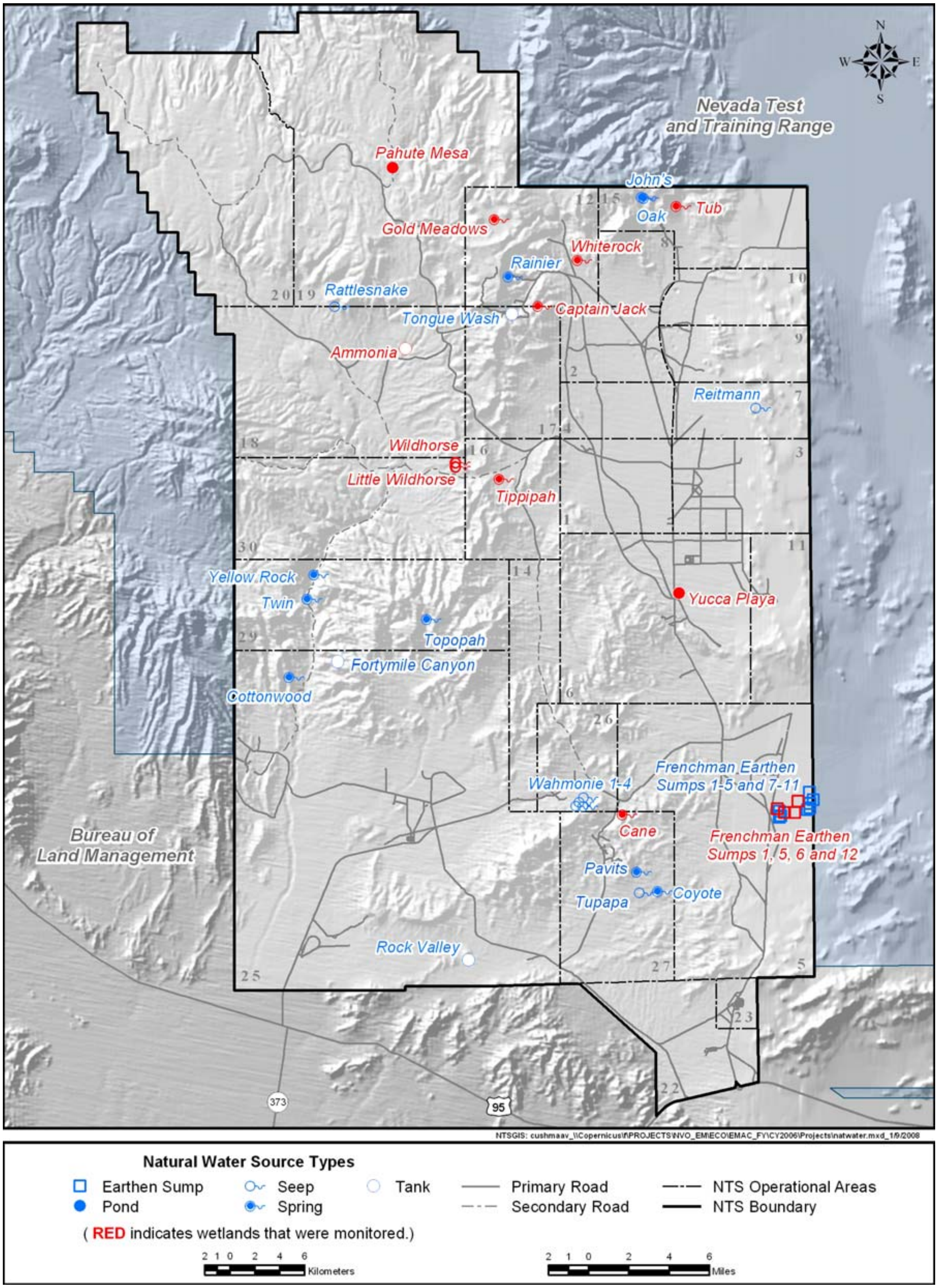

Figure 7-3. Water sources on the NTS, including those monitored in 2007

Table 7-2. Hydrology and disturbance data recorded at natural water sources on the NTS

Water Source	Date	Surface Area of Water (m^2)[a]	Surface Flow Rate (L/min)[b]	Disturbance at Spring
Cane Spring	10/31/07	10	NM[c]	Heavy cattail growth in cave pool
Captain Jack Spring	9/5/2007	35	0.6	None
Gold Meadows Spring	5/25/07	0	NM[c]	Spring dry
Gold Meadows Spring	9/24/07	200	NM[c]	Horse trampling
Little Wildhorse Seep	11/7/07	3	NM[c]	Horse trampling
Pahute Pond	11/29/2007	500	NM[c]	None
Tub Spring	7/25/2007	<1	0.02	None, Guzzler constructed
Tippipah Spring	07/26/2007	210	NM[c]	None
Whiterock Spring	10/15/2007	5	4.5	None, Guzzler constructed
Wildhorse Seep	11/7/07	6	NM[c]	Horse Trampling

[a] m^2 = square meters
[b] L/min = liters per minute
[c] NM = not measurable due to diffused flow

Table 7-3. Number of wildlife species observed or inferred at NTS natural water sources during 2007

Wildlife Species Observed at NTS Natural Water Sources	Cane Spring	Captain Jack Spring	Gold Meadows Spring	Gold Meadows Spring	Little Wildhorse Seep	Pahute Pond	Tippipah Spring	Tub Spring	Whiterock Spring	Wild Horse Seep
Date Observed (month/day) of 2007:	**10/31**	**10/19**	**7/12**	**10/15**	**11/8**	**11/28**	**7/18**	**7/25**	**7/11**	**11/8**
Mammals										
Bobcat (*Lynx rufus*)						P		P		
Coyote (*Canus latrans*)	P	P	P	P	P	P	P	P	P	P
Cottontail rabbit (*Sylvilagus audubonii*)							1		1	
Feral horse (*Equus caballus*)			P	P	P					P
Mule deer (*Odocoileus hemionus*)	P	P	P	P	P	P	P	P	P	P
Birds										
Black-throated sparrow (*Amphispiza bilineata*)								1		
Chukar (*Alectoris chukar*)		>10					>20	>12		
Common raven (*Corvus corax*)		1							1	
Mourning dove (*Zenaida macroura*)							>1	1	1	
Sage sparrow (*Amphispiza bellii*)	1									
Numbers of bird species detected:	**1**	**2**	**0**	**0**	**0**	**0**	**2**	**3**	**2**	**0**

P= Species presence inferred from sign

7.5 Fairy Shrimp Inventory on the NTS

7.5.1 Yucca and Frenchman Flat Playas

NSTec biologists monitored constructed and natural water sources after fall rains in 2007 to inventory species of shrimp that hatched on the playa wetlands. A large late-September rainfall event deposited 2.5–5 cm (1–2 in.) of rain on most NTS wetlands. This combination of water and cooler temperatures appears to have been the major stimulus for the hatching of several species of fairy shrimp. Ten separate wetland habitats were sampled during September–November on Yucca and Frenchman Playas (Figures 7-4 and 7-5). On Yucca Playa four locations (one natural and three man-enhanced sites) were sampled (Figures 7-6 and 7-7), and on Frenchman Playa two natural and four man-made depressions (Figures 7-8 and 7-9) were sampled. Sampling was conducted because few samples have been taken historically, and the abundant surface water provided an opportunity to describe species presence from a variety of habitat types in both Frenchman and Yucca Playas.

Shrimp were sampled using hand-held nets. Two types of nets were utilized: a fine mesh net <1 millimeter (mm) mesh, and a 3 mm mesh net. Numerous grab samples were taken by pushing the net from the shoreline along the bottom out to about 1.8–3 m (6–10 ft) from shore, and all organisms collected in the net were put into a metal pan after washing away excess sediment. All grab samples from each habitat were combined into one sample for each site per day. All animals collected were removed from each net grab and added to the composite sample. Each sample was preserved in 10 percent formalin and later transferred to 75 percent ethyl alcohol after two weeks. All shrimp were identified following Pennak (1978). Shrimp from each sample were washed through a 1 mm (0.04 in.) mesh net, sorted by species, and counted.

Alkali fairy shrimp were collected from all ten sites sampled in 2007 (Table 7-4). Only alkali fairy shrimp were present in the Yucca Playa Channel (Figure 7-7). Four species were identified from the ten sample locations (Table 7-4). One species, the giant fairy shrimp (*Branchinecta gigas*), was restricted to one small pond (YPW01) on Yucca Playa (Figure 7-6). Three species of shrimp were collected from this small ephemeral pool. Examples of three species collected from Yucca Flat are shown in Figure 7-10. The giant fairy shrimp is a predator and appeared to be sustained by high numbers of the alkali fairy shrimp (*Branchinecta mackini*). Only 18 giant fairy shrimp were caught from repeated grab samples taken from these ten sites on three separate dates.

The paddletail shrimp (*Thamnocephalus platyurus*) was collected from only two sites (FMF05 and FMF06) (Figure 7-9) of ten sites sampled in 2007 and occurred only on Frenchman Playa. Another predaceous species, the tadpole shrimp, (*Triops longicaudatus*) was found to be common on both playas but was not present at all sites sampled in 2007. Interestingly, it was found at one site (FMF1) to be a highly dominant species comprising roughly >95 percent of the total numbers caught. In fact, only pieces (no complete organisms) of the alkali fairy shrimp were recovered from our net samples, suggesting a high level of predation.

Figure 7-4. Locations on Yucca Playa where fairy shrimp were collected in 2007
(Note: YPW01 and YPW02 are vegetated wetlands not previously described.)

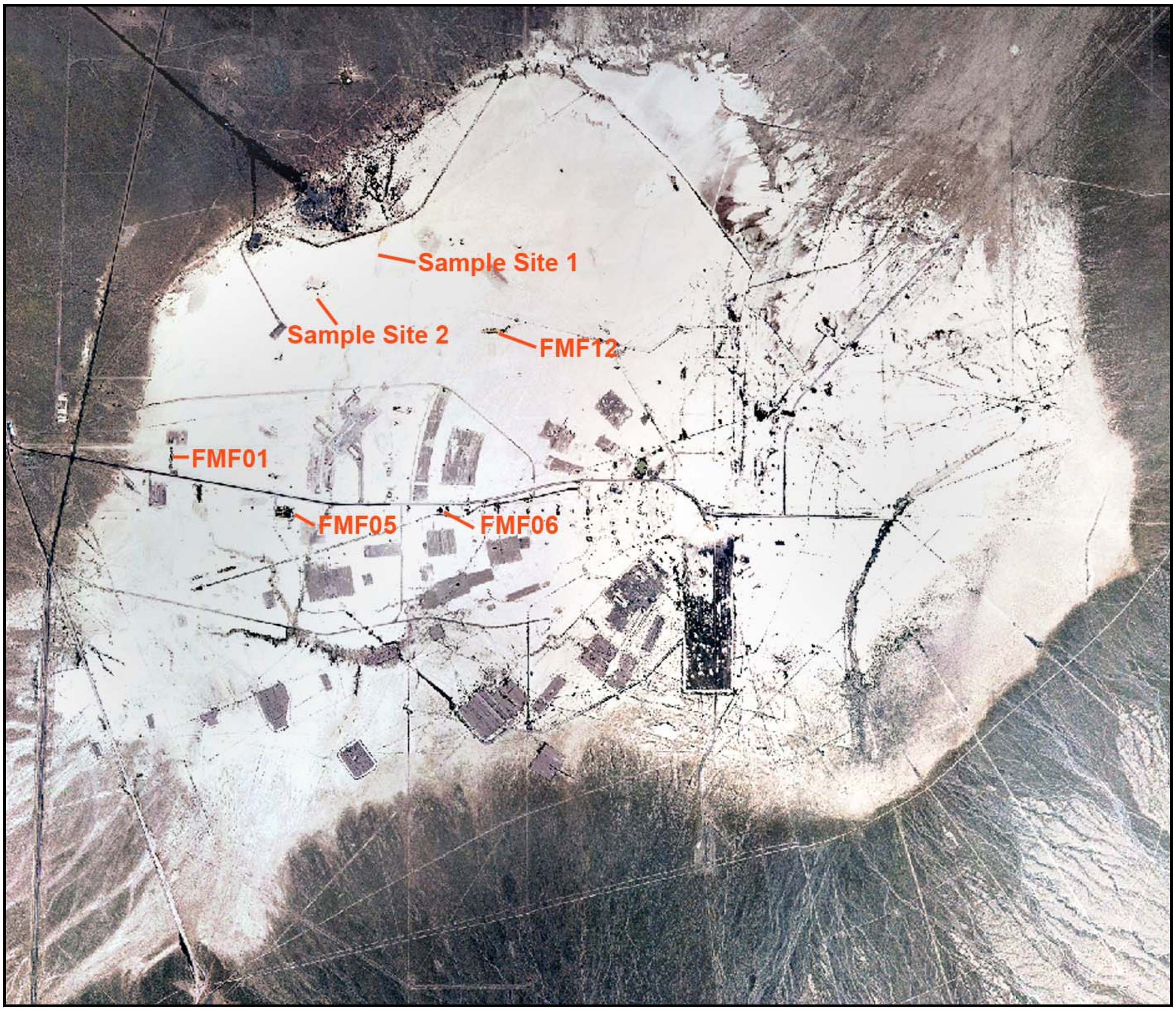

Figure 7-5. Locations on Frenchman Playa sampled for fairy shrimp in 2007
(Note: FMF01-FMF12 are vegetated wetlands described in previous years.)

Two shallow unvegetated habitats were also sampled on north Frenchman Playa (Figure 7-8), Sample Sites 1 and 2, near the inflow of the Cambric Ditch. Two species were collected from these habitats with alkali fairy shrimp being more common than the tadpole shrimp. The tadpole shrimp is the only known predaceous species on Frenchman Playa.

Previous records of fairy shrimp from the NTS are limited to opportunistic samples taken from 1998 to 2005. The clam shrimp (*Eulimnadia antlei*) was collected from the Yucca Playa Pond in August of 1998. One archival sample from Frenchman Playa, dated August 14, 1964, contained a tadpole shrimp, paddletail shrimp, and a clam shrimp. Starkweather (1995, unpublished data) first collected the giant fairy shrimp and the alkali fairy shrimp in February 1995 from Yucca Playa.

Figure 7-6. Small human-made wetland on Yucca Playa where the giant fairy shrimp was collected
(Photo by D. J. Hansen, October 30, 2007)

Figure 7-7. Long, narrow human-made channel on south Yucca Playa where alkali fairy shrimp were collected
(Photo by D. J. Hansen, October 30, 2007)

Figure 7-8. Sample Site 1, a shallow pond site on Frenchman Playa where shrimp were collected in 2007
(Photo by D. J. Hansen, October 17, 2007)

Figure 7-9. A human-made wetland (FMF-6) on Frenchman Playa where the paddletail shrimp was collected on October 17, 2007
(Photo by D. J. Hansen, April 7, 2004)

Table 7-4. Shrimp species collected on Yucca and Frenchman Playas in 2007

Species		Giant fairy shrimp	Alkali fairy shrimp	Paddletail shrimp	Tadpole shrimp
Yucca Playa	**Sample Date**				
Yucca Playa Pond	23-Aug		P		P
Yucca Playa Pond	15-Oct		P		
YPW01[a]	23-Oct	P	P		P
YPW01[a]	30-Oct	P	P		P
YPW01[a]	6-Nov	P	P		
YPW02[a]	23-Oct		P		
Yucca Playa Channel	30-Oct		P		
Frenchman Playa					
Sample Site 1	17-Oct		P		P
Sample Site 2	17-Oct		P		P
FMF01[b]	17-Oct		P		P
FMF05[b]	17-Oct		P	P	P
FMF06[b]	17-Oct		P	P	P
FMF12[b]	17-Oct		P		P

[a]YPW = Yucca Playa constructed wetlands
[b]FMF= Frenchman constructed wetland
P = Present

Figure 7-10. Three species of shrimp collected from wetland YPW01 on Yucca Playa: (a) giant fairy shrimp, (b) tadpole shrimp, (c) alkali fairy shrimp
(Photo by D. J. Hansen, October 6, 2007)

7.5.2 Non-Playa Shrimp Species on the NTS

An unidentified fairy shrimp species of the genus *Branchinecta* was collected from Pahute Mesa Pond (December 4) and Gold Meadows Pond (December 5). It is a small species measuring approximately 12–15 mm (0.5–0.6 in.) long. It was abundant under the ice at both sites and may be restricted to winter because fewer predators are active at this time. Identification of this species has not yet been confirmed but will be verified by Christopher Rogers from Eco Analysts in Woodland, California. Two additional habitats were sampled for fairy shrimp in December—the Ammonia Tanks and a canyon 1 km (0.62 mi) northwest of Camp 17 Pond. Both locations had ample surface water, but no fairy shrimp were detected. These sites contained light-colored, coarse-textured sediments. These sediments were different than the dark-colored, fine-textured depositional sediments of Pahute Pond and Gold Meadows Pond where this species was found.

7.6 Constructed Water Source Monitoring

NSTec biologists conducted quarterly monitoring of constructed water sources. These sources, located throughout the NTS (Figure 7-3) include 38 plastic-lined sumps at 19 sites. Several ponds or sumps are located next to each other at the same project site. Many animals rely on these human-made structures as sources of free water. However, wildlife and migratory birds may drown in steep-sided or plastic-lined sumps as a result of entrapment, or ingest contaminants in sumps with drilling-fluids or evaporative ponds. Ponds are monitored to assess their use by wildlife and to develop and implement mitigation measures to prevent such structures from causing significant harm to wildlife.

Constructed water sources (Figure 7-3) were visited during March, June, September, and December 2007. At each site, the presence or absence of standing water and the presence of animals or their sign around the water source were recorded. Sediment ramps or plastic ladders, which allow animals to escape if they fall in, have also been installed at many plastic-lined sumps, and the presence, absence, and condition of these structures were also noted. All dead animals (or any remains of an animal) in or adjacent to a human-made water source were recorded (Table 7-5).

During 2007, use by birds of plastic-lined sumps was generally low due to extremely dry conditions with reduced pond surface area as the summer progressed. A late September rainfall was responsible for a noteworthy accumulation of rainwater in sumps (Table 7-5). No dead animals were detected from sumps during 2007. Few ponds were monitored in December in Areas 19 and 20 due to snow conditions. Use was limited to few passerine birds, shorebirds and ducks (e.g., common ravens [*Corvus corax*], turkey vultures, horned larks [*Eremophila alpestris*], house finches [*Carpodacus mexicanus*], and teal [*Anas* spp.]). Sumps are commonly used by coyotes and sometimes mountain lions searching for deer.

Sediment ramps were shown to be used by wildlife from the presence of fresh tracks on the sediment ramps. For example, a new sediment ramp constructed in Area 6 at ER 6-1 in 2007 appeared to be heavily used by coyotes. It is recommended that sediment ramps be constructed in every deep sump on the northern NTS where deer abundance is high. Sediment ramps, where installed, have been very effective in allowing animals to exit sumps without becoming entrapped.

Table 7-5. Results of monitoring plastic-lined sumps for wildlife mortality at the NTS for 2007

Quarter[a]	Number of ponds monitored	Number of ponds with water	Surface area m^2	Number of sediment ramps	Number of dead animals detected
Jan–Mar	28	5	510	18	none
April–June	32	0	0	18	none
July–Sept	32	23	8,000	18	none
Oct–Dec	14	10	1,350	5	none

[a] Monitoring conducted during last month of each quarter

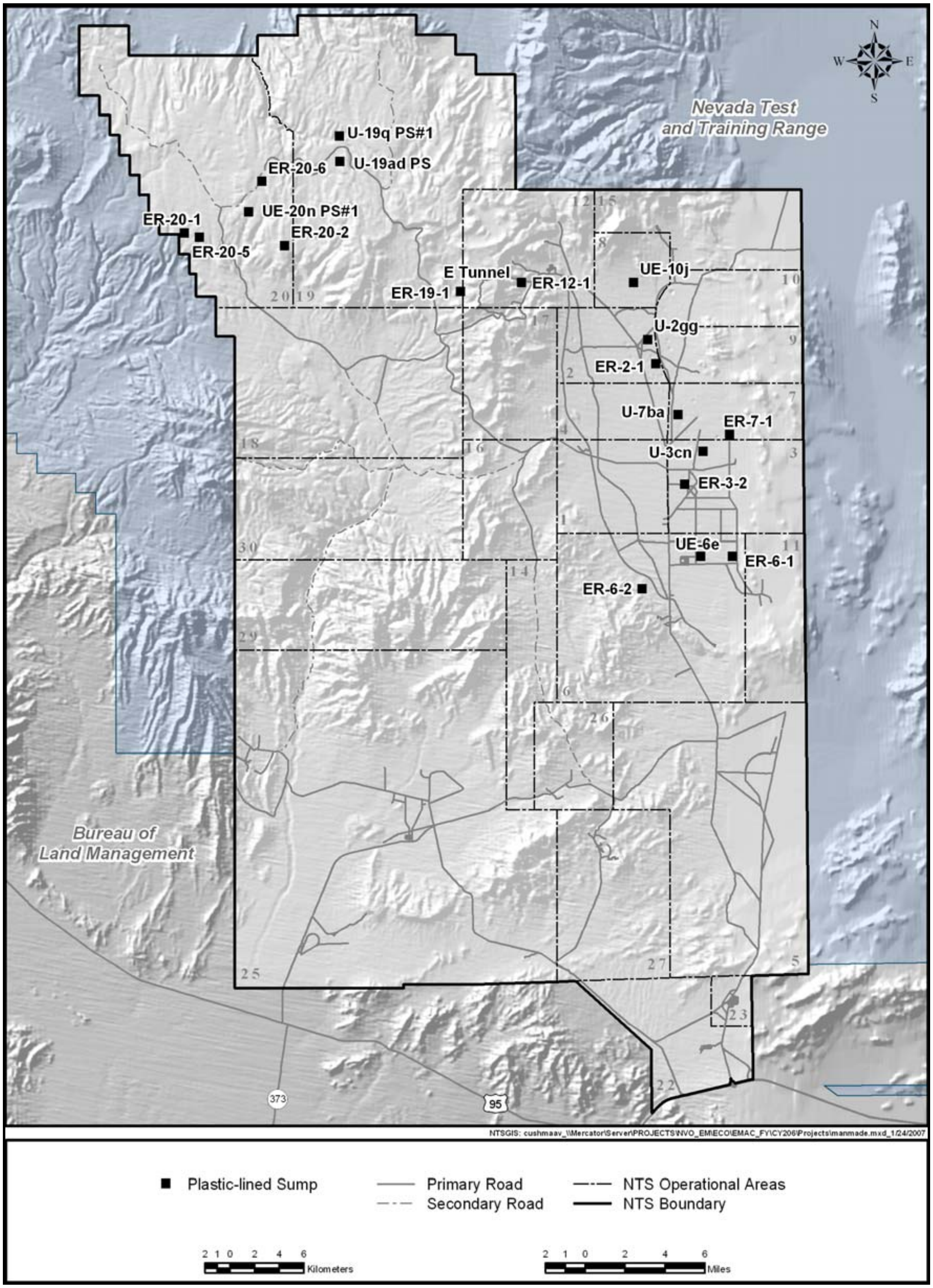

Figure 7-11. Constructed water sources monitored for wildlife use and mortality on the NTS during 2007

8.0 HABITAT RESTORATION MONITORING

The focus of the habitat restoration program on the NTS has changed over the years. In the 1970s and 1980s, habitat restoration efforts were on the research level and numerous trial plots were set up at various locations on the NTS. The primary objectives of these research plots were to evaluate revegetation techniques that would reduce soil erosion, restore wildlife habitat, and reduce wildland fire potential. At these research sites, different seeding rates and mixes were used and compared to other studies, such as the use of transplants. Many, if not most, of the research sites were in the lower, more arid regions of the NTS, primarily around Yucca and Frenchman flats (Romney et al., 1989; Hunter et al., 1980; Hunter et al., 1987; Wallace and Romney, 1980, Wallace et al., 1980).

In the late 1980s and early 1990s, several imminent projects required revegetation at an operational level and research became specific to the project. One such proposed project was the remediation of plutonium contaminated soils on the NTS and the Tonopah Test Range (TTR) (Wallace and Romney, 1977; Winkel 1993; Winkel et al., 1994; Winkel, 1995). Water harvesting/conservation techniques and the selection of suitable plant species were also the focus of research. Meanwhile, research at Yucca Mountain refined direct seeding and transplanting techniques and studied the response of different native plant species to the various reclamation techniques (Civilian Radioactive Waste Management System, 1999). Because of the poor growing conditions experienced this year, none of the research sites was monitored.

In the late 1990s reclamation moved to an operational level. The Double Tracks remediation site, which was a little over 3 ha (9 ac), was seeded in the fall of 1996. The following year four Corrective Action Units (CAU) were revegetated on the TTR and U-3ax/bl CAU on the NTS (Anderson and Ostler, 2002). At all four sites, the construction of a vegetated soil cover cap was part of the closure design.

Revegetation procedures varied somewhat among the different sites. At Central Nevada Test Area, a combination of seeding and transplanting was used. All of the TTR sites were seeded but not irrigated. The U-3ax/bl site on the NTS was seeded and, like the Double Tracks site, was irrigated during the first growing season (BN, 2006). All sites were fenced to exclude large grazing animals, rabbits, or both.

Active restoration of sites burned by wildland fires has not been a common practice on the NTS, until a fire burned approximately 121 ha (330 ac) around facilities in Area 12. The fire, termed the Egg Point Fire, removed the vegetation from steep, rocky slopes, which created a risk of increased erosion during precipitation events. The area was revegetated in the fall of 2002 and spring of 2003 using seeding and transplanting methods. As an immediate protection to the exposed soils, a soil-stabilizing solution was applied to high-risk areas the following winter and spring. At several more recent wildland fire sites, some seeding has occurred at the research level to evaluate timing of seeding as well as species performance.

These reseeded areas are monitored periodically to evaluate long-term effects of the revegetation techniques used. The results of the monitoring program in 2007 are reported in the following sections.

8.1 Methods

Habitat restoration monitoring procedures vary from site to site but for the most part follow the same pattern. Sampling usually occurs during the period of peak production, late spring and early summer for most sites on the NTS and surrounding areas. Several linear transects are located on each site to provide a representative sampling of the site. Plant cover is measured beginning the fifth year after revegetation or as may be required by regulation. Plant density is typically measured the first, third, and fifth years after reseeding, and continued at five-year intervals. Data for both cover and density are summarized for each transect and each site.

In most cases reference sites are also sampled. Reference sites are representative of the type of vegetation that occurred prior to the disturbance and restoration activities. The amount of plant cover, density, and species richness of plants on the reference sites serve as standards for the restoration site and provide a means of determining revegetation success. Specific standards have not been set for any of the sites presented in this report; however, a standard of 70 percent of the cover and density measured on the reference site is typically used and is applied in this report.

8.2 Monitoring Results: Project Sites

The Double Tracks remediation site on the TTR was scheduled to be monitored in 2006, ten years after revegetation, but access was restricted because of a site reevaluation. This site was the first of four storage-transportation nuclear test sites to be remediated and revegetated on the TTR (Hall and Anderson, 1999). Access was granted in 2007 and this site was monitored.

The four CAUs located on the TTR were monitored in 2007. They included CAUs 400-Five Points Landfill, and Bomblet Pit, CAU 426-Cactus Springs Waste Trenches, and CAU 404-Rollercoaster Sewage Lagoons. The results of monitoring efforts for these projects are presented in the following sections. Plant cover and density data are reported for the third, fifth, and tenth year after revegetation, which was in 1997.

8.2.1 Double Tracks

On May 15, 1963, the Double Tracks test, which consisted of plutonium and depleted uranium, was exploded on the Nevada Test and Training Range to study the dispersal of radionuclides in the environment (Church, 1969; Shreve, 1965). As a result of the explosion, plutonium was scattered across the Double Tracks site (Shreve, 1964).

During the summer and early fall of 1996, remediation of the Double Tracks site occurred. The remediation process entailed scraping the top 5 to 15 cm (2 to 6 in.) of contaminated topsoil, packaging the soil, and transporting it to a disposal site at the NTS. The last phase of the remediation process was to revegetate the land surface disturbed by the remediation process. The revegetation objective was to establish a permanent native vegetative cover on the site to reestablish wildlife habitat.

During the fall of 1996, all of the areas to be reclaimed were ripped to a depth commensurate with the degree of compaction. Areas with large dirt clods were disked to smooth the seedbed. Additionally, portions of the site were recontoured to predisturbance conditions with emphasis on reestablishing natural drainages.

Native species were used in the seed mix in proportions similar to what naturally occurs on the site. To determine species composition, a reference area was located adjacent to the remediation site, and plant density and cover data were collected from 15 transects, measuring 50 m (164 ft), in July 1995 (Anderson and Hall, 1996). A seed mix was then developed based on the density and cover data from the reference area. Additional species, such as *Pleuraphis jamesii* (Galleta), *Grayia spinosa* (Spiny hopsage), and *Atriplex. canescens* (fourwing saltbush), which were not found on the reference area, were included in the seed mix because they do occur in the general vicinity. The remediation site was broadcast-seeded in November 1996, at a rate of 23.5 pure live seed (PLS) kilograms per hectare (kg/ha) (21.0 pounds per acre [lb/ac]), using a tractor-drawn seed drill. Several lengths of chain were attached to the back of the seeder and dragged along the ground to lightly cover the seed. A polyacrylamide gel was applied at a rate of 22.4 kg/ha (20.0 lbs/ac). Gel crystals were used to increase the moisture-holding capacity of the soil and enhance germination.

After seeding was complete, the site was mulched with wheat straw at a rate of 4,500 kg/ha (4,000 lbs/ac). After the straw was blown on the site, a tractor-drawn crimper was used to crimp the straw into the soil.

An irrigation system, designed by Harward Irrigation Systems, was set up onsite in December 1996. Water was stored in two 37,854 L (10,000 gal) storage tanks and pumped through a delivery system composed of nine separate zones. The site was irrigated during the late fall of 1996 and the spring of 1997.

Monitoring of the site (Figure 8-1) first occurred in June of 1997 and again in June of 1998. Densities of seeded and non-seeded plants by species were counted in five 1–2 m^2 quadrats randomly located along 15 50-m (164-ft) transects. In May of 2007, plant densities were again estimated using similar methodologies. Plant cover was also measured in 2007 for the first time on the site. Both plant density and plant cover were estimated for the remediation and reference sites. Average plant cover on the remediation site was 53 percent of plant cover on the reference area, although after 10 years cover would be expected to be higher on the revegetated site. The majority of the cover was from shrubs (Table 8-1) with only a small percentage from forbs. Although grasses do not contribute significantly to the overall plant cover on the reference site, there was no grass cover on the remediation site.

It was evident by the lack of annual growth of perennial plants and the lack of annual forbs this year that the effects of below normal precipitation the last few years continues to have an effect on the vegetation. The perennial plants present onsite appeared to be of a size that would indicate that they are established and are obviously able to withstand the harsh conditions typical of this region. The lack of grasses this year may be the result of the dry conditions that have been experienced in this area over the last few years.

Table 8-1. Percent plant cover on the Double Tracks remediation site and reference area in 2007

	Remediation Site	Reference Area
Shrub	6.8	11.0
Grass	0.0	0.4
Forbs/Annuals	0.2	1.8
Total Plant Cover	7.0	13.2
Bare Ground	84.6	70.8
Litter	8.4	16.0

Figure 8-1. Double Tracks remediation site in 1996 prior to revegetation (top photo); in 1998, two years after revegetation was completed (middle photo); and in 2007 (bottom photo) 11 years after revegetation was complete.

View is looking south from ground zero. (Photos by D. Anderson 1996, 1998, and 2007)

Plant density on the remediation site declined over the last ten years (Table 8-2). The decline is primarily the result of decrease in the number of grasses and forbs. Shrub density is what it was in 1998 (Table 8-2). Grass density, however, is only 17 percent of what it was in 1998. The decrease in grass density as well as the decline in forb density are probably the result of the lack of precipitation the last few years. Grasses and forbs are not as tolerant of drier conditions as the shrubs.

The density of shrubs on the remediation site is only about 30 percent of the shrub density on the reference area. Grass and forb density, however, are about the same as they are on the reference area (Table 8-2). The number of shrub and grass species has declined from 1998 to 2007. In 1998 there were six shrub species and two grass species that made up total plant density, the same number as on the reference area. In 2007 only five shrubs and one grass species were found on the remediation site. This is not a significant reduction but does indicate that some species, until well established, are less tolerant of extended drier conditions. *G. spinosa* was encountered on the remediation site the first two years after revegetation and is found on the reference area. However, ten years after revegetation of the remediation site at the Double Tracks site, no *G. spinosa* was found. There is a similar situation for *Krascheninnikovia lanata* (winterfat), which was present the first couple years after revegetation but was not encountered during sampling this year. A few plants of *K. lanata* were observed onsite this year. Several showed signs of heavy browsing. This species is a preferred species by native browsers and often is browsed to a point where the plant cannot recover and dies (see Section 8.3.3).

There is a good mix of shrubs establishing on the site. The density for *A. canescens, A. confertifolia* (shadscale), *Ephedra nevadensis* (Nevada joint-fir), and *Picrothamnus desertorum* (bud sagebrush) is about the same (Table 8-10). Of special interest is the establishment of *P. desertorum*. This shrub is a common native species, but seed is not available commercially so it was not included in the seed mix. It is encouraging to see that it has become one of the dominant shrubs on the site as a result of immigration from adjacent native populations of the species.

E. nevadensis is not a common component of the local native plant community but is found in the immediate area. It was included in the seed mix and has established well. No volumetric data were taken on plant species this year, but simple observations of this species as well as the other three major shrubs, showed that these are mature plants of moderate height and width with a few showing signs of flowering and setting seed.

Another species that was included in the original seed mix and appeared to establish on the site the first couple years was *Elymus elymoides* (squirreltail). This species was relatively abundant in 1998 but was not found on the site this year. *E. elymoides* is not found on the reference area. *Dasyochloa pulchella* (low woollygrass) is one of the two grass species encountered on the reference area. This species was not included in the seed mix for the Double Tracks site and has not established.

Overall vegetation has established well on the Double Tracks remediation site (Figure 8-1). Plants are establishing on the site although both plant density and cover are less than the density and cover on the reference area. Above normal precipitation has only been experienced two or three of the last ten years at this site. With a few good growing years, i.e., sufficient precipitation, plants will increase in size and vigor. Other species that are not found on the site now may establish in future years.

Table 8-2. Plant density on the Double Tracks remediation site and reference area in plants/m^2 with plants/ft^2 in parentheses

Species	1997	1998	2007	Reference 2007
Shrubs				
Atriplex canescens (fourwing saltbush)	0.5 (0.04)	0.2 (0.02)	0.4 (0.04)	0.2 (0.02)
Atriplex confertifolia (shadscale)	0.6 (0.06)	0.6 (0.06)	0.5 (0.05)	0.5 (0.05)
Ephedra nevadensis (Nevada jointfir)	0.8 (0.07)	0.6 (0.06)	0.4 (0.04)	0.0 (0.00)
Grayea spinosa (spiny hopsage)	0.2 (0.02)	0.1 (0.01)	0.0 (0.00)	0.1 (0.01)
Lycium andersonii (wolfberry)	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)
Krascheninnikovia lanata (winterfat)	0.6 (0.06)	0.2 (0.02)	0.0 (0.00)	0.2 (0.02)
Picrothamnus desertorum (bud sagebrush)	0.0 (0.00)	0.0 (0.00)	0.4 (0.04)	0.8 (0.07)
Sarcobatus vermiculatus (greasewood)	0.4 (0.04)	0.2 (0.02)	0.2 (0.02)	0.2 (0.02)
Grasses				
Achnatherum hymenoides (Indian ricegrass)	1.9 (0.18)	1.0 (0.09)	0.4 (0.04)	0.3 (0.03)
Elymus elymoides (squirreltail)	0.8 (0.07)	1.3 (0.12)	0.0 (0.00)	0.0 (0.00)
Dasyochloa pulchella (low woolygrass)	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)	0.2 (0.02)
Summary by Life-form				
Shrubs	1.4 (0.13)	0.6 (0.06)	0.6 (0.05)	1.8 (0.17)
Grasses	4.6 (0.43)	2.5 (0.23)	0.4 (0.04)	0.5 (0.05)
Forbs/Annuals	0.9 (0.08)	1.19 (0.11)	0.6 (0.05)	0.4 (0.04)
Total Plant Density	6.9 (0.64)	4.3 (0.40)	1.6 (0.14)	2.7 (0.25)

8.2.2 CAU 400-Five Points Landfill

The Five Points Landfill was remediated and revegetated in the fall of 1997. The site is located upslope from Cactus Flats on the TTR. Five transects, two on the section revegetated in the fall of 2000 and not damaged from flooding, and three in the area revegetated in the fall of 2004 after flooding, were sampled in 2007. Plant cover, density, and species richness were averaged over the two and three transects, respectively. The reference area, located north of the revegetated area, was also sampled. Plant cover and density for the two transects in the non-flooded areas and the reference area are presented in this report.

Although overall plant cover is the second lowest recorded since this site was revegetated, perennial plant cover, which includes perennial shrubs and grasses, is the highest it has been since 2003. Plant cover in 2007 was 75 percent of the reference area, so this site met the reclamation success standard for cover. The amount of shrub cover this year was the highest ever recorded at the Five Points Landfill site. Grass cover, although not as high as it was the first three years after revegetation, was the highest it has been in the last four years. There were no annual forbs or grasses this year, which also occurred in 2003 (Table 8-3).

Table 8-3. Percent plant cover on CAU 400-Five Points Landfill. Data reported for areas that were not flooded.

	2000	2002	2007	Reference Site 2007
Shrub	2.5	8.3	10.6	11.7
Grass	10.0	22.5	3.8	7.5
Forbs/Annuals	3.3	1.7	0.0	0.0
Total Plant Cover	15.8	32.5	14.4	19.2
Bare Ground	17.5	17.5	28.1	20.8
Litter	66.7	50.0	57.5	60.0

Plant density for perennial species was 2.2 plants/m^2 (0.20 plants/ft^2) this year (Table 8-4), similar to density estimates in 2005 (NSTec, 2007). These two years represent the lowest density values recorded for this site. Shrub density has decreased over the last five years. *A. canescens* continues to be the most dominant shrub at the site. Only two other species, *P. desertorum* and *K. lanata* have been found on the site. *K. lanata* was present last year but was not encountered this year. *P. desertorum* has never been very abundant. Average *P. desertorum* density has only been 0.1 plants/m^2 (0.01 plants/ft^2) the last two years. Density for *A. canescens* has ranged from 0.7 to 1.4 plants/m^2 (0.07 to 0.13 plants/ft^2) over the previous six years, but dropped to 0.5 plants/m^2 (0.05 plants/ft^2) this year. Overall shrub density was 0.6 plants/m^2 (0.06 plants/ft^2) this year, which is the lowest shrub density recorded to date.

Using a revegetation standard of 70 percent plant density, vegetation on the Five Points Landfill site exceeds the standard (Table 8-4). Species richness is higher on the revegetated area than on the reference area. There are three shrub species and three grass species on the revegetated site and one shrub species and two grass species on the reference area.

Table 8-4. Plant density on CAU 400-Five Points Landfill in plants/m^2 with plants/ft^2 in parentheses

Species	2000	2002	2007	Reference Site 2007
Shrubs				
Atriplex canescens (fourwing saltbush)	0.7 (0.07)	1.0 (0.09)	0.5 (0.05)	0.0 (0.0)
Chrysothamnus greenei (Greene's rabbitbrush)	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)	0.6 (0.06)
Krascheninnikovia lanata (winterfat)	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)
Picrothamnus desertorum (bud sagebrush)	0.0 (0.00)	0.1 (0.01)	0.1 (0.00)	0.0 (0.00)
Grasses				
Achnatherum hymenoides (Indian ricegrass)	4.8 (0.45)	3.2 (0.30)	1.0 (0.10)	1.2 (0.11)
Elymus elymoides (squirreltail)	2.2 (0.20)	0.3 (0.03)	0.4 (0.04)	0.1 (0.01)
Pleuraphis jamesii (galleta)	0.0 (0.00)	0.0 (0.00)	0.01 (0.00)	0.0 (0.00)
Summary by Life-form				
Shrubs	0.7 (0.07)	1.1 (0.10)	0.6 (0.06)	0.6 (0.06)
Grasses	7.1 (0.66)	3.6 (0.33)	1.4 (0.14)	1.3 (0.12)
Forbs	10.2 (0.94)	0.4 (0.04)	0.0 (0.0)	0.0 (0.0)
Total Plant Density	18.0 (1.67)	5.0 (0.47)	1.98 (0.17)	1.97 (0.17)

8.2.3 CAU 400-Bomblet Pit

The Bomblet Pit located near the bottom of Cactus Flat on the TTR was seeded in the fall of 1997. The site prior to restoration efforts was heavily disturbed and dominated by *Halogeton glomeratus* (halogeton). The revegetated area and the undisturbed area directly east of the site were sampled this year as has been done in previous years.

Perennial plant cover has steadily increased over the last few years to a high of 22.5 percent this year (Table 8-5). As in previous years, all of the cover is from shrubs. Grasses were found on the site the first few years after revegetation, but since then grasses have not established on the site. Grass cover is relatively low on the reference area, but there are grasses present.

Table 8-5. Percent plant cover on CAU 400-Bomblet Pit

	2000	2002	2007	Reference Site 2007
Shrub	15.8	18.8	22.5	11.3
Grass	2.6	0.0	0.0	2.5
Forbs/Annuals	0.0	0.0	0.0	0.0
Total Plant Cover	18.4	18.8	22.5	13.8
Bare Ground	63.2	61.3	60.0	65.0
Litter	18.4	20.0	17.5	21.3

Shrub density decreased from 2006 to 2007 (NSTec, 2007 [Table 8-6]), mainly due to a decrease in the density of *A. confertifolia*. *P. desertorum* remained about the same and *A. canescens* was present as it was in 2006. There were no grasses encountered in 2007 on the revegetated site. Some *Achnatherum hymenoides* (Indian ricegrass) was found on the site in 2006 for the first time in the last five years. There were no annual forbs on the revegetated site or the reference area.

Perennial plant cover on the Bomblet Pit site is almost double the amount of cover on the reference area. This site exceeds the reclamation success criteria for cover, density, and richness. When considering cover by lifeform, however, there are deficiencies. Grasses are completely absent, so neither grass cover or grass density meet reclamation success criteria. Possibly with consecutive favorable growing seasons over time grasses may reestablish at the Bomblet Pit site. The fact that there were some plants of *A. hymenoides* last year is encouraging.

8.2.4 CAU 426-Cactus Springs Waste Trenches: Project Area

The Cactus Springs Waste Trenches site is located on the eastern slope of the Cactus Range just south and east of Cactus Peak. The site is about 200 m (656 ft) higher than the other closure sites. A project area and the waste trench cover cap were revegetated in the fall of 1997.

Perennial plant cover on the project area at this site was the lowest it has been since 2000. Shrub cover decreased to 2.5 percent this year, which is about half the plant cover of the last couple of years (Table 8-7). Grass cover was the lowest it has been since monitoring began in 2000. There are still grasses present at the site, but there was minimal growth this year. Plant cover was only 43 percent of the reference area, so this site does not meet the reclamation success standard for cover.

Table 8-6. Plant density at CAU 400-Bomblet Pit in plants/m^2 with plants/ft^2 in parentheses

Species	2000	2002	2007	Reference Site 2007
Shrubs				
Atriplex canescens (fourwing saltbush)	0.5 (0.04)	0.3 (0.03)	0.1 (0.01)	0.0 (0.00)
Atriplex confertifolia (shadscale)	6.8 (0.63)	6.5 (0.60)	3.7 (0.34)	1.3 (0.12)
Krascheninnikovia lanata (winterfat)	0.3 (0.02)	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)
Picrothamnus desertorum (bud sagebrush)	3.8 (0.35)	2.5 (0.23)	1.8 (0.16)	3.6 (0.33)
Grasses				
Achnatherum hymenoides (Indian ricegrass)	2.5 (0.23)	0.2 (0.01)	0.0 (0.00)	0.4 (0.04)
Elymus elymoides (squirreltail)	3.1 (0.29)	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)
Pleuraphis jamesii (galleta)	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)	0.2 (0.02)
Summary by Life-form				
Shrubs	11.3 (1.05)	9.2 (0.85)	5.5 (0.51)	4.9 (0.46)
Grasses	5.6 (0.52)	0.2 (0.01)	0.0 (0.00)	0.6 (0.06)
Forbs	5.4 (0.50)	0.3 (0.02)	0.0 (0.00)	0.0 (0.00)
Total Plant Density	22.3 (2.07)	9.6 (0.89)	5.5 (0.51)	5.5 (0.51)

Table 8-7. Percent plant cover on CAU 426-Cactus Springs Waste Trenches: Project area

	2000	2002	2007	Reference Site 2007
Shrub	0.8	5.0	2.5	17.5
Grass	5.8	12.5	5.0	0.0
Forbs/Annuals	0.0	1.7	0.0	0.0
Total Plant Cover	6.7	19.2	7.5	17.5
Bare Ground	50.0	42.5	67.5	63.8
Litter	43.3	38.3	25.0	18.8

Overall perennial plant density was also about half what it was in 2002. Shrub density has been about the same since 2000. The decrease this year from last year is due to the absence of both *A. confertifolia* and *Chrysothamnus viscidiflorus* (Douglas rabbitbrush) (Table 8-6). The density of *Ephedra nevadensis* and *Ericameria nauseosa* (rubber rabbitbrush) was the same as last year. The fluctuations from year to year in overall perennial plant density have been the result of the changes in grass density. Grass density has ranged from 1.6 plants/m^2 (0.15 plants/ft^2) in 2003 to over 6 plants/m^2 (0.56 plants/ft^2) in 2000 and 2005 (see Table 8-6 of NSTec, 2007). There was a decrease this year for all three grass species.

Table 8-8. Plant density at CAU 426-Cactus Springs Waste Trenches: Project area in plants/m^2 with plants/ft^2 in parentheses

Species	2000	2002	2007	Reference Site 2007
Shrubs				
Artemisia nova	0.0	0.1	0.0	0.8
(black sagebrush)	(0.00)	(0.00)	(0.00)	(0.07)
Atriplex canescens	0.1	0.0	0.1	0.0
(fourwing saltbush)	(0.01)	(0.00)	(0.01)	(0.00)
Atriplex confertifolia	0.1	0.0	0.0	0.1
(shadscale)	(0.01)	(0.00)	(0.00)	(0.01)
Chrysothamnus viscidiflorus	0.1	0.1	0.0	0.0
(Douglas' rabbitbrush)	(0.01)	(0.01)	(0.00)	(0.00)
Ephedra nevadensis	0.3	0.2	0.4	0.0
(Nevada jointfir)	(0.02)	(0.02)	(0.03)	(0.00)
Ericameria nauseosa	0.1	0.0	0.1	0.0
(rubber rabbitbrush)	(0.01)	(0.00)	(0.01)	(0.00)
Krascheninnikovia lanata	0.0	0.0	0.0	0.0
(winterfat)	(0.00)	(0.00)	(0.00)	(0.00)
Picrothamnus desertorum	0.0	0.1	0.0	0.2
(bud sagebrush)	(0.00)	(0.01)	(0.00)	(0.02)
Grasses				
Achnatherum hymenoides	1.4	0.6	0.2	0.2
(Indian ricegrass)	(0.13)	(0.06)	(0.02)	(0.02)
Elymus elymoides	5.2	2.9	2.1	0.0
(squirreltail)	(0.48)	(0.27)	(0.20)	(0.00)
Pleuraphis jamesii	0.2	0.1	0.1	1.6
(galleta)	(0.02)	(0.01)	(0.01)	(0.15)
Summary by Life-form				
Shrubs	0.7	0.5	0.5	1.0
	(0.06)	(0.05)	(0.05)	(0.09)
Grasses	6.8	3.5	2.3	1.7
	(0.63)	(0.33)	(0.21)	(0.16)
Forbs/Annuals	16.9	1.8	0.1	0.0
	(1.57)	(0.17)	(0.01)	(0.00)
Total Plant Density	24.4	5.8	2.9	2.7
	(2.26)	(0.54)	(1.09)	(0.25)

8.2.5 CAU 404-Rollercoaster Sewage Lagoons

The Rollercoaster Sewage Lagoon site covers approximately 2.2 ha (5.5 ac). Three-fourths of the site is the project area disturbed during remediation activities and was revegetated along with the cover cap in the fall of 1997. This site is located midslope between the playa bottoms of Cactus Flat and the foothills of the Cactus Range.

Plant cover decreased from 2006 to 2007 at this site (NSTec, 2007). The 17.2 percent cover recorded this year (Table 8-9) is greater than the cover for the reference area (15.6 percent), so this site has exceeded the reclamation success standard. Shrub cover decreased slightly and grass cover was zero. The only other year there was no grass cover was in 2004.

Density for the two dominant shrubs on the project area at the Rollercoaster Sewage Lagoon site decreased this year from 2002. *A. confertifolia* and *P. desertorum* continue to be important components of the plant community. Overall there was a 30 percent decrease in the density of shrubs from last year to this year. The total plant density for the site in 2007 (5.6 plant/m^2) exceeded the total plant density of the reference area (5.5 plants/m^2), so this site has met the reclamation success standard. Species richness of the revegetated site (four species) met the success standard of 75 percent of the reference area (five species).

Table 8-9. Percent plant cover on CAU 404-Rollercoaster Sewage Lagoons—Project area

	2000	2002	2007	Reference Site 2007
Shrub	9.0	18.5	16.7	13.5
Grass	3.5	0.5	0.0	2.1
Forbs/Annuals	0.0	0.0	0.6	0.0
Total Plant Cover	12.5	19.0	17.2	15.6
Bare Ground	56.5	53.0	61.7	64.6
Litter	31.0	28.0	21.1	19.8

P. jamesii and *Achnatherum hymenoides* were the only perennial grasses found at the site. *E. elymoides* was found the first few years after revegetation but has not established on the site. The density of grasses has decreased slightly over the last five years (Table 8-10). There were no annual forbs or grasses encountered on the project area this year.

8.3 Monitoring Results: Cover Caps

Part of the closure cover remediation process involved the placement of an engineered cover cap followed by the establishment of a vegetative cover. The main objectives of the vegetative cover are to control surface soil erosion and minimize the quantity and depth of water infiltration. Shallow rooted native plants capture and remove soil moisture via evapotranspiration. This year two cover caps of the CAU closure sites on the TTR and one at U-3ax/bl on the NTS were monitored. Results are presented in the following sections.

8.3.1 CAU 426-Cactus Springs Waste Trenches: Cover Cap

The cover cap at the Cactus Springs Waste Trenches is relatively small compared to the ones at the Rollercoaster Sewage Lagoons sites and U-3ax/bl. The site is adjacent to Cactus Springs at the base of the Cactus Range Mountains. It was revegetated in the fall of 1997 using a seed mix of species native to the area. The site has been monitored periodically since it was revegetated.

Table 8-10. Plant density at CAU 404-Rollercoaster Sewage Lagoons—Project area in plants/m² with plants/ft² in parentheses

Species	2000	2002	2007	Reference Site 2007
Shrubs				
Atriplex canescens (fourwing saltbush)	0.3 (0.03)	0.2 (0.02)	0.0 (0.00)	0.0 (0.00)
Atriplex confertifolia (shadscale)	10.0 (0.93)	6.9 (0.64)	3.9 (0.36)	0.6 (0.06)
Krascheninnikovia lanata (winterfat)	0.0 (0.00)	0.1 (0.01)	0.0 (0.00)	0.0 (0.00)
Picrothamnus desertorum (bud sagebrush)	1.7 (0.16)	1.2 (0.11)	1.4 (0.13)	2.9 (0.27)
Grasses				
Achnatherum hymenoides (Indian ricegrass)	2.5 (0.23)	0.5 (0.04)	0.1 (0.01)	0.4 (0.04)
Elymus elymoides (squirreltail)	6.2 (0.58)	0.1 (0.01)	0.0 (0.00)	0.0 (0.00)
Dasyochloa pulchella (low woolygrass)	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)	0.2 (0.02)
Pleuraphis jamesii (galleta)	0.8 (0.07)	0.3 (0.03)	0.1 (0.01)	0.9 (0.08)
Summary by Life-form				
Shrubs	12.1 (1.12)	8.4 (0.78)	5.4 (0.50)	3.6 (0.35)
Grasses	9.5 (0.88)	0.9 (0.08)	0.2 (0.02)	1.6 (0.15)
Forbs/Annuals	3.5 (0.32)	0.7 (0.07)	0.0 (0.00)	0.3 (0.03)
Total Plant Density	25.0 (2.32)	10.0 (0.93)	5.6 (0.52)	5.5 (0.51)

Plant cover on the cover cap at the Cactus Springs Waste Trenches site increased this year from last (NSTec, 2007). The 23.3 percent total plant cover (Table 8-11) is the highest amount recorded to date at this site. Shrub cover increased from 6.7 percent in 2002 to 20.0 percent this year. Grass cover was the same as last year.

The amount of plant cover on the cover cap exceeds a revegetation standard of 70 percent of the cover found on a reference area. The standard for shrub cover would be 70 percent of 17.5 percent or 12.3 percent, which is exceeded. There was no grass cover on the reference area, but there was 3.3 percent on the cover cap. Based on plant cover, the standards for assessing revegetation success were exceeded this year.

Perennial plant density decreased from last year (NSTec, 2007). The density of shrubs was about 25 percent less this year than last, and grass density was only 20 percent of what it was last year. The 1.9 plants/m^2 (0.18 plants/ft^2) for overall plant density is the lowest recorded to date at this site (Table 8-12). Shrub density is the lowest it has been since 2000, and grass density is the lowest it has ever been. The density of *E. nauseosa* was only 25 percent of what it was last year. *E. elymoides* and *P. jamesii* were completely absent this year for the first time since the site was revegetated. The density of *A. hymenoides* was a third of what it was last year.

Revegetation success standards based on plant density were established as was done for plant cover. Again using 70 percent of the plant density measured on the reference area as the standard, a density of 1.9 plants/m^2 would be needed to achieve revegetation success. That was the density of plants on the cover cap this year (Table 8-12). Shrub density actually exceeded the standard for shrub density, but the density of grasses was only about a third of the standard.

Table 8-11. Percent plant cover at CAU 426-Cactus Springs Waste Trenches: Cover cap

	2000	2002	2007	Reference Site 2007
Shrub	0.0	6.7	20.0	17.5
Grass	3.3	8.3	3.3	0.0
Forbs/Annuals	0.0	0.0	0.0	0.0
Total Plant Cover	3.3	15.0	23.3	17.5
Bare Ground	85.0	78.3	66.7	63.8
Litter	11.7	6.7	10.0	18.8

Table 8-12. Plant density at CAU 426-Cactus Springs Waste Trenches: Cover cap in plants/m² with plants/ft² in parentheses

Species	2000	2002	2007	Reference Site 2007
Shrubs				
Artemisia nova (black sagebrush)	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)	0.8 (0.07)
Picrothamnus desertorum (bud sagebrush)	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)	0.2 (0.02)
Atriplex confertifolia (shadscale)	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)	0.1 (0.01)
Ephedra nevadensis (Nevada jointfir)	0.1 (0.01)	0.1 (0.01)	0.3 (0.03)	0.0 (0.00)
Chrysothamnus viscidiflorus (Douglas' rabbitbrush)	1.0 (0.09)	1.3 (0.12)	0.9 (0.08)	0.0 (0.00)
Ericameria nauseosa (rubber rabbitbrush)	0.1 (0.01)	1.1 (0.11)	0.2 (0.02)	0.0 (0.00)
Krascheninnikovia lanata (winterfat)	0.1 (0.01)	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)
Grasses				
Achnatherum hymenoides (Indian ricegrass)	1.3 (0.12)	0.7 (0.07)	0.4 (0.04)	0.2 (0.02)
Elymus elymoides (squirreltail)	1.0 (0.09)	0.2 (0.02)	0.0 (0.00)	0.0 (0.00)
Pleuraphis jamesii (galleta)	1.4 (0.13)	0.7 (0.06)	0.0 (0.00)	1.6 (0.15)
Summary by Life-form				
Shrubs	1.3 (0.12)	2.5 (0.24)	1.5 (0.14)	1.0 (0.09)
Grasses	3.7 (0.37)	1.6 (0.15)	0.4 (0.04)	1.7 (0.16)
Forbs/Annuals	0.1 (0.01)	1.1 (0.11)	0.0 (0.00)	0.0 (0.00)
Total Plant Density	5.0 (0.46)	5.3 (0.49)	1.9 (0.18)	2.7 (0.25)

8.3.2 CAU 404-Rollercoaster Sewage Lagoons: Cover Cap

The Rollercoaster Sewage Lagoon site covers approximately 2.2 ha (5.5 ac) midslope between the Cactus Mountain Range and Cactus Flats on the TTR. About one quarter of the site is a cover cap that is 1 m (3.2 ft) higher than the rest of the site. The cover cap was seeded with a mix of native shrubs and grasses in the fall of 1997. Plant cover and density as well as overall condition of the cover cap have been monitored since the spring of 1998.

Plant cover on the cover cap decreased from an all-time high of 36.3 percent in 2005 to 25.6 percent in 2006 (NSTec, 2007) and 7.5 percent in 2007 (Table 8-13). Shrub cover and grass cover decreased from 2002 levels. Shrub cover decreased to 7.5 percent, which represents the second lowest amount of shrub cover since the site was revegetated. Grass cover is lower than it was in 2002, but about what it has been for the last four years (NSTec, 2007). Forbs have only contributed to overall cover two of the six years the site was sampled. The composition of plant cover is nearly an equal percentage of grass cover and shrub cover. At most sites, shrubs are the most dominant and grasses contribute less to overall plant cover.

Table 8-13. Percent plant cover at CAU 404-Rollercoaster Sewage Lagoons: Cover cap

	2000	2002	2007	Reference Site 2007
Shrub	6.3	10.0	7.5	13.5
Grass	12.5	16.3	10.0	2.1
Forbs/Annuals	0.0	0.0	0.0	0.0
Total Plant Cover	18.8	26.3	17.5	15.6
Bare Ground	73.8	65.0	67.5	64.6
Litter	7.5	8.8	9.2	19.8

Plant density was lower this year than it has ever been on the cover cap (Table 8-14). However, there are still about four individual shrubs and three individual grasses found within 1 m^2 (0.09 ft^2). *A. confertifolia* continues to be the most dominant species. *P. desertorum* and *A. canescens* are present, but at lower densities. *P. jamesii* is the most common grass. The only other grass encountered was *A. hymenoides,* which has declined in density over the last five years. In 2006, a few plants of *E. elymoides* were found, but none was encountered in 2007.

There has been a gradual decline in the density of shrubs and grasses since the site was revegetated. There was a decrease in shrub density in 2007 from 6.3 shrubs/m^2 (0.59 shrubs/ft^2) in 2006 to 4.1 shrubs/m^2 (0.38 shrubs/ft^2) in 2007. A similar decline occurs for grasses. Overall, the decrease in shrub and grass density over the past five years from 2005 to 2007 appears to result from a decrease in the density of *A. confertifolia, P. desertorum, P. jamesii,* and *A. hymenoides.*

Total plant cover exceeds the amount of cover found on the reference site (Table 8-13). Shrub cover is, however, just 55 percent of the shrub cover on the reference area, whereas grass cover is five times the amount of cover found on the reference site. Shrub and grass densities, although the lowest reported to date, are still well above the density reported for the reference area (Table 8-14). Shrubs are slightly more abundant on the cover cap than on the reference area, and grass densities are about twice what they are on the reference area. Species richness of the revegetated site (six species) exceeded species richness on the reference area (five species), so the reclamation success criteria for species richness was met at this site.

Table 8-14. Plant density at CAU 404-Rollercoaster Sewage Lagoons: Cover cap in plants/m^2 with plants/ft^2 in parentheses

Species	2000	2002	2007	Reference Site 2007
Shrubs				
Picrothamnus desertorum	2.1	1.7	0.8	2.9
(bud sagebrush)	(0.19)	(0.15)	(0.08)	(0.27)
Atriplex canescens	0.9	0.6	0.3	0.0
(fourwing saltbush)	(0.08)	(0.06)	(0.03)	(0.00)
Atriplex confertifolia	10.9	7.0	3.0	0.6
(shadscale)	(1.01)	(0.65)	(0.28)	(0.06)
Krascheninnikovia lanata	0.3	0.1	0.0	0.0
(winterfat)	(0.03)	(0.01)	(0.00)	(0.00)
Grasses				
Achnatherum hymenoides	3.8	2.8	0.3	0.4
(Indian ricegrass)	(0.35)	(0.26)	(0.03)	(0.04)
Elymus elymoides	10.8	1.6	0.0	0.0
(squirreltail)	(1.00)	(0.14)	(0.00)	(0.00)
Dasyochloa pulchella	0.0	0.0	1.0	0.2
(low woolygrass)	(0.00)	(0.00)	(0.09)	(0.02)
Pleuraphis jamesii	8.6	4.7	2.8	0.9
(galleta)	(0.80)	(0.43)	(0.26)	(0.08)
Summary by Life-form				
Shrubs	14.2 (1.31)	9.3 (0.86)	4.1 (0.38)	3.6 (0.33)
Grasses	23.2 (2.15)	9.0 (0.84)	3.0 (0.28)	1.6 (0.15)
Forbs/Annuals	0.5 (0.04)	0.3 (0.03)	0.1 (0.01)	0.3 (0.03)
Total Plant Density	37.8 (3.51)	18.6 (1.73)	7.2 (0.67)	5.5 (0.51)

8.3.3 CAU 110-Area U-3ax/bl: Cover Cap

A cover cap for the U-3ax/bl disposal unit in Area 3 of the NTS was approved and constructed in the fall of 2000. Immediately after the construction of the cover cap, actions were taken to reestablish a cover of native vegetation. The surface of the completed closure cover was ripped to about 15 cm (6 in.) and disked to provide a suitable seedbed. A seed mix consisting of nine native shrub species, two native grasses, and one native forb was used to seed the surface soils using a Tye drill seeder equipped with multiple drag chains. All plant species included in the seed mix are typically shallow rooted plants. A straw mulch was applied and secured using a Finn crimper. The slopes of the cover cap and the area between the cover and fence were not seeded. All revegetation activities were completed by the end of December 2000. The success of the revegetation effort has been monitored annually since the spring of 2001.

The success of the revegetation efforts at the U-3ax/bl cover cap was determined by estimating plant cover, density, and species richness data and comparing it to non-seeded areas or to similar vegetation types on the NTS. However, there are no sites within close proximity of the U-3ax/bl closure cover that have not been disturbed. Field sampling this year was completed on May 7, 2007. Five of the 15 100-m (328-ft) long permanent transects were randomly selected for sampling (transect numbers 2, 6, 7, 8, and 14). Three of the five 50-m (164-ft) permanent transects located between the cover cap and the perimeter fence, a non-seeded area, are typically sampled and compared to the seeded area. In 2007, the non-seeded area was not sampled because, like last year, there was no vegetation.

Perennial plant cover was 10.6 percent in 2007, a significant decrease from the 19.6 percent experienced last year, yet still higher than it was in 2004 (Table 8-15). The only plant contributing to plant cover this year was *A. confertifolia*. In previous years, other common shrubs such as *E. nevadensis* and *K. lanata* both contributed to overall plant cover. Grasses have never established well on the cover cap and have never contributed to overall perennial plant cover. This year, like last year, there were no annual plants. Precipitation has been below normal the last two years. Since September of 2006, only 2.5 cm (1.0 in.) of rain has been recorded, obviously insufficient for any annual growth and even detrimental to perennial plant growth and vigor.

Table 8-15. Percent plant cover at CAU 110 U-3ax/bl: Cover Cap

	2004	2006	2007	Unseeded
Shrub	9.6	19.6	10.6	0.0
Grass	0.0	0.0	0.0	0.0
Forbs/Annuals	3.2	0.0	0.0	0.0
Total Plant Cover	12.8	19.6	10.6	0.0
Bare Ground	72.6	57.2	63.6	58.7
Litter	14.6	23.2	25.8	41.3

With the lack of precipitation, noxious annual plants, such as *Salsola iberica* (Russian thistle) and *H. glomeratus*, have not been present in either the seeded or non-seeded areas. As mentioned in previous years, reseeding the cover cap with perennial native plant species, followed by a short-term intensive irrigation, has resulted in a viable perennial plant cover somewhat resistant to typical drought conditions, thus providing a persistent vegetative cover, even during below normal precipitation periods. Without such a persistent perennial plant cover, active evapotranspiration would be dependant on annual plant growth that has been negligible the last two years. Annual plants are non-existent during severe or continuous periods of drought and even during favorable growing conditions their short lifespan (weeks) limits their contribution to evapotranspiration.

The amount of exposed soil as measured by the percentage of bare ground has averaged a little more than 60 percent over the last four years (Table 8-15), not much different than the amount of bare ground on the non-seeded areas. The amount of litter on the closure cover averages 22 percent, notably lower than the 41 percent on the non-seeded areas.

Based on historic data for a similar native vegetation community (Webb et al., 2003), the amount of vegetative cover measured this year on the cover cap is lower than would be expected. Composition of the plant cover is different than was reported historically. *P. desertorum, G. spinosa,* and *Lycium andersonii* (Anderson wolfberry) are common in the native plant community but they have not established on the cover cap. These species were included in the mix of seeds used to revegetate the site knowing that they are typically very difficult to establish from seed. Previously, a few individual plants of *P. desertorum* and *G. spinosa* have been observed on the site, but neither species is present in sufficient numbers to contribute to overall vegetative cover.

The other difference between the U-3ax/bl cover cap and the native vegetation is in the amount of perennial grasses. Grasses have not contributed to plant cover on the cover cap to date. Historically, grasses make up between one and three percent (Webb et al., 2003); less than one percent was recorded in 1963, increasing to 2.5 percent in 1973. Grasses contribute a small amount to overall plant cover in this vegetation type; however, it should be more than is currently measured on the closure cover. *A. hymenoides* and *E. elymoides* are present on the cover cap, and with time and more favorable growing conditions, they may contribute more to total plant cover.

The 2.0 perennial plant species/m^2 (0.02 plants/ft^2) represents the lowest density measured on the cover cap to date (Table 8-16). The decrease cannot be attributed to a single species, but rather a decline in *A. confertifolia, E. nevadensis, K. lanata* and the complete absence of both perennial and annual grasses. *A. hymenoides* has been present at the site since it was revegetated. It declined to 0.1 plants/m^2 (0.01 plants/ft^2)last year and was not observed during sampling this year. Several individual plants of *A. canescens* are still present on the site although not encountered on the sampled plots.

The decrease in plant density this year may be the indirect result of an increase in plant growth a couple of years ago. In response to the increase in the plant growth, small mammal populations increased two to three years ago (NSTec, 2007). At the same time, a marked increase in the number of lagomorphs (rabbits) took place over much of the NTS. The severe drought conditions last year have left these two groups of animals without sufficient food. It was evident during the vegetation sampling session this year that many plants are being grazed to a point where they may not recover. The most common plant experiencing heavy utilization is *K. lanata*. It is more palatable than *A. confertifolia* or *E. nevadensis* and is preferred by browsing animals. *A. confertifolia* also showed signs of heavy browsing. This is quite uncommon because this species is not commonly browsed. In many instances not only has the above-ground biomass been browsed, but animals have burrowed into the roots, in search of moist and more palatable portions of the plant (Figure 8-2). In most cases plants recover from above-ground browsing; however, the attack on the roots of the plant usually results in plant mortality. Over the past few years, the density of *A. confertifolia* has decreased as plants have matured and resources have become more limiting. The intensive browsing observed this year coupled with the effects of severe drought conditions may result in even lower plant densities in future years. At the same time, the plants that are present are native to the area and have adapted to dry conditions. When favorable growing conditions return these plants will flower and set seed, as they have in previous years, thus improving the potential of young plants establishing and filling any voids that may have been created from plant mortality during this drought period.

Table 8-16. Plant density on the Area 3 U-3axbl: Cover Cap in plants/m^2 with plants/ft^2 in parentheses

Species	2004	2006	2007	Unseeded 2007
Shrubs				
Atriplex confertifolia (shadscale)	2.3 (0.21)	1.9 (0.18)	1.4 (0.13)	0.0 (0.00)
Ephedra nevadensis (Nevada jointfir)	1.5 (0.14)	1.3 (0.12)	0.4 (0.03)	0.0 (0.00)
Krascheninnikovia lanata (winterfat)	0.7 (0.07)	0.3 (0.03)	0.2 (0.02)	0.0 (0.00)
Grasses				
Achnatherum hymenoides (Indian ricegrass)	0.4 (0.04)	0.1 (0.01)	0.0 (0.00)	0.0 (0.00)
Annual Grasses	0.5 (0.05)	1.2 (0.11)	0.0 (0.00)	0.0 (0.00)
Forbs				
Eriogonum species (annual buckwheat)	7.8 (0.72)	0.2 (0.02)	0.0 (0.00)	0.0 (0.00)
Halogeton glomeratus (halogeton)	3.9 (0.36)	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)
Salsola iberica (Russian thistle)	77.0 (7.15)	3.2 (0.30)	0.0 (0.00)	0.0 (0.00)
Other Annual Forbs	0.4 (0.04)	0.1 (0.01)	0.0 (0.00)	0.0 (0.00)
Summary by Life-form				
Shrubs	4.5 (0.42)	3.5 (0.33)	2.0 (0.19)	0.0 (0.00)
Grasses	0.9 (0.08)	1.3 (0.12)	0.0 (0.00)	0.0 (0.00)
Forbs/Annuals	89.1 (8.28)	3.5 (0.33)	0.0 (0.00)	0.0 (0.00)
Total Plant Density	94.5 (8.78)	8.3 (0.77)	2.0 (0.19)	0.0 (0.00)

Figure 8-2. A plant of *K. lanata* girdled by herbivores such as rabbits or small mammals

8.4 Monitoring Results: Egg Point Fire Revegetation Site

A wildfire named the Egg Point Fire burned approximately 121 ha (300 ac) in Area 12 on August 16, 2002. The majority of the plant cover was lost to the fire; however, there were no significant impacts to wildlife or to any sensitive plant or animal species. In the fall of 2002, the area was seeded with a mix of native plant species, and the following spring approximately 5,000 transplants of plants native to the site were planted in high priority areas.

Vegetation monitoring of the burn site has been conducted annually since 2003 to assess the recovery of the vegetation from the effects of the fire and to evaluate the revegetation techniques used in the restoration efforts. Monitoring initially focused on seed germination and more recently on plant establishment. Data are collected annually to document the species of plants that are colonizing the site, the density of each species, and the contribution of each species to overall plant cover. Data are also collected to document the invasion of non-native annual species.

The area affected by the Egg Point Fire is a mosaic of different vegetation and soil types. Most of the area burned was either *Coleogyne ramosissima* (blackbrush) or *Pinus monophylla*/*Artemisia nova* (Pinyon pine/black sagebrush) vegetation types. Rocky shallow soils are typical of the upper slopes of the burned area, while deeper soils characterize the lower slopes and bottom areas. Different seed mixes were designed for both the upper slopes and lower slopes.

Permanent belt transects, each 50 m (164 ft) long and 1 m (3.2 ft) wide, are sampled annually to assess vegetative cover and plant density. The transects are nested within the different vegetation and soil types. Typically a minimum of three transects are located within each of the different soil-vegetation combinations. A total of 53 transects are located throughout the site. All or a subset of the transects are sampled.

Plant cover was first measured in 2005 on 16 of the 53 transects. In 2007 all sites were sampled for both plant cover and density. Sampling was stratified into upper and lower slopes because different seed mixes were used in the two areas.

8.4.1 Upper Slopes

Overall plant cover decreased substantially from 2005 to 2007 with the largest decreases in grass and forb cover. Shrub cover actually increased by about 50 percent from 2005 to 2007 (Table 8-17). Grass cover was only five percent of what it was two years ago. Growing conditions were much better in 2005 when the region experienced above-normal precipitation than this year. The last two years precipitation has been below normal and the little rainfall that has been received has been in small amounts and very little has infiltrated the soil. The decrease in both forb and grass cover is an indication that growing conditions were poor this year. The big increase in litter this year indicates significant growth of plants in previous years (Table 8-17).

Table 8-17. Percent plant cover on upper slopes of the Egg Point Fire revegetation site

	2005	2007
Shrub	2.2	3.4
Grass	13.4	0.6
Forbs/Annuals	12.0	1.1
Total Plant Cover	27.6	5.2
Bare Ground	62.2	48.4
Litter	10.2	46.4

Plant density more than doubled from 2005 to 2007 (Table 8-18). The increase was due to 35 percent increase in forbs and a 14 fold increase in exotic or invasive species. The density of shrubs decreased by about 30 percent from 2005 to 2007 and perennial grasses decreased by 65 percent during the same period. The only shrub species that increased substantially was *A. nova*, which increased from 0.03 plants/m^2 (0.002 plants/ft^2) in 2005 to 0.13 plants/m^2 (0.01 plants/ft^2) in 2007. *A. canescens* and *E. nauseosa* decreased by about the same percentage. There were only minor variations in the density of other shrubs.

There was a slight increase in the density of *Aristida purpurea* (threeawn grass) and a relative substantial increase in *P. jamesii*. The density of all other perennial grasses decreased. Of significance is the decrease of *Poa secunda* from almost 1 plant/m^2 (0.09 plants/ft^2) in 2005 to no plants in 2007 (Table 8-18). Time of sampling may have biased the results somewhat this year. Sampling occurred throughout the summer, and early flowering species like *P. secunda* may have dried up by the time sampling was conducted. *P. jamesii* is just the opposite. It grows during the hotter summer months, and as sampling progressed through the summer the likelihood of encountering this species would increase.

The only annual forb is Erodium and it increased. Overall forbs increased by nearly 0.07 plants/m^2 (0.006 plants/ft^2) *Heliomeris multiflora* var. *nevadensis* (Nevada goldeneyes) and *Linum lewisii* (Lewis flax) both common forbs on the site in previous years decreased by about 50 percent from 2005 to 2007. One forb, however, increased from none in 2005 to 1.03 plants/m^2 in 2007. *Erodium cicutarium* is a common annual forb on the NTS and is commonly found in great abundance on disturbed areas, such as a burn. This species is considered a nuisance species as are several other species that were found in abundance this year on the Egg Point burn area. There were substantial increases in two exotic grass species, *Bromus rubens* and *B. tectorum*. The density of these two species increased from just 0.5 plants/m^2 (0.05 plants/ft^2) in 2005 to over 8 plants/m^2 (0.76 plants/ft^2) in 2007. *Vulpia ocotoflora,* (Mediterranean grass) an introduced species, was found at the site for the first time this year. Although density is small in comparison to the density of the other two annual grasses, just its presence indicates that it may become a dominant component of vegetation in the future.

S. iberica was present on the site in 2005 and the density of this species, like the other exotics, increased from 2005 to 2007 (Table 8-18). Overall there was more than a 14 fold increase of exotic/invasive species from 2005 to 2007. Typically, these annual invasive species do well when growing conditions are not favorable for perennial native species. The density of these species will be monitored in the future to determine their effect on the establishment of native, perennial shrubs and grasses.

8.4.2 Lower Slopes

There was a similar trend in changes in plant cover from 2005 to 2007 on lower slopes as on upper slopes. Shrub cover increased and both grass and forb cover decreased. However, the magnitude of the change for shrubs was greater. There was 55 percent increase on the upper slopes, but on the lower slopes there was a 350 percent increase in shrub cover. Perennial grass and forb cover declined as it did on the upper slopes (Table 8-19; see also Table 8-17).

As was noted for the upper slopes, there was a marked increase in the amount of litter encountered. The increase from 2005 to 2007 was about the same as it was for the upper slopes, again indicating that in previous years there was a substantial amount of plant growth.

Table 8-18. Plant densities on upper slopes of the Egg Point Fire revegetation site in plants/m² with plants/ft² in parentheses

Species	2005	2007
<u>Major Shrubs</u>		
Artemisia nova (Black sagebush)	0.03 (0.00)	0.13 (0.01)
Atriplex canescens (Fourwing saltbush)	0.12 (0.01)	0.02 (0.00)
Chrysothamnus viscidiflorus (Douglas' rabbitbrush)	0.07 (0.01)	0.06 (0.01)
Coleogyne ramosissima (blackbrush)	0.21 (0.02)	0.20 (0.02)
Ericameria nauseosa species (Rubber rabbitbrush)	0.31 (0.03)	0.21 (0.02)
Miscellaneous Shrubs	0.12 (0.01)	0.09 (0.01)
<u>Major Grasses</u>		
Achnatherum hymenoides (Indian ricegrass)	0.14 (0.01)	0.10 (0.01)
Aristida purpurea (Threeawn grass)	0.01 (0.00)	0.03 (0.00)
Elymus elymoides (Squirreltail)	0.17 (0.02)	0.07 (0.01)
Poa secunda (Sandberg's bluegrass)	0.95 (0.09)	0.00 (0.00)
Pleuraphis jamesii (Galleta)	0.08 (0.01)	0.27 (0.03)
Miscellaneous grasses	0.02 (0.00)	0.05 (0.01)
<u>Major Forbs</u>		
Heliomeris multiflora var.*nevadensis* (Nevada goldeneyes)	0.81 (0.07)	0.48 (0.04)
Linum lewisii (Lewis flax)	0.74 (0.07)	0.35 (0.03)
Penstemon eatonii (Eaton's penstemon)	0.12 (0.01)	0.15 (0.01)
Polygala subspinosa (Spiny milkwort)	0.00 (0.00)	0.13 (0.01)
Sphaeralcea species (Globemallow)	0.18 (0.02)	0.17 (0.01)
Miscellaneous Forbs	0.13 (0.01)	0.17 (0.01)
<u>Exotic/Invasive Species</u>		
Bromus rubens (Red brome)	0.19 (0.02)	0.69 (0.06)
Bromus tectorum (Cheatgrass)	0.30 (0.03)	7.33 (0.68)
Erodium cicutarium (Filaree)	0.00 (0.00)	1.03 (0.10)
Salsola species (Russian thistle)	0.04 (0.00)	0.07 (0.01)
Vulpia octoflora (Mediterranean grass)	0.00 (0.00)	0.06 (0.01)
<u>Summary by Life-form</u>		
Shrubs	1.09 (0.10)	0.74 (0.07)
Grasses	1.43 (0.13)	0.50 (0.05)
Forbs	1.96 (0.18)	2.63 (0.24)
Exotic/Invasive	<u>0.53</u> <u>(0.05)</u>	<u>8.15</u> <u>(0.76)</u>
Total Plant Density	5.01 (0.47)	12.01 (1.12)

Table 8-19. Percent perennial plant cover on the lower slopes of the Egg Point Fire revegetation site

	2005	2007
Shrub	1.2	5.4
Grass	20.2	0.6
Forbs/Annuals	11.5	1.6
Total Plant Cover	32.8	7.6
Bare Ground	52.5	41.9
Litter	14.6	50.5

Overall plant density on the lower slopes of the Egg Point burn area increased from 2005 to 2007. There was a 35 percent increase from two years ago on the lower slopes, which compares to a 140 percent increase on the upper slopes (Table 8-20; see also Table 8-18). Again the increase was not in perennial shrubs and grasses but in annual forbs and exotic or invasive grasses. On the upper slopes, there was a four-fold increase in the density of *A. nova*, a common native shrub. However, on the lower slopes this species decreased from a high of 0.4 plants/m^2 (0.04 plants/ft^2) in 2005 to none this year. Also of note are decreases in the density of *C. viscidiflorus* and *C. ramosissima*, both species common in the native plant community.

On the lower slopes there was a decrease in the density of *E. elymoides* and *P. secunda* and a slight increase in the density of *A. hymenoides* and *P. jamesii*. For reasons explained previously, timing of sampling may account for the increase in *P. jamesii* and the decrease in *P. secunda*.

There were increases in the density of *H. multiflora* var. *nevadensis* and *Penstemon palmeri* (Palmer's penstemon) from 2005 to 2007, but again the major increases occurred with *E. cicutarium,* which increased from none in 2005 to 2.21 plants/m^2 (0.2 plants/ft^2) in 2007. The two *Bromus* species increased also from a combined density of 0.4 plants/m^2 (0.04 plants/ft^2) in 2005 to 3.3 plants/m^2 (0.03 plants/ft^2) in 2007. The other exotic/invasive annual grass, *V. octoflora*, was not encountered on the lower slopes. Overall there was a 214 percent increase in exotic/invasive plant species from 2005 to 2007.

Table 8-20. Perennial plant densities on the lower slopes of the Egg Point Fire revegetation site in plants/m² with plants/ft² in parentheses

Species	2005	2007
Major Shrubs		
Artemisia nova (Black sagebush)	0.39 (0.04)	0.00 (0.00)
Atriplex canescens (Fourwing saltbush)	0.04 (0.00)	0.08 (0.01)
Chrysothamnus viscidiflorus (Douglas' rabbitbrush)	0.21 (0.02)	0.08 (0.01)
Coleogyne ramosissima (blackbrush)	0.35 (0.03)	0.15 (0.01)
Ephedra viridis (Green ephedra)	0.01 (0.00)	0.01 (0.00)
Ericameria nauseosa species (Rubber rabbitbrush)	0.31 (0.03)	0.48 (0.04)
Purshia stansburyiana (Stansbury's cliffrose)	0.10 (0.01)	0.03 (0.00)
Miscellaneous Shrubs	0.01 (0.00)	0.04 (0.00)
Major Grasses		
Achnatherum hymenoides (Indian ricegrass)	0.14 (0.01)	0.18 (0.02)
Aristida purpurea (Threeawn grass)	0.00 (0.00)	0.00 (0.00)
Elymus elymoides (Squirreltail)	0.10 (0.01)	0.04 (0.00)
Poa secunda (Sandberg's bluegrass)	1.28 (0.12)	0.00 (0.00)
Pleuraphis jamesii (Galleta)	0.02 (0.00)	0.06 (0.01)
Miscellaneous grasses	0.00 (0.00)	0.00 (0.00)
Major Forbs		
Heliomeris multiflora var. *nevadensis* (Nevada goldeneyes)	0.73 (0.07)	0.82 (0.08)
Linium lewisii (Lewis flax)	0.98 (0.09)	0.68 (0.06)
Penstemon eatonii (Eaton's penstemon)	0.50 (0.05)	0.04 (0.00)
Penstemon palmeri (Palmer's penstemon)	0.04 (0.00)	0.18 (0.02)
Sphaeralcea ambigua (Desert globemallow)	0.26 (0.02)	0.10 (0.01)
Miscellaneous Forbs	0.02 (0.00)	0.23 (0.02)
Exotic/Invasive Species		
Bromus rubens (Red brome)	0.02 (0.00)	0.26 (0.02)
Bromus tectorum (Cheatgrass)	0.39 (0.04)	3.06 (0.28)
Erodium cicutarium (Filaree)	0.00 (0.00)	2.21 (0.21)
Salsola species (Russian thistle)	0.46 (0.04)	0.15 (0.01)
Summary by Life-form		
Shrubs	1.44 (0.13)	0.86 (0.08)
Grasses	1.55 (0.14)	0.28 (0.03)
Forbs	2.52 (0.23)	4.34 (0.40)
Exotic/Invasive	1.11 (0.10)	3.48 (0.32)
Total Plant Density	6.62 (0.62)	8.95 (0.83)

9.0 MONITORING THE NPTEC

9.1 Task Description

Biological monitoring at the NPTEC on the playa of Frenchman Lake in Area 5 is performed, if necessary, for certain types of chemical releases as per NPTEC's programmatic Environmental Assessment. In addition, the Environment, Safety, Health, and Quality Division has requested that NSTec monitor any test that may impact plants or animals downwind off the playa. A Biological Monitoring Plan for the NPTEC was prepared in FY 1996 and updated in FY 2002 (BN, 2002). It describes how field surveys will be conducted to determine test impacts on plants and animals and to verify that NPTEC's program complies with pertinent state and federal environmental protection requirements. The design of the monitoring plan calls for the establishment of three control transects and three treatment transects at three distances from the main chemical release points on the playa. The control and treatment transects have similar environmental and vegetation characteristics.

NSTec biologists are tasked to review chemical release test plans to determine if field monitoring along the treatment transects is required for each test as per the monitoring plan criteria. All test-specific field monitoring is funded through the NPTEC. Since 1996, the majority of chemical releases being studied at NPTEC have used such small quantities that downwind test-specific monitoring has not been necessary.

9.2 Task Progress Summary

NSTec reviewed chemical spill test plans for the following activities in 2007: Tarantula II and Black Widow 50, 100, and 150. Chemicals were released at such low volumes or low toxicity that there was no need to monitor downwind transects for biological impacts.

Baseline monitoring was only conducted at established control-treatment transects near the NPTEC in September–October. This monitoring noted the condition of plants and the presence of wildlife sign during the period of vegetative growth following summer rainfall. A spring sampling was not conducted because of the drought that was occurring since the middle of 2006, and no new growth of plants had occurred during the spring of 2007. No differences in biota were noted along downwind (treatment) versus upwind (control) transects. There was a decline in the amount of small mammal activity at both the 3-km and 5-km (1.9-mi and 3.1-mi) transects compared with 2005 and 2006 transects (Table 9-1). The lack of precipitation and vegetation production in 2007 appear to have had a negative impact on small mammal reproduction and activity in 2007. Baseline monitoring data are collected to document cumulative impacts over time of test center activities on biota downwind of the facility. These data are made available to neighboring land managers upon request.

Table 9-1. Active small mammal burrows recorded on 1-km transects during October sampling 2005–2007

TRANSECTS	2005	2006	2007
1 km (0.62 mi) Control	8	13	2
1 km (0.62 mi) Treatment	0	2	0
3 km (1.86 mi) Control	337	475	305
3 km (1.86 mi) Treatment	60	39	25
5 km (3.11 mi) Control	365	322	293
5 km (3.1 mi) Treatment	520	373	190

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