Spring Mountains National Recreation Area
Las Vegas Ranger District
Humboldt-Toiyabe National Forest

2010 Annual Report

Monitoring and Evaluation for Conserving Biological Resources of the Spring Mountains National Recreation Area

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Jim Menlove, Ecologist with Interior West Forest Inventory and Analysis program at the Rocky Mountain Research Station located in Ogden, UT, contributed FIA analysis and reporting information.

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Abe Springer and Larry Stevens from NAU were instrumental in developing the Cost Reimbursable Agreement and providing oversight and leadership for the spring inventory program.

Training and technical support provided by Rob Vaughn from the Remote Sensing Applications Center on the use of GIS Spatial Analyst and the TEUI Toolkit RSAC provided the contract team and SMNRA staff with a greater appreciation of these tools to assist with data analysis and presentation.

Don Fallon, Intermountain Region inventory and monitoring coordinator, assisted the contract team with the TEUI Toolkit training and development of the annual report outline and review.

Michael Wilson, Debra Finch, and Bill Block, Science Program Managers for the Rocky Mountain Research Station, provided support and staff assistance for inventory and monitoring and development of this report.

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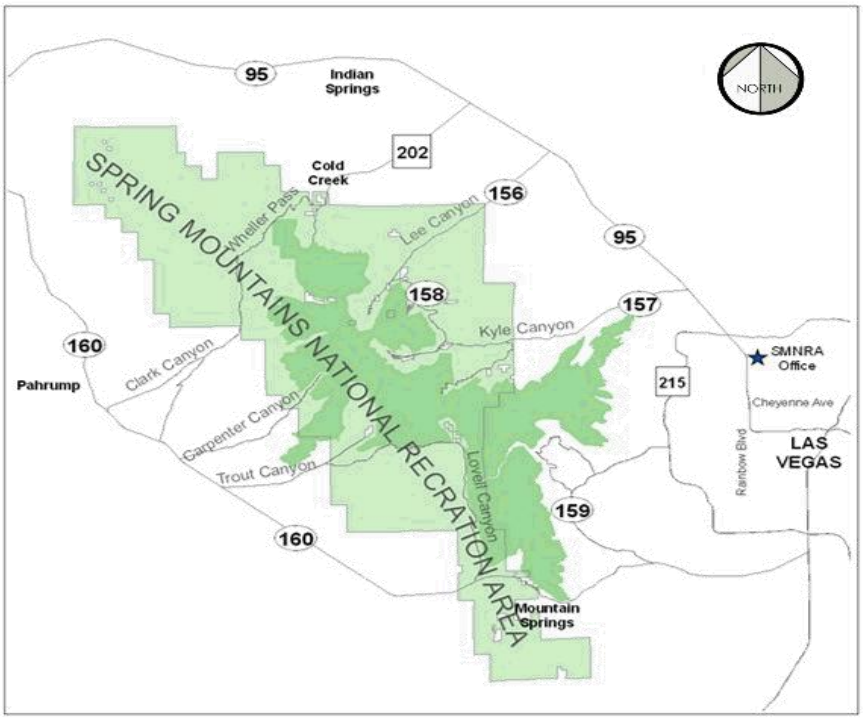
Figure 1-1: Spring Mountains National Recreation Area



Mount Charleston, Spring Mountains National Recreation Area

1. Introduction

The Spring Mountains National Recreation Area (SMNRA) includes approximately 316,000 acres of National Forest System lands managed by the Humboldt-Toiyabe National Forest in Clark and Nye Counties, Nevada (see Figure 1-1). The Spring Mountains have long been recognized as an island of endemism, harboring flora and fauna found nowhere else in the world. Conservation of the species endemic to and resident in the Spring Mountains is a goal described in the Organic Act for the SMNRA (Public Law 102-63, August 4, 1993).

Management direction for the SMNRA was established in an amendment (USFS 1996) to the Toiyabe National Forest Land and Resource Management Plan (USFS 1986) which is often referred to as the "General Management Plan" (GMP).

In 1998, a Conservation Agreement (USFS 1998) was developed between the Forest Service, US Fish and Wildlife Service and State of Nevada, Department of Conservation and Natural Resources affirming the parties' commitment to providing long-term protection for the rare and sensitive flora and fauna of the SMNRA. The Conservation Agreement is being revised and updated and is proceeding through the approval process (USFS 2011a). Since the SMNRA's establishment, efforts to conduct inventory and monitoring have contributed to a greater understanding of the species' habitats and status. However, several problems persist in the approach to monitoring and evaluation which led to the development of a comprehensive strategy for inventory and monitoring within the SMNRA.

The ***Spring Mountains NRA Inventory and Monitoring Strategy*** (I&M Strategy) (USFS 2008) was developed to establish a comprehensive inventory and monitoring program to provide a basis for protecting and conserving resident biological resources. I&M Strategy objectives included:

- Establish a sustainable monitoring and evaluation system with respect to cost over a 10-20 year time horizon.
- Provide high quality data using statistically sound inventory and monitoring methods when possible and appropriate.
- Identify data gaps associated with priority monitoring questions and methods for acquiring needed data.
- Utilize data and information systems that support dynamic and scalable evaluation processes.
- Provide the ability to detect locally and globally induced changes in ecological context as well as the ability to focus on species specific information.

Species that are the focus of this monitoring and evaluation effort were identified in the SMNRA Landscape Assessment (ENTRIX, Inc. 2008) and are reflected in the updated Conservation Agreement (CA) (USFS 2011a). Species and their priorities are listed in Table 1-1.

Monitoring questions and priorities established in the I&M Strategy are detailed in Appendix A.

Table 1-1: Spring Mountains NRA Conservation Agreement Species List

Tier 1 Species	
Invertebrates	Acastus checkerspot (*Chlosyne acastus robusta*) Spring Mountains dark blue butterfly (*Euphilotes ancilla purpurea*) Spring Mountains dark blue butterfly (*Euphilotes ancilla cryptica*) Morand's checkerspot (*Euphydryas chalcedona morandi*) Mt. Charleston blue butterfly (*Plebejus shasta charlestonensis*) Charleston ant (*Lasius nevadensis*) Spring Mountains pyrg (*Pyrgulopsis deaconi*) Southeast Nevada pyrg (*Pyrgulopsis turbatrix*)
Vascular Plants	Clokey's milkvetch (*Astragalus aequalis*) Egg milkvetch (*Astragalus oophorus var. clokeyanus*) Spring Mountains milkvetch (*Astragalus remotus*) Trianglelobe moonwort (*Botrychium ascendens*) Scalloped moonwort (*Botrychium crenulatum*) Narrowleaf moonwort (*Botrychium lineare*) Moose moonwort (*Botrychium tunux*) Clokey's greasebush (*Glossopetalon clokeyi*)
Tier 2 Species	
Invertebrates	Spring Mountains comma skipper (*Hesperia colorado mojavensis*) Nevada admiral (*Limenitus weidemeyerii nevadae*) Spring Mountains icarioides blue butterfly (*Plebejus icarioides austinorum*) Carole's fritillary butterfly (*Speyeria carolae*) Spring mountainsnail (*Oreohelix handi*) Kyle Canyon mountainsnail (*Oreohelix jaegeri*)
Mammals	Townsend's big eared bat (*Corynorhinus townsendii*) Allen's big-eared bat (*Idionycteris phyllotis*) Palmer's chipmunk (*Neotamias palmeri*)
Reptiles	Western redtail skink (*Eumeces gilberti rubricaudatus*)
Vascular Plants	Charleston Mountain angelica (*Angelica scabrida*) Charleston Mountain pussytoes (*Antennaria soliceps*) King's rosy sandwort (*Arenaria kingii spp. rosea*) Spring Mountains rockcress (*Boechera nevadensis*) Shortstyle draba (*Draba brachystylis*) Jaeger's draba (*Draba jaegeri*) Charleston Mountain draba (*Draba paucifructa*) Nevada willowherb (*Epilobium nevadense*) Clokey's buckwheat (*Eriogonum heermannii var. clokeyi*) Dwarf greasebush (*Glossopetalon pungens*) Charleston Peak mousetail (*Ivesia cryptocaulis*) Jaeger's mousetail (*Ivesia jaegeri*) Keck's beardtongue (*Penstemon leiophyllus* var. *keckii*) Jaeger's beardtongue (*Penstemon thompsoniae spp. jaegeri*) Clokey's catchfly (*Silene clokeyi*) Compact chickensage (*Sphaeromeria compacta*) Charleston Mountain kittentails (*Synthyris ranunculina*) Jones' townsend daisy (*Townsendia jonesii var. tumulosa*) Charleston Mountain violet (*Viola purpura var. charlestonensis*)

Species included in this list are the focus of the Conservation Agreement and Strategy. Species were included because they

> *"…are either endemic to the Spring Mountains or have such a limited or restricted range that the viability of the species depends on the Spring Mountains population(s). For the purposes of prioritization of proactive conservation actions when resources are limited, the signing agencies grouped species into two categories, either Tier 1 or Tier 2. Tier 1 species are the highest priority for proactive conservation when resources are limited; Tier 2 species are a priority when additional resources are available."* (USFS 2011a, page 4).

The I&M Strategy identified species addressed in the CA as either Species of Concern or Species of Interest (SOC/SOI) and did not include all species listed in the 2011 revision of the Conservation Agreement. As a result, references to SOC/SOI from the SMNRA I&M Strategy have been replaced with the term "**CA Species**" which refers to the species listed in Table 1-1 and additional species have been added to Table 1-1 based on the revised CA.

The SMNRA inventory and monitoring program was initiated in June 2010. This annual report describes the analysis and evaluation of data collected during 2010 and analysis of legacy data sets. The annual report is organized into the following sections:

- **Section 2** – Describes inventory and monitoring data collection methods and inventory and monitoring efforts completed in 2010 and those planned for 2011;
- **Section 3** – Presents analysis and evaluation of data collected with respect to the conservation of biological diversity for selected species within the SMNRA by assessing information regarding ecological context, species conservation, and management interactions; and
- **Section 4** - Provides recommendations for changes in the Forest Plan, Conservation Agreement and Strategy, management activities or programs, or the inventory and monitoring program.

Detailed data summaries and analyses are included in the **Appendices**.

Botrychium ascendens

Botrychium lineare

2. Data Collection Methods and Programs

Inventory and monitoring systems established in the I&M Strategy consists of multiple systematic sampling methods, informed species-specific surveys, genetic analysis, and structured observations. The inventory and monitoring component strategies and relationships are summarized in Table 2-1.

Table 2-1: Inventory and Monitoring Program Strategy Summary

Program Component	Inventory and Monitoring Strategy
Intensified Forest Inventory and Analysis (FIA) Program	In keeping with initial objectives to provide long-term, cost-effective monitoring, inventory will focus on plant communities using an intensified FIA grid rather than attempt the prohibitively expensive individual species sampling for all plant CA Species. The base FIA program will be: (1) Extended to include sampling vegetation in non-forested areas, (2) Intensified to focus on specific ecological settings by increasing the plot ratio to 7 times the base grid, and (3) Re-measurement reduced from 10 years to 5 years to accelerate collection of data useful for monitoring trends and conditions affecting ecological context. Information on known butterfly host and nectar plants, invasive species and CA Species lists will be incorporated into data collection procedures.
Springs/Riparian Inventory	Springs and associated riparian areas provide important habitats for a number of CA Species, in addition to other species unique to spring/riparian settings. Inventory and monitoring of springs and riparian areas will focus on these sites because of the high density of CA Species, sensitivity of these areas to disturbance by multiple sampling/inventory crews, and the cost of multiple site visits. Inventory of all known springs using a common inventory protocol over a five-year cycle will provide a baseline for all springs and allow for comparison of information between springs. Data collected will allow design of more intensive surveys of a sub-set of the springs within the SMNRA.
Genetic Analysis and Monitoring	The primary use for genetic analysis is to address questions of population health and structure. Taxonomic questions can be addressed on an opportunistic basis, taking advantage of the GenBank database, once that database has been sufficiently populated with congener species to allow clarification of taxa below the species level (sub-species and varieties). Collection of genetic material will be accomplished in conjunction with other monitoring methodologies.
Species-Specific Surveys and Monitoring	In those instances where ongoing inventory and monitoring of individual species is underway, those efforts will continue. Over time a "bridge" between individual species methods and integrated monitoring via FIA and the Riparian/Springs protocol could result in the cessation of monitoring for some individual species. As data from FIA and the integrated springs/riparian monitoring become available, potential habitats for these and other species can be identified and species-specific surveys conducted with greater efficiency.
Implementation and Monitoring (IM) Audits	IM Audits review consistency of implementation with NEPA documentation and contracts or implementation instructions and the effectiveness of design and mitigation measures. Priorities for activities or projects to be audited are based on the ability of management to influence the outcome and risk and uncertainty associated with project or activity effects on CA Species. IM Audits are focused on the identification of adjustments that can be made for the audited project/activity and when possible applied as improvements in future project design or mitigation measures.

The following subsections describe the inventory and monitoring components in detail and summarize work done in 2010 and work planned in 2011.

a. Intensified Forest Inventory and Analysis

The Forest Inventory and Analysis program serves as the nation's census of forested lands. It uses a grid from which to select sample locations and a system of sampling panels to sample across years. Plots are composed of sub-plots designed to collect information for numerous data elements. The system employs an annual sampling scheme to provide annual updates useful for monitoring trends. Extension of the base grid into non-forested areas and increasing the number of samples would be required to provide appropriate data accuracy for the SMNRA.

Ancillary and regionally specific monitoring protocols have been developed for use in conjunction with standard FIA protocols to focus on individual or groups of species. The grid-based system is valuable for detecting changes in ecological context, either globally or locally induced, and for developing inferences on both ecological sustainability and species' habitat relationships. An important feature of this system is the resulting high data quality and statistical reliability.

The intensification of the base FIA program is a principle component of the overall inventory and monitoring program for the Spring Mountains National Recreation Area. FIA provides the rigor and recurrent sampling framework necessary to develop information needed to effect adaptive management-based changes in management promoting species conservation. This is the primary reason for selecting FIA as the foundation for subsequent evaluation and analysis.

The FIA intensification for the SMNRA is designed to address the need for data necessary to monitor trends in ecological context as well as data useful for developing habitat relationships and improving information on CA Species occurrence. The Design Tool for Inventory and Monitoring (DTIM) was used to match information needs associated with individual monitoring questions to FIA data collection protocols and analysis reports. Using existing estimates of sampling errors, DTIM estimates the number of sample plots needed to provide acceptable results.[1]

The intensified FIA program for the SMNRA includes the following principal modifications:

1) **Increased sampling intensity** - To achieve acceptable statistical accuracy, the plot density within the SMNRA will be increased on all lands by a factor of 7 times the standard FIA sampling grid on all lands. This means approximately 350 FIA plots would be located across the SMNRA, resulting in roughly 7 plots for every 6000 acres.

2) **Procedures applicable to SMNRA needs** - Sampling procedures and species lists for this survey are specifically designed to gather information on species identified as CA Species. All plots would be sampled according to IW-FIA standard protocols. These include national FIA "core" protocols, and IW-FIA also measures downed woody material, understory plant cover, and presence of invasive species. In addition, crews would collect data on CA Species plants for SMNRA. This would include recording CA Species as understory plants where appropriate, as well as presence under a special

[1] An electronic copy of preliminary data entered into DTIM was provided to the SMNRA as a separate document.

protocol similar to that for invasive species. Depending on variability of the samples, the SMNRA may then wish to consider dropping back from 7X to 5X in accommodate additional CA Species sampling on a larger transect at FIA locations by additional specialists after completion of the first inventory cycle.

3) **Extension into non-forested lands** - FIA normally samples only vegetation on forested plots. On the SMNRA all plots will be sampled for vegetation and down woody material, regardless of land use/land cover. The non-forest vegetation field guide is located at ftp://ftp.ogden.rmrs.fs.fed.us/pub/distribution/acpmanual2006/booklet_All_conditions_Pilot_asof050906.doc

4) **Shorter re-measurement cycle** - The rate of re-measurement will be improved from the standard 10 years to 5 years for at least the first 5 years to decrease the time needed to gather data needed to provide the ecological context for individual species evaluations and establish a baseline for evaluating ecological trends.

   Intensifying the sample plus reducing to a 5-year cycle means SMNRA-level reports will be meaningful as soon as the second and possibly the first field surveys are completed. Because FIA data are available in an accessible database, these data will be available for analysis and evaluation much quicker than traditional systems. In addition, the sampling errors for all estimates, such as for specific species or species groups, will be known.

5) **Collection of genetic material for analysis** - All of the plant species listed in Table 1-1 are appropriate for genetic monitoring and are anticipated to be found in conjunction with implementation of the intensified FIA program. Collection procedures for plant genetic material will be coordinated annually with staff from the RMRS Wildlife Genetics Analysis Lab in Missoula, MT.

2010 Accomplishments

Field data collection was not initiated in 2010 to accommodate changes in protocols for understory species and invasive species being made to the *National FIA Field Manual* (USFS 2010) during late 2010. Because these data are important to address SMNRA monitoring questions, this delay was recommended and accepted by SMNRA leadership.

Plot locations have been selected and identification of sample panels for each of the five years in the program has been accomplished. Field crew training and contracting arrangements for 2011 are moving forward.

Analysis of FIA data collected in 1997 on the base grid (51 forested plots) was used to construct data tables addressing monitoring questions originating from Forest Plan standards or monitoring items. Tables addressing these monitoring questions are included in Appendix B.

This effort identified a number of analytical issues regarding different definitions of size class breaks, criteria for defining “old growth,” and an inconsistency between the existing vegetation cover types used in the Forest Plan and those used by the Interior West FIA program.

2011 Program Plans

Because of the delay in 2010, two sample panels will be implemented in 2011. Figure 2-1 shows the location of plots to be completed during the next year. A total of 140 plots will be installed by inventory crews.

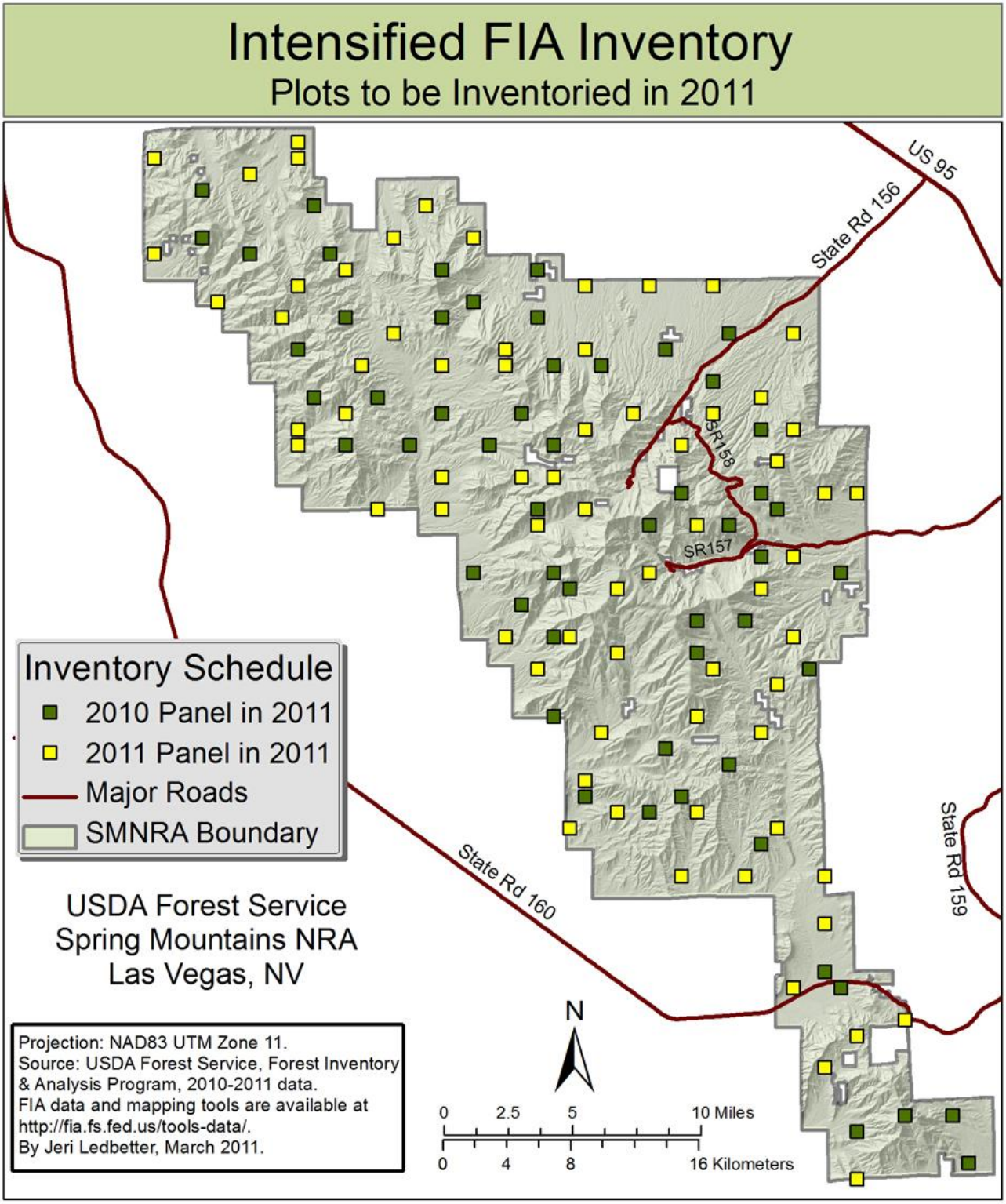
An additional scheduling challenge will be to attempt to visit plots at the time of year when the CA Species are most likely to be flowering. If crews miss the flowering stage and are thus unable to identify the plants, then they could take samples for identification by SMNRA or RMRS staff.

The same FIA field crews sampling base grid plots within Nevada will also conduct sampling on the intensified plots within the SMNRA ensuring consistency in data quality and collection procedures between the two programs.

Genetic material will not be collected during the 2011 inventory program. Analysis of the 2011 data will be used to determine whether collection of genetic material on FIA plots is warranted. Emphasis will be placed on observation of whether the FIA plots represent habitats with CA Species as observed during travel from plot-to-plot.

Chlosyne acastus robusta

Figure 2-1: Intensified FIA Inventory Plots to be Inventoried in 2011



b. Springs and Riparian Area Inventories

Springs and riparian areas within the Spring Mountains National Recreation Area (SMNRA) provide habitats for and sustain a disproportionate number of species compared to uplands. Recognizing the importance of these sites to the sustainability of many species identified as CA Species the SMNRA Inventory and Monitoring Strategy (USFS 2008) focused additional attention on these areas. The SMNRA landscape analysis (ENTRIX, Inc. 2008) identified 149 known springs and associated riparian areas within the NRA.

1) **Sampling Program** - To allow data interpretation and evaluation to be applied as early in the inventory program as possible, a 5-year sampling program was developed. Use of a 5-year sampling program is paired with the FIA re-measurement cycle to assist in the collection and compilation of SMNRA-wide data as soon as possible.

   The methodology used to develop the sampling program for the SMNRA used a "list frame with a random start" to develop a systematic (stratified random) sampling schedule. The primary factor considered during the development of the sampling schedule was a balanced geographic representation across the four 4th code hydrologic units (or HUC) within the SMNRA. The 4th code hydrologic units were used as strata so that:

   a. Each HUC would be equally represented in each year's data, which allows for statistical inference to be made about each HUC each year;

   b. A regional event (such as fire) would not affect a disproportionate amount of sites for a HUC or the ability to collect data in a HUC in a given year.

   Sample sites were stratified by 4th code hydrologic unit. Annual sampling "quotas" for each 4th code hydrologic unit were determined based on the number of sites within each 4th code hydrologic unit. Sites were selected within the list frame (spreadsheet) utilizing a random start and random numbers assigned to each site. Table 2-2 summarizes the sampling schedule by 4th code hydrologic unit.

Table 2-2: SMNRA Springs Sampling Schedule by 4th Code Hydrologic Unit

Region	HUC-4 Name	HUC-4	CY10	CY11	CY12	CY13	CY14	Total
Lower Colorado	Las Vegas Wash	15010015	11	11	12	11	11	56
Great Basin	Sand Spring – Tikaboo Valleys	16060014	4	3	3	4	3	17
	Ivanpah-Pahrump Valleys	16060015	14	14	14	14	14	14
California	Upper Amargosa	18090202	2	1	1	1	1	6
		Total	**31**	**29**	**30**	**30**	**29**	**149**

2) **Protocols and procedures for the SMNRA** - Inventory will be accomplished using the national *Forest Service Groundwater Dependent Ecosystems Level II Inventory Field Guide* (USFS, 2011b)[2] with additional data elements for the SMNRA. Additional data collection focuses on approximately 60 CA Species and known host and nectar plants for butterflies.

3) **Quality Assurance/Quality Control (QA/QC)** - Key aspects of QA/QC procedures include:

   a. Training in the use of the protocol provided to all crew members and supervisors.
   b. Data collection and recording on field forms was used during the 2010 field season. Data collected will be transferred to a MS Access database for eventual migration to the FS NRIS database. Spot checks of data entry on the field forms and data transfer to the MS Access database will be performed and noted as part of the QA/QC process.
   c. To evaluate observer variability and accuracy in applying the protocol, a minimum of two sites will be re-sampled. The evaluation of observer variability will indicate the level of accuracy associated with data collection and may identify needs for modifying the national protocol components or instructions.

4) **Species identification** - Collection of specimens for identification will follow accepted procedures for collection. SMRNA and RMRS staff will conduct species identification.

5) **Collection of genetic material** - This effort will also support the genetics analysis program. Collection of genetic material for analysis will include spring snails and plant species listed in Table 1-1 associated with springs and riparian environments.

2010 Accomplishments

A Cost Reimbursable Agreement (9/2/10) between Northern Arizona University (NAU) and the SMNRA of the Humboldt-Toiyabe National Forest was established to utilize the expertise of NAU staff and students in conducting spring and riparian inventories and provide teaching opportunities for NAU staff involved in the SMNRA inventory effort.

Training for NAU and SMNRA staff was conducted from September 7-9, 2010 and included an office review of methods and procedures for the Groundwater Dependent Ecosystems Level 2 Field Guide and field training at Mack's Spring. Training included methods for collection of genetic material and collection of samples for identification.

Springs inventories were conducted by the NAU survey team from September 11-13 and October 20-30, 2010 (see Figure 2-2). The NAU springs inventory team visited a total of 25 sites during these two field efforts (see Appendix D-1) and used the National Forest Service Groundwater Dependent Ecosystems Level II Inventory Field Guide to inventory and assess 19 of those sites. Two previously unmapped and unnamed springs were identified (inventorying one of those), and one site that was due to be surveyed in a subsequent year, were included in the 2010 inventory effort. For safety reasons, the team did not inventory Roses Spring planned for 2010, but intends to conduct that survey in 2011. Nine additional

[2] Currently scheduled for publication in July 2011.

springs planned for 2010 were dry, were not springs, or occurred on private land, and therefore were not surveyed.

Refinements and recommendations identified by the NAU survey crew Include:

1) **Safety** - Crew safety is the first priority during site visits. Safety-related decisions remain the purview of the crew leader and crew members. As many of the sites in the Spring Mountains are distant from roads, and some access roads are in poor condition, intra-crew communications in these remote settings presents a challenge. Equipment for future surveys should include high quality radios.
2) **Spring Locations** - The springs GPS points provided by the Forest Service were of variable quality. In cases where no spring could be found near the GPS point, the team would inventory the nearest spring. Such decisions should be left to the judgment of the crew leader.
3) **Travel Distances** – Distance to each spring from the nearest road, provided by the Forest Service, did not account for steep gradient and rugged terrain, and therefore did not reflect the difficulty in accessing the sites. The sampling program design will result in higher costs than the alternative of sampling more remote springs in clusters. The future sampling program should be adjusted to reduce overall travel time.
4) **Inclusion of Features that are not Springs**- If a feature is not a groundwater-dependent ecosystem (GDE) (e.g., guzzlers, waterfalls, wells. etc.), the team did not visit it; however, they visited any feature that they believed might have been a GDE (e.g., some livestock tanks are excavated springs). Features that are not a GDE should be dropped from the sampling program if this information is known.
5) **Additional Data Elements Collected** – The crew measured slope, aspect, and the solar radiation budget, and collected water samples for water quality analyses (^{18}O and ^{2}H) although those measurements are not requested in the protocols. We modified field survey forms to include fields for those data.
6) **Plant Identification** – Plant specimens are being dried at NAU in Flagstaff, and will be organized for preparation and identification. We will continue to be in contact with the SMNRA regarding identification and disposition of specimens collected.
7) **Genetic Material Collection** –Genetic samples were collected from four sites for two plant species and two gastropod species. Samples have been delivered to the SMNRA.
8) **Inventory Forms and Data Base Entry** – Data collected have been compiled and entered into the GDE database. Field forms and sketch maps were delivered to the SMNRA.

Information collected in 2010 was analyzed and is presented in a series of tables and reports that provide:

a) Site reports for each spring (Appendix D-2)
b) NRA-wide summary reports (Appendix D-3)
c) Information needed to address SMNRA monitoring questions (see Appendix D-4).

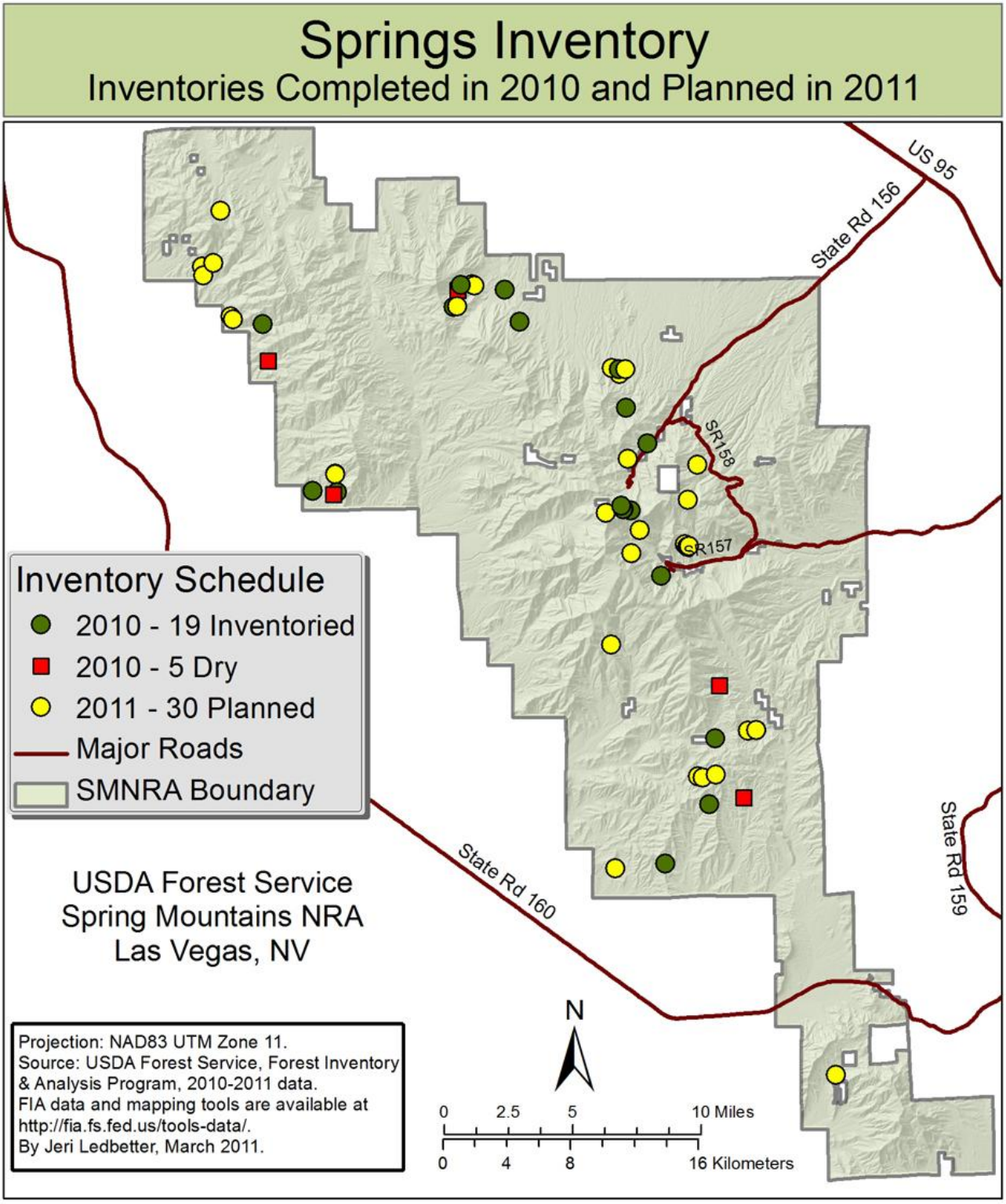
2011 Program Plan

The NAU inventory team will conduct inventories of 30 sites during 2011, including the one not surveyed in 2010 for safety reasons. The field schedule will be designed to conduct sampling at the time of year when the species of concern and interest are most likely to be flowering.

Based upon the NAU team's recommendations, the inventory sample schedule has been adjusted to allow for crew safety determinations, inclusion of new springs, and sampling of spring "clusters" in situations where access is difficult and time consuming. Also, the team will review aerial imagery and previous inventory reports in advance of the surveys to more accurately determine the location of the sites as well as the most efficient access route. Figure 2-2 depicts springs to be sampled in 2011.

Astragalus oophorus clokeyanus

Figure 2-2: Springs Inventories Completed in 2010 and Planned in 2011



c. Genetic Monitoring and Analysis

Genetic monitoring uses individual genetic differences to infer population attributes such as size, structure, migration, and population of origin (for immigrants). These metrics are related to studies of phylogeny, which uses genetic differences to determine relationships between species. For phylogeny, one is looking for genetic differences that are fixed within a species but differ between species. For genetic population monitoring, one is looking for genetic differences that occur among individuals.

Genetic monitoring requires 3 stages. The first is one of "discovery," in which interesting areas of DNA are located, analyzed, and inexpensive assays are developed to identify differences. The second phase involves collecting the samples, and in the third the genetic assays developed during discovery are applied to collected materials and population metrics derived. The advantages of genetic monitoring over direct population monitoring lie in the greatly reduced sampling required as well as in the ability to evaluate important population attributes that are generally not accessible through other methods. For species that have not been previously genetically monitored, some level of discovery must be done prior to analysis. However, this process does not need to delay sample collection; samples once stabilized are durable and can be stored for years. Monitoring for change can be done after the fact, a property unique to DNA monitoring.

1) **Genetic analysis priorities** - Priorities for genetic monitoring and analysis include CA Species where genetic analysis will be most beneficial and are depicted in Table 2-3.

Table 2-3: Species Targeted for Genetic Analysis and Monitoring

Priority Group 1	Palmer's chipmunk (*Neotamias palmeri)* Acastus checkerspot (*Chlosyne acastus robusta)* Spring Mountains dark blue butterfly (*Euphilotes ancilla purpurea*) Morand's checkerspot (*Euphydryas chalcedona morandi*) Mt. Charleston blue butterfly (*Plebejus shasta charlestonensis*)
Priority Group 2	Spring Mountains pyrg (*Pyrgulopsis deaconi)* Southeast Nevada pyrg (*Pyrgulopsis turbatrix)* Clokey's milkvetch (*Astragalus aequalis)* Egg milkvetch (*Astragalus oophorus var. clokeyanus)* Spring Mountains milkvetch (*Astragalus remotus*) Trianglelobe moonwort (*Botrychium ascendens)* Scalloped moonwort (*Botrychium crenulatum)* Narrowleaf moonwort (*Botrychium lineare)* Moose moonwort (*Botrychium tunux*) Jones' Townsend daisy (*Townsendia jonesii var. tumulosa)*

Of the species identified for genetic monitoring, only chipmunk (not Palmer's) populations have been studied genetically. Thus, for Palmer's chipmunk, the discovery phase is anticipated to be less intensive—methods developed for other chipmunk species can be evaluated. For the rest, discovery will need to begin with virtually no prior knowledge. In the past, this would be a major impediment to genetic monitoring, however recent advances in fast DNA sequencing and screening have greatly reduced the time and effort associated with exploring an organism's DNA. Discovery still remains a major expense. Currently, one should anticipate approximately $20,000 per species, including

laboratory costs for discovery, though in a year or two this could easily drop by an order of magnitude. It should also be noted that, for long term monitoring, this is a one-time startup expense.

2) **Collection of genetic material** - Obtaining genetic samples if the organism is "in hand" is almost always fast and easy, and samples can be compactly stored. Materials to stabilize sample DNA are generally very inexpensive: animal tissues can be dried, plant tissues crushed onto cards containing chemicals that arrest enzymatic processes and preserve DNA. Thus, if genetic samples can be obtained opportunistically while doing other surveys, the costs of sample acquisition are generally trivial.

   All of the plant species identified as being appropriate for genetic monitoring are also anticipated to be found using intensified FIA. The 2 species of spring snails are anticipated to be found during springs/riparian surveys. Thus, except for the Palmer's chipmunk, separate surveys to collect genetic materials are not anticipated. If, however, these species are not found during the other surveys or are only found very rarely, then additional surveys must be added.

   Plant species collection methods are similar for all plants. Surveys should be conducted during periods when plants are identifiable and tissues are alive. The collector should be trained and tested in plant identification to minimize misidentification of collected plants. All sampling will be done within and in the immediate area around FIA locations. Searches should begin within the sub plots (7.32m radius), then extend into the surrounding "annular" plot (17.95m radius) and finally throughout the "lichen plot" which encloses all of the sub-plots. No more than 12 samples should be taken at each plot for each species and no more than 3 samples should be taken from each subplot/annular plot. If the sampling unit is the lichen plot, then samples should be distributed as evenly as possible across the unit.

3) **Sample distribution** - Genetic surveys should be spatially distributed, but otherwise many of the representative sampling rules do not apply. For example, within a given spatial location samples can be collected based largely on convenience; if you see a chipmunk, it is perfectly acceptable to set live traps specifically to maximize the likelihood of trapping that organism. For plants this might involve, within a given square kilometer, preferentially sampling microsites where the likelihood of detecting the organism is highest. For each location where the organism is found, there is virtually never a reason to collect more than 30 samples. These 2 attributes: being able to preferentially sample and the need to collect relatively few samples at each location where the organism exists greatly enhance the ability to obtain adequate samples for monitoring when the organisms are rare or very clumped in their distributions. For this same reason, samples obtained through other non-standard mechanisms are generally useful. For example, if various crews such as wilderness guards were trained to identify these plant species, trained as to how to collect genetic samples (generally trivial training), and given sampling materials (small, light and inexpensive), they could opportunistically collect samples when they encountered them at virtually no cost.

   Given the need for extensive discovery coupled with the low costs of obtaining samples and the stability of those samples once collected, a reasonable approach is to begin sample collection for all

species, initially focusing on opportunistic collection. Early discovery should only be done for those species deemed the highest priority, allowing the price of discovery to drop.

4) **Sample collection and management** – Genetic samples are stored in envelopes, labeled with the location, date, and species name, and stored in desiccant for future analysis.

   FIA plot/subplot locations should be identified on the envelope and each sample should be identified by a four letter species abbreviation (Genus/species), the date of collection, and the collector's initials. Similar procedures are used for genetic material collected during springs inventories, trapping, and other opportunistic sampling.

5) **Analysis and reporting** -Analysis and reporting of results will be facilitated by an agreement with the RMRS Wildlife and Terrestrial Habitat and Grassland, Shrubland, and Desert research programs. Genetics analysis results will be posted in GenBank. Summary reports as well as published research will be prepared. This information can then be used by NatureServe to evaluate their rankings of species status which is used to identify CA Species.

2010 Accomplishments

The first year of implementation included providing an overview of data collection procedures for individuals involved in different components of the inventory and monitoring program. Genetic sampling and analysis were conducted in association with springs inventories and a trapping program for Palmer's chipmunk.

Spring snails and plant genetic material in association with springs inventories were collected at four sites for two plant species and two spring snail species. Samples are archived and stored at the SMNRA office.

Palmer's Chipmunk

Palmer's chipmunk (*Neotamias palmeri*) is a medium sized chipmunk whose range is limited to the higher elevation areas of the Spring Mountains. A second chipmunk species, the Panamint chipmunk (*Neotamias panamintinus*), lives in lower elevation areas. The Panamint chipmunk is not closely related to Palmer's (Piaggio and Spicer 2001), but field identification of the two species is unreliable.

McKelvey, et.al. (2011) describes the genetic sampling and analysis of Palmer's chipmunk conducted in 2010. The goals of this study are to 1) verify the range of Palmers chipmunk, 2) determine whether it co-occurs with Panamints, and if so where, 3) determine the population structure of Palmer's across the Spring Mountains specifically looking for the presence of isolated sub-populations, and 4) look for signs of potential hybridization between the two species.

In the first partial season, study goals were to 1) develop an effective approach to trap Palmer's chipmunks, 2) develop genetic markers that allow analysis of population structure in Palmer's, and 3) develop nuclear DNA markers that discriminate Palmer's from Panamint chipmunks and thereby both allow reliable species identification without the need for extra genetic tests and evaluate potential hybridization.

The purpose of trapping was to detect chipmunks if present and, ideally, collect a large enough sample to perform group statistics on the organism's DNA with each trapping area serving as a group. Importantly, these grids were not designed to evaluate either abundance or density.

Starting in mid-September, scouting locations for trap placement began in three popular recreation areas in the Spring Mountains, Kyle Canyon, Deer Creek, and Upper Lee Canyon. Trapping locations were based on a combination of historic capture locations for Palmer's and logistical constraints. The primary purposes of trapping were to test the efficacy of trapping in areas where chipmunks were known to exist and to provide the RMRS lab in Missoula with Palmer's and some Panamint chipmunk samples to allow development and evaluation of genetic methods. These sites were therefore not systematically located. A total of 67 samples were collected at four sites and genomic DNA was extracted from 66 samples.

The prototype sampling and analysis for Palmer's chipmunks in the fall of 2010 achieved its goals. Sampling methods were sufficient to collect sample groups when chipmunks were present and could be carried out efficiently. Genetic analyses using nine microsatellite loci indicate that there is sufficient variability to detect population substructure. While not definitive, it appears that these loci also allow separation of Panamint and Palmer's chipmunks.

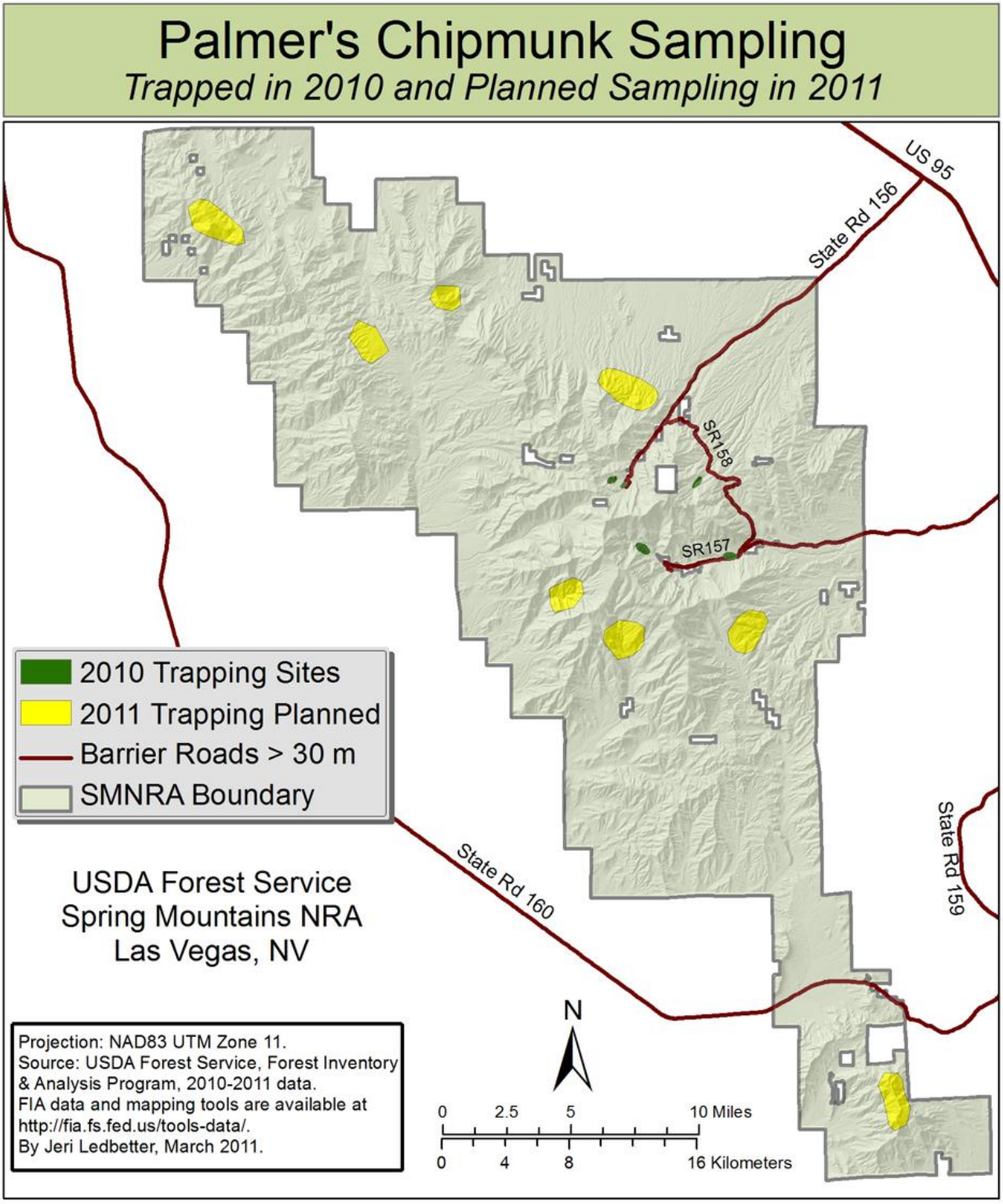
Assuming that the bulk of the samples were Palmer's, the level of variability in these markers and the lack of substructure is indicative of the maintenance of a relatively large, well connected, population in this area of the Spring Mountains. Given that Palmer's have likely been separated from other chipmunks for thousands of years, the DNA variability in the population should be at or below the drift/mutation equilibrium associated with the long term effective population size in the Spring Mountains.

2011 Program

In 2011 sampling will occur across the range of Palmer's. Analyses will be much more detailed and will include diagnostic species level tests to verify our ability to use nuclear markers to identify species, and include standard population genetic analyses.

Palmer's Chipmunk (*Neotamias palmeri)*

Figure 2-3: Palmer's Chipmunk Genetic Sampling Locations



d. Species-Specific Surveys

Species-specific surveys and surveys conducted in association with project or activity analysis provide valuable information with respect to understanding a portion of an individual species' life history and occurrence within the SMNRA. Additional information on species life history and the ecological context in which the species exists is needed.

The role of individual or multiple species surveys[3] is important to developing information necessary to address overarching questions related to CA Species occurrence, trend and status and to practice adaptive management designed to protect and conserve CA Species. Equally important is that these surveys be conducted within a framework that allows for the development of information of sufficient data quality to identify and support change in management. Rather than de-emphasize individual species monitoring, in later phases of the program it may be necessary to increase the amount of effort devoted to these surveys.

This change is consistent with the expectation that systematic surveys (FIA and the Springs Inventory) will generate information that will identify potential habitats, where surveys should be conducted, and provide initial information on population trends for CA Species. It is important to note that the data stream from fine scale individual species monitoring, as well as the data stream from broad scale methods, are not collected in isolation but all data streams enter agency databases. The analysis of the multi-scale data set provides a more complete picture of the factors influencing population dynamics. Analysis will also illuminate knowledge gaps that may require additional monitoring or research efforts. Geographic Information System analysis methods can be used to provide additional insight into species distribution and population dynamics.

Five individual species monitoring efforts have been underway within the SMNRA for the past decade or were being initiated at the time the I&M Strategy was developed. They include:

- Monitoring the stability of three alpine plant species communities known to provide habitats for several species in partnership with The Nature Conservancy.
- Monitoring for Egg milkvetch in partnership with The Nature Conservancy.
- Monitoring for Charleston Mountain angelica in partnership with The Nature Conservancy.
- Monitoring of Palmer's chipmunk being conducted by the US Geological Survey.
- A study conducted under contract by University of Nevada, Las Vegas (UNLV) to monitor butterflies and study their ecology within the SMNRA.

The I&M Strategy included recommendations for ongoing species-specific surveys described in Table 2-4.

[3] The term survey as used in this document is a structured investigation to determine species occurrence and distribution using potential habitat parameters to define the survey area as opposed to a statistically designed sampling scheme.

Table 2-4: Ongoing Species-Specific Survey Recommendations

Species/Group	Recommendations
Alpine plant communities	Based upon monitoring trends for the alpine plant communities and the ability to use intensified FIA to accomplish the same trend monitoring with greater statistical accuracy, this effort should be completed, data evaluated and results published.
Charleston Mtn. Angelica	Evaluate existing occurrence data with GIS analysis tools to determine potential habitat. Potential habitat with limited occurrence data should be surveyed during program years 1-3. If all potential habitats have sufficient occurrence data to validate habitat relationships, this effort should be completed and data evaluation results published.
Egg milkvetch	Evaluate existing occurrence data with GIS analysis tools to determine potential habitat. Potential habitat with limited occurrence data should be surveyed during program years 1-3. If all potential habitats have sufficient occurrence data to validate habitat relationships, this effort should be completed and data evaluation results published.
Charleston ant	Evaluate the taxonomic status through consultation with the appropriate expert(s). If the taxonomic status is confirmed, determine potential habitat with GIS analysis tools. Survey the previous collection sites and potential habitats and determine if it is extant in the SMNRA. If a population is confirmed, monitoring can be implemented.

Funding was recommended to remain constant during the first 3 program years and focused on accomplishment of tasks described above. Data evaluation may identify additional monitoring questions related to these species that should be considered as a result of analysis and evaluation described in Section 3. In later program years, funding is expected to increase to reflect additional species surveys that can be more effectively designed and implemented using the ecological context data generated by the FIA and Spring inventory and monitoring programs.

1) **Survey program priorities** - Candidates for individual species monitoring (Table 2-5) were selected based upon current knowledge and concerns regarding their population trends. Several species have documented declines in population numbers, and all have significant knowledge gaps with regard to life history and distribution. Species specific surveys can be used to provide fine-scale information on life history, demographics, and reproductive cycles, factors that determine population trends (i.e. net changes in the number of individuals in a population).

Table 2-5: Species Specific Survey Priorities

Priority Group 1	Palmer's chipmunk (*Neotamias palmeri)* Acastus checkerspot (*Chlosyne acastus robusta)* Spring Mountains dark blue butterfly (*Euphilotes ancilla purpurea*) Morand's checkerspot (*Euphydryas chalcedona morandi*) Mt. Charleston blue butterfly (*Plebejus shasta charlestonensis*) Charleston ant (*Lasius nevadensis)* Charleston Mountain angelica (*Angelica scabrida)* Egg milkvetch (*Astragalus oophorus* var*. clokeyanus)*
Priority Group 2	Clokey's greasebush (*Glossopetalon clokeyi)* Western redtail skink (*Eumeces gilberti rubricaudatus)*

2) **Survey methods and protocols** - Many protocols and methods for monitoring rare plants and animals have already been developed and published in peer reviewed journals and compiled in books. These methods have the statistical rigor that *ad hoc* methods often lack. In keeping with the philosophy of the SMNRA I&M Strategy, previously developed and tested methodologies should be the choice for individual species monitoring. Protocols are also available that address groups of species by life-form.

3) **Analysis and reporting** – Species-specific surveys are conducted to establish a baseline for trend analysis and to refine potential habitat models and habitat relationships. The Spatial Analyst or the TEUI Geospatial Toolkit will be used to link species occurrence data from all monitoring sources and information on ecological context developed from FIA and Springs/Riparian monitoring will be combined with "traits" from the Geospatial Data Stack to identify potential habitat where surveys should be conducted. Additional evaluation focused on cause and effect relationships and future refinement of monitoring questions is likely.

   The first priority is to evaluate data collected in ongoing species monitoring efforts to determine if the data are sufficient to answer the monitoring questions posed at the start of the program. Once the data set has been evaluated, new questions can be formulated and future monitoring goals established.

   All species proposed for individual species surveys and monitoring will require a review of existing data and literature in order to select the appropriate monitoring protocol. Work within the last decade has developed a number of standard protocols for rare butterfly, plant and ant monitoring.

   Ecological and/or research expertise will be required in order to select the appropriate monitoring methods. Data interpretation will require ecologist or research scientist expertise. Analysts capable of using the TEUI Geospatial Toolkit will be required.

4) **Data management** - All monitoring efforts, including the individual species monitoring, will be entered into FS corporate databases, including NRM-NRIS-Terra and the Threatened, Endangered and Sensitive Plant (TESP) database (USFS 2008a, USFS 2008b).

5) **Collection of genetic material for analysis** - All of the plant species listed in Table 1-1 are appropriate for genetic monitoring and are anticipated to be found in conjunction with

implementation of the intensified FIA program. Collection procedures for plant genetic material will be coordinated annually with staff from the RMRS Wildlife Genetics Analysis Lab in Missoula, MT.

2010 Accomplishments and 2011 Plans

Areas surveyed for specific species or in association with project analyses are displayed on Figure 2-4.

Charleston Ant

The genus *Lasius* has world-wide distribution and *The Ants of Nevada* (Wheeler and Wheeler 1986) report seven species of *Lasius* from the Spring Mountains. Cole (1956) is the only report of *Lasius nevadensis*. His paper details the original collection in 1954 and naming of the new *Lasius* species. There are no published reports of collection or collection efforts since 1954. Therefore, we know that *L. nevadensis* is rarely collected (all specimens were collected during a 1-week period in 1954), but the distribution and rarity or commonness of this species is unknown. Members of the subgenus to which *L. nevadensis* has been assigned are exclusively subterranean, with the exception of summer mating flights. Cole collected the species during such a mating flight event. The subterranean habitat of the species makes it unlikely that human disturbance will impact nests and colonies.

The distribution and abundance of *Lasius nevadensis* has never been determined. Work by the Forest Service's Remote Sensing Applications Center (RSAC) has demonstrated that, based on our current knowledge, much of the SMNRA is potential habitat. The dispersal characteristics of *Lasius* make it very unlikely that, in 1954, *L. nevadensis* was restricted to the old ski tow site. The 1954 collection effort by Cole was likely limited to that area because of easy road access. With the exception of the 2009 Ant Safari, no collection efforts have been reported since 1954. Until a systematic collection effort is made throughout suitable habitat, the true distribution and abundance of *Lasius nevadensis* will remain unknown.

Determining the distribution and abundance of *L. nevadensis* will require sampling during the mating flight, and should include traps to capture dispersing winged queens, as well as ground searches to observe emergence of alate individuals, and to locate colonies and workers. Sampling should be conducted across the range of suitable habitats throughout the SMNRA. Initially, traps should be placed in grid-fashion across suitable habitat to identify presence of the species. If *L. nevadensis* is found, then ground searches can be conducted to locate colonies that can then be studied to determine habitat requirements of associated species (root aphids and scales, as well as tree and shrub species on which the scale/aphids rely for food).

Charleston Ant Safaris - Charleston Ant Safaris were initial steps in the process of re-locating the Charleston ant and were conducted with the following objectives in mind:

- Community outreach to provide a citizen science opportunity for children and adults.
- Determine the timing of ant mating flights at the original collection site of *Lasius nevadensis*.
- Review available literature on *Lasius nevadensis* and develop a plan for resolving the status of *L. nevadensis*.
- Make the first effort to collect *Lasius nevadensis* since 1954.

2009 Charleston Ant Safari - The Charleston Ant Safari was a successful collaboration between the RMRS and the SMNRA (Pendleton 2010). Events were held on July 17th, July 25th, and August 15, 2009. The

Charleston Ant Picnic was held July 25th to commemorate the 55th anniversary of the discovery of the Charleston Ant. Approximately 50 people attended the picnic. Over 100 people, including 37 children, attended at least one day of the safari, and many attended on more than one day.

On July 17, 2009, two individuals of one species of alate ants were collected. On the 25th through the 28th of July, 2009, at least eight species of alate ants were collected. On August 15, 2009, very few alate individuals were observed. These collections demonstrate that a mating flight occurs during the same timeframe as when Cole collected *L. nevadensis* 55 years ago.

2010 Charleston Ant Safari – More than 50 volunteers attended the 2010 Charleston Ant Safari (Pendleton 2011). They participated in a science discussion, a search and collection of ant specimens, art activities and games. The morning activities were followed by the 2nd annual Charleston Ant picnic. The worker specimens collected are still being examined, but winged specimens of *Lasius nevadensis* were not collected in 2010. Locating ants in 2010 was more difficult due to the layer of chippings from a fuels reduction treatment done at the only known location of the Charleston ant. The depth of the wood chips was within the prescription, but mating flights observed in 1954 were only observed coming from soil with a low amount of litter (Cole 1956). 2010 plans to erect traps to collect winged alate specimens of the Charleston ant were cancelled due to unanticipated budget restrictions.

2011 Charleston Ant Survey Plans – Plans include consulting with ant biologists to refine the methodology for collecting ant specimens and developing a comprehensive plan for sampling appropriate areas of the SMNRA. The 3rd Charleston Ant Safari will be conducted in July at the site of the original collection, as well as other areas as determined in consultation with the ant biologists. If *Lasius* sp. are collected, they will be sent to museums for definitive identification. If specimens are identified as the Charleston ant, the specimens will be available for genetic analysis. Once located, detailed studies of the life history of the Charleston ant, including the root scale species it feeds on, host plants, etc. will be undertaken. Detailed studies, along with expanded presence surveys, will provide the information necessary to determine the ant's rarity and conservation status.

Alpine Plant Communities

Seven CA Species occupy the alpine zone (3455-3627 m). The alpine studies were initiated in order to learn more about these species' status and trends in the coming year. The alpine studies will be extensively reviewed, and all other information and data relevant to the alpine zone species compiled.

The following reports and publications address these communities:

Baggs, J. 2006. 2004 Biological monitoring report for alpine herbaceous, bristlecone pine woodland, and riparian spring-fed high elevation plant communities, Humboldt-Toiyabe National Forest, Spring Mountains National Recreation Area. Unpublished report for the Humboldt-Toiyabe National Forest, Spring Mountains National Recreation Area, Las Vegas, Nevada. 25 pp. + Appendices.

Beyer, C. 2003b. Progress report, high elevation plant community monitoring in the Spring Mountains NRA. Unpublished report for the Humboldt-Toiyabe National Forest, Spring Mountains National Recreation Area, Las Vegas, Nevada. Dated March 25, 2003. 8 pp.

Nachlinger, J. L. 2000a. Biological monitoring plan for three high elevation plant communities on the Humboldt-Toiyabe National Forest, Spring Mountains National Recreation Area. Unpublished report on file with the U.S. Fish and Wildlife Service, Las Vegas, Nevada and with the U.S. Department of Agriculture, Humboldt-Toiyabe National Forest, Spring Mountains National Recreation Area, Las Vegas, Nevada. 27 pp.

Nachlinger, J. L. 2000b. Baseline 1998-1999 biological monitoring report for alpine herbaceous, bristlecone pine woodland, and riparian spring-fed high elevation plant communities. Unpublished report on file with the U.S. Fish and Wildlife Service, Las Vegas, Nevada and with the U.S. Department of Agriculture, Humboldt-Toiyabe National Forest, Spring Mountains National Recreation Area, Las Vegas, Nevada. 35 pp.

Charleston Mountain Angelica

Charleston Mountain Angelica occurs in a variety of ecosystems at elevations from 1,128 to 3500 meters. The most detailed analysis of this species status was completed 15 years ago by Nachlinger and Combs (1996) and work by Walker (2005) provides an update. The populations examined by Walker appeared to be stable. There are reports and studies of this species which are not available in the species reference database. During the coming year the database will be updated, the information thoroughly reviewed and a summary of current knowledge constructed. The summary of knowledge will be updated with the data generated through the I&M program.

The following reports or publications have been developed for Charleston Mountain Angelica:

Nachlinger, J. L., and J. Combs. 1996. Biological Monitoring Plan for *Angelica scabrida* (rough angelica). Reno: The Nature Conservancy, unpublished report to the U. S. Fish and Wildlife Service/The Nature Conservancy. The Nature Conservancy. Prepared for Toiyabe National Forest Service, Las Vegas Ranger District. April 1991. pp 1-39.

Walker, K. C. 2005. 2005 Biological Monitoring Report for *Angelica scabrida* on the Humboldt-Toiyabe National Forest Spring Mountains National Recreation Area. Unpublished report for the Humboldt-Toiyabe National Forest, Spring Mountains National Recreation Area, Las Vegas, Nevada. 11 pp. + Appendices.

Egg Milkvetch

Smith (2001) produced a very comprehensive evaluation of this species' status. Egg milkvetch exhibits broader habitat tolerances than many rare species and inhabits a variety of ecosystems between 2070-2690 m. elevations. Smith (2001) and other studies provide a baseline upon which new location data, study and survey data collected during the last nine years, and the I&M program data can be added. Walker (2006) has not yet been added to the species reference database, which illustrates the need for having all relevant material readily available for use in species' evaluations.

Publications and reports on Egg milkvetch include:

Beyer, C. and N. Sikula 2002. 2002 Summary Report Draft of Biological Monitoring for *Astragalus oophorus* var. *clokeyanus* (Clokey eggvetch) on the Humboldt-Toiyabe National Forest, SMNRA. U.S. Forest Service. Unpublished document in U.S. Forest Service files.

Nachlinger, J. and S. Sheldon. 1995. Status report for *Astragalus oophorus* var. *clokeyanus*. Reno: The Nature Conservancy, prepared for the U. S. Fish and Wildlife Service, Reno, Nevada. 20 pp.

Smith, F. J. 2001. Current knowledge and conservation status of *Astragalus oophorus* var. *clokeyanus* Barneby (Fabaceae), the Clokey eggvetch. Report prepared for Nevada Natural Heritage Program, Carson City, Nevada, and U. S. Fish and Wildlife Service, Reno, Nevada

Walker, K. C. 2006. 2005 Biological Monitoring Report for *Astragalus oophorus* var. *clokeyanus* (Clokey eggvetch) on the Humboldt-Toiyabe National Forest Spring Mountains National Recreation Area. Unpublished report for the Humboldt-Toiyabe National Forest, Spring Mountains National Recreation Area, Las Vegas, Nevada. 15 pp. + Appendices.

Butterfly Studies

Butterfly monitoring was implemented following the 1998 conservation agreement. The studies listed below were conducted or are underway to monitor and determine the population status of the rare butterflies of the Spring Mountains. Sustaining a monitoring effort has proved difficult (Edwards and LaVoie 2009) but Thompson and Garrett initiated a new monitoring study in 2010. A synthesis of published literature, internal project surveys, and reports will be prepared in the coming year.

The following reports and publications address butterfly species addressed by the CA:

Thompson, D., P. Garrett, and H Stephen. 2011 (Draft). Butterfly Autecology Study – Spring Mountains National Recreation Area, Nevada. Unpublished report submitted to the U.S. Forest Service Springs Mountains National Recreation Area, Las Vegas, Nevada. 73p.

Boyd BM and GT Austin. 1999. Final Report on Butterfly Investigations in the Spring Mountains, Nevada, 1998, and A Proposed Monitoring Program for Endemic Species. Unpublished report submitted to U.S. Forest Service Spring Mountains National Recreation Area, Las Vegas, Nevada. 94 p.

Boyd BM, GT Austin, and BM Boyd. **2000**. Report on Butterfly Investigations in the Spring Mountains, Nevada, 1999. Unpublished report submitted to the U.S. Forest Service Spring Mountains National Recreation Area, Las Vegas, Nevada. 36 p.

Boyd BM. 2005. Speyeria carolae: Study in the Spring Mountains, Clark County, Nevada 2004 –2005. Unpublished report submitted to the U.S. Forest Service Spring Mountains National Recreation Area, Clark and Nye Counties, Nevada. 10 p.

Boyd B and D Murphy. **2008**. A Report on the Status of the Mount Charleston Blue Butterfly and its Essential Resources at and Adjacent to the Las Vegas Ski and Snowboard Resort – 2008. Unpublished report submitted to Las Vegas Ski and Snowboard Resort, Las Vegas, Nevada.

DataSmiths. 2007. Report on butterfly surveys at three locations in the Spring Mountains, Clark County, NV. Unpublished report submitted to the USDA Forest Service, Las Vegas, Nevada. 31 p.

Weiss SB, AD Weiss, DD Murphy, and GT Austin. 1997. Final Report on Endemic Butterflies of the Spring Mountains. Unpublished report submitted to the U.S. Fish and Wildlife Service Nevada State Office, Reno, NV. 90 p.

Project Survey Areas

These data provide observations and habitat data at a number of locations. Since there are knowledge gaps in distribution and habitat relationships for all of the CA species, incorporating project survey data into the I&M database is very important. Procedures need to be established to insure that all project survey data is available in the database.

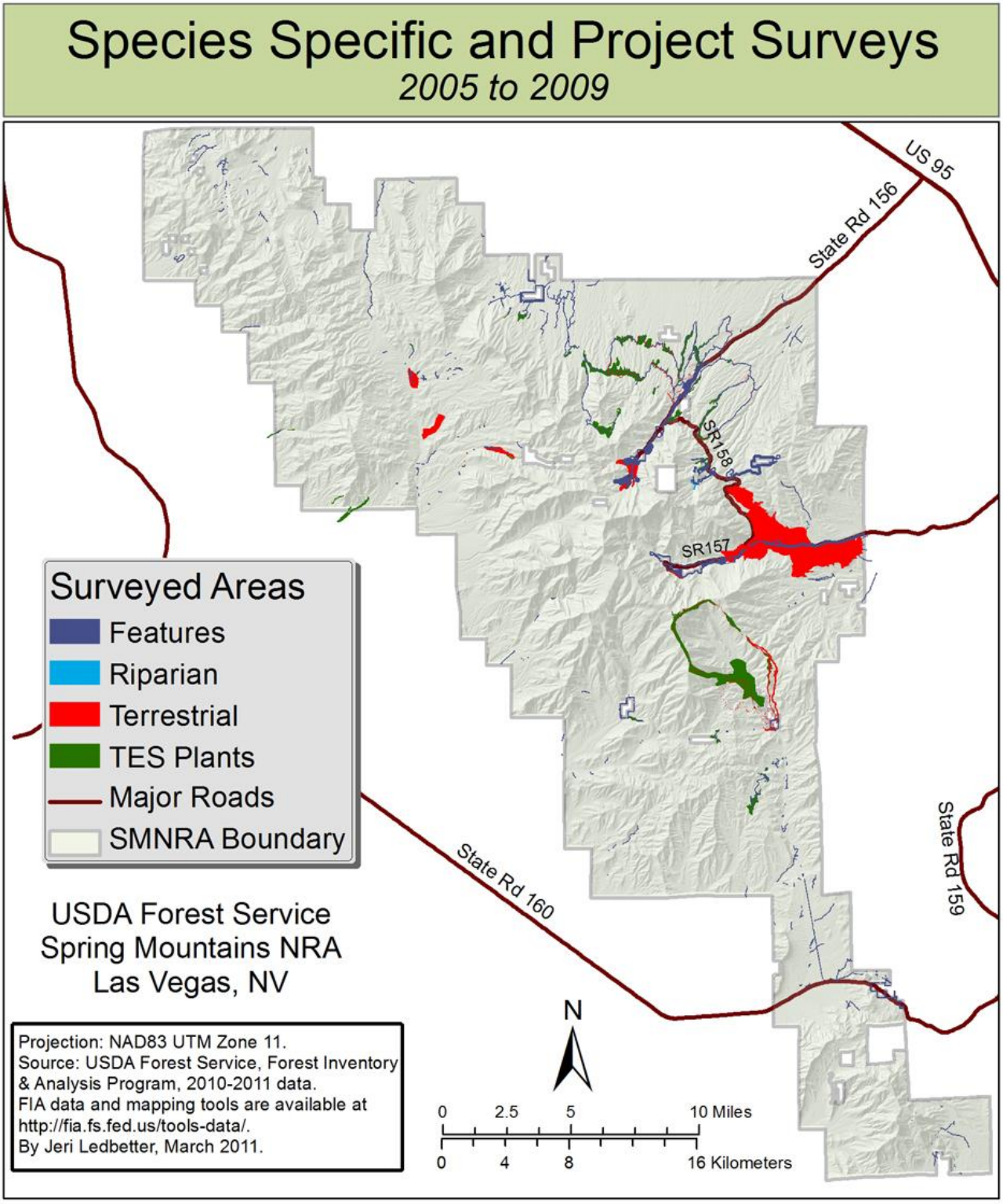
Project survey areas and species specific surveys conducted from 2005 to 2009 are shown on Figure 2-4. Survey categories included on this map include:

Features – Inventories of roads, trails, fences and other infrastructure and facilities
Riparian – Surveys of species associated with riparian areas
Terrestrial – Surveys for terrestrial species associated with uplands
Threatened, Endangered, and Sensitive (TES) Plants – Surveys for Tier 1 and 2 plant species

Data for surveys conducted in 2010 were not loaded into NRM-NRIS at the time of publication.

Euphilotes ancilla purpura

Figure 2-4: Species-Specific and Project Surveys

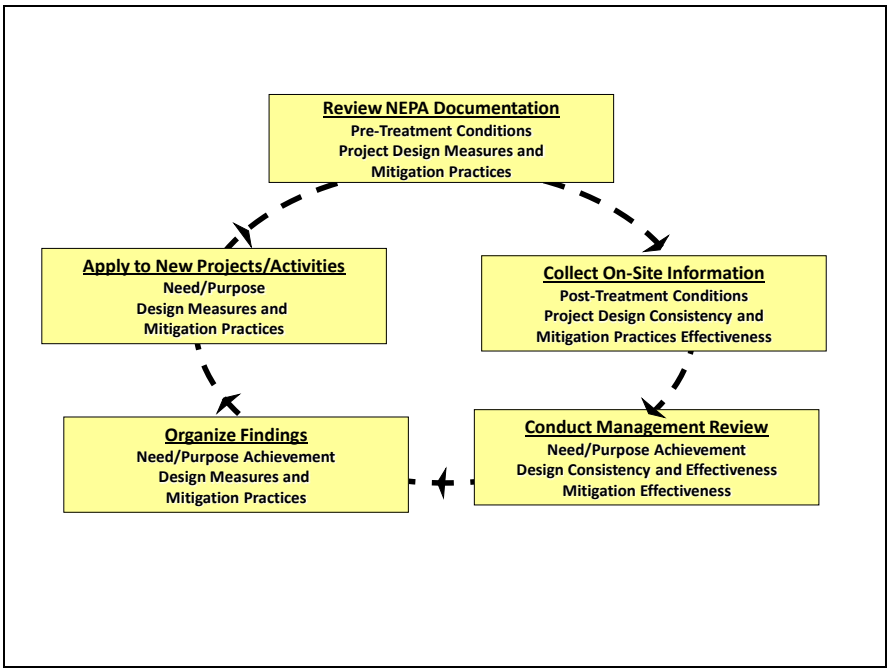


e. Implementation and Monitoring Audits

Implementation and Monitoring Audits (IM Audits) provide a low cost opportunity to observe, evaluate, and make corrections in project planning, design, and implementation via a structured review process that provides a foundation for identifying corrective actions. The purpose of these audits is to facilitate organizational learning and continuous improvement.

Organizational learning and continuous improvement will be facilitated through incorporation of the Plan-Do-Check-Learn cycle established in Environmental Management Systems (ISO 2007). Figure 2-6 is adapted from this process.

Figure 2-5: Implementation and Monitoring Audit Process



Review of each project or activity will begin with what was **planned** through a review of the NEPA documents that authorized implementation and link them to the implementation direction, which may take the form of contract documents or direction to a force account crew. This will be followed with an on-the-ground **check** of the actual implementation – the **do** – versus planned and approved action, including discussion about whether and how well the implemented project achieved the objectives. Finally, we will discuss and document – the **learn** – what worked and what needs adjustment or further investigation for future implementation.

A similar learning procedure is used to evaluate the audit process itself. This evaluation will look at the **planning** for the audits (how the project(s) was selected, was the direction and training appropriate, were documents available for review in a timely manner). Reviewing the conduct of the audits – the **do** –how the field visit was conducted will be examined, whether information already collected in other ways was also used, as well as how the results were compiled and analyzed. Finally, the **learn** part of the cycle to make sure that management will be assessed, planning, and implementation were all involved, and that there is a mechanism to incorporate any learning into future activities. In summary,

the learning cycle asks what will we do differently the next time such a **project** is designed and implemented, and what will be done differently the next time such an **audit** is designed and implemented.

1. **Audit priorities** - The SMNRA I&M Strategy set priorities for evaluating projects and activities using the Implementation and Monitoring Audit Program. The Table 2-6 shows those projects and activities to be addressed during the first three years of the program.

Table 2-6: Implementation and Monitoring Audit Priorities

2010	2011	2012
• Mechanical hazardous fuel reduction projects • Wildland fire suppression and restoration	• Mechanical hazardous fuel reduction projects • Wildland fire suppression and restoration • Recreational climbing effects on cliff-dwelling CA Species • Cumulative effects on riparian areas and springs • Wildland fire recovery • Wildland fire suppression techniques and recovery	• Mechanical hazardous fuel reduction projects • Wildland fire suppression and restoration • Recreational climbing effects on cliff-dwelling CA Species • Cumulative effects on riparian areas and springs • Wildland fire recovery • Wildland fire suppression techniques and recovery • OHV management practices • Recreational caving effects on CA Species

2. **Audit procedures** –Planning is expensive and time-consuming – the results should be worth it. The audit process begins with a completed (implemented) project but with a review of the project planning documents. By doing that, we can take a step back and look at a completed cycle of planning/doing. Audit procedures include the following basic steps:

   a. **Review NEPA Analysis and Documentation** – This portion of the audit examines documentation of the NEPA decision and analysis documentation. Specific questions addressed include:

      - Are the planning and implementation documents readily available? Is the planning process easy to follow from the purpose and need for action, through the proposed action, and the predicted results and effects?
      - **Pre-treatment** conditions – Do we understand what we decided to do? Is the proposed action clear and sufficiently detailed for implementation?
      - Was the proposed action changed in the decision document?
      - **Project design measures and mitigation** practices – Is the documentation specific to the project?
      - Are the implementing documents – silvicultural prescriptions, contracts, etc. – consistent with the decision?

b. Collect On-Site Information/Implementation – This phase of the audit process involves on-site examination of results and a comparison with the desired outcomes described in documentation examined in the first step. Specific areas addressed include:

- **Post-treatment conditions** – Did we do what we said we were going to do? If not, why not, and is there any documentation of the change?
- **Project design consistency and mitigation practices** – Were the design measures and mitigation practices adhered to? If not, what are the consequences, and how long will they last?
- Has the treatment or project result been "tested"? Did it perform as we would have liked? Has post-treatment wildland fire behavior been modeled? What were the results? Have fire behavior analysts or suppression specialists examined the results and reached any conclusions?
- Are there any surprises? How about shocks?
- What would you most like to do over?

c. Conduct Management Review – Results of the document review and on-site information phases are presented to SMNRA leadership with the focus on the following questions:

- What did we learn this year from current and past implementation? Did we achieve the new condition we desired? Are the new conditions better or worse than we hoped? If it is several years since implementation, are the improved conditions lasting as long as we would like?
- Project design consistency and mitigation practices effectiveness – how did the standards and guidelines affect the achievement of the desired conditions?
- Are there any immediate adjustments we need to make in projects currently being planned for future implementation?
- Are there major concerns identified during this year's reviews?

d. Organize Findings/Prepare Audit Report- The Audit Report organizes the findings from all activities and project reviews and references back to previous years' findings as appropriate. This is where all the results are synthesized and recommendations made for changes to local unit planning and implementation, and more importantly recommendations to the Forest and Regional levels regarding the possible need for changes in broader direction or the need for additional research.

e. Apply to New Projects/Activities – This phase of organizational learning and improvement focuses on the application of audit findings and recommendations to ongoing and proposed projects and activities.

f. Review of audit procedures - It is useful to take a conscious look at how audits are conducted; whether there are useful findings; and whether or not those findings make a difference in future

planning, project implementation and, ultimately, improved conditions on the ground. A structured evaluation of the IM Audit program will be conducted to make sure we are maximizing the payoff for our effort, or whether we need to make adjustments in future audits.

Figure 2-6: IM Audit Site Visits for the SMNRA Hazardous Fuels Reduction Project

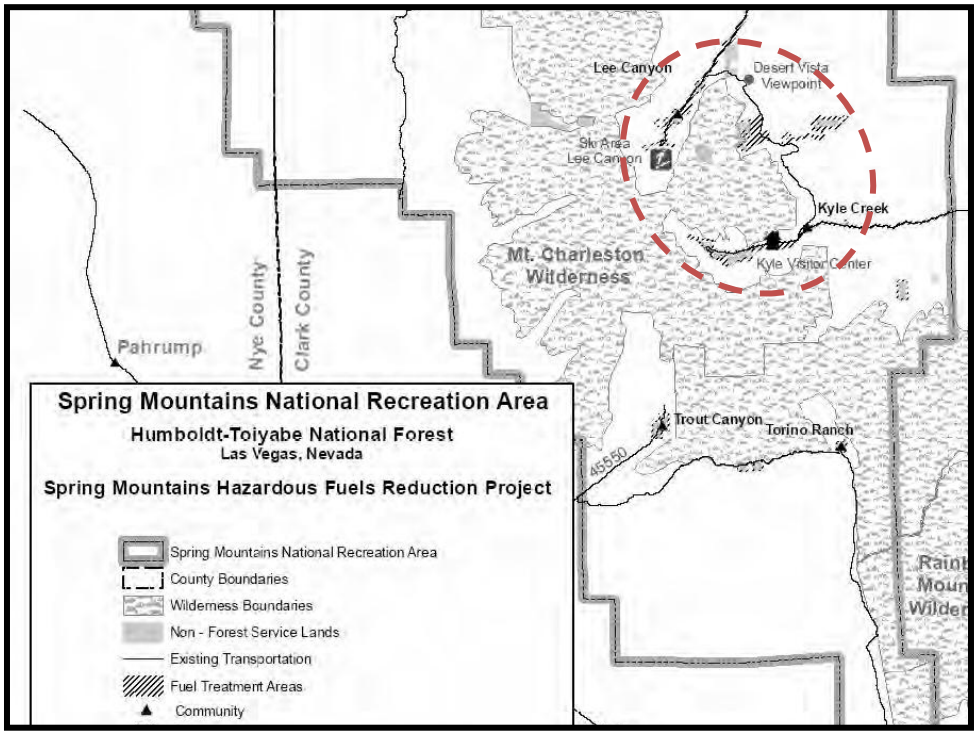
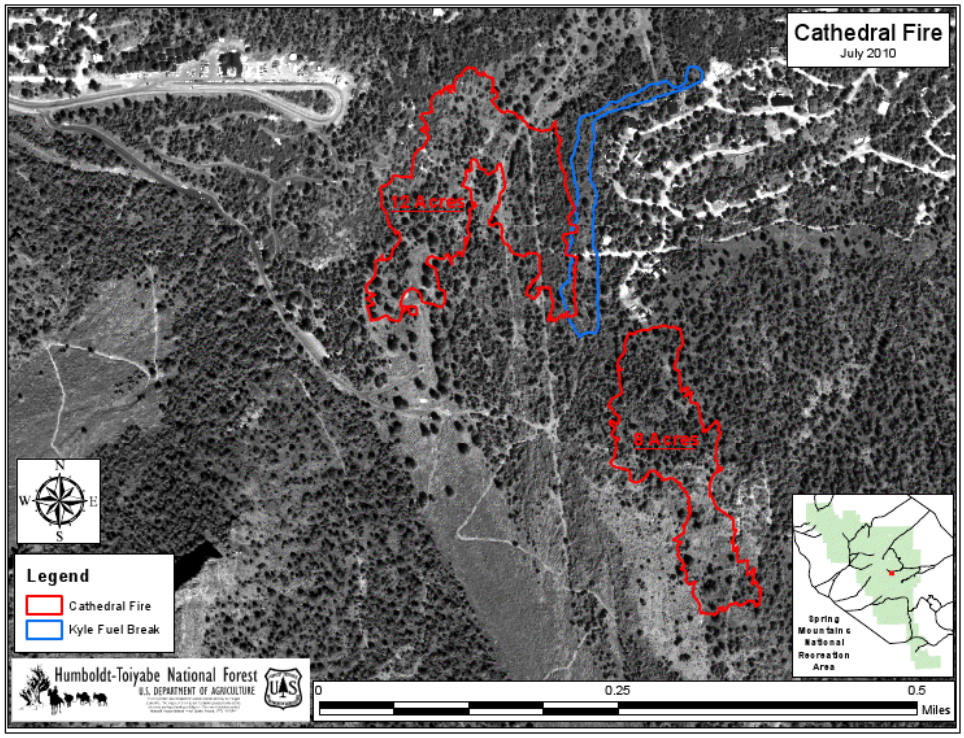


Figure 2-7: Cathedral Wildfire



2010 Accomplishments

The first round of IM Audits was conducted on projects selected by the Deputy Forest Supervisor during a three-day workshop held October 19-21, 2010. Participants included the line and staff personnel involved in the planning and implementation of future hazardous fuel reduction treatments and wildland fire suppression efforts. Current hazardous fuel reduction treatment activities were analyzed and approved by the District Ranger in the Spring Mountains Hazardous Fuels Reduction Project EA, Decision Notice, and FONSI on December 20, 2007. These treatments are nearly complete, providing the audit team the opportunity to evaluate areas where treatments were in progress as well as those where treatment was complete. Many of the same participants were involved in suppression and restoration of the Cathedral Wildland Fire that was also selected for the audit. This wildland fire occurred partly in the same area as some of the hazardous fuel reduction treatments in Kyle Canyon, although before the treatments were completed.

The 2010 Implementation and Monitoring Audit Report (METI, 2011) documents the findings of the IM Audit workshop, and addresses the implementation and effectiveness of wildland fire suppression and restoration strategies and techniques used in the Cathedral Wildland Fire (see Figure 2-7), and design features and mitigation measures employed in the hazardous fuel reduction treatments in Kyle Canyon, Deer Creek, and Lee Canyon (see Figure 2-6). It is organized into two main sections, each of which addresses both implementation and effectiveness monitoring, and makes observations and recommendations. The report concludes with specific recommendations regarding future hazardous fuel reduction proposals.

An evaluation of audit procedures and effectiveness was conducted in conjunction with the management review held on January 12, 2011. SMNRA leadership and staff were supportive of the overall approach and endorsed its use in 2011.

2011 Audit Program Plan

The second round of IM Audits was to address monitoring questions associated with the management of recreational use of caves and cliffs. Since no management actions have been taken or implemented, the IM Audit process cannot address monitoring questions (MQ) associated with the management of cliffs and cave recreational uses. Instead, the focus during 2011 will look at efforts to reduce recreation effects to riparian and spring areas (MQ 8 and MQ 51), efforts to manage motorized recreation (OHV) and limit other uses (outfitters and guides) to protect CA Species and their habitats (MQ 5), and to determine whether wild horses adversely affect the habitats of some CA Species associated with springs and riparian areas (MQ 45). An evaluation of soil and water conservation practices associated with these uses (MQ56) will also be included in the IM Audit.

These audits will build on the findings of the demonstration audit conducted of the Bristlecone Pine Trail Project. In addition, the upcoming IM Audits will provide a look at the challenging area of management of effects from activities that are not management initiated but that have effects on particularly rare and sensitive resources that are critical to the protection and conservation of CA Species habitats.

Plebejus Shasta charlestonensis

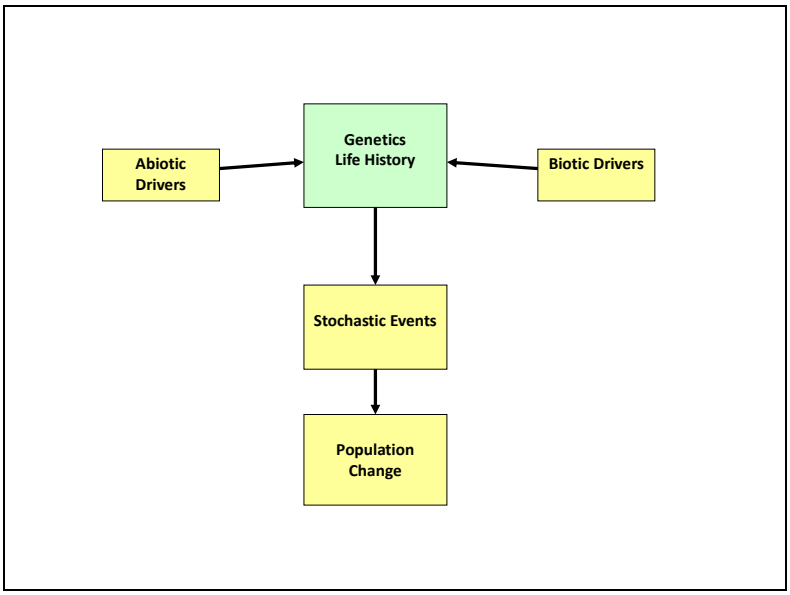
Lasius nevadensis, head

3. Analysis and Evaluation

Data analysis and evaluation are critical components of the adaptive management cycle. Data and information generated from inventory and monitoring activities provide a foundation for addressing monitoring questions. This evaluation provides managers an understanding of relationships between conservation actions (or inaction) and desired outcomes. It also provides the basis for identifying and determining the need for changing land and resource management plan components, the CA and supporting conservation strategy, programs, projects or activities, or the monitoring program.

For the purposes of this effort, analysis and evaluation are focused on the conservation of CA Species within the SMNRA. In addressing this goal, it is important to understand the ecological underpinnings of the I&M Strategy (see Figure 3-1).

Figure 3-1: Ecological Underpinnings of the Inventory and Monitoring Strategy



Population trends (net change in the number of individuals in a population) are determined by factors acting at a number of scales. Examples of fine scale would include the square centimeter where a seed lands, den locations and species interactions in a meter square plot. Larger scales would include the community, migration corridors, and ocean temperature patterns. Fine-scale patterns often cannot be understood without knowledge of global and regional processes.

In many cases, regional and landscape-scale forces can swamp the fine-scale forces that determine population dynamics. Factors that influence population change, both fine and large-scale, may be either biotic (biological factors) or abiotic (physical factors). These factors (drivers) influence a population's genetic structure and life history through differential mortality and reproduction. For rare species with limited population size, random (stochastic) events, both biotic (e.g. ungulate grazing pattern) and abiotic (e.g. tornado path), can have an enormous impact on net population change. The SMNRA inventory and monitoring program collects both biotic and abiotic data at multiple scales. The combined data set provides information on species' population dynamics necessary to support an adaptive management approach to conserving and sustaining the ecological and species diversity of the SMNRA.

These ecological concepts can be described in terms of six basic outcomes; each with a specific monitoring focus and affiliated monitoring questions. Outcomes are analyzed and evaluated in three groups (1) ecological context, (2) species conservation, and (3) management interactions. The monitoring focus and specific monitoring questions associated with each analysis and evaluation group are described in Table 3-1.

Table 3-1: Analysis and Evaluation Monitoring Question Groups

Analysis and Evaluation Group	Outcomes	Monitoring Focus	Monitoring Questions[4]
Ecological Context	Ecological Context	Are changes in ecological context occurring that may affect species distribution or population sustainability?	29, 30, 33, 34, 49, 50, 53, 40, 42, 45, 44, 25, 23,
Species Conservation	Species Occurrence	Where do CA Species occur within the SMNRA?	32, 35, 36, 38, 4, 3, 17, 37, 1, 16, 24, 28, 26, 27, 18
	Habitat Relationships	How do individual species relate to their habitats?	
	Population Sustainability	How well distributed and robust is the population of individual species?	
Management Interactions	Implementation Consistency	Are the design measures and mitigation measures related to CA Species specified in the project or activity management NEPA decision implemented?	31, 33, 38, 8, 39, 5, 7, 9, 51, 59, 43, 56, 57,55, 41
	Design Measure and Mitigation Practice Effectiveness	How effective are the design measures or mitigation practices in achieving desired results with respect to CA Species conservation?	

Effectively addressing the outcomes associated with many monitoring questions will require information from several inventory and monitoring sources. Similarly the interpretation and analysis of data collected by different inventory and monitoring components will support analysis and evaluation with respect to each of these outcomes as illustrated in Table 3-2.

Table 3-2: Relationships between Ecological Outcomes and I&M Program Components

Outcomes	Intensified FIA	Springs Riparian	Genetic Monitoring	Species Surveys	IM Audits
Ecological Context	X	X			
Species Occurrence	X	X		X	
Habitat Relationships	X	X	X	X	
Population Sustainability			X		
Implementation Consistency					X
Design/Mitigation Effectiveness					X

Data from these programs combined with existing datasets provide the basis for analysis and evaluation and development of recommendations for the conservation of biological resources in the SMNRA.

[4]Monitoring questions are listed in priority order as identified in the SMNRA I&M Strategy (USFS, 2008), see Appendix A.

a. Ecological Context

Monitoring Focus - Are changes in ecological context occurring that may affect species distribution or population sustainability?

Species included in the CA inhabit ecosystems whose stability is affected by a number of drivers. The SMNRA is currently affected by a novel set of drivers that these systems have not previously experienced. The primary disturbance processes discussed below have significantly affected the flora and fauna of the SMNRA. The springs/riparian and FIA monitoring will provide data on invasive species and tree cover loss to insects and disease, and fire. The SMNRA, in partnership with the National Park Service, monitors invasive species. Fire occurrence and impacts are monitored by SMNRA staff. This large data set will provide the basis for monitoring the ecological context of the CA species and their habitats.

Primary disturbance processes or drivers of importance affecting ecological context of the SMNRA include:

Climate Change

Climate influences all of the disturbances discussed in this section. For example, drought induces bark beetle susceptibility in conifers and precipitation and drought contribute to fire frequency and severity. Climate changes that have the most potential impact on Spring Mountain ecosystems include:

- Drought and changes in precipitation patterns can result in a cascade of ecosystem changes
- Changes in plant phenology can potentially lead to a decoupling of pollinator lifecycles with the availability of pollen and nectar resources
- Higher temperatures, particularly winter night time temperatures that limit species elevational ecotone limits, and the lack of snow retention at higher elevations
- Increased CO_2 levels may differentially affect vegetation community dynamics, plant phenology, and below-ground nutrient cycling

Climate models predict a rapid rate of climate change in southern Nevada (Rehfelt et al. 2006), particularly at lower elevations. While the rate of change may be somewhat slower at higher elevations (Loarie et al 2009), shifts in ecotones upward are predicted, e.g. a shift in the blackbrush/pinyon-juniper ecotone (Esque et al 2009) and bristlecone pine movement into the alpine community (Desert Research Institute 2008).

The SMNRA maintains a network of climate monitoring stations. The data collected at these stations provide the context for examining change in ecosystems and CA species' populations since climate is a major driver of ecosystem change. The climate data collected will be a valuable asset to the I&M analysis process. (James Hurja 2011).

Wildland Fire Exclusion – Departure from Vegetation Range of Natural Variability

Many of the ecological settings within the SMNRA are fire-adapted ecosystems (Provencher 2008) and have been affected by fire exclusion as a result of wildland fire suppression. The role of wildland fire within the SMNRA is not well documented and understood.

An important reference point in understanding the ecological context of the SMNRA is the analysis of the range of natural variability for biophysical settings of the SMNRA developed by Provencher (2008). Table 3-4 displays the percentage of area within each of the biophysical settings by seral stage or transition stage used in the LANDFIRE vegetation dynamics modeling.

Table 3-4: The Range of Natural Variability for Biophysical Settings of the SMNRA

Biophysical Setting		Natural Range of Variability					
Code [a]	**Name**	**A** [b]	**B**	**C**	**D**	**E**	**U**
1019	Pinyon-Juniper Woodland	5	5	25	65	0	0
1020	Subalpine Limber-Bristlecone Pine Woodland	15	15	70	0	0	0
1052	Mesic Montane Mixed Conifers	10	30	15	35	10	0
1054	Ponderosa Pine Woodland	10	9	20	60	1	0
1061	Seral Aspen	25	50	15	9	1	0
1062	Curlleaf Mountain Mahogany Woodland	10	15	10	20	45	0
1079	Black Sagebrush	15	40	20	25	0	0
1082	Blackbrush	25	75	0	0	0	0
1104	Mogollon Chaparral	10	90	0	0	0	0
1126	Montane Sagebrush Steppe	20	50	15	10	5	0
1143 [c, d]	Alpine Fell-Field	5	95	0	0	0	0
1145	Subalpine-Montane Mesic Meadow	5	40	55	0	0	0
1145wm [c]	Subalpine-Montane Wet Meadow	5	40	55	0	0	0
1154	Montane Riparian	25	55	20	0	0	0
1155washes	Warm Desert Riparian Systems-Washes	25	75	0	0	0	0

a. Landfire core code that is not preceded by the two-digit map zone identification
b. Standard LANDFIRE coding for the 5-box vegetation model: A=early-development, B = mid-development, open; C = mid-development, closed; D = late-development, open; E = late-development, closed; and U = uncharacteristic.
c. Biophysical settings not in the original map zone 13 of LANDFIRE.
d. Initially coded as 1144, alpine tundra, by Spatial Solutions. Alpine fell-field (1143) was initially identified by NatureServe and LANDFIRE, but not included in the last biophysical setting maps by LANDFIRE.

Existing vegetation conditions by biophysical setting and similar vegetation transition stages was estimated as part of the LANDFIRE calibration process for the SMNRA. This information was developed during a workshop conducted in February 2009, but has only been validated by local knowledge and photo-interpretation. Unfortunately these data are not correlated against the same biological settings used by LANDFIRE so a direct comparison cannot be made between historic and current vegetation using a common typology. Maps of existing vegetation developed for the SMNRA use a different classification system (legend) again making the comparison of historic vegetation patterns and composition to existing vegetation difficult.

An analysis of fire history in the Spring Mountains has not been conducted. There have been numerous large fires throughout the area which can be used to improve knowledge of fire behavior under different

burning conditions. Understanding fire's history and behavior under different conditions helps managers effectively and efficiently manage future wildland fires.

Insects and Disease

Plant and animal diseases are sensitive to temperature, rainfall, and humidity. Climate changes affect host/pathogen systems and projected climate change may intensify disease outbreaks (Harvell et al. 2002). Bark beetle and rust in conifers are of greatest concern (Ford et al. in review) in the Spring Mountains as plant communities migrate up in elevation. Plants and pathogens that have been previously separated by distance may come into contact (Desert Research Institute 2008). The potential for large-scale die-offs of key species and the consequences for ecosystems can be illustrated by the recent widespread mortality of pinyon, *Pinus edulus*. In 2002-2003, 40-80% of pinyons in a four-state region died following prolonged drought and unusually high temperatures (Breshears et al. 2005). Regional mortality of key species has the potential to rapidly alter vegetation composition and associated ecosystem properties for decades.

Bat White-Nose Syndrome

White-nose syndrome, a disease of bats caused by the fungus *Geomyces destructans,* was first discovered on the east coast of the United States in 2006 and has rapidly moved south and west across the US. Over 1 million bats have died from the disease in the eastern United States. White-nose syndrome is a disease of hibernating bats and is spread by bat-to-bat contact and from infected cave environments. Fungal spores can also be transported by individuals and caving equipment. In February 2011, the USFWS issued decontamination recommendations for cavers and their equipment (www.fws.gov/whitenosesyndrome). They have also developed guidelines for cave closure in order to limit the spread of the disease. As of 2011, the closest report to SMNRA of suspected white-nose syndrome is from western Oklahoma. It is unknown whether non-hibernating bats can be infected with the fungus. The Conservation Agreement lists two bat species and if the rapid westward spread of the disease continues, development of contingency plans for the management of caves and their associated bats within the SMNRA is warranted. Other locations that host large numbers of wintering bats may also require monitoring and management action.

Invasive Species

Drought can increase the susceptibility of ecosystems to invasion by nonnative species, especially with elevated CO_2 (Smith et al. 2009). Prolonged drought can result in increased frequency and severity of fires, creating openings for rapid colonization by invasive herbaceous species. Invasive species generally produce large quantities of seed with effective dispersal capability, allowing rapid population expansion and migration to new areas. Invasives species may replace native species as vegetation shifts in response to climate change. Early germinating annuals, such as cheatgrass and red brome, can displace later-germinating native species by depleting the soil moisture necessary for their germination and growth. Streams, roads, and trails are corridors for rapid spread of invasive species.

There are a large number of non-native plant species in the SMNRA. Clokey (1951) reported few weed species in 1935 but as roads were constructed and recreational activity increased so did the number of nonnative plant species. Nachlinger and Reese (1996) documented 31 species of nonnative plants in or

adjacent to their plots. Glenne (2003) compiled a list of 120 nonnative plant species in the SMNRA and adjacent BLM land. The Weed Sentry program recorded and mapped invasive species along roadways in the SMNRA from 2004-2009. This information is compiled in a geo database which is on file at the SMNRA. Future weed surveys will be conducted by the Forest Service and the information will be added to the geo database. Of particular concern are: the invasive brome species which compete with native species and alter fire cycles; perennial rye grass, planted for post fire restoration; and salt cedar which is extremely problematic at springs and other moist habitats (ENTRIX, Inc. 2008).

Desirable Non-Native/Introduced Species

Four species of nonnative wildlife, wild horses and burros, elk, and the Lahontan cutthroat trout, are resident in the SMNRA and pose documented or potential impacts on CA species and Spring Mountain ecosystems. These species are managed by other state and federal agencies. Wild horses and burros are managed by the BLM under the Free Roaming Wild Horses and Burro act. Elk and Lahontan cutthroat trout were introduced and managed by the Nevada Department of Wildlife (NDOW) to provide hunting and fishing opportunities.

Wild Horses and Burros

Wild horses and burros are managed as self-sustaining populations of healthy animals, with the goal of maintaining a balance with other multiple uses, including providing critical habitat for focal, threatened and endangered species. The appropriate management level (AML) for the 3 jointly managed horse management areas (HMA), (listed in Table 3-5) which surround the SMNRA is presently 147 wild horses and 146 burros. All of the herd management areas for the Spring Mountains, together, make up the herd management area complex (HMA). The Spring Mountains Herd Management Area Complex (HMA) covers a total of 671,625 acres and includes both BLM and Forest Service land. The AML represents the maximum number that can graze without damaging the range. There is a history of disturbance caused by excess numbers of horses and burros, with moderate to high levels of disturbance from wild horses and burros documented at six springs surveyed in the Spring Mountains NRA in 1995 (USFS 1998). The annual population increase since 2006 is estimated to be 17 to 20 percent for wild horses and 20 percent for burros, a fact that makes maintenance of appropriate population size difficult.

In January 2007, a roundup resulted in the capture of 368 horses and 400 burros from the Johnnie and Wheeler HMAs, of which approximately 75 horses and 37 burros were released back into the Spring Mountains. Despite this roundup, the BLM estimates that numbers were still above sustainable levels, with the next gather not scheduled for another 5 years (Cummings 2010).

Wild horses and burros primarily consume herbaceous vegetation and some parts of woody vegetation in a wide variety of vegetation types, with use concentrating at spring/seeps in the SMNRA. Excessive use of grasses and forbs decreases the regeneration capability of these plants, resulting in decreased forage availability with successive years. Ground disturbance caused by trampling, particularly in areas surrounding sensitive springs and seeps, creates conditions favorable to invasive non-native species such as cheatgrass or red brome, or noxious weeds such as knapweed

or perennial pepperweed. These weedy species out-compete native species, altering ecosystem function (BLM 2011, Cummings 2010, ENTRIX,Inc. 2008).

Table 3-5 - AML and Population Summary for the Spring Mountains Complex

HMA/WHT	AML		Population Estimate	
	Horses	Burros	Horses	Burros
Red Rock	50	50	21	201
Johnnie	47	21	85	573
Wheeler / Spring Mountains	50	75	268	126
Total	147	146	374	900

ENTRIX, Inc. 2008

AMLs for wild horse and burro numbers are based on seven percent of available water and forage resources, which is intended to reduce, but does not eliminate, the potential for overgrazing and soil compaction.

Elk

First introduced in 1935 with subsequent releases in the 1980s, elk populations were estimated at 246 in 1996 but subsequently declined to 130 in 2009. Reasons cited for the decline include increased recreational and off-road-vehicle (ORV) use within the herd unit area, habitat degradation caused by excessive numbers of horses and burros, and extended periods of drought.

Elk cause some degree of trampling disturbance through use of springs and seeps as water sources. Grazing of herbaceous vegetation also has the potential to impact CA species. In 2009, the level of reproduction was not deemed sufficient to sustain the population (Cummings, 2010, ENTRIX, Inc. 2008).

Lahontan Cutthroat Trout

The Lahontan cutthroat trout occurs only in Carpenter Canyon on the West side of the SMNRA (ENTRIX, Inc. 2008). It is not known to occur elsewhere on the Spring Mountains, and it is managed for recreational fishing by NDOW. Impact of this introduction on stream flora and fauna is unknown at this time. In the coming year, efforts will be made to locate any data that will shed light on potential impacts.

Table 3-6 presents the analysis and findings developed based upon existing data and data collected in 2010 and legacy data for monitoring questions related to ecological context.

Table 3-6: Analysis and Evaluation of Monitoring Questions Related to Ecological Context

Monitoring Question 29 - How does current wildland fire management affect CA Species and habitats compared to historical fire patterns? What are the consequences of wildland fire on CA Species and their habitats?
The role of wildland fire in the SMNRA has been influenced by fire exclusion leading to significant differences between current vegetation composition and historic patterns. Fire Regime/Condition Class mapping indicates a large portion of the SMNRA is vulnerable to fire intensities that will significantly impact ecological function and site conditions in some instances delaying recolonization of sites and delaying successional patterns. The effect of climate change on fire patterns within the SMNRA cannot be determined without an improved baseline understanding of fire behavior for recent large fire events. • Fire Regime/Condition Class distribution on the SMNRA identifies a significant departure from historic conditions in some vegetation types and a high risk of fire intensity that may severely affect ecological function. • CA Species are vulnerable to significant impact from wildland fire. Fire intensity is of primary concern (Condition Class). Historic vegetation patterns and seral stages are not reflected in current vegetation composition affecting the availability of potential habitats for some CA Species. • With respect to the management of wildland fire, the 2010 IM Audit identified the need to analyze major fire events and conditions to improve understanding of recent fires and their behavior on the landscape. This information is essential to determining an appropriate suppression response.
Monitoring Question 30 - How do we restore fire dependent ecosystems where it has been excluded? What are the consequences of wildland fire suppression?
TNC's evaluation (Provencher, 2008) of historic vegetation and departure of existing vegetation from this baseline provides information needed to address this question and concludes that there are significant departures from historic conditions affecting resiliency of these systems from disturbance events, possibly affecting CA Species and their habitats. • Treatment of hazardous fuels in areas with values at risk must be completed to allow effective use of wildland fire for resource benefits. • A SMNRA-wide vegetation management and habitat restoration plan is identified in the 2011 Conservation Agreement. The CA (2.1|A.1) identifies the following findings: - Vegetation management should be oriented toward achieving the historic distribution derived from Provencher, 2008 (see Table 3-4). - Actions should provide strategies for effectiveness monitoring of prescribed treatments and restoration. • Specific actions are identified for aspen stands, ponderosa pine woodlands, Pinyon-juniper woodlands, montane mixed conifer, low elevation desert habitats, dry wash systems, and riparian areas.
Monitoring Question 33 - How effective are fuels treatments in restoring fire to its natural role in the environment?
The 2010 IM Audit identified that hazardous fuel treatments were providing protection to people and property. Without these treatments being completed, the use of wildland fire to restore natural conditions is limited in certain areas. Additional treatments are needed to provide adequate protection of values at risk in Kyle and Lee Canyons and other portions of the SMNRA. • Treatment of hazardous fuels in areas with values at risk must be completed to allow effective use of wildland fire for resource benefits.
Monitoring Question 34 - How can we maintain the appropriate amounts of wildland fire to maintain healthy ecosystems?
The 2010 IM Audit identified that hazardous fuel treatments were providing protection to people and property. Without these treatments being completed, the use of wildland fire to restore natural conditions is limited in certain areas. Additional treatments are needed to provide adequate protection of values at risk in Kyle and Lee Canyons. • Treatment of hazardous fuels in areas with values at risk must be completed to allow effective use of wildland fire for resource benefits. • A SMNRA-wide vegetation management and habitat restoration plan is identified in the revised Conservation Agreement. The CA (2.1|A.1) identifies the following findings: - Vegetation management should be oriented toward achieving the historic distribution derived from Provencher, 2008 (see Table 3-4). - Actions should provide strategies for effectiveness monitoring of prescribed treatments and restoration. • Specific actions are identified for aspen stands, ponderosa pine woodlands, Pinyon-juniper woodlands, montane mixed conifer, low elevation desert habitats, dry wash systems, and riparian areas.

Table 3-6: Analysis and Evaluation of Monitoring Questions Related to Ecological Context (Continued)

Monitoring Question 49 - Where are springs, fen, and streams distributed and how are baseline conditions, including water quality and yield being affected?
A map of known or anticipated spring locations is presented in Appendix D-1. Approximately 20% of those sites were sampled in 2010, and 20% will be sampled during each of the next 4 years. A summary of all the data collected at the spring sites in 2010 is presented in Appendix D 3.2. While this SMNRA-wide data summary is a statistically valid sample of springs, this type of report will benefit from an additional season of inventory in 2011, at which time approximately 40% of the spring sites within the SMNRA will have been sampled. • Hydrology: The average flow at the spring sites was 2.6 L/sec, although the median was only 0.1 L/sec. Only one site had an elevated water table that could be measured. Other hydrologic data, including water quality data, are presented in Appendix D 3.2. • Soil: Most of the spring sites had rocky substrate and very little soil development. Only one site had soil characteristics that might be considered fen-like, although it probably would not meet all the criteria of a fen. Additional information on the soils data are presented in Appendix D 3.2. • Fauna: Horse, elk, deer, and northern flicker were the terrestrial vertebrates observed most frequently (over 35% of sites). Many other species, primarily birds, were observed although at a low percentage of sites. The most frequently observed aquatic macroinvertebrates were true flies (Order *Diptera*), caddisflies (Order *Trichoptera*), and mud snails (Family *Hydrobiidae*). It is noteworthy that springsnails (*Pyrgulopsis* genus, *Hydrobiidae* family) were found at 4 of the 19 springs, suggesting that those four springs have remained perennial for a very long time, and that the water quality has not changed significantly in centuries or longer. Additional data on fauna are presented in Appendix D 3.2. • Vegetation: Data on vegetation are summarized in Monitoring Questions 50 and 53, as well as in Appendix D 3.2. • Disturbance and Management: The most common disturbances were associated with animals (presumably horses, burros, elk and deer) which resulted in trails, trampling, grazing and browsing of vegetation, and various ground disturbances. In addition, adjacent site characteristics were considered to be unfavorable at most spring sites. Altered flow patterns were also observed at a majority of sites. Additional data on disturbance and management are presented in Appendix D 3.2.
Monitoring Question 50 - What are the current riparian vegetation composition, structure and pattern associated with springs, fens, and streams?
Appendix D 3.2 provides summary information on the vegetation of the springs based on the data collected in 2010 at approximately 20% of the springs of the SMNRA. Each additional year will provide more data with which to describe the vegetation of the springs and riparian areas of the SMNRA. As a first step in answering this question, the vegetation data collected in 2010 were compared to riparian vegetation community types described in Weixelman et al. (1996), and the results are summarized below. • Five sites were consistent with the *Rosa woodsii* community type of Weixelman et al. (1996). • Five sites had little or no vegetation (mostly very small sites). • Four sites did not fit a community type described in Weixelman et al. (1996) but could informally be called the *Baccharis sergiloides*/*Artemisia bigelovii* community type. • Two sites fit the *Salix lasiolepis*/*Rosa woodsii var. ultramontana* community type of Weixelman et al. (1996). • Two sites were high elevation, steep rock slopes which did not fit any community type described in Weixelman et al. (1996) but could informally be called the *Primula fragrans* community type. • One site fit the Mesic Graminoid community type of Weixelman et al. (1996).

Table 3-6: Analysis and Evaluation of Monitoring Questions Related to Ecological Context (Continued)

Monitoring Question 53 - What is the ecological status of riparian areas?
Information from the spring surveys that can be used to address the ecological status of riparian areas includes: the abundance of introduced plant species, the proportion of upland to wetland vegetation, encroachment of upland woody plants, abundance of vegetation in general, and the amount of bryophyte cover. A high ecological status will generally include minimal cover of introduced species, abundant wetland vegetation, no encroachment of upland woody plants, abundant vegetation, and some cover of bryophytes. Disturbance is a natural part of spring and stream/riparian ecosystems, and many riparian plants can tolerate or even thrive with disturbance. Excessive disturbance, as can occur with anthropogenic activities, can impede recovery of native wetland plants (and bryophytes), and can enable establishment of introduced species. Summaries of data relating to ecological status of each site sampled in 2010 are presented in Appendix D 4.1. A more complete assessment of ecological status could be done using the plant species cover values for each site to evaluate the ecological status in relation to the expected vegetation for the environment of each site. • About half the sites are primarily wetland and facultative vegetation (Prevalence Index below 3). The other sites were dominated by facultative and upland vegetation (Prevalence Index 3 to 3.9). More wetland vegetation would probably be associated with high ecological status. • Encroachment of upland woody vegetation appeared to be a minor problem at the sites sampled. • The wetland vegetation at about half the spring sites did not exhibit high vigor. This could be an indicator of excessive disturbance and lower ecological status, or a product of a drought induced water deficit. • Over half the sites did not seem to have enough vegetation to prevent erosion. The arid conditions of the SMNRA contribute to the sparseness of vegetation, but disturbance has likely contributed to the inadequate level of vegetation. • Bryophytes are present at nearly all sites, which is a good indicator. But the cover is below 5% at most sites. The sites with the most wetland vegetation (lowest Prevalence Index) have the most bryophyte cover, which is consistent with the ecology of bryophytes.
Monitoring Question 40 - What is the current trend (distribution and abundance) of invasive species?
The invasive species data collected by NPS is not entering the SMNRA data stream and steps are being taken to assure that this data is part of the NRM-NRIS database for the SMNRA. FIA data collection will provide information to address this question following the 2011 inventory season. Springs inventory data indicate the presence of non-native vegetation at springs sites and tamarisk or salt cedar was observed at one spring site (see Appendix D 3.2).. • Insufficient data available in NRM-NRIS to generate findings. • Non-native species are present at several spring sites, but invasive species were only observed at one spring site.
Monitoring Question 45 - Do wild horses adversely affect the habitats of some CA Species?
The annual population increase since 2006 is estimated to be 17 to 20 percent for wild horses and 20 percent for burros, a fact that makes maintenance of appropriate population size difficult. Wild horses and burros typically use the herbaceous and woody vegetation in a wide variety of vegetation types with use concentrating at spring/seeps in the NRA. Excessive use of forage decreases the regeneration capability of these plants, resulting in decreased forage availability with successive years. Ground disturbance caused by trampling, particularly in areas surrounding sensitive springs and seeps, creates conditions favored by invasive non-native species such as cheatgrass or red brome, or noxious weeds such as knapweed or perennial pepperweed. These weedy species out-compete native species, further reducing vegetation diversity. Insufficient data have been collected on the uplands to accurately characterize and identify site-specific effects from wild horses and burros on CA Species Horses were observed at 42% of spring sites and there was evidence of wild horse activity at 68% of sites surveyed in 2010 (see Appendix D-3.2). Many of those sites also had evidence of excessive erosion and insufficient vegetation to prevent erosion (see Appendix D-4.3). The majority of sites also had evidence of animal trails, trampling, and grazing/browsing (see Appendix D-3.2). • Wild horses were likely a significant component of disturbances noted at springs since horses, and evidence of horses, were observed at many sites, therefore wild horses and burros have likely had adverse effects on habitat for CA species at springs.

Table 3-6: Analysis and Evaluation of Monitoring Questions Related to Ecological Context (Continued)

Monitoring Question 42 - What role should wildland fire play in areas with invasive plant species? What are the consequences and threats from invasive species that typically follow fire such as cheatgrass in lower elevations?
Information from the Fire Effects Information System can serve as a foundation for understanding the consequences of invasive species following wildland fire. • If more detailed information is required to understand these relationships, consider reframing the question as a research proposal or fire synthesis need for submission to the Joint Fire Sciences Program, the Southern Nevada Agency Partnership, or to the Rocky Mountain Research Station (Fire and Fuel Program and/or Terrestrial Wildlife Program).
Monitoring Question 44 - What are the consequences of climate change and drought on CA Species and their habitats?
Insufficient data have been collected. FIA and Springs monitoring over a sufficient time frame is required. • Insufficient data to generate findings.
Monitoring Question 25 - Are the landscapes being managed within a range of variability that promotes resiliency for CA Species and their habitats? Have ecological systems been altered – therefore, affecting CA Species and their habitats?
TNC's evaluation (Provencher, 2008) of historic vegetation and departure of existing vegetation from this baseline provides the information needed to address this question and concludes that there are significant departures from historic conditions affecting resiliency of these systems from disturbance events, possibly affecting CA Species and their habitats. The Conservation Agreement identifies the need to develop a SMNRA-wide vegetation management and habitat restoration plan. The Conservation Agreement describes relationships between different vegetation types and CA Species (USFS 2011a, pages 15-17). The draft interagency program for hazardous fuels treatment (USFS 2011c) describes vegetation treatments designed to modify fire behavior in areas where fire threatens values at risk. Assessment of this monitoring question raised an additional question: Is there reliable data for the entire SMNRA that would enable the determination accurate historic conditions, especially when considering the effects of climate change? • A SMNRA-wide vegetation management and habitat restoration plan is identified in the 2011 Conservation Agreement. The CA (2.1|A.1) identifies the following: - Vegetation management should be oriented toward achieving the historic distribution identified in Appendix 5 (derived from Provencher, 2008). - Actions should provide strategies for effectiveness monitoring of prescribed treatments and restoration. - Specific actions are identified for aspen stands, ponderosa pine woodlands, Pinyon-juniper woodlands, montane mixed conifer, low elevation desert habitats, dry wash systems, and riparian areas. • In some instances the objectives of the interagency hazardous fuel treatment program complement efforts to restore vegetation composition, structure, and distribution to historic conditions. In others these objectives are in conflict with the Conservation Agreement's strategy because of the overriding need to protect people and property and other values at risk, including habitats for some CA species where resulting fire intensity will significantly alter site conditions. • Wildland Fire Management Plan direction for the SMNRA does not exist or should properly reflect the objectives, standards and guidelines in the General Management Plan which provide for the use of wildland fire for resource benefit. - Identify areas where Fire Management Units 2 and 3 apply within the SMNRA and incorporate this information into WFDSS. - Identify species habitat values-at-risk for inclusion in WFDSS based upon potential habitat models and occurrence data. • Review of the climate change literature and evaluation of climatic conditions needed to maintain ecological communities in their current elevation zones, indicate that returning to historic distribution is unlikely, regardless of management actions.
Monitoring Question 23 - What are the effects of air quality on vegetation?
A review of air quality research in Southern Nevada is underway (USGS and others). FIA will collect information on ozone damage in lichens that can provide data on air quality effects to vegetation. • Insufficient data to generate findings.

Ecosystems providing habitats for plant and animals of the SMNRA are affected by a number of drivers, including climate, fire, insect and disease, and invasive or introduced species. Data collected through FIA and SMNRA monitoring programs provide the basis for characterizing current habitat parameters and evaluating the effects of these drivers on population dynamics of CA Species. Of equal importance

to monitoring current and future ecological conditions is an understanding of the current range of habitat variability within SMNRA community types, and how composition of community types differs from historic conditions. LANDFIRE models provide some insight into the range of natural variability of these communities and the degree of departure from historic conditions. Existing data are being applied to the monitoring questions developed in the I&M Strategy. Answers to most monitoring questions will require the additional data generated by the I&M program over subsequent years through FIA and springs inventories, genetic studies, and surveys and studies of individual CA Species.

b. Species Conservation

As outlined in the CA (USFS 2011a, page 3) many of the CA Species have been identified for protection because little is known about species distribution, life history, and their response to management and drivers of ecosystem change. During the past decade numerous studies and investigations have been conducted to address these concerns. A perpetual issue facing parties to the CA has been the organization and access to current and best available data for supporting management decisions regarding species conservation. Data and information issues related to species conservation are being addressed on two fronts:

Species Reference Database - Life history, research and studies

The SMNRA I&M Strategy recommended development of a Species Reference Database or library containing all published and unpublished information for each of the CA Species, accessible in a digital format to all SMNRA staff, and maintained with current information. The Species Reference Library was initially established in the spring of 2008 using the R-4 Planning, Appeals, and Litigation MS Access Database as a framework. Initial entries into the MS Access database were made using a literature search conducted by the RMRS. Work by the SMNRA staff during 2010 has located a number of reports and documents not previously included in the Species Reference Database. The published literature for the CA Species dated 2009-2011 is also being added to the species database and work will continue to add unpublished information found in SMNRA files.

Natural Resource Information System – Survey areas and occurrence data

The Forest Service maintains the Natural Resource Information System as a component of the Natural Resource Manager (NRM-NRIS). NRM-NRIS is supported by a national management organization that follows standards developed by the Federal Geographic Data Committee and provides standardization across different program organizations within the agency. Data summaries, analysis, reports, and map products are supported through the NRIS Output tools: Corporate Data Warehouse (CDW), Geospatial Interface (GI), and I-Web User Views. The CDW provides read-only, historical, and aggregated data using an Online Analytical Processing (OLAP) design that provides snapshots of the transactional (editable) data repository. Benefits of the CDW include availability of outputs for general use, a variety of formats for data delivery (e.g., reports, maps, raw and summarized data), and data at national spatial extents. Users access the CDW through various database connection methods including standard ArcMap, the GI, and, in the future, web services.

As noted above, occurrence and survey area data has been included in a number of reports and documents prepared by and for the SMNRA. This information is not in a standard format and has not been compiled into data sets for each species. The compilation and standardization of all available location data in NRM-NRIS is underway for Tier 1 CA Species (see Table 1-1) and when completed, work on the Tier 2 CA Species location data will begin.

Monitoring Focus – Where do CA Species occur within the SMNRA?

Systematic distribution surveys have not been conducted for CA Species. The I&M program focuses on filling this and other CA Species information gaps. Once survey areas and occurrence data are loaded into NRM-NRIS, maps depicting species occurrence and tabular information can be prepared. This information can then be used in a variety of ways to inform management decisions and better understand where CA Species occur within the SMNRA.

Species Status Review

The CA and the Nevada Heritage/Nature Serve are in general agreement as to the status of CA Species but Nevada Heritage/Nature Serve have not been able to access significant information contained in studies and reports prepared for the SMNRA. Species with larger distributions, such as the *Botrychium sp.*, have had a Nature Serve status review within the last 5 years, but many SMNRA endemics have not had a status review for over 10 years. The Mt. Charleston Blue butterfly is the exception with a 2008 status review.

The Nature Serve fact sheets for CA Species do not, in most cases, contain all available information. The Species Reference Database will provide an improved basis for preparing a species report and annual updates as additional data are collected. Individual species reports will be compared with the Nature/Serve fact sheet prepared for each CA Species. If the information compiled in the species report illustrates a discrepancy between the species database report and the Nature/Serve status, the SMNRA staff will be notified and the FWS consulted. The report and a request to update the species status will be forwarded to Nevada Heritage/Nature Serve.

Monitoring Focus – How do individual species relate to their habitats?

The primary knowledge gap for all species listed in the CA is distribution within the SMNRA ecosystems. CA Species habitat relationships will be developed using two complementary approaches that allow for improvement over time as life history information becomes available and information on species occurrence improves. The combination of these two modeling techniques will be used in generating future potential habitat maps with known levels of accuracy and a more complete description of habitat traits and biophysical relationships.

Potential Habitat Modeling

The Species Reference Database provides information about how CA Species relate to their habitats and life history information and also provides insight into the abiotic and biotic forces which determine the species distribution. From these references habitat characteristics such as elevation range, aspect, soils, etc. can be inferred and used to develop models of potential habitats for individual species using Spatial

Analyst, which is a standard ArcGIS analysis tool. Appendix B contains preliminary habitat models for nine selected Tier 1 CA Species.

The accuracy of habitat modeling can be estimated using occurrence data as a basis for comparing predicted to actual habitat. As occurrence data improves as a result of the intensified FIA program and springs inventory program, accuracy of future versions of habitat models can be assessed.

Habitat Characteristic Modeling

Modeling of habitat characteristics relies upon observed locations to generate habitat characterizations and to map their locations. The TEUI Geospatial Toolkit is used to conduct this analysis. The program uses GIS information to characterize observed locations and generate a potential habitat map which classifies the SMNRA landscape as to the probability of a CA Species occurring at that location.

As more location and habitat data is collected, the accuracy of the potential habitat map improves. The intensified FIA program will produce the first systematic inventory of the entire SMNRA and will provide information occurrence data which will significantly enhance the ability to identify habitat characteristics. Habitat characteristic models will be developed following FIA data collection in 2011.

Monitoring Focus – How well distributed and robust is the population of individual species?

FIA data, previous and ongoing studies data, potential habitat maps, project surveys, and the Species Reference Database, when examined in total, provide the information needed to review the current conservation status of the CA Species and direct recommendations for future studies, changes in conservation status, if warranted, and to produce sound management recommendations. The FIA data provides a statistically sound and robust data set which will be used to track ecosystem changes and ecotone movement that will likely impact CA Species.

Distribution, population size, stressors/drivers of changes to ecosystems which contain CA Species and climate data are of particular interest when reviewing the conservation status of SMNRA species. If after all FIA plots have been sampled and all other data has been summarized and significant gaps remaining the list of factors above, then the species is a likely candidate for species specific studies. An evaluation of the information currently available may also suggest the need for species specific studies.

The ultimate measure of species robustness is a heterogeneous gene pool (see Section 2.c). For example, a species with wide distribution across the SMNRA, not genetically isolated from subpopulations and having a heterogeneous gene pool would warrant a lower tier conservation status than a species with a restricted distribution, low population numbers and a homogeneous gene pool.

Table 3-7 presents the analysis and findings that were developed based upon review of existing data and data collected in 2010 for monitoring questions related to species conservation.

Table 3-7: Analysis and Evaluation of Monitoring Questions Related to Species Conservation

Monitoring Question 32 - What are the effects (positive/negative) on CA Species habitats from mechanical fuel treatments?
Chipping and mastication depths were identified in the 2010 IM Audit as potentially causing adverse effects to some Tier 1 CA Species. This disposal method was used to avoid effects to Palmer's chipmunk, a Tier 2 CA Species. • Decisions to implement design or mitigation measures for CA Species should consider the relative risk to different species using the tiered approach described in the CA. Risks to Tier 2 CA Species should generally not outweigh those to Tier 1 CA Species. • Wood chips from the fuel reduction treatments act as a mulch which inhibits the emergence of many species (including CA species). Mitigation (creating openings in the chip layer) at locations with known or potential habitats for CA Species is possible, but may be cost prohibitive. Monitoring data on the USGS pre-treatment plots can be used to assess effects and provide a basis for remedial treatment design, if warranted.
Monitoring Question 35 - What effects has wildland fire had on the conditions in key CA Species habitats and should these and other areas be protected from wildland fire?
These relationships cannot be determined at this time, insufficient data are available to construct accurate potential habitat maps • Insufficient data to generate findings.
Monitoring Question 36 - What actions can be taken to reduce wildland fire occurrences (severity) resulting in unwanted type conversion or unacceptable environmental effects?
Existing and confirmed Fire Regime/Condition Class Mapping (Provencher 2008) indicates where fire intensity will be severe enough to compromise ecological function. This information will need to be intersected with potential habitat maps. These relationships cannot be determined at this time, insufficient data are available to construct accurate potential habitat maps • Insufficient data to generate findings.
Monitoring Question 38 - What wildland fire suppression strategies and techniques can be used to minimize impacts to CA Species?
The 2010 IM Audit assessed the effectiveness of Minimum Impact Suppression Techniques (MIST) used for the Cathedral Wildland Fire and concluded that these techniques were effective in minimizing ground disturbance effects to potential CA Species habitats. Use of MIST techniques is required in Wilderness but not for the balance of the SMNRA. • Consider use of MIST as a standard practice within the SMNRA to provide mitigation of suppression actions when direct or indirect attack is selected as an appropriate suppression strategy.
Monitoring Question 4 - Are recreational climbing activities affecting CA Species plants in cliff areas or disrupting roosting areas for CA Species bats and other nesting CA Species?
No data collected in these locations. Volunteer programs are being investigated to determine if users can be of assistance in gathering observational data. • Insufficient data to generate findings.
Monitoring Question 3 - How do recreation activities affect CA Species and habitats? Which types and locations of recreation activities are having more substantial effects on CA Species and habitats?
Information from the Landscape Analysis and Infra can be used to determine the "footprint" associated with recreation facilities and uses. This information will need to be intersected with potential habitat maps. These relationships cannot be determined at this time, insufficient data are available to construct accurate potential habitat maps • Insufficient data to generate findings.
Monitoring Question 17 - What are the consequences of distributing recreation use outside presently developed canyons and increasing disturbance in previously undisturbed areas? Are there CA Species habitats where recreation impacts to habitat should be avoided?
Information from the Landscape Analysis and Infra can be used to determine the "footprint" associated with recreation facilities and uses. This information will need to be intersected with potential habitat maps. These relationships cannot be determined at this time, insufficient data are available to construct accurate potential habitat maps • Insufficient data to generate findings.

Table 3-7: Analysis and Evaluation of Monitoring Questions Related to Species Conservation (Continued)

Monitoring Question 37 - What is the rate of wildfire recovery on burned species? Is there a difference in recovery time for high vs. low intensity?
Information from the Fire Effects Information System can serve as a foundation for understanding fire effects. Fire Regime/Condition Class estimates fire intensity as a departure from historic conditions and characterizes fire effects in terms of impact to ecological function. • This question is more appropriately addressed through a research or administrative study design. Establishing control points in advance of a wildland fire is difficult to accomplish because of the degree of uncertainty associated with fire occurrence in specific locations.
Monitoring Question 1 - What are the effects and impacts of dispersed recreation uses, including OHVs to CA Species and their habitats?
IM Audits in 2011 will address this question. Monitoring associated with the Motor Vehicle Use Plan will also provide information to address this question. • Insufficient data to generate findings.
Monitoring Question 16 - How can the effects of existing recreation developments and uses be managed to minimize effects on CA species and their habitats? What are the effects of concentrated uses and their overlap with CA Species and their habitats?
Information from the Landscape Analysis and Infra database can be used to determine the "footprint" associated with recreation facilities and uses. This information will need to be intersected with potential habitat maps. These relationships cannot be determined at this time, insufficient data are available to construct accurate potential habitat maps • Insufficient data to generate findings.
Monitoring Question 24 - Where are opportunities for restoration and/or creation of habitat for CA Species located?
These relationships cannot be determined at this time, insufficient data are available to construct accurate potential habitat maps • Insufficient data to generate findings.
Monitoring Question 28 - What is the average number of downed woody logs per acre?
Appendix C-2.3 displays information for the SMNRA from the 1997 FIA periodic inventory. This baseline information uses a minimal number of plots and is not statistically accurate for the SMNRA. • The average number of down and dead trees (over 5 inches in diameter) per acre in mixed conifer was 0.0. FIA collects data on down and dead trees over 5 inches and the Forest Plan established monitoring requirements for data on down and dead trees over 4 inches in diameter. • Reconciliation of data definitions between FIA and the Forest Plan will need to occur.

Table 3-7: Analysis and Evaluation of Monitoring Questions Related to Species Conservation (Continued)

Monitoring Question 26 - How many snags per acre are present in mixed conifer, riparian areas, and in P-J?
Appendix C-2.1 developed from FIA data collected in 1997 provides information on the distribution of snags. This baseline information uses a minimal number of plots and is not statistically accurate for the SMNRA. Springs inventories only collect data regarding trees within the area surveyed and provide limited information to address this question. The spring's survey recorded trees, but not snags. It would not be difficult to record snags in the future, particularly because there are so few • The average number of snags per acre calculated using data from FIA shows: - The average number of snags per acre in P-J was 11.0 snags/acre over 5 inches dbh. - The average number of snags per acre mixed conifer is 9.5 snags/acre over 5 inches dbh. • FIA collects data on standing dead trees over 5 inches dbh and the Forest Plan monitoring requirement defines snags as being over 4 inches dbh. Reconciliation of data definitions between FIA and the Forest Plan will need to occur. • The number of snags per acre in riparian areas cannot be statistically determined using Forest Service GDE Level 2 Inventory procedures. Only four spring sites in the SMNRA had trees and they had very few trees. One site had one tree, two sites had two trees and one site had three trees. There were six species of trees observed at the springs. Given the limited number of trees at the springs, there are probably very few snags at the springs as well. If data on snags present in riparian areas is essential, the GDE Level 2 protocol will need to be augmented to meet this need.
Monitoring Question 27 - What percentage of mixed conifer is old growth habitat?
Appendix C-2.2 developed from FIA data collected in 1997 provides information on the distribution of age classes in the SMNRA. This baseline information uses a minimal number of plots and is not statistically accurate for the SMNRA. • The definition of mixed conifer from the Multi-Species Habitat Conservation Plan (Clark County, 2008) and the 11 ecosystems used by Southern Nevada Agency Partnership (SNAP) consists of ponderosa pine, white fir and ponderosa pine/mountain shrub communities. - If 150 or older is used as the definition of old growth, then the 1997 FIA data indicates a total of 32,872 acres of240,533 forested acres or 13.7% as old growth. - If old growth is defined as greater than 200 years old, then only ponderosa pine is in that age class with 19,090 acres of 240,533forested acres (7.9%) as old growth. - These data are not corrected for fires occurring between 1997 and 2010. • The definition of old growth to be applied within the SMNRA will need to be determined.
Monitoring Question 18 - What are the direct and cumulative effects of woodcutting and gathering on CA Species and their habitats?
Additional information is needed regarding CA species distribution to evaluate the overlap between wood gathering locations and CA species habitats. • Insufficient data to generate findings.

Little is known about species distribution, life history, and their response to management and drivers of ecosystem change. A perpetual issue facing parties to the CA has been the organization and access to current and best available data for supporting management decisions regarding species conservation.

These issues will be addressed as data from the I&M program is collected through the following steps:

1) Complete and maintain the species reference data base so all relevant information is compiled and readily available for analysis and evaluation;
2) Compile and standardize all available location data in the Forest Service's Natural Resource Information System. This step is underway for Tier 1 CA species;
3) Use of the GIS tools (Spatial Analyst) and the TEUI Geospatial Toolkit to produce potential habitat models and habitat characteristic models for all CA species; and
4) FIA data collected in 2011 will provide a statistically robust dataset of community distribution and CA species occurrence.

This information will then be used to update the Nevada Heritage/Nature Serve database for status reviews and provide the SMNRA with the information and tools needed to manage and conserve the biological diversity of the Spring Mountains.

c. Management Interactions

In addition to external factors affecting the ecological context for CA Species and their habitats, management interactions are a significant factor directly and indirectly affecting CA Species and their habitats. In those cases where habitat is of limited extent the cumulative effects of uses over time can cause significant effects.

Interactions between management activities and biological resources are often complicated and require a rigorous study design to determine cause-and-effect relationships. Structured systematic observations can also be used to evaluate these interactions and make adjustments in design and implementation. IM Audits investigate the linkages between planning and decision documents, implementing guidance and contracts, and on-the-ground results.

Monitoring Focus – Are the design measures and mitigation practices related to CA Species specified in the project or activity management NEPA decision implemented?

Design measures and mitigation practices are used to avoid or mitigate effects to CA Species. Implementation of design features and mitigation measures specified in NEPA decision documents may be compromised because contracts and instructions to crews are often subject to interpretation; there are changes in personnel between planning and implementing decisions, and the amount of time between a decision and its implementation.

Monitoring Focus – How effective are the design measures or mitigation practices in achieving desired results with respect to CA Species conservation?

The effectiveness of design measures or mitigation practices during implementation of projects or activities is also subject to interpretation in contract and project/activity administration. Processes for documenting changes are designed to record administration decisions. This documentation can provide a source of information for assessing the effectiveness of design measures or mitigation practices. Post treatment observations are another method of gathering this information.

Hazardous Fuel Treatment Monitoring

In partnership with the USGS, the SMNRA instituted a monitoring study designed to assess the effects of hazardous fuel treatments. Plots were established in different habitats at two scales (a) ecological sites and (b) micro-sites. Information was gathered prior to treatment. Post treatment monitoring data have not been collected and currently there are no plans to collect these data (James Hurja 2011)

Implementation and Monitoring Audits

IM Audits focus on implementation and effectiveness monitoring to develop observations and recommendations. IM Audits conducted in 2010 addressed both focus areas associated with management interactions (METI, Inc. 2011).

Activities and projects audited were identified based on priorities identified in the I&M Strategy. Priorities were determined using a combination of the risk and uncertainty associated with the effects of different management actions and the ability of management to influence the outcome. Wildland fire suppression and restoration and mechanical treatment of hazardous fuel were selected as priorities for 2010.

Table 3-8 presents the analysis and findings developed during the 2010 IM Audit and other monitoring data which address monitoring questions related to management interactions with CA species and their habitats.

Table 3-8: Analysis and Evaluation of Monitoring Questions Related to Management Interactions

Monitoring Question 31 - How effective are design features and mitigation measures associated with mechanical fuels treatments in protecting/conserving CA Species habitats?
The 2010 IM Audit evaluated design features and mitigation measures used in the December 20, 2007 Spring Mountains Hazardous Fuels Reduction EA and decision documents. Review of the EA/DN and contract documents in addition to on-site review of treatments in Kyle and Lee Canyons and along the Deer Creek Road serve as the basis for the Audit's findings and recommendations. • The relationship between desired conditions for ecological restoration and hazard reduction were not well coordinated. - Treatments in blackbrush were not necessary because existing conditions achieve desired conditions. - Hazard reduction treatment objectives were well defined and used interchangeably (e.g., fuel break vs. fire break). - Removal of surface fuels, especially large woody debris was not necessary to meet fire behavior objectives. • Several design measures resulted in unintended consequences: - Pruning ladder fuels in P-J created vectors for insects and disease. Pruning in association with thinning and disrupting surface fuel continuity was not necessary to achieve fire behavior objectives. - Prescribed burning of piles within one year of treatment is not feasible and the consequences and effects of off-site disposal or chipping outweigh those of burning in a subsequent season. - Chipping and mastication of trees, shrubs and limbscreated chip depths that may affect nutrient cycling, fire behavior, and other ecological functions. • Design criteria used had varying degrees of effectiveness: - Measures for streambank protection, botany, and butterfly protection are well described and effective when properly applied. - Botany measures were effective where flagging occurred. However, it appears that there were inaccuracies in the GIS layers used (especially for milkvetch), so flagging did not protect all populations. - Visual design criteria (V 1 to V18) are out of sync with the complexity of the EA. Terms like "consider," "retain and enhance," and "natural appearing" are too subjective, ambiguous and difficult to translate to contract language for implementation. If visual resources are important to the SMNRA, which are expected with its high levels of recreation and public use, then they should be important enough to be reflected in project design. - Design criterion S2 gives a species preference for tree retention. Bristlecone pine should be designated as the most preferred tree species. • Monitoring requirements are described and appear to be appropriate for this project.

Table 3-8: Analysis and Evaluation of Monitoring Questions Related to Management Interactions (Cont.)

Monitoring Question 33 - How effective are fuels treatments in restoring fire to its natural role in the environment?
The 2010 IM Audit evaluated the effectiveness of fuel treatments in restoring fire to its natural role in the environment by examining the desired conditions described in the December 20, 2007 Spring Mountains Hazardous Fuels Reduction EA and decision documents, the Cathedral Wildland Fire suppression actions, and a general evaluation of treatment locations with respect to the use of wildland fire for resource benefits. The audit team also reviewed the Clark County Community Wildland Fire Protection Plan (Clark County 2005) and the recently completed Spring Mountains Multi-Jurisdictional 10-Year Hazardous Fuel and Fire Prevention Strategy (USFS, 2011c); both of these documents identify additional areas requiring treatment and values at risk. • The ability to restore fire to its natural role in the SMNRA is dependent upon the reduction of risk to people, property and high value resources. Hazardous fuel treatment objectives described in the EA were defined based on altering fire behavior allowing direct attack by suppression crews within the areas treated (WUI). • Desired conditions at times represent a compromise between fire and fuel objectives on one hand and ecological condition and function objectives on the other. For example, pinyon/juniper communities in the SMNRA have a skewed distribution of desired age classes with too much (approximately 95%) in the oldest age class instead of 65% experienced historically. Retention of islands and clumps of these species instead of uniform thinning and retention of larger trees could have achieved fuel reduction objectives and begun to restore historic age class distribution. • Current interpretation of Forest Plan direction (as amended by the General Management Plan) and the letter of delegation to the Incident Management Team for the Cathedral Wildland Fire do not allow for the use of wildland fire for resource benefits. This interpretation may not be correct based on the General Management Plan amendment to the Forest Plan. • Additional treatments needed to provide protection of values at risk are needed based upon the recently completed Inter-Agency Hazardous Fuel Treatment Plan and Community Wildland Fire Protection Plans. Until these treatments can be accomplished the ability to use wildland fire for resource benefits or prescribed fire to restore ecological conditions is generally infeasible because of the high degree of risk and uncertainty associated with the current fuel loading areas with values at risk. • Maintenance of treatment areas recently accomplished and previously treated areas is critical to long-term restoration of wildland fire to the SMNRA.
Monitoring Question 38 - What wildland fire suppression strategies and techniques can be used to minimize impacts to CA Species?
The 2010 IM Audit evaluated the Letter of Delegation to the Incident Command Team and objectives established in the Wildland Fire Decision Support System for the Cathedral Wildland Fire regarding suppression strategies and techniques. • The objectives in the Delegation of Authority letter to in-coming IMT's originate in Forest Plan direction that by its nature is general and broad in scope. Corresponding detailed direction has not been described for the SMNRA. There were some general objectives that did not specifically state what was important to protect or what some of the direction was to follow, i.e., "Follow the Humboldt National Forest Management Plan" … and "minimize impacts to protect natural resources that occur in fire area." • A single Resource Advisor was assigned and worked directly with the Type 3 IMT. This worked because the wildland fire was small (less than 20 acres) and of short duration and the Resource Advisor was knowledgeable regarding the area and its resources. • Minimum Impact Suppression Tactics (MIST) were used on the Cathedral fire. Objectives in the Delegation of Authority letter specified use of MIST whenever practical in all wilderness areas, but were silent on the use of MIST outside designated wilderness. • Although this fire was outside wilderness, MIST tactics used were effective. The amount of hand fireline was minimized by using the road systems in the picnic area as fire lines and burning out from those roads. In addition, limited amounts of fireline were constructed on the east side and top of the fire.
Monitoring Question 8 - How effective are efforts to reduce recreation effects to riparian and spring areas?
Will be audited in 2011 • Insufficient data to generate findings.

Table 3-8: Analysis and Evaluation of Monitoring Questions Related to Management Interactions (Cont.)

Monitoring Question 39 - What wildland fire suppression techniques are most effective in setting the stage for post-fire restoration? (e.g., Fire retardant use restrictions)
The 2010 IM Audit evaluated the Letter of Delegation to the Incident Command Team and objectives established in the Wildland Fire Decision Support System for the Cathedral Wildland Fire regarding suppression strategies and techniques. This question will be reviewed in the 2012 IM Audit if suppression and restoration activities occur in the interim. • The Letter of Delegation specified mop-up and turn-back instructions which addressed restoration of firelines and areas disturbed during suppression efforts. • An evaluation of the need for a Burned Area Evaluation and Restoration plan concluded that fire intensity and disturbance did not warrant restoration efforts beyond what would be accomplished by the Incident Management Team. • A single Resource Advisor was assigned and worked directly with the Type 3 IMT. This worked because the wildland fire was small (less than 20 acres) and of short duration and the Resource Advisor was knowledgeable regarding the area and its resources. • Minimum Impact Suppression Tactics (MIST) were used on the Cathedral fire. Objectives in the Delegation of Authority letter specified use of MIST whenever practical in all wilderness areas, but were silent on the use of MIST outside designated wilderness. • Although this fire was outside wilderness, MIST tactics used were effective. The amount of hand fireline was minimized by using the road systems in the picnic area as fire lines and burning out from those roads. In addition, limited amounts of fireline were constructed on the east side and top of the fire.
Monitoring Question 5 - How effective are efforts to manage motorized recreation (OHV) and limit other uses (outfitters and guides) to the protection and conservation of CA Species and their habitats?
Will be audited in 2011 • Insufficient data to generate findings.
Monitoring Question 9 - How effective are management efforts in reducing negative effects to CA Species dependent on caves?
No management actions have been taken. Efforts to seek volunteer assistance from users to minimize effects and to monitor effects from caving are being pursued. • Insufficient data to generate findings.
Monitoring Question 51 - How effective is riparian fencing in protecting springs and riparian areas? What thresholds warrant this level of mitigation?
Will be audited in 2012. Information from Springs Inventories will also be used to address this question. • Insufficient data to generate findings.
Monitoring Question 59 - Is recreation use or grazing by wild horses/burros or recreational livestock impacting bank stability?
Bank stability is not directly assessed in the protocol used at the spring/riparian sites. In addition, there are limited perennial streams, so there are limited streambanks to assess. Some information from the spring surveys that can be used to get a sense for the amount of disturbances to stream channels and streambanks are observations of disturbance from recreation and ungulates, flow extraction, and channel erosion. In addition, the field surveys included questions about adequate vegetation to prevent erosion and observation of excessive erosion of deposition. Those observations are presented for each site in a Table in Appendix D 4.3. • Recreation: Only a few observations of disturbance by recreation (primarily camp sites) were noted, although it can be difficult to determine the cause of disturbances. • Flow extraction: Many sites had flow extraction or diversion, which likely affects bank stability either directly where flow is removed, or indirectly by decreasing moisture available to plants and thereby decreasing their growth and ability to stabilize banks. • Grazing: Wild or domestic grazing disturbance was noted at most sites. It is difficult to determine how much those animals have impacted streambanks. • Channel erosion: About half of the sites had evidence of channel erosion. The limited flow from these springs means that channels and streambanks are not always well defined, which makes it difficult to assess impacts to streambank stability. • Vegetation to prevent erosion: Most sites did not seem to have adequate vegetation to prevent erosion of streambanks. In addition, most sites had evidence of excessive erosion and deposition. From the springs survey data it is not possible to determine why there is inadequate vegetation and why there is excessive erosion and deposition.

Table 3-8: Analysis and Evaluation of Monitoring Questions Related to Management Interactions (Cont.)

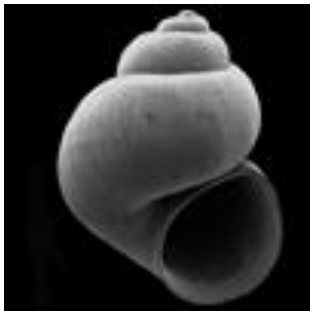
Monitoring Question 43 - Are P-J treatments being invaded by cheatgrass?
Will be audited in 2012. Invasive species inventories conducted in cooperation with the NPS also provide information to address this question. • Insufficient data to generate findings.
Monitoring Question 56 - Are soil and water conservation practices being implemented and are they effective?
The 2010 IM Audit evaluated design features and mitigation measures used in the December 20, 2007 Spring Mountains Hazardous Fuels Reduction EA and decision documents. Review of the EA/DN and contract documents in addition to on-site review of treatments in Kyle and Lee Canyons and along the Deer Creek Road serve as the basis for the Audit's findings and recommendations. The 2010 IM Audit evaluated the Letter of Delegation to the Incident Command Team and objectives established in the Wildland Fire Decision Support System for the Cathedral Wildland Fire regarding suppression strategies and techniques. Future IM Audits will also evaluate this question. • Design measures for streambank protection were well described and effective. • No soil erosion or sedimentation was observed during the field portion of the Audit. • Concerns regarding the movement of burn piles and the effect on drainage structures during runoff were experienced in the Mountain Springs area, but these situations were corrected and were not observed during the field portion of the Audit. • Although this fire was outside wilderness, MIST tactics used were effective. The amount of hand fireline was minimized by using the road systems in the picnic area as fire lines and burning out from those roads. In addition, limited amounts of fireline were constructed on the east side and top of the fire.
Monitoring Question 57 - Are soil disturbing activities creating excessive sedimentation or soil loss?
The 2010 IM Audit evaluated design features and mitigation measures used in the December 20, 2007 Spring Mountains Hazardous Fuels Reduction EA and decision documents. Review of the EA/DN and contract documents in addition to on-site review of treatments in Kyle and Lee Canyons and along the Deer Creek Road serve as the basis for the Audit's findings and recommendations. The 2010 IM Audit evaluated the Letter of Delegation to the Incident Command Team and objectives established in the Wildland Fire Decision Support System for the Cathedral Wildland Fire regarding suppression strategies and techniques. Future IM Audits will also evaluate this question. Data from the spring surveys were used to evaluate sedimentation and soil loss (see Appendix D 4.1). A number of "disturbances" related to soil alteration were noted at the spring sites, such as trampling, trails, excavation and other ground disturbance. • The 2010 IM Audit concluded that the design measures for streambank protection were well described and effective. • No soil erosion or sedimentation was observed during the field portion of the 2010 IM Audit. • Concerns regarding the movement of burn piles and the effect on drainage structures during runoff were experienced in the Mountain Springs area, but these situations were corrected and were not observed during the field portion of the 2010 IM Audit. • The 2010 IM Audit noted that although this fire was outside wilderness, MIST tactics used were effective. The amount of hand fireline was minimized by using the road systems in the picnic area as fire lines and burning out from those roads. In addition, limited amounts of fireline were constructed on the east side and top of the fire. • Nearly all spring sites inventoried in 2010 had more than one of those disturbances associated with soil alteration noted. Over half the sites had evidence of altered flow patterns and excessive erosion or deposition. About half the sites had bare ground that was greater than 10% of the surface area. These data suggest that there has been significant alteration of soil at the spring sites. The arid environment probably makes these sites more vulnerable to soil disturbance than sites in less arid environments.

Table 3-8: Analysis and Evaluation of Monitoring Questions Related to Management Interactions (Cont.)

Monitoring Question 55 - How are management actions and human uses affecting water quality and quantity?
Will be audited in 2012. Information from Springs Inventories can also be used to address this question. • Insufficient data to generate findings.
Monitoring Question 41 - What are the most effective methods of treatment of high priority invasive species? Are there specific thresholds of infestations at which treatments are no longer effective?
Will be audited in 2012. • Insufficient data to generate findings.

IM Audits are conducted with the purpose of determining whether design measures and mitigation practices have been implemented and to evaluate their effectiveness. The 2010 IM Audit focused on the effects of wildland fire suppression and restoration and mechanical treatment of hazardous fuel. Many of the findings and recommendations generated during the IM Audit had direct application to future hazardous fuel treatments and wildland fire suppression and restoration actions.

Studies designed to assess pre- and post-treatment effects from hazardous fuel treatments were initiated, however, data on post treatment conditions is not currently scheduled or funded.



Pyrgulopsis deacon

Astragalus aequalis

Astragalus remotus

4. Conclusions/Need for Change

Long-term conservation of species and their habitats within the SMNRA requires an adaptive approach based on a combination of quantitative data and qualitative information. Ecosystems and management interactions are composed of dynamic and complex interactions occurring at different temporal and spatial scales. Managers can not accurately predict the interplay of all of these factors and must rely on continual monitoring and adaptation to achieve conservation goals and outcomes.

Management adaptations originate from multiple sources and often require adjustments to a variety of plans, programs and activities. Analysis and evaluation results described in the previous section serve as the basis for identifying potential changes. The following recommendations have been identified.

a. Need for Change in Forest Plan Direction

The Toiyabe National Forest Land and Resource Management Plan (USFS 1986) as amended by the General Management Plan for the Spring Mountains NRA (USFS 1996) establishes management objectives, standards and guidelines, and monitoring requirements. This direction can be amended at the SMNRA scale or individual project-specific amendments can be made. Revision of the General Management Plan/Forest Plan can also be made.

Analysis and evaluation identified the following regarding potential changes in Forest Plan direction:

1. **Wildland Fire Management Direction** –The Toiyabe Forest Plan direction as amended by the General Management Plan is not consistently understood or interpreted and is often not accurate. Discussions during the 2010 IM Audit identified a Forest-level interpretation that Forest Plan direction prohibits the use of wildland fire for resource benefits within the SMNRA. This same view persists among many SMNRA staff members interviewed as part of the IM Audit.

   The General Management Plan amended the Toiyabe Forest Plan in regards to wildland fire management as follows:

   Objective 12.5 – Allow fires to play their historic roles, where consistent with the protection of wilderness resources, public safety, and private property and developed facilities in surrounding areas.

   Standard 0.19 – Suppress all fires within the wildland/urban interface and within the Creosote and Blackbrush Land Type Associations.

   Guideline 0.20 – Use prescribed natural fire throughout the SMNRA, where lives and property can be protected and outside the Creosote and Blackbrush Land Type Associations, to achieve ecosystem health goals and reduce fuels when conditions, fuel, weather, and national/local fire seasons allow.

   Guideline 0.22 – Use prescribed fire, silvicultural and mechanical treatments, and shaded fuel breaks throughout the SMNRA to achieve ecosystem health goals, reduce fuel loads, and protect public safety, developed areas, and private property.

Guideline 12.1 – Allow natural disturbances (fire, flood, avalanche) to achieve desired condition of vegetation mosaic. Use management tools to achieve desired condition only if other alternatives are not available.

Clearly the Forest Plan provides the ability of the SMNRA to use wildland fire for resource benefit and to fully implement current agency wildland fire management policy.

Recommendation: No change to Forest Plan direction is needed. Forest-level interpretations regarding implementation of wildland fire management options with respect to wildland/urban hazardous fuel treatments and fire conditions need to be evaluated and operational standards described for the SMNRA or portions of the SMNRA. Several actions are recommended in the 2010 IM Audit with regard to representing Forest Plan direction for wildland fire in the Wildland Fire Decision Support System (WFDSS), including:

a) Identify areas where Fire Management Units 2 and 3 apply within the SMNRA.

b) Identify species habitat values-at-risk based on potential habitat models, known habitats, and occurrence data.

b. Need for Change in the Conservation Agreement or Conservation Strategy

The Conservation Agreement identifies the species that are the focus of the IM Strategy. As information on species distribution and population sustainability improves, some species may be dropped from the Conservation Agreement. The Conservation Strategy identifies assessment and adaptive management (USFS 2011a, page 9) as a fundamental principle upon which the CA and conservation strategy were developed. Similarly, conservation strategies and actions described may also be modified. Conservation actions described in the CA that warrant additional discussion or evaluation based on inventory and monitoring results include:

1. **Species Status Review -** The Nature Serve fact sheets for CA Species do not, in most cases, reflect all available information. The Species Reference Database provides an improved basis for preparing a species report and annual updates as additional data are collected. A preliminary review of several species suggests that adjustments may be needed with respect to their assignment to different priority tiers and whether the Spring Mountains population is essential to species viability based on improved information regarding species distribution.

   Recommendation: A review of the compiled information should be undertaken to insure that the CA tier status and the Nature Serve ranking is consistent with the best available knowledge.

2. **Vegetation Management and Habitat Restoration** (Objective 2.1|Recommended Action 2.1|A) – Desired seral stage/vegetation condition distribution across different vegetation cover types specified in the General Management Plan and described by Provencher (2008). Reliance on the natural range of variability and restoration of vegetation composition, structure, and pattern assume historic vegetation patterns can be replicated as a management goal is unlikely given the predicted rate of climate change and vulnerability of some species to changes in temperature or

moisture regimes needed for propagation and resiliency necessary to sustain species in their current and historic distribution patterns. The lack of an existing vegetation map that corresponds to the same vegetation classification system used by Provencher and LANDFIRE is also problematic because differences between current vegetation types and historic distribution cannot be evaluated and priorities set for restoration.

Recommendation: Develop a map of existing vegetation using a consistent classification system to that used by Provencher to facilitate development of a vegetation and habitat management plan.

Recommendation: Priorities for vegetation management and restoration should be established using multiple factors, including the following:

a) Management options available based on direction in the GMP. For example, different management options are available in Wilderness and Wilderness Study Areas, Research Natural Areas, and other management areas identified by the plan.

b) Vulnerability of species and habitats to climate change. As a part of developing a management plan, attention to different species' vulnerability to climate change should be evaluated and assist in establishing desired vegetation seral stage/distribution objectives and restoration priorities. For example, species dependent on micro-sites likely affected by climate change may warrant more attention than those species dependent on a broader range of habitats or habitats that are better represented that will not be affected by climate change.

c) Abundance and representation of existing and potential sites. Some existing cover types, such as aspen, represent small portions of the SMNRA and potential sites for establishment are limited. These sites could be given a higher priority for treatment than sites, such as pinyon-juniper, that are well represented and have more potential sites available.

d) Relative CA Species priorities. The Conservation Strategy and CA identify species conservation priorities using Tier 1 and Tier 2 to establish priorities. This same approach should be used to set priorities for habitat restoration given limited resources and opportunities for modifying existing vegetation composition, structure and distribution.

Recommendation: Management of wildland fire for beneficial resource outcomes and the use of prescribed wildland fire are components of vegetation and habitat restoration plans for the SMNRA. Wildland fire management objectives must consider both values-at-risk, which may include some CA Species habitats, and overall vegetation management restoration goals. Operational guidance for managing wildland fire is provided in a fire management plan which needs to be developed and approved for the SMNRA and should be consistent with the vegetation management restoration plan.

3. Springs Conservation and Restoration Actions- (Objective 2.2|Recommended Action 2.2|E)

Conservation and restoration priorities within the SMNRA described in the Conservation Strategy are based on springs where springsnails and moonworts, both Tier 1 CA Species, are known to occur.

In some instances restoration actions have been taken in the past, but have not achieved their objectives. Habitats for these CA Species have not been correlated to spring type or riparian vegetation community type which may provide an indicator of potential habitats vs. existing or known habitats. Vulnerability of springs to climate change effects is another variable not accounted for in setting conservation and restoration priorities.

Although the Conservation Strategy places emphasis on restoration and enhancement of springs which are described as "functional-at-risk" or "non-functional", there is no consistent basis for identifying which springs are in these different categories. The Proper Functioning Condition (PFC) approach as referenced in the Conservation Strategy is intended for riparian areas or wetlands and is not appropriate for evaluating springs. The recommended conservation action also fails to recognize limitations on restoration practices based on standards and guidelines in the GMP (e.g., Wilderness, Wilderness Study Areas, and Research Natural Areas).

Recommendation: The Conservation Strategy should adopt a process for setting conservation and restoration priorities that considers the following factors:

a) Ecological condition. Information in Appendix D 4.3 can provide the basis for assessing ecological condition for springs in the SMNRA and developing a ranking system similar to that used in the PFC process.

b) Management options available based on direction in the GMP. For example, different management options are available in Wilderness and Wilderness Study Areas, Research Natural Areas, and other management areas identified by the plan.

c) Abundance and representation of springs by spring type and riparian vegetation community type. Inventories of known springs within the SMNRA have not been conducted using standardized procedures; therefore the distribution of springsnails and moonworts is unknown. Neither are relationship of CA Species to different spring types, flow regimes, and vegetation community types.

c. Changes in Management Activities or Programs

Monitoring and evaluation provides valuable information that can be used to modify ongoing and future activities and programs. The following recommendations were identified based on the findings in Section 3 and by individual inventory and monitoring program efforts:

1. Recommendations for Invasive Species and Disease/Recreation Management

Recreation users and their equipment and livestock represent one of the primary vectors for the introduction of invasives species and disease transmission. Once invasive species or diseases become established the cost and probability of successful eradication or elimination become exponential over time. As a result, successful management strategies employ prevention as a primary component of

management. The following recommendations for future recreation management are focused on invasive species and disease transmission that warrant immediate attention:

Recommendation: The CA identifies concerns and approaches regarding a new threat to bat populations, white-nose syndrome disease transmission by recreation users/cave users (CA Action 3.2, which should be addressed immediately. In addition to discussions with user groups, a Regional Forester's or Forest Supervisor's Special Order restricting or prohibiting use may need to be issued to ensure disease transmission does not affect Tier 2 CA Species bat populations.

Recommendation: The CA discusses and identifies actions associated with the introduction and spread of noxious weeks and invasive species as a concern to CA Species and their habitats by recommending implementation of a *Weed-Free Hay and Livestock Feed Program* (CA Action 3.2|B.2)**.** A Regional Forester's Special Order was issued in 2003 requiring the use of certified weed-free feed. A coordinated and progressive enforcement program of this Special Order should be instituted within and adjacent to the SMNRA.

2. Recommendations for Future Wildland Fire Suppression and Restoration Actions

The following summarizes recommendations for future wildland fire suppression and restoration actions as identified in the 2010 Implementation and Monitoring Audit Report (METI, Inc. 2011).

Suppression Planning and Direction Recommendations:

a) Review and specifically state specific direction for suppression and fire impacts described in the Forest Plan as amended by the SMNRA General Management Plan. Clearly identify the important values needing protection and the specific expectations of the agency administrator(s) to help the IMT successfully accomplish all objectives.

b) Hold discussions at the Forest level to describe and possibly adopt modified MIST guidelines outside wilderness to protect sensitive sites and resources.

c) Prepare templates for the Delegation of Authority specific to the SMNRA that properly reflect the full range of fire management options available. Continue utilizing WFDSS to assist in development of future Delegation of Authority letters.

d) Develop an annual WFDSS fire exercise to stay current with the process and any future changes. Conduct annual training prior to fire season that includes exercises in WFDSS, and involves all SMNRA staff.

e) Preload as much information as possible into WFDSS so important information is readily available when future wildland fires occur.

f) Use the flexibility in Fire Management Unit (FMU) 2 anywhere outside Creosote and Blackbrush Landtype Associations on the SMNRA to ensure firefighter safety and to take appropriate action

commensurate with the values at risk needing protection. Identify where FMU 3 direction applies and limitations on implementation.

g) Analyze past fire history in the Spring Mountains. There have been numerous large fires throughout the area. Understanding fire's history in the area helps to effectively and efficiently manage future wildfires.

Coordination Recommendations:

h) Improve communication, operational understanding, and relationships among all the entities involved in wildland fire suppression by developing patterned and rehearsed responses. All parties need to share an understanding of who is responsible for what, under what circumstances, and the roles of different jurisdictions. This understanding is particularly important when transitioning from initial attack responsibilities to Incident Management Team and Unified Command responsibilities.

i) In the absence of appropriate pre-suppression planning and coordination, the District runs the risk of committing resources needed to advise agency administrators on the management of the incident vs. participating in and directing initial attack on site.

Resource Protection Recommendations:

j) Increase the cadre of trained Resource Advisors on the SMNRA. Hold a preseason meeting or some other session to discuss values at risk and operational situations (e.g., the use of springs as water sources), that might be a problem in managing an incident. Build a GIS layer showing this information and make it available to incoming IMT's.

k) Develop GIS layers for all values at risk that can be readily accessed at the time of a fire or could be provided to in-coming IMT's to help them understand location of all values at risk within and surrounding the planning area on a wildfire. This information will also assist in the development of WFDSS objectives and strategies and incident-specific letters of delegation.

Recommendations for Managing Fire Behavior:

l) Locate past fuel breaks and treatments on-the-ground and record them in GIS. Assess their current condition and effectiveness. Develop maintenance plans and schedules.

m) Conduct fire behavior modeling to generate fire behavior runs under different fuel and weather conditions. This will show different fire spread/intensities and will begin to show the critical thresholds when various objectives may or may not be able to be met. Validate these runs with local fire behavior knowledge and experience.

3. Recommendations Regarding Future Hazardous Fuel Treatments

Recommendations for Review of Approved Projects:

a) Within Kyle and Lee Canyons additional hazardous fuel treatments will be implemented in association with reconstruction of developed recreation sites. Recreation reconstruction contracts should be reviewed prior to implementation to ensure the results of the 2010 IM Audit are reflected in the contract specifications and documented in the project file.

b) The use of chipping as an activity fuel disposal technique should be carefully considered before use in any areas identified as potential habitat for CA Species. Priorities for conservation of CA Species should be considered when determining whether pile and burn in place vs. chipping. For example, the requirement to burn piles associated with protection of Palmer's chipmunk nests (a Tier 2 species) within the same year as treatment resulted in the use of chipping or mastication over large portions of areas treated and may have detrimental effects to many vascular plants and insects identified as Tier 1 species.

   Consider the following mitigation practices:

   - Allow piles to be burned when moisture content is low enough to foster 75% or greater consumption of fuels and spread to adjacent areas is minimal (e.g., when snow cover exists adjacent to piles.)
   - Do not require construction of fireline around piles to minimize ground disturbance.
   - Use chipping or mastication as a disposal method when piles cannot be located outside water courses, key habitat areas for CA Species, or protection of other values at risk cannot be assured.

Recommendations for Design Features and Mitigation Measures for Future Projects:

In addition to recommendations regarding chipping and mastication for disposal of activity fuels described above, future project proposals should consider the results of the 2010 IM Audit. Specific groups of design measures and rationale common to potential treatments include:

a) Design measures that are not necessary to obtain the objective of keeping flame lengths and fire behavior within the limits expected for direct attack by hand crews:

   1) Pruning (S9)- In all cases, drop design measures that specify pruning because they are not needed when surface fuel continuity has been disrupted and stands are thinned. Resulting wounds provide a vector for insects and disease that may actually increase fuel hazards.
   2) Tree/Shrub Removal (S11-13, S15) - Do not remove black brush when fire behavior objectives specify flame lengths of 2 feet or less. Retain mountain mahogany in clumps rather than applying uniform thinning spacing guidelines.

b) Design measures better addressed through proposed treatment design:

1) Visual Effects (V 1 through V18) - Visual design measures should be built into the proposed actions as opposed to being identified as design measures. They cannot be effectively translated to contract terms and are more appropriately dealt with during project design.

c) Design measures determined to be effective that should be retained in future proposals and necessary modifications include:
1) Botany – improve the source of GIS information used to develop contract specifications and designate areas of concern on the ground closer to the timing of actual treatment.
2) Cultural and Historic Sites –no changes.
3) Riparian and Streambank Protection –no changes.
4) Soil Protection – no changes.

d) Fuel Treatment and Activity Fuel Disposal Descriptions – Desired conditions and options for disposal of activity fuels need to be better described and linked to sites that can serve as examples of desired results (e.g., Old Kyle, Stimson LDS Camp, Lee/Foxtail) and describe the specifications for activity fuel disposal and removal of materials.

e) Do not propose actions that should be addressed as part of the annual operating plan or maintenance requirements under the terms and conditions of existing authorizations that are the responsibility of the permit holder or grantee. These include highway and powerline rights-of-way, permitted areas for recreation residences, ski areas, organization camps, and other authorized uses.

f) Do not create expectations for resource specialists in environmental documents that are inconsistent with contract relationships.

4. Monitoring Hazardous Fuel Treatment Areas

During the 2010 IM Audit concerns were expressed regarding the potential effects of chipping and mastication of material removed on CA Species. The USGS study plots installed prior to hazardous fuel treatments provide an excellent opportunity to monitor the effects of different treatment practices on CA Species and their habitats. Unfortunately, funding for the post-treatment monitoring was not available.

Recommendation: Post-treatment monitoring on a subsample of plots installed by the USGS should be conducted. To ensure proper design of an appropriate sampling program and modifications to data collection protocols this effort should be coordinated with the Rocky Mountain Research Station.

d. Changes in the Monitoring and Evaluation Program

As with other aspects of the management approach for species conservation in the SMNRA, monitoring and evaluation programs must also be evaluated to determine whether the monitoring components and focus need to be changed. Given the complexity of the SMNRA inventory and monitoring program these changes are anticipated to originate from a combination of implementation experience, changed conditions and

information, and management determination that monitoring is no longer warranted or new monitoring questions need to be addressed.

The following recommendations for change in the monitoring and evaluation program were identified based on an evaluation of legacy data sets and data collected during 2010.

1. Reconciliation of Definitions and Classes used by the SMNRA and FIA

Analysis of data collected by FIA in 1997 identified a number of areas where the definitions and class breaks used in the SMNRA General Management Plan or Forest Plan need reconciliation.

Recommendation: Reconcile definitions and classes used by the SMNRA, FIA and other programs like LANDFIRE to facilitate analysis and evaluation.

- Cover types such as "Mixed Conifer" need to be defined using criteria that can be applied to FIA data. A similar need to crosswalk Forest Plan seral stage goals for landtype associations, FIA cover types, and LANDFIRE/TNC biophysical settings should also be addressed.
- Specific dbh requirements for snags by cover type are not known and must be referenced to FIA data.
- Old growth criteria and definitions are not described and must be referenced to FIA data.
- Down/dead trees greater than 5 inches are measured by FIA, the SMNRA monitoring question defines dead/down logs greater than 4 inches. Will this create any issues?

2. Change in IM Audit Focus for 2011 and 2012

Modifications will be made in the IM Audit program focus in FY11 and 12 because management actions have not been initiated to deal with recreation effects from recreational climbing and caving.

Recommendation:

FY 11 will focus on riparian/springs effects associated with recreation use, OHV management, fencing and other protection, implementation of soil and water conservation practices.

FY12 will focus on invasive species management, firewood gathering, and implementation of soil and water conservation practices. Wildland fire suppression and restoration maybe included if fires occur.

3. Change in the Springs Inventory Program Sampling Schedule

Changes in the sampling program for springs must be made to be more efficient and to reduce overall costs by inventorying springs that are adjacent vs. making multiple visits over the 5 year program to the same locations. Adjustments to the sampling schedule are also necessary because the total number of springs managed by the SMNRA and their distribution by Hydrologic Unit were in error because of a combination of mapping and classification errors.

Recommendation: Adjust the springs sampling schedule shown in Table 4-1.

Table 4-1: Revised SMNRA Springs Sampling Schedule by 4th Code Hydrologic Unit

Region	HUC-4 Name	HUC-4	CY10	CY11	CY12	CY13	CY14	Total
Lower Colorado	Las Vegas Wash	15010015	10	10	12	7	11	50
Great Basin	Sand Spring – Tikaboo Valleys	16060014	5	4	2	5	3	19
	Ivanpah-Pahrump Valleys	16060015	10	16	16	17	13	72
California	Upper Amargosa	18090202	0	0	0	1	0	1
		Total	**25**	**32**	**30**	**30**	**27**	**149**

4. Integration of Climate Change Monitoring

The SMNRA has instituted and maintained a climate change monitoring program consisting of several stations located at various elevations and aspects. Funding and operation of this program has been independent of the I&M Strategy, but provides valuable contextual information for assessing the effects of climate change on species sustainability and climate induced ecological changes.

Recommendation: Include the operation and maintenance of the climate change programs as an integral part of I&M Strategy program implementation requests.

5. Improved Inventory and Monitoring Program Coordination

Numerous inventory and monitoring projects or activities are occurring within the SMNRA by multiple entities. All research projects should have a permit and study plan on file with the SMNRA. In some instances activities may be occurring without proper authorization or approval (e.g., special use permit or cooperative agreement).

Activities within Wilderness must be authorized consistent with establishment legislation and Wilderness management plans. Similarly, activities within the Carpenter Creek Research Natural Area must be coordinated with and approved by the Director of the Rocky Mountain Research Station.

Research needs are coordinated and monitored through the Southern Nevada Agency Partnership (SNAP). An equivalent process to review proposals, coordinate efforts, and apply results of inventory and monitoring conducted outside the scope of the SMNRA I&M Strategy does not exist. The current system for issuing permits and tracking research activities within the SMNRA, including all research activities funded by federal, state and local agencies, is not adequate to insure that information gathered by research projects enters the I&M data stream.

Recommendations:

a) Investigate approaches to improved coordination of inventory and monitoring activities within the SMNRA, including data capture and application. Processes used by the USFWS and FS can be used as models for improving the research tracking abilities of the SMNRA.

b) Ensure appropriate authorizations or approvals are in place for inventory and monitoring activities. Activities within Wilderness must be authorized consistent with establishment legislation and employ minimum impact techniques.

c) Ensure activities within the Carpenter Creek Research Natural Area are reviewed and approved by the Director of the Rocky Mountain Research Station.

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Appendices - Monitoring Observation and Analysis Reports

Appendix A – Monitoring Questions and Priorities
Appendix B – Potential Habitat Models for Selected Species
Appendix C – Forest Inventory and Analysis Tables
Appendix D – Springs Inventory Data Reports

Appendix A – Monitoring Questions and Priorities

Question Number	Priority Group A – Resiliency to Wildland Fire
29	How does current wildland fire management affect CA Species and habitats compared to historical fire patterns? What are the consequences of wildland fire on CA Species and their habitats?
31	How effective are design features and mitigation measures associated with mechanical fuels treatments in protecting/conserving CA Species habitats?
32	What are the effects (positive/negative) on CA Species habitats from mechanical fuel treatments?
35	What effects has wildland fire had on the conditions in key CA Species habitats and should these and other areas be protected from wildland fire?
36	What actions can be taken to reduce wildland fire occurrences (severity) resulting in unwanted type conversion or unacceptable environmental effects?
30	How do we restore fire dependent ecosystems where it has been excluded? What are the consequences of wildland fire suppression?
33	How effective are fuels treatments in restoring fire to its natural role in the environment?
34	How can we maintain the appropriate amounts of wildland fire to maintain healthy ecosystems?
38	What wildland fire suppression strategies and techniques can be used to minimize impacts to CA Species?

Question Number	Priority Group B – Resiliency to Wildland Fire/Recreation Management
4	Are recreational climbing activities affecting CA Species plants in cliff areas or disrupting roosting areas for CA Species bats and other nesting CA Species?
3	How do recreation activities affect CA Species and habitats? Which types and locations of recreation activities are having more substantial effects on CA Species and habitats?
8	How effective are efforts to reduce recreation effects to riparian and spring areas?
17	What are the consequences of distributing recreation use outside presently developed canyons and increasing disturbance in previously undisturbed areas? Are there CA Species habitats where recreation impacts to habitat should be avoided?
37	What is the rate of wildfire recovery on burned species? Is there a difference in recovery time for high vs. low intensity?
1	What are the effects and impacts of dispersed recreation uses, including OHVs to CA Species and their habitats?
39	What wildland fire suppression techniques are most effective in setting the stage for post-fire restoration? (e.g., Fire retardant use restrictions)
5	How effective are efforts to manage motorized recreation (OHV) and limit other uses (outfitters and guides) to the protection and conservation of CA Species and their habitats?
7	Are management actions to limit effects to CA Species from recreational climbing activities effective?
9	How effective are management efforts in reducing negative effects to CA Species dependent on caves?
16	How can the effects of existing recreation developments and uses be managed to minimize effects on SOC/SOI and their habitats? What are the effects of concentrated uses and their overlap with CA Species and their habitats?

Appendix A – Monitoring Questions and Priorities (Continued)

Question Number	Priority Group C – Water Resources/Invasive Species Management
49	Where are springs, fen, and streams distributed and how are baseline conditions, including water quality and yield being affected?
50	What are the current riparian vegetation composition, structure and pattern associated with springs, fens, and streams?
51	How effective is riparian fencing in protecting springs and riparian areas? What thresholds warrant this level of mitigation
53	What is the ecological status of riparian areas?
59	Is recreation use or grazing by wild horses/burros or recreational livestock impacting bank stability?
40	What is the current trend (distribution and abundance) of invasive species?
43	Are P-J treatments being invaded by cheatgrass?
42	What role should wildland fire play in areas with invasive plant species? What are the consequences and threats from invasive species that typically follow fire such as cheat grass in lower elevations?
56	Are soil and water conservation practices being implemented and are they effective?
57	Are soil disturbing activities creating excessive sedimentation or soil loss?
55	How are management actions and human uses affecting water quality and quantity?

Question Number	Priority Group D – Invasive Spp./SOC/SOI Habitat Mgmt./Other Disturbances & Uses
24	Where are opportunities for restoration and/or creation of habitat for CA Species located?
41	What are the most effective methods of treatment of high priority invasive species? Are there specific thresholds of infestations at which treatments are no longer effective?
45	Do wild horses adversely affect the habitats of some CA Species?
44	What are the consequences of climate change and drought on CA Spcies and their habitats?
28	What is the average number of downed woody logs per acre?
25	Are the landscapes being managed within a range of variability that promotes resiliency for CA Species and their habitats? Have ecological systems been altered – therefore, affecting CA Species and their habitats?
26	How many snags per acre are present in mixed conifer, riparian areas, and in P-J?
27	What percentage of mixed conifer is old growth habitat?
18	What are the direct and cumulative effects of woodcutting and gathering on CA Species and their habitats?
23	What are the effects of air quality on vegetation?

Note: References to Species of Concern and Species of Interest have been converted to Conservation Agreement Species.

Acastus checkerspot

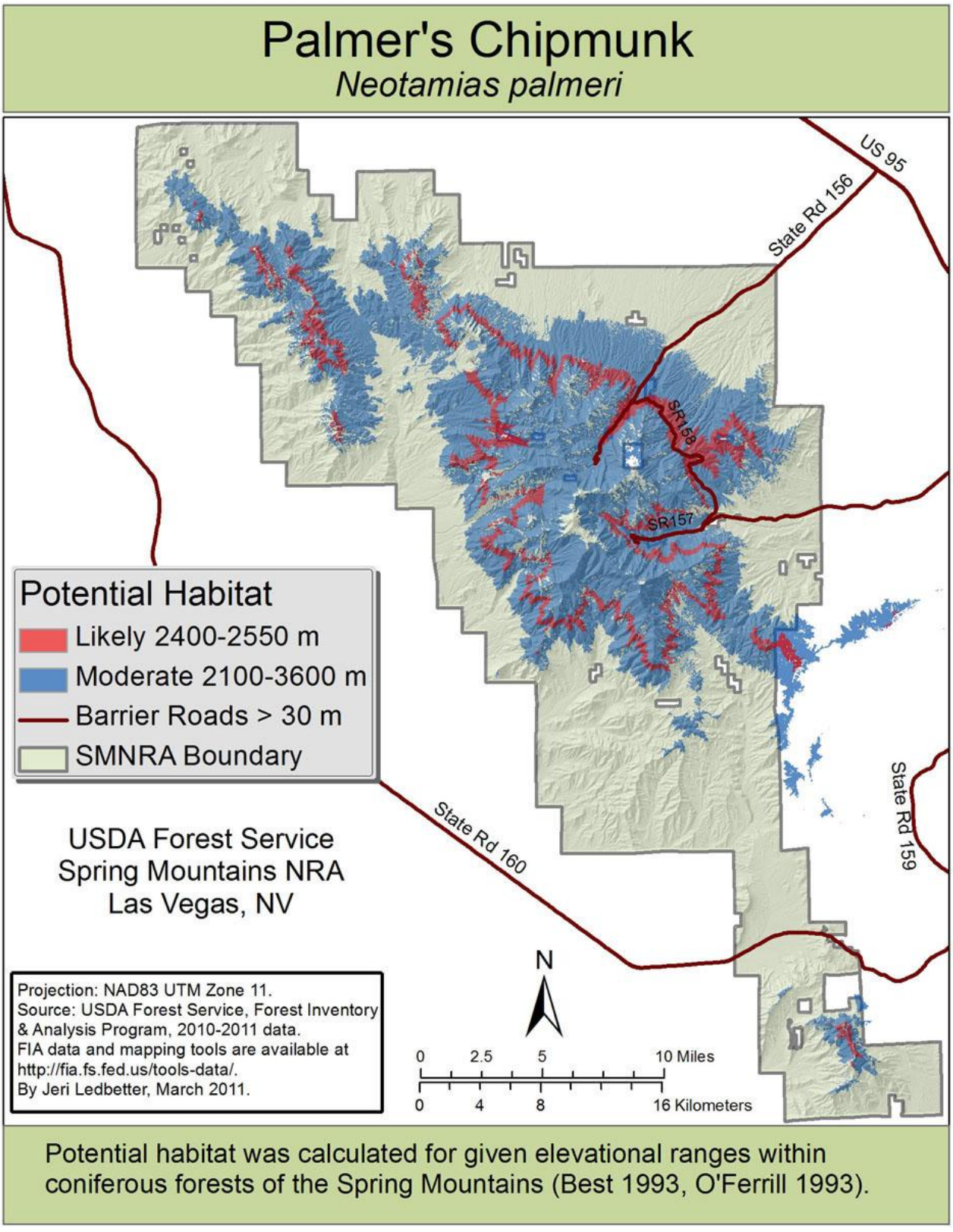
Euphilotes ancilla purpura

Appendix B -Potential Habitat Models for Selected Species

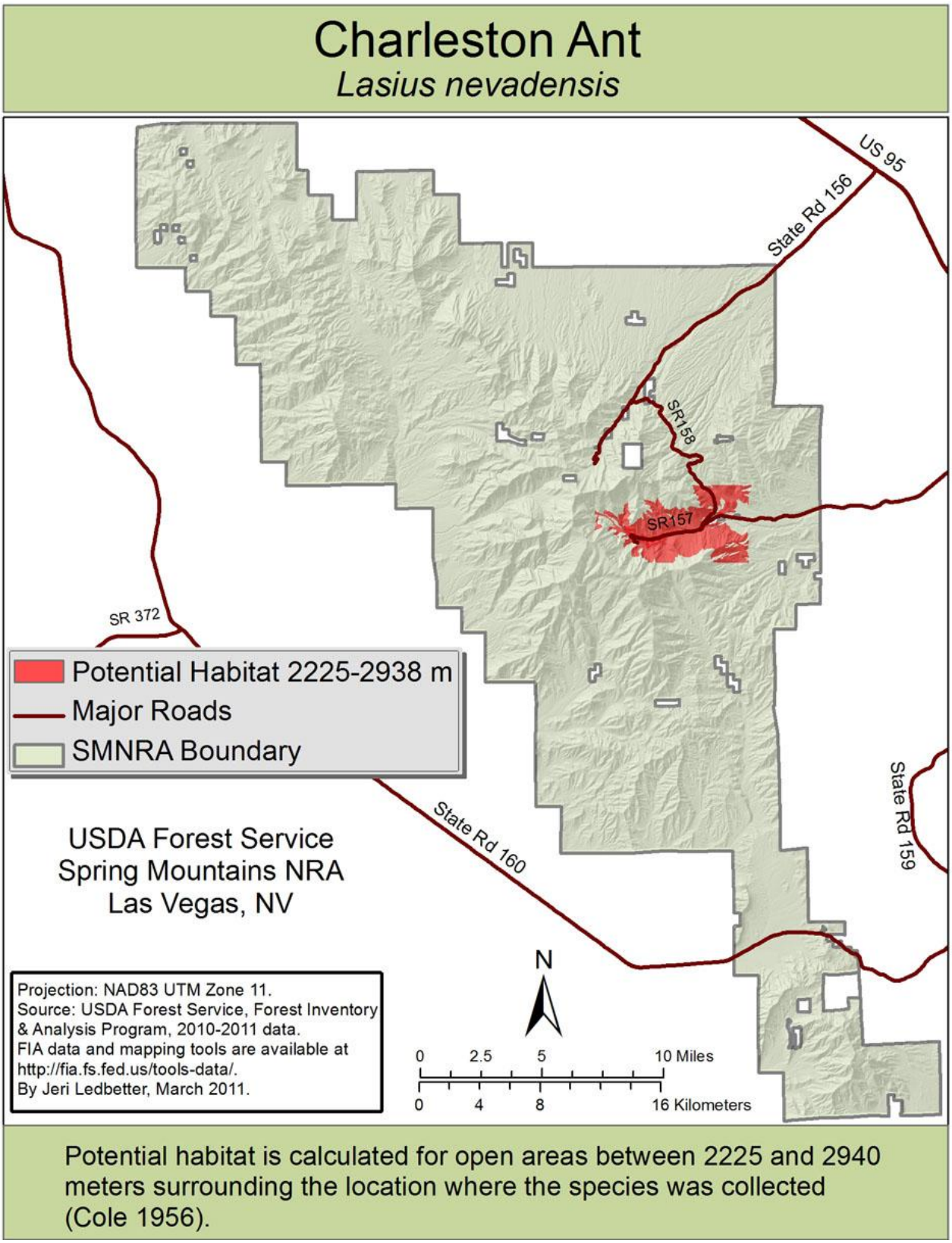
B-1: Palmer's chipmunk
B-2: Charleston ant
B-3: Clokey's milkvetch
B-4: Egg milkvetch
B-5: Spring Mountains milkvetch
B-6: Acastus checkerspot
B-7: Morand's checkerspot
B-8: Mt. Charleston blue butterfly
B-9: Spring Mountains dark blue butterfly

References

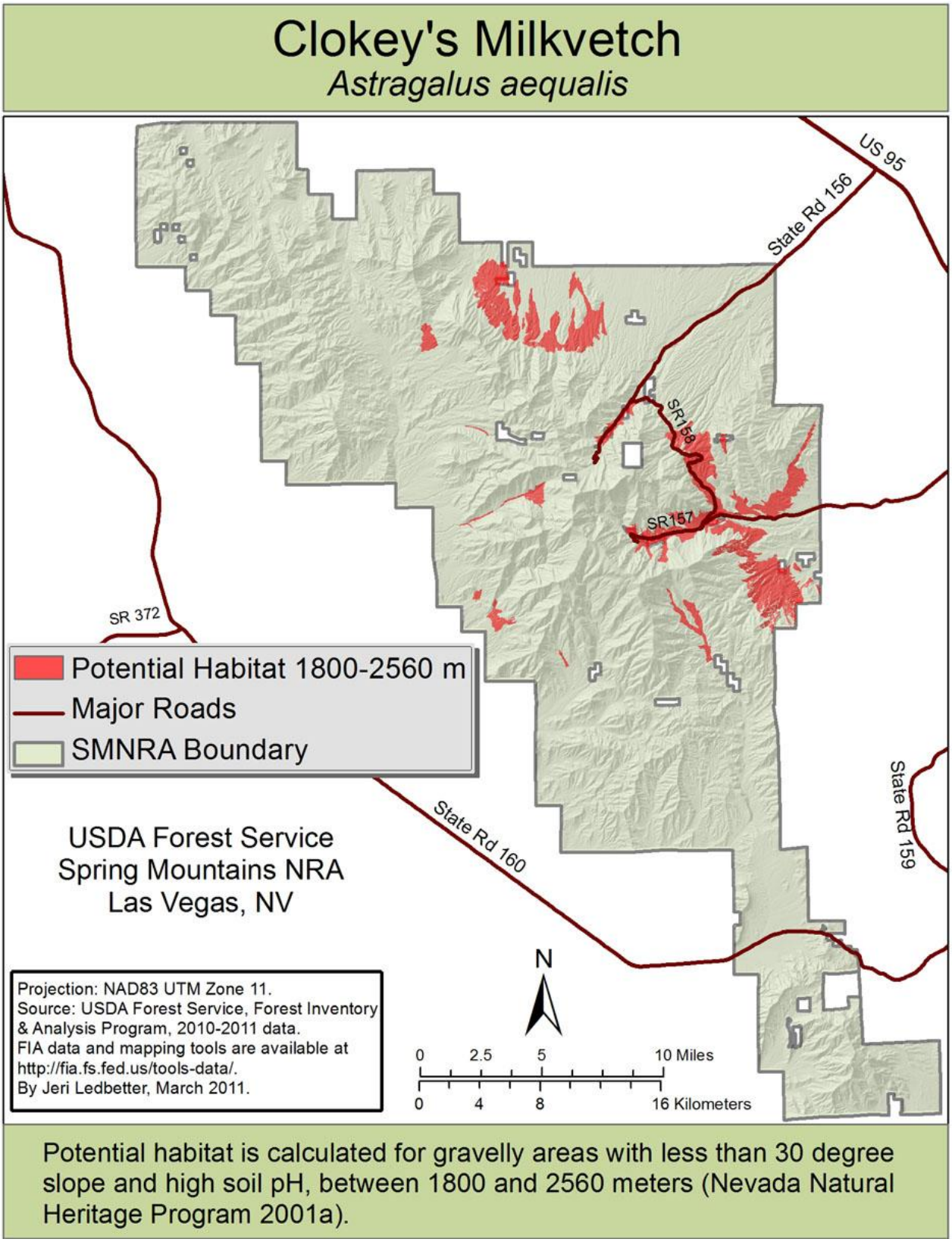
Appendix B-1: Potential Habitat for Palmer's Chipmunk



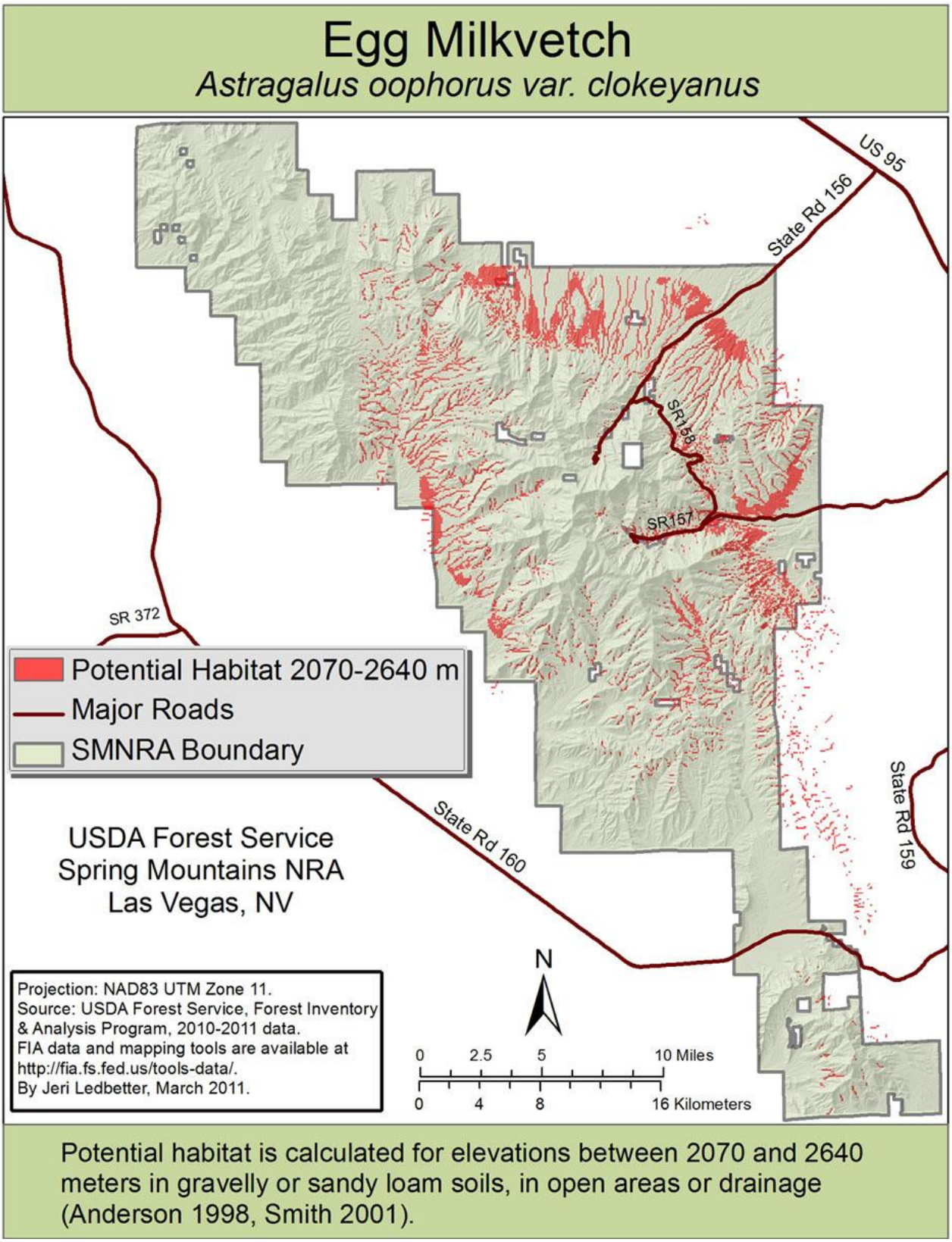
Appendix B-2: Potential Habitat for Charleston Ant



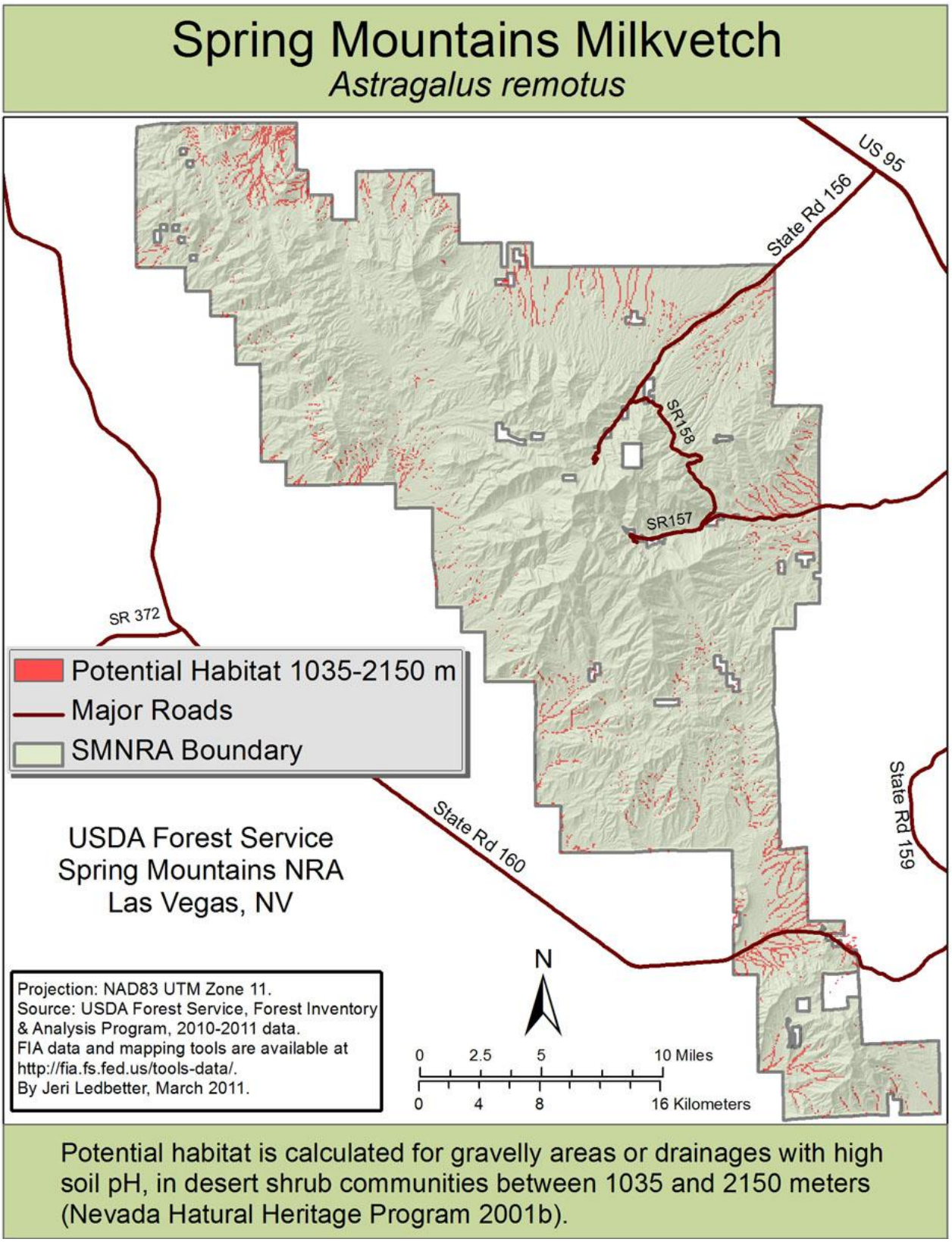
Appendix B-3: Potential Habitat for Clokey's Milkvetch



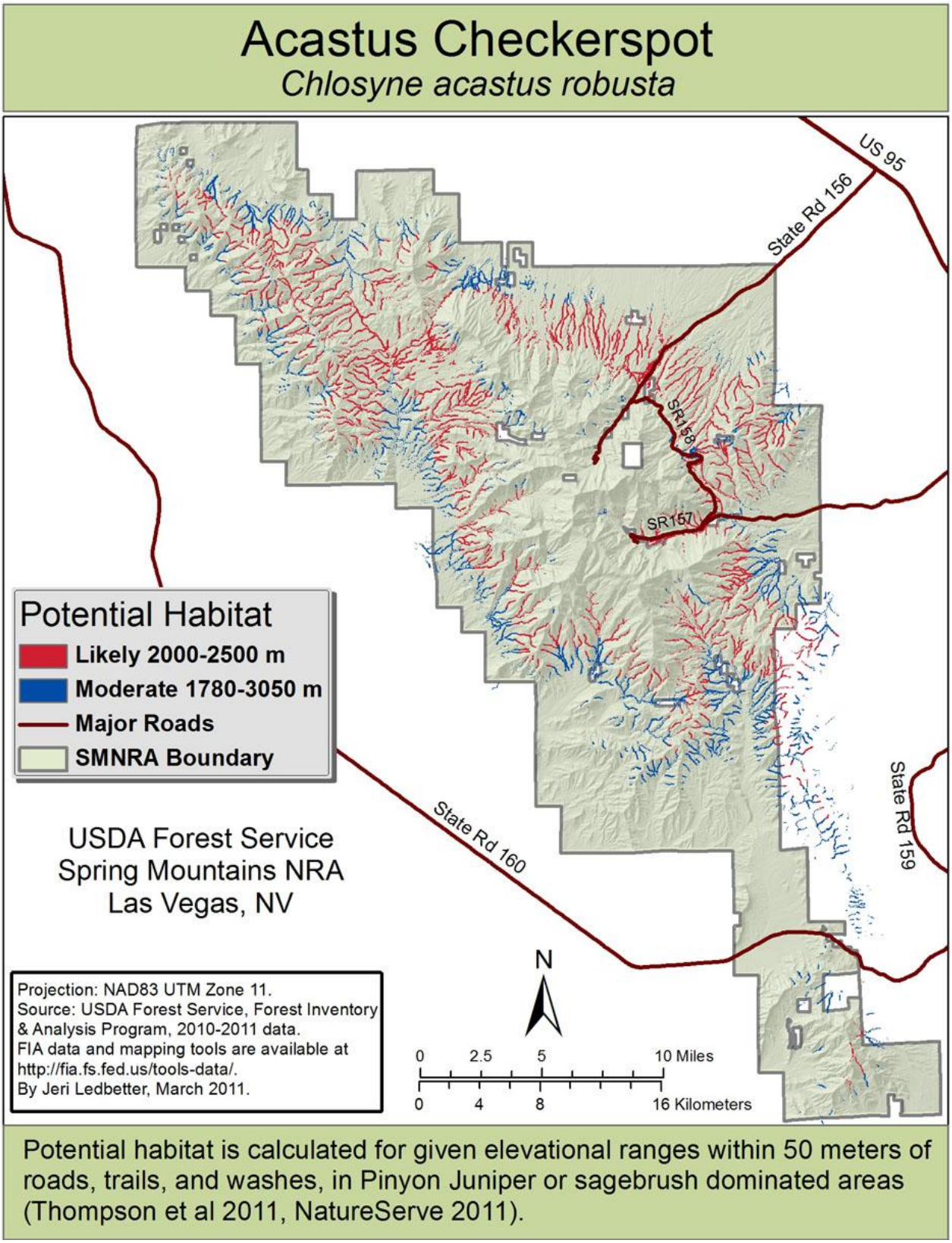
Appendix B-4: Potential Habitat for Egg Milkvetch



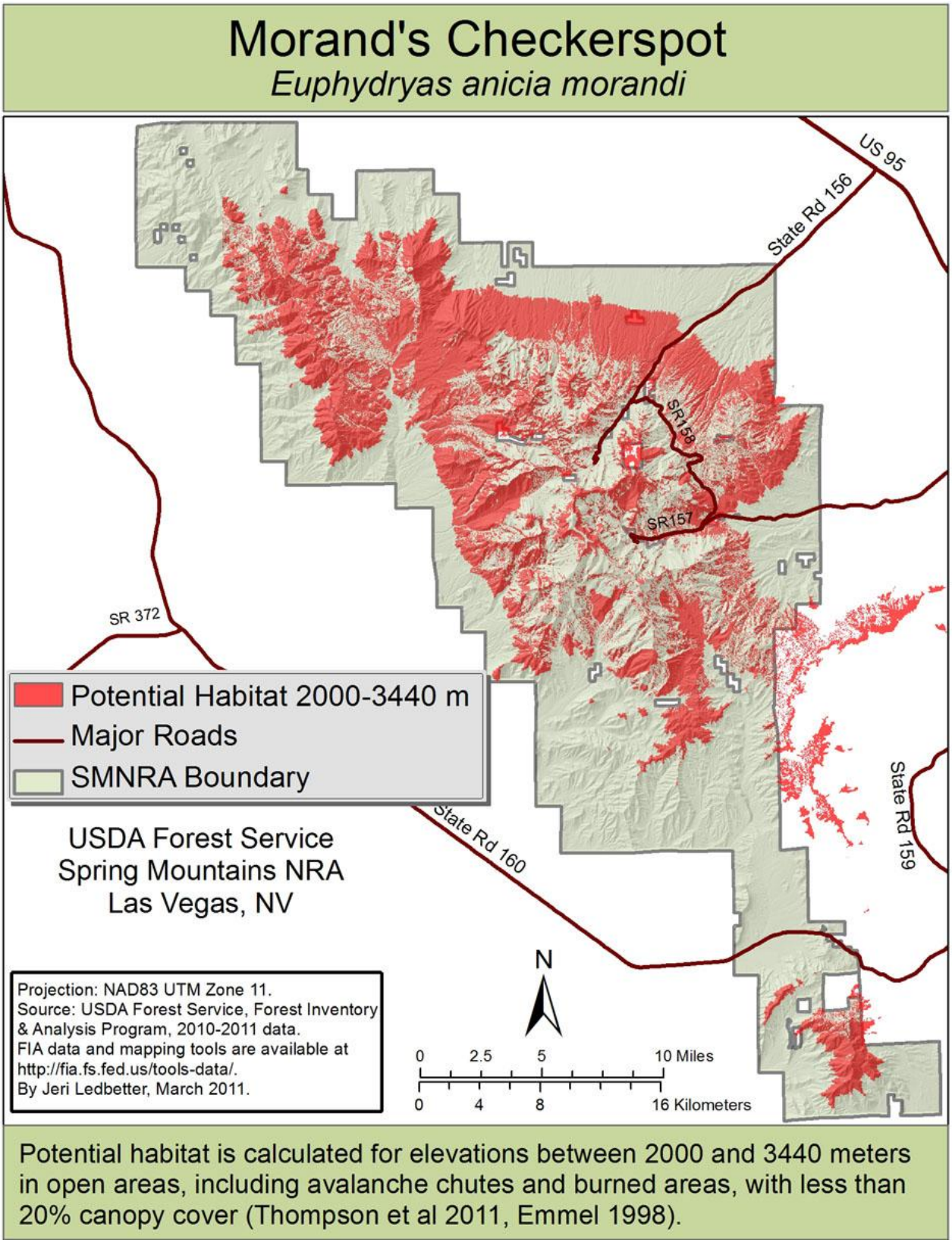
Appendix B-5: Potential Habitat for Spring Mountains Milkvetch



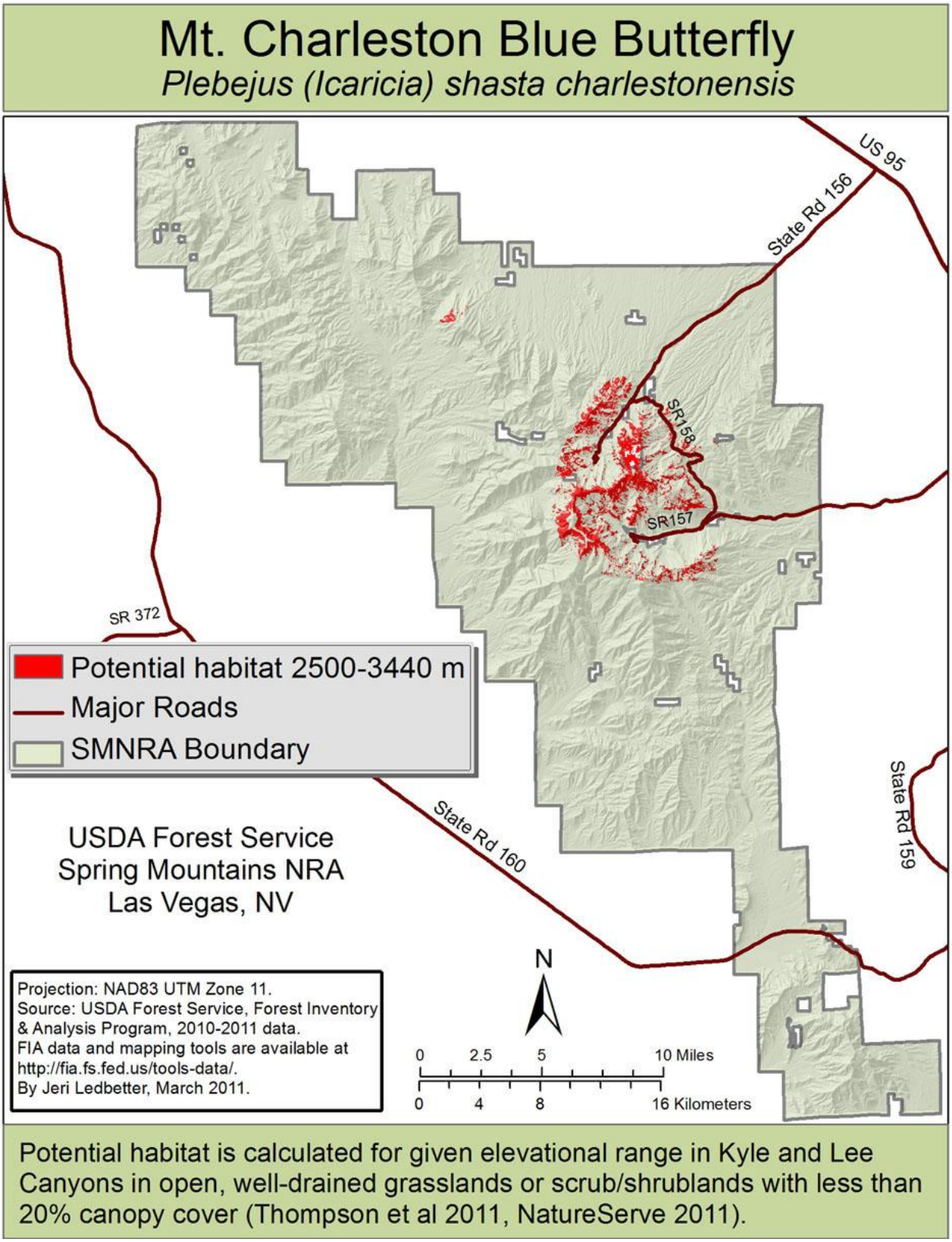
Appendix B-6: Potential Habitat for Acastus Chekerspot



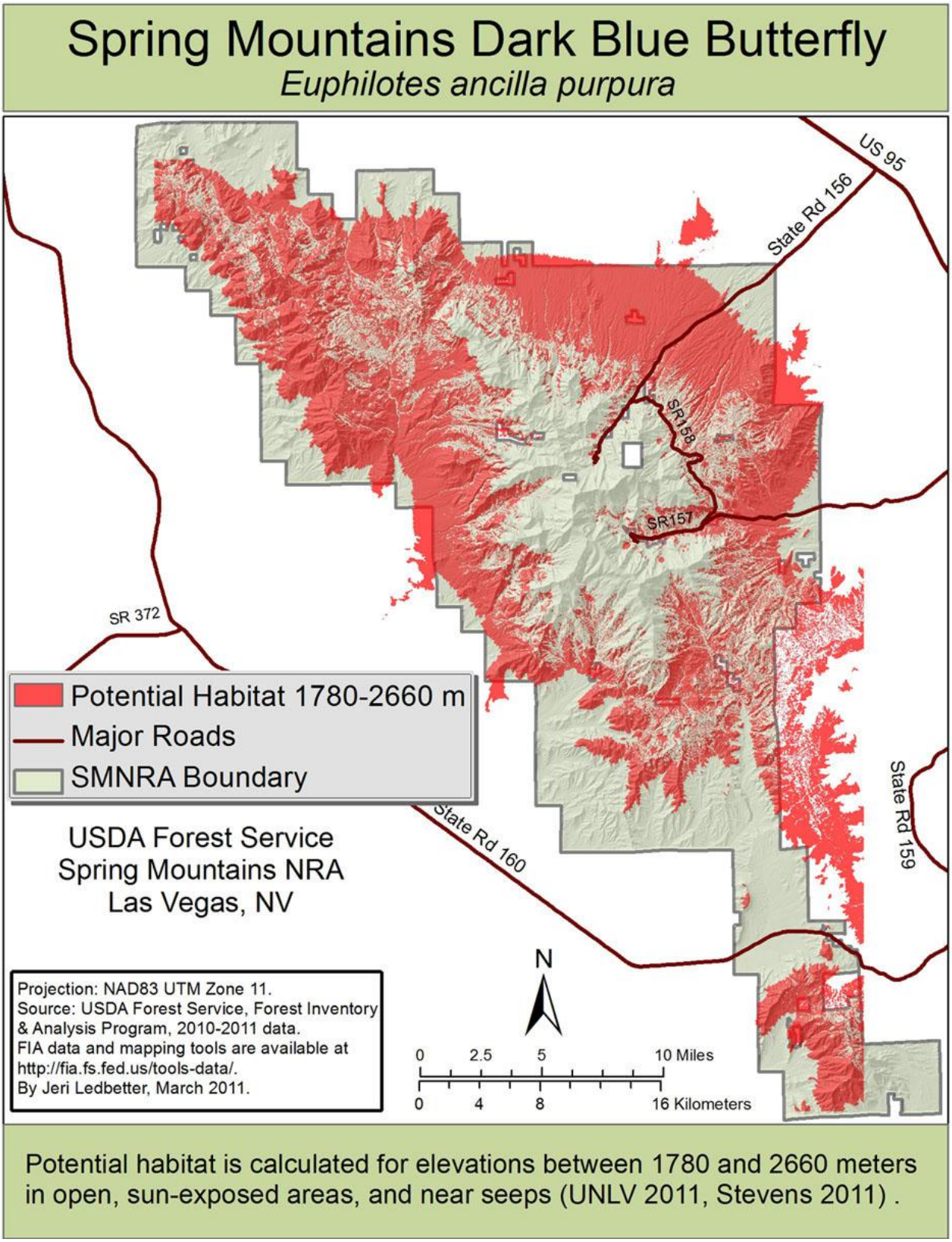
Appendix B-7: Potential Habitat for Morand's Chekerspot



Appendix B-8: Potential Habitat for Mount Charleston Blue Butterfly



Appendix B-9: Potential Habitat for Spring Mountains Dark Blue Butterfly



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Appendix C – Forest Inventory and Analysis Report Tables

C-1 Area-wide Summaries

To be developed following the 2011 inventory

C-2: Monitoring Question Reports

C-2.1: Monitoring Question 26 - How many snags per acre are present in mixed conifer and P-J?

C-2.2: Monitoring Question 27 - What percentage of mixed conifer is old growth habitat?

C-2.3: Monitoring Question 28 - What is the average number of downed woody logs per acre?

Appendix C-2.1: Monitoring Question 26 - How many snags per acre are present in mixed conifer and P-J?

Table 1: Number of standing dead trees (snags) (5 inches diameter and greater) on SMNRA forest land by forest type and elevation, 1997.

Measure: Standing dead meeting specific dbh requirements by cover type.

Issues: 1- MQ cover types may not match FIA forest types. Could match if cover type criteria were known.

2- Specific dbh requirements by cover type are not known.

	Elevation						
Forest type	4001-5000 feet	5001-6000 feet	6001-7000 feet	7001-8000 feet	8001-9000 feet	9001-10000 feet	Total
	trees						
Pinyon-juniper	--	146,843	860,136	610,123	--	250,179	1,867,281
Ponderosa pine	--	--	--	--	70,767	--	70,767
White fir	--	--	--	--	305,152	--	305,152
Cercocarpus woodland	--	--	--	--	68,908	--	68,908
Nonstocked	--	--	--	--	--	--	--
All types	--	146,843	860,136	610,123	444,827	250,179	2,312,108

Table 2: Area of SMNRA forest land by forest type and elevation, 1997.

	Elevation						
Forest type	4001-5000 feet	5001-6000 feet	6001-7000 feet	7001-8000 feet	8001-9000 feet	9001-10000 feet	Total
	acres						
Pinyon-juniper	5,945	20,629	99,142	37,682	--	6,254	169,652
Ponderosa pine	--	--	--	5,945	13,145	--	19,090
White fir	--	--	--	--	13,782	6,891	20,672
Cercocarpus woodland	--	--	--	--	6,891	--	6,891
Nonstocked	--	--	18,144	6,083	--	--	24,227
All types	5,945	20,629	117,286	49,710	33,818	13,145	240,533

Table 3: Standing dead trees (snags) (5 inches diameter and greater) per acre on SMNRA forest land by forest type and elevation, 1997.

Forest type	Elevation						Total
	4001-5000 feet	5001-6000 feet	6001-7000 feet	7001-8000 feet	8001-9000 feet	9001-10000 feet	
	trees/acre						
Pinyon-juniper	0.0	7.1	8.7	16.2	--	40.0	11.0
Ponderosa pine	--	--	--	0.0	5.4	--	3.7
White fir	--	--	--	--	22.1	0.0	14.8
Cercocarpus woodland	--	--	--	--	10.0	--	10.0
Nonstocked	--	--	0.0	0.0	--	--	0.0
All types	0.0	7.1	7.3	12.3	13.2	19.0	9.6

Table 4: Number of standing dead trees (snags) (5 inches diameter and greater) on SMNRA forest land by species and diameter class, 1997.

Species	Diameter class *(inches at breast height or root collar)*											Total
	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-24.9	25.0-28.9	29.0-32.9	
	trees											
White fir	--	143,246	--	60,735	43,631	--	28,597	--	40,849	--	--	317,058
Utah juniper	--	59,446	59,446	59,446	--	87,396	--	59,446	--	59,446	--	384,629
Rocky Mountain bristlecone pine	--	--	--	--	--	--	--	--	21,665	--	--	21,665
Ponderosa pine	--	--	--	--	--	--	--	27,136	--	--	10,061	37,197
Singleleaf pinyon	184,536	125,090	312,724	--	59,446	--	62,545	--	--	--	--	744,341
Curlleaf mountain-mahogany	247,081	375,602	121,991	62,545	--	--	--	--	--	--	--	807,219
All species	431,617	703,384	494,162	182,727	103,078	87,396	91,142	86,582	62,513	59,446	10,061	2,312,108

Appendix C-2.2: Monitoring Question 27 - What percentage of mixed conifer is old growth habitat?

Table 1: Area of SMNRA forest land by forest type and stand-age class, 1997.

Measure: Acres/percentage of area meeting old growth definitions.

Issues: 1- Old growth criteria/definitions are not known.
2- Mixed conifer criteria are not known.

	STDAGE_class						
Forest type	0 years (nonstocked)	1-50 years	51-100 years	101-150 years	151-200 years	201-250 years	Total
	acres						
Pinyon-juniper	--	31,272	76,626	49,245	12,509	--	169,652
Ponderosa pine	--	--	--	--	--	19,090	19,090
White fir	--	--	--	6,891	13,782	--	20,672
Cercocarpus woodland	--	--	6,891	--	--	--	6,891
Nonstocked	24,227	--	--	--	--	--	24,227
All types	24,227	31,272	83,517	56,136	26,291	19,090	240,533

Appendix C-2.3: Monitoring Question 28 - What is the average number of downed woody logs per acre?

Table 1: Number of downed dead trees (5 inches diameter and greater) on SMNRA forest land by forest type and elevation, 1997.

Measure: Number of down logs (>4 inches) per acre.

Issues: Down dead trees >5 inches dbh/drc were measured.

	Elevation						
Forest type	4001-5000 feet	5001-6000 feet	6001-7000 feet	7001-8000 feet	8001-9000 feet	9001-10000 feet	Total
	trees						
Pinyon-juniper	--	59,446	1,604,477	565,843	--	187,634	2,417,401
Ponderosa pine	--	--	--	--	--	--	--
White fir	--	--	--	--	--	--	--
Cercocarpus woodland	--	--	--	--	--	--	--
Nonstocked	--	--	300,331	--	--	--	300,331
All types	--	59,446	1,904,808	565,843	--	187,634	2,717,732

Table 2: Area of SMNRA forest land by forest type and elevation, 1997.

	Elevation						
Forest type	4001-5000 feet	5001-6000 feet	6001-7000 feet	7001-8000 feet	8001-9000 feet	9001-10000 feet	Total
	acres						
Pinyon-juniper	5,945	20,629	99,142	37,682	--	6,254	169,652
Ponderosa pine	--	--	--	5,945	13,145	--	19,090
White fir	--	--	--	--	13,782	6,891	20,672
Cercocarpus woodland	--	--	--	--	6,891	--	6,891
Nonstocked	--	--	18,144	6,083	--	--	24,227
All types	5,945	20,629	117,286	49,710	33,818	13,145	240,533

Table 3: Downed dead trees (5 inches diameter and greater) per acre on SMNRA forest land by forest type and elevation, 1997.

Forest type	Elevation						Total
	4001-5000 feet	5001-6000 feet	6001-7000 feet	7001-8000 feet	8001-9000 feet	9001-10000 feet	
	trees/acre						
Pinyon-juniper	0.0	2.9	16.2	15.0	--	30.0	14.2
Ponderosa pine	--	--	--	0.0	0.0	--	0.0
White fir	--	--	--	--	0.0	0.0	0.0
Cercocarpus woodland	--	--	--	--	0.0	--	0.0
Nonstocked	--	--	16.6	0.0	--	--	12.4
All types	0.0	2.9	16.2	11.4	0.0	14.3	11.3

Appendix D – Springs Inventory Data Reports

D-1: Springs Inventory Program

- D 1.1: Distribution of Springs within the SMNRA
- D 1.2: Springs Inventoried in 2010

D-2: Site Reports

- D 2.1: Site Report Attributes List
- D 2.2: Sample Site Report

D-3: NRA-wide Summary Reports

- D 3.1: NRA-wide Report Attributes List
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D-4: Monitoring Question Reports

- D 4.1: Monitoring Question 53 – What is the ecological status of riparian areas?
- D 4.2: Monitoring Question 57 – Are soil disturbing activities creating excessive sedimentation or soil loss?
- D 4.3: Monitoring Question 59 – Is recreation use or grazing by wild horses/burros or recreational livestock impacting bank stability?

References

Appendix D 1.1: Distribution of Springs within the SMNRA

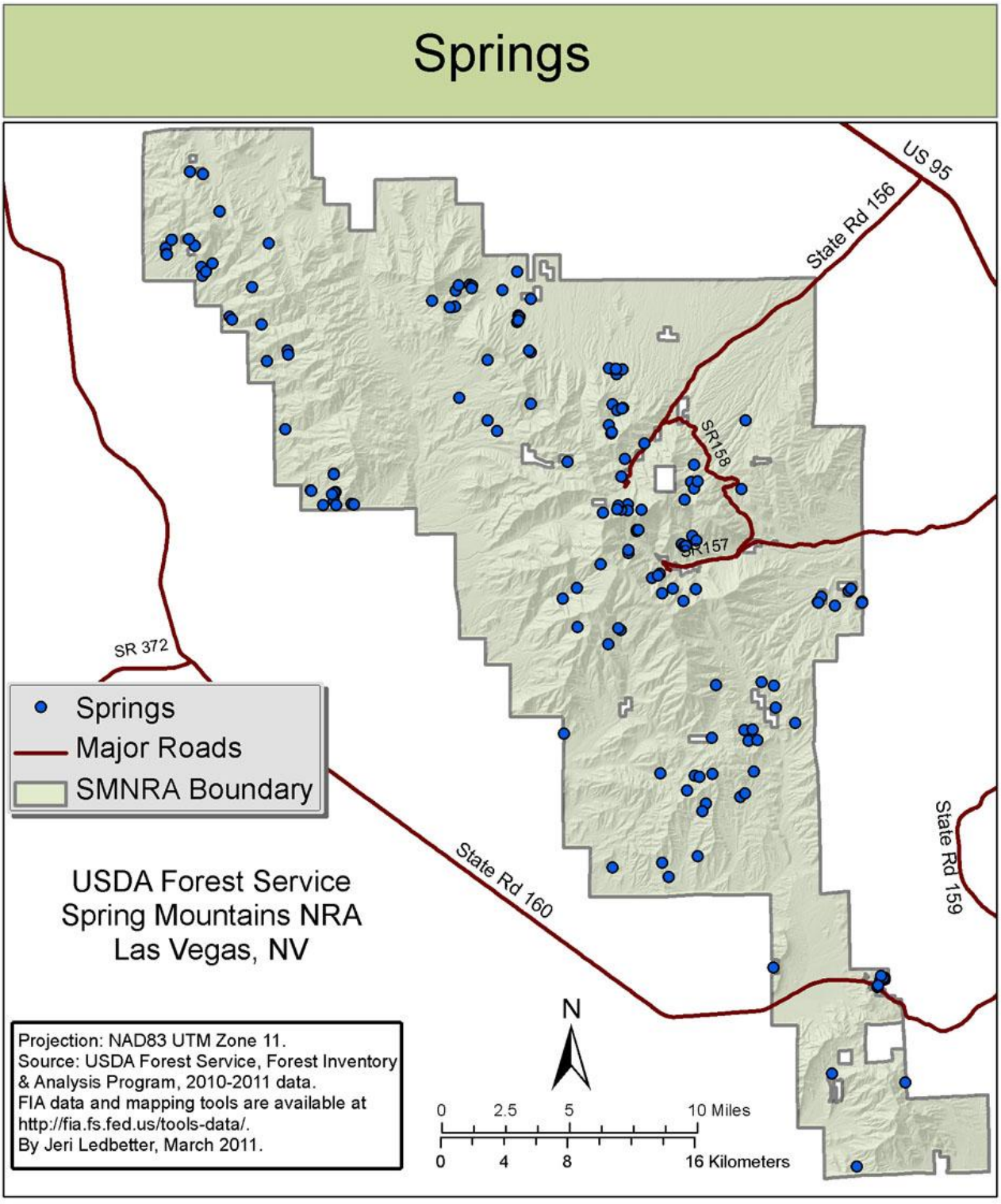


Figure 1. Springs (142) planned for sampling during the 2010-2015 inventory program

Appendix D 1.2: Springs Inventoried in 2010 and Inventory Status				
Original Name	**New Site Name**	**Site ID**	**Inventory Plan**	**Inventory Status**
None	Middle Mud lower spring unnamed	None	None	NAU Found – survey in future year
None	Upper Two Springs	None	Future	NAU verified
None	Pipilo Spring unnamed	R4HTSMNRAH20190	None	NAU Found
No Name 108	Falls	None	2010	Not surveyed - not a spring
No Name 126	Tank	None	2010	Not surveyed - not a spring
Guzzler	(Not on updated map)	None	2010	Not surveyed - not a spring
No Name 114	No Name 114 (falls)	None	2010	Not surveyed - not a spring
No Name 81	No Name 81 (Tank)	None	2010	Not surveyed - not a spring
Wheeler Well	Wheeler Well	None	2010	Not surveyed - not a spring
No Name 15	Unnamed Spring 35	R4HTSMNRAH2O069	2010	Not Surveyed - Private Land
Rock Spring	Rock Spring	R4HTSMNRAH2O071	2010	Not Surveyed - Private Land
No Name 12	(not in FS map per JH)	None	2010	Not surveyed - unknown
Roses Spring	Roses Spring	R4HTSMNRAH2O137	2010	Not Surveyed - Wx hazard
Cougar Spring	Upper Cougar Spring	R4HTSMNRAH2O080	2010	Surveyed 2010
No Name 112	Stanley B Spring #3	R4HTSMNRAH2O100	2010	Surveyed 2010
No Name 124	Unnamed Spring 21	R4HTSMNRAH2O126	2010	Surveyed 2010
No Name 167	Unnamed Spring 1	R4HTSMNRAH2O027	2010	Surveyed 2010
No Name 177	Upper Lost Cabin Spring	R4HTSMNRAH2O148	2010	Surveyed 2010
No Name 40	Upper Sawmill Spring	R4HTSMNRAH2O024	2010	Surveyed 2010
No Name 50	Middle Mud Spring	R4HTSMNRAH2O090	2010	Surveyed 2010
No Name 56	Macks Canyon 1	R4HTSMNRAH2O092	2010	Surveyed 2010
No Name 67	Unnamed Spring 67	R4HTSMNRAH2O095	2010	Surveyed 2010
No Name 86	Upper Horse Springs	R4HTSMNRAH2O113	2010	Surveyed 2010
No Name 97	Two Springs	R4HTSMNRAH2O026	2010	Surveyed 2010
No Name 98	Unnamed Spring 56	R4HTSMNRAH2O048	2010	Surveyed 2010
No Name 99	Three Springs 1	R4HTSMNRAH2O122	2010	Surveyed 2010
Wood Canyon	Wood Canyon Spring	R4HTSMNRAH2O078	2010	Surveyed 2010
Mary Jane Falls	Mary Jane Falls	R4HTSMNRAH2O103	2010	Surveyed 2010 - No Spring
No Name 146	Unnamed Spring 2	R4HTSMNRAH2O034	2010	Surveyed 2010 - No Spring
No Name 165	Cane Spring 1	R4HTSMNRAH2O003	2010	Surveyed 2010 - No Spring
No Name 48	Pahrump Spring	R4HTSMNRAH2O020	2010	Surveyed 2010 - No Spring
No Name 88	Lower Horse Springs	R4HTSMNRAH2O115	2010	Surveyed 2010 - No Spring
No Name 30	Unnamed Spring 37	R4HTSMNRAH2O039	2010	Surveyed 2010 - No Spring (see Quartzite Wall)
None	Quartzite Wall Unnamed	R4HTSMNRAH20191	None	Surveyed 2010 (NAU Found)
No Name 101	Three Springs 2	R4HTSMNRAH2O123	2013	Surveyed 2010, Planned 2013
Willow Spring	Willow Spring	R4HTSMNRAH2O084	2013	Surveyed 2010, Planned 2013
Coal Spring	Coal Spring	R4HTSMNRAH2O153	?	Surveyed 2010, Planned future

Appendix D 2.1: Site Report Attributes List

The table below lists the different attributes that can be summarized based on the spring survey data. Detailed descriptions of these attributes, their meaning, and potential uses can be found in the ***Groundwater Dependent Ecosystems Level II Inventory Field Guide.***

Table 1: List of Attributes that can be Described for Each Site

Category	Attributes Summarized
Vegetation	Percent cover of each plant species Prevalence Index (based on wetland indicator status) Diameter of trees (average or "quadratic mean diameter" by species) Density of tree species (per ha) Basal area of tree species (m^2 per ha) Bryophyte cover (%) Ground cover (% bare, gravel, basal vegetation, litter, etc.)
Soil	Depths and thicknesses of organic and mineral layers List of redoximorphic features observed Texture and color
Hydrology	Water table depth average Flow (for springs and channels) Water quality - pH - Conductivity - Oxygen-reduction potential (ORP) - Dissolved oxygen - Temperature
Fauna	Species list of animals (vertebrates, invertebrates, etc.)
Disturbance	Lists of disturbances observed in these categories: - Hydrologic alteration - Soil alteration - Structures - Recreation effects - Animal effects - Other disturbances observed
Management Indicator Tool	List of indicators of management activities affecting site

Appendix D 2.2: Sample Site Report

Site Name: Mack's Canyon 1
Site ID: R4HTSMNRAH2O092
Land Status: USDA Forest Service
Region, Forest: 4, Humboldt-Toiyabe
District: SMNRA
State, County: NV, Clark

Survey Date: 9/28/2010
GDE Type (primary): hillslope spring
GDE Type (secondary): helocrene
Aspect: 301 degrees (northwest)
Elevation: 2497 m
Area: 745 square meters
Dominant Surrounding Vegetation: Tree dominated
Surficial Material: Alluvium, Colluvium, Residuum
Lithology: Sedimentary, Limestone
Water Table Type: Unknown
Inflow Pattern: Groundwater inflow dominated
Outflow Pattern: Surface water outflow dominated
Occurrence of Surface Water: Developed channel(s) with flowing water, Patches of standing water

Mack's Canyon 1.

Plant Species	Cover (%)
Primula fragrans	26.3
Abies concolor	15.3
Apiaceae family	12.0
Carex sp.	10.4
Equisetum laevigatum	7.6
Poa sp.	7.4
Maianthemum stellatum	4.9
Viola sororia	3.8
Juniperus scopulorum	3.3
Aquilegia formosa	2.3
Platanthera sparsiflora	2.1
Parnassia sp.	1.7
Carex subfusca	1.4
Ribe cereum	1.1
Carex aurea	0.6
Rosa woodsii	0.3

Vegetation Attribute	Results
Prevalence Index (based on wetland indicator status)	1.8
Tree Diameter, Density and Basal Area by species	none
Bryophyte cover (%)	30.4

Ground Cover	Cover (%)
Litter	52.0
Bryophyte	38.5
Basal vegetation	4.7
Water	3.4
Bare soil	0.7
Wood	0.7
Bedrock	0
Boulder	0
Cobble	0
Gravel	0
Stone	0

Appendix D 2.2: Sample Site Report (Continued)

Site Name: Mack's Canyon 1
Site ID: R4HTSMNRAH2O092
Land Status: USDA Forest Service
Region, Forest: 4, Humboldt-Toiyabe
District: SMNRA
State, County: NV, Clark

Soil Attributes	Results
Depth of organic layer	5 cm
Thickness of organic layer	>50 cm
Depth of mineral layer	NA
List of redoximorphic features	redox concentrations
Texture and color	sandy loam, 10YR2/2

Hydrologic Attributes	Results
Water table depth average	7 cm
Flow	0.13 L/sec
Water quality	
- pH	7.55
- Conductivity (uS/cm)	337
- Oxygen-reduction potential (ORP)	NA
- Dissolved oxygen (mg/L)	NA
- Temperature (degrees C)	6.82

Faunal Category	Species Observed
Vertebrates	Clark's nutcracker, common raven, crossbill sp., dark-eyed junco, elk, moutain chickadee, northern flicker, redtail hawk, Swainson's thrush
Invertebrates	Succineidae Catinella, Planariidae, Elmidae, Limnephilidae, Lycaenidae

Disturbance Category	Disturbances Observed
Hydrologic alteration	Diversion
Soil alteration	Pedestals animal, Pipes, Trails
Structures	Fence
Recreation effects	Litter, shotgun shells, and a golf ball at site
Animal effects	Grazing, Trails, Trampling, Wild animals
Other disturbances	Refuse, Tree cutting
Management Indicators	Altered natural surface or subsurface flow patterns. Adjacent site characteristics do not support favorable site conditions.

Appendix D 3.1: NRA-wide Report Attributes List

The table below lists the attributes that can be described using the data collected at the sites. Data from all the sites would be used to calculate these summary attributes for the springs of the SMNRA. Data definitions and information data element use are described in the ***Groundwater Dependent Ecosystems Level II Field Guide.***

Table 1. List of attributes that can be summarized for all sites sampled in the SMNRA.

Category	Attributes Summarized
Vegetation	List of all species observed Species cover averages Native and introduced species cover averages Prevalence Index average Trees per site and per ha Basal area per ha Species count per site Byrophyte cover average Ground cover averages
Soil	Average depths and thicknesses of organic and mineral layers Percent of sites with each redoximorphic feature Percent of sites with each soil texture and color
Hydrology	Water table depth average Flow average Water quality averages - pH - Conductivity - Oxygen-reduction potential (ORP) - Dissolved oxygen - Temperature
Fauna	Species list of animals (birds, mammals, insects, etc.) Percent of sites with various animals
Disturbance	Lists of disturbances observed Percentage of sites with each disturbance
Management Indicator Tool	Percent of sites with each management indicator

Appendix D 3.2: 2010 Springs Inventory Data

This section presents summarized data for all 19 springs surveyed in 2010. Six different spring types were observed in the surveys, which are listed in the table below. In some cases, sites included two spring types, which are described as primary and secondary types.

Table 2. Spring types (Springer and Stevens 2008) observed in 2010

Spring Type	Primary (Number of Sites)	Secondary (Number of Sites)
Hillslope	7	1
Rheocrene	6	1
Hanging garden	3	1
Cave	1	0
Gushet	1	0
NA (concrete tank)	1	0
Helocrene	0	2

Vegetation

There were 80 vascular plant species recorded during the sampling of the 19 spring sites. There were 10.2 species per site on average.

The herbaceous species that were most abundant were scented shootingstar (*Primula fragrans*, formerly *Dodecatheon redolens*) with 6.5% cover, stinging nettle (*Urtica dioica*) with 6.5% cover, onerow yellowcress (*Nasturtium microphyllum*) with 4.5% cover, and Western Columbine (*Aquilegia formosa*) with 3.7% cover. Moss (Byrophyte) cover averaged 12.0%.

The shrub species that were most abundant were Woods' rose (*Rosa woodsii*) with 9.3% cover, desert baccharis (*Baccharis sergiloides*) with 5.6% cover, Bigelow sage (Artemisia bigelovii) with 4.8% cover, and ashy silktassel (Garrya flavescens) with 3.7% cover.

The tree species that were most abundant were Rocky Mountain juniper (*Juniperus scopulorum*) with 5.2% cover, white fir (*Abies concolor*) with 3.4% cover, and ponderosa pine (*Pinus ponderosa*) with 2.2% cover. Only five sites had trees within the site (greater than 5 cm in diameter), and there were only 2 to 4 individual trees per site. Those data translate into 0.7 trees per site, 52.3 trees per ha, and basal area of 11.9 m^2/ha, although the median for all three of those variables was 0 because most sites had no trees. Some sites had no trees within the site, but had cover of trees from just outside the site.

Native species averaged 25.5% cover and 13 non-native species averaged 3.4% cover at the spring sites. One site (Unnamed 1 Spring) had an introduced species (tamarisk) and the cover at that site was 2.6%. If cover was averaged across all sites, the average cover of introduced species at spring in the SMNRA would be 0.1%.

The vegetation data were used to calculate the Prevalence Index which represents the abundance of wetland vegetation. The average for the Prevalence Index was 2.6, which is on a scale of 1 (all obligate wetland species) to 5 (all upland species).

The vegetation data collected in 2010 were compared to riparian vegetation community types described in Weixelman et al. (1996) and the results are summarized below although there was not always a close match because springs and riparian areas do not always have the same vegetation types.

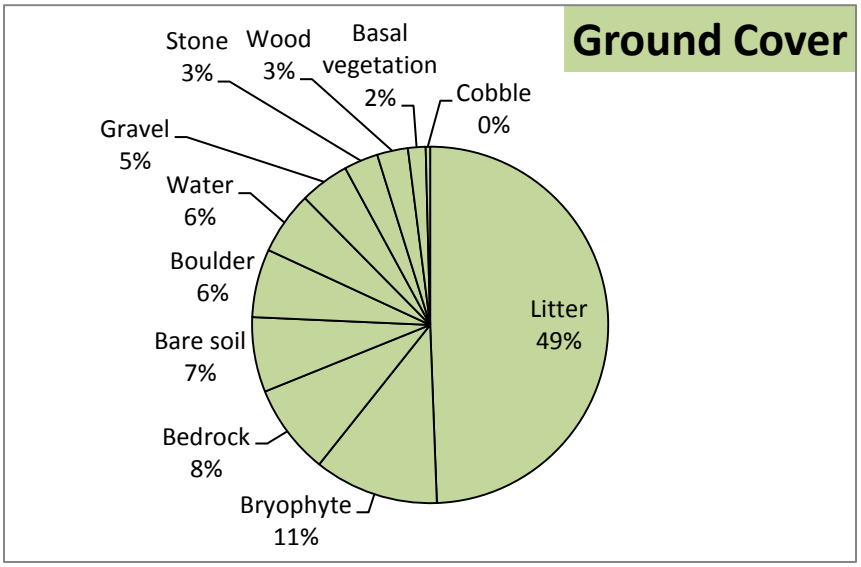
Table 3. Community types (from Weixelman et al. 1996) of the springs inventoried in 2010.

Community Type	Number of Sites
Rosa woodsii Community Type	5
Little or no vegetation -often very small sites-	5
Baccharis sergiloides/*Artemisia bigelovii* Community Type [A]	4
Salix lasiolepis/Rosa woodsii var. ultramontana Community Type	2
Primula fragrans Community Type (high elevation, steep rock slopes) [A]	2
Mesic Graminoid Community Type	1

[A] Informal designation, did not fit a community type described in Weixelman et al. (1996)

Ground cover data are represented in the figure below, with litter being the most abundant ground cover.

Figure 1. Average ground cover data for the 19 spring sites sampled in 2010.



Soil

Few sites (6) had organic soil and the average depth was only 3.3 cm, although one site (Mack's Canyon) had an organic layer of over 50 cm. That site also had redoximorphic features. Of the few sites where soils were appropriate for sampling the soil texture was sandy loam and the soil colors were 10Y (2/2 and 4/2) and 5Y (2/1 and 3/2). The sites where soils were not sampled had gravel, rock, and bedrock substrate.

Hydrology

Measurement of water table depth (primarily intended for wetlands) was only appropriate at one site, and the average depth there was 7 cm. Flow measurement was done at springs and runout channels of wetlands for 20 sites and the average flow was 2.6 L/second, with a range of 0.0008 to 23.3 L/second (Figure 2). Data on water quality are presented in Table 2and Figure 2.

Table 2. Water quality data from springs sampled in 2010.

Attribute	Minimum	Median	Average	Maximum	Sites Measured
Temperature (centigrade)	3.0	9.5	10.7	18.0	n=16
pH	6.5	7.3	7.2	8.6	n=19
Specific Conductance (microsiemens/centimeter)	136.0	486.5	608.7	2400.0	n=19
Oxygen-reduction potential (mV)	NA	NA	-22.0	NA	n=1
Dissolved oxygen (mg/L)	4.6	NA	7.5	10.4	n=2

Box and whisker plots are presented in Figure 2 to show the distribution of the hydrologic data for the spring sites (for attributes with more than 2 sites sampled).

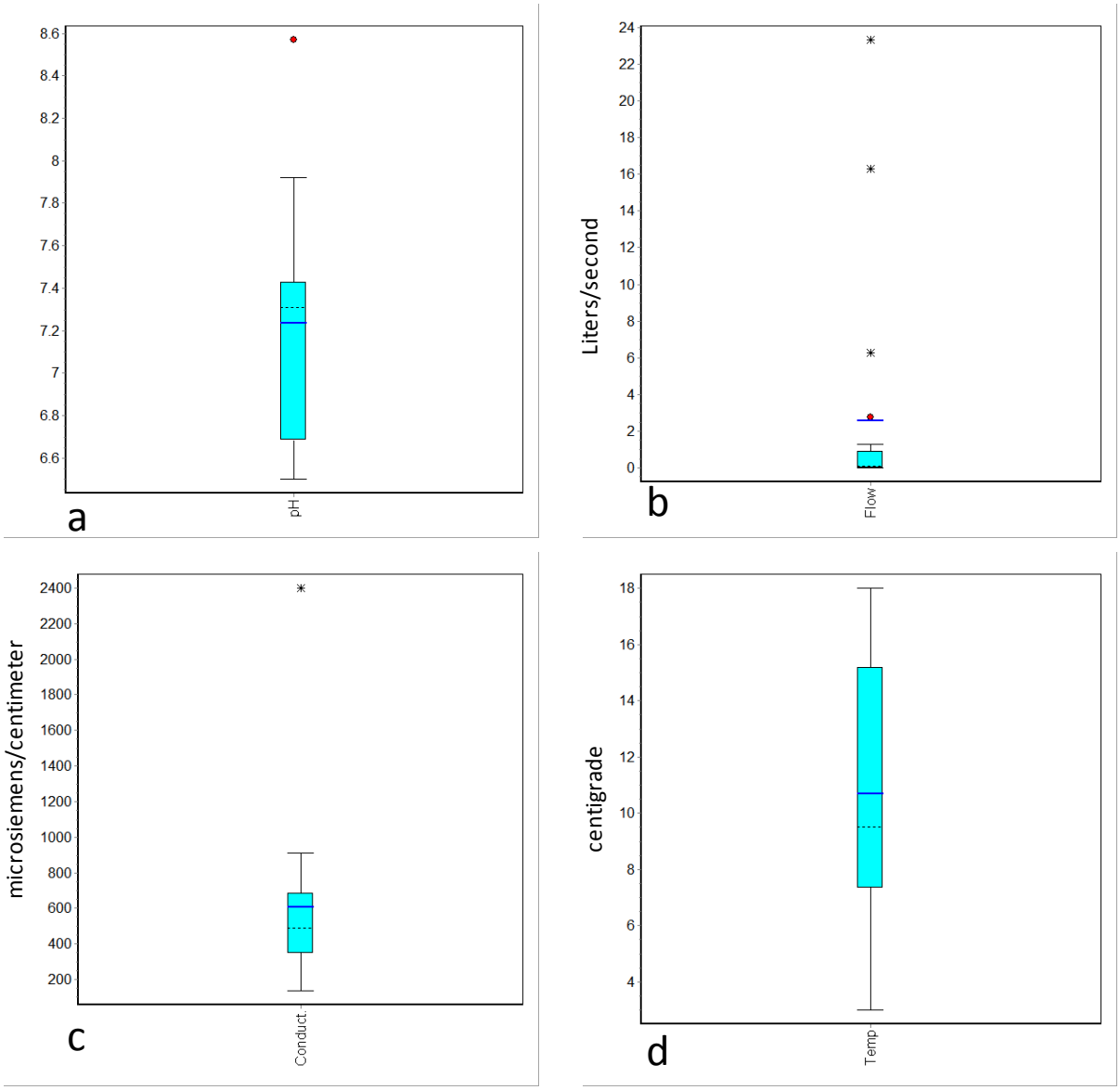


Figure 2. Distribution of hydrologic parameters for (a) pH; (b) flow values (L/sec); (c) conductivity (microsiemens/centimeter); and (d) temperature (centigrade) of springs sampled in 2010. Mean values are solid blue line and median values are dashed blue line.

Fauna

Aquatic macroinvertebrates were found through spot searches at the spring sites (not a complete survey of the area). The macroinvertebrates that were found at the most sites were the following taxa: true flies, Order *Diptera* (32% of sites); caddisflies, Order *Trichoptera* (26% of sites); and mud snails, Family *Hydrobiidae* (21% of sites). It is noteworthy that springsnails (*Pyrgulopsis* genus, *Hydrobiidae* family) were found at 4 of 19 springs.

Terrestrial vertebrates were observed at a number of sites, through observation and spot searches. The animals that were observed the most are shown in the table below. An additional 22 vertebrate species (mostly birds) were observed, but each of those animals was only observed at a single site.

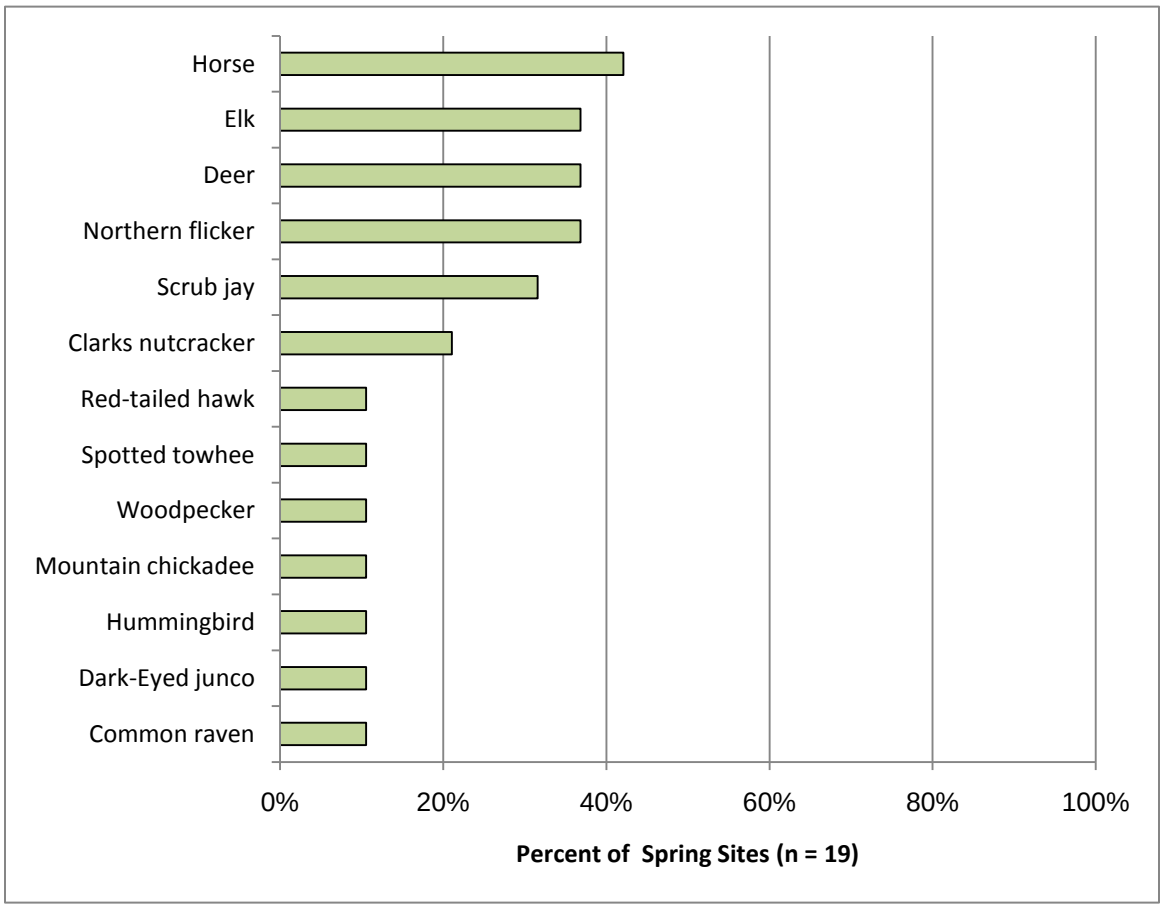


Figure 3: Percent of sites where terrestrial vertebrates were observed at the spring sites sampled in 2010. An additional 22 vertebrate species (mostly birds) were observed at only one site, but are not included in this figure.

Disturbances

At each site the disturbances observed were noted, and the summary for all the sites sampled in 2010 is presented in Figure 4.

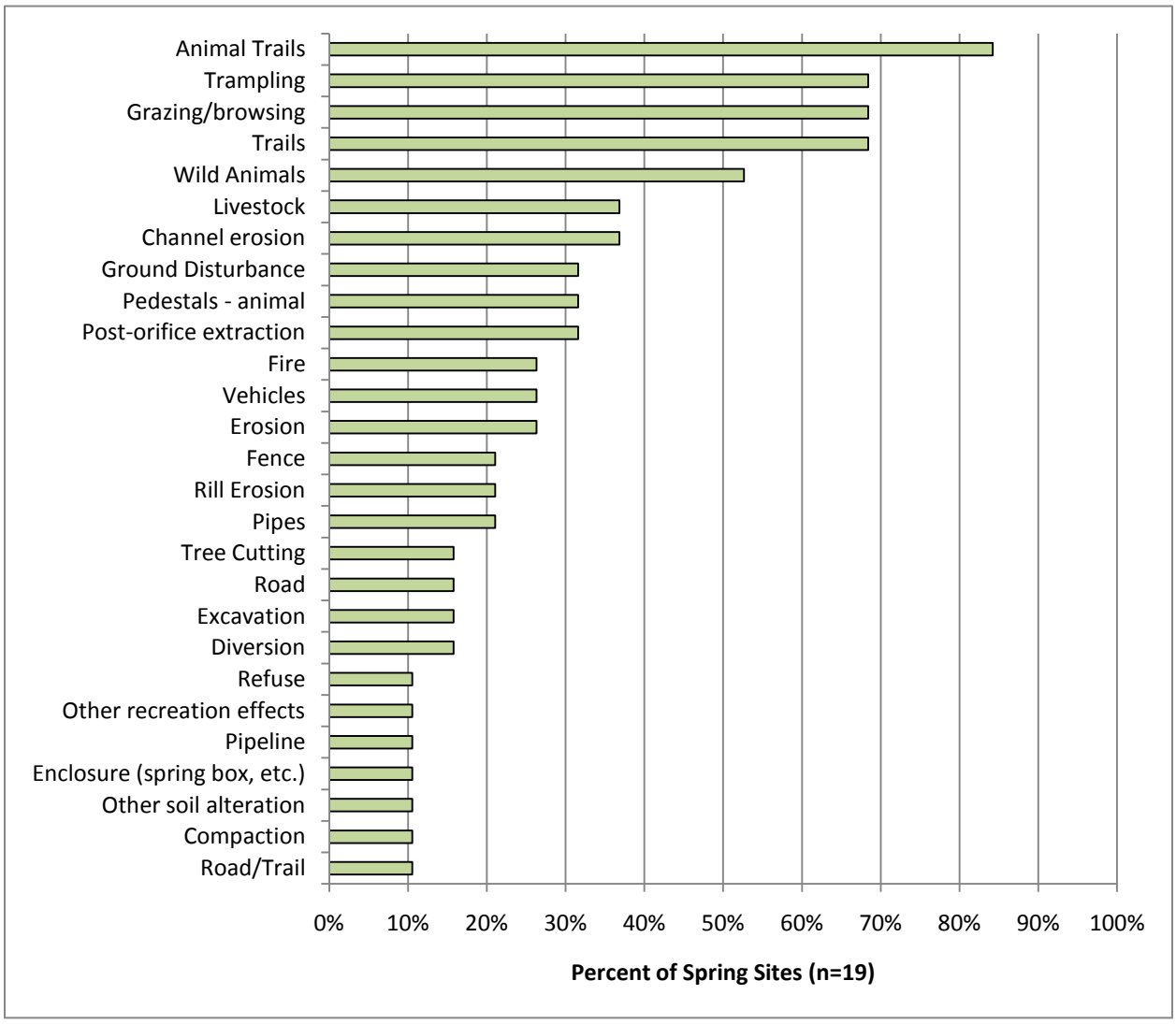


Figure 4: Percent of spring sites where the listed disturbances were observed, based on sampling during 2010. An additional eight disturbances were observed at only one site and are not included in this figure.

Management Indicator Tool

A summary of the responses to the questions in the Management Indicator Tool are presented in Figure 5.

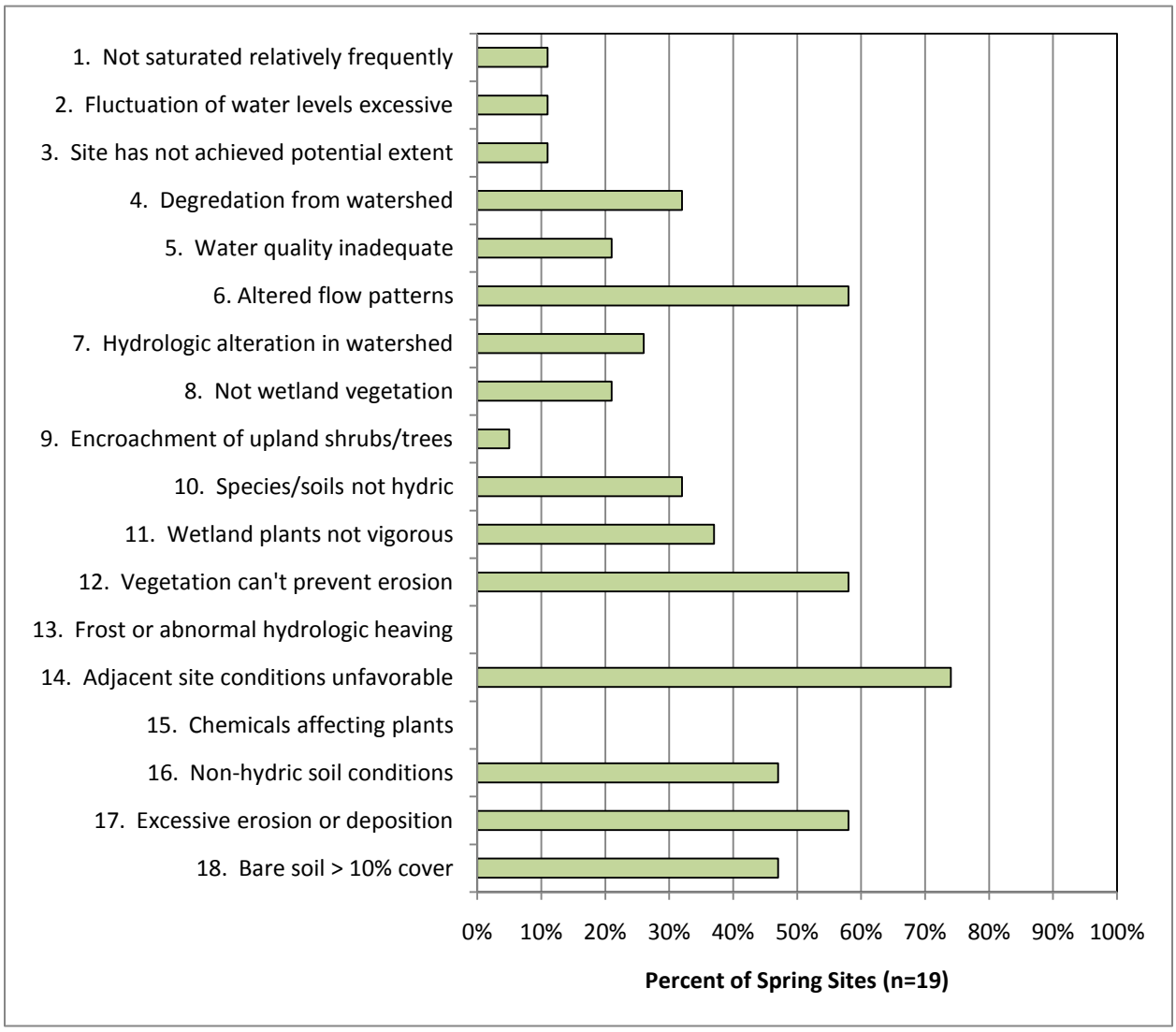


Figure 5: Percent of sites where management indicators were observed based on the sampling of spring sites during 2010.

Appendix D 4.1: Monitoring Question 53 – What is the ecological status of riparian areas?

Site Name	Site ID	Size (m^2)	Introduced Species Cover (%)	Management Indicator Questions Relevant to Ecological Status				Prevalence Index (1= wetland; 5= upland)	Bryophyte Cover (%)
				Primarily Upland Plants	Encroachment of Upland Shrubs/Trees	Wetland Plants do not Exhibit Vigor	Inadequate Vegetation to Prevent Erosion		
Macks Canyon 1	R4HTSMNRAH2O092	745	0					1.8	30.4
Willow Spring	R4HTSMNRAH2O084	462	0					3.0	0.3
Unnamed 67 Spring	R4HTSMNRAH2O095	352	0			X	X	2.9	2.5
Quartzite Wall Unnamed Spring	R4HTSMNRAH20191	270	0.5				X	3.1	9.5
Middle Mud Spring	R4HTSMNRAH2O090	233	0		X	X		1.9	0.4
Three Springs 1	R4HTSMNRAH2O122	180	0	X			X	3.0	17.7
Coal Spring	R4HTSMNRAH2O153	140	41.3				X	1.5	1.3
Wood Canyon Spring	R4HTSMNRAH2O078	137	1.1				X	3.3	0.1
Three Springs 2	R4HTSMNRAH2O123	101	0.9					1.1	16.8
Stanley B 3 Spring	R4HTSMNRAH2O100	95	0				X	3.2	3.3
Upper Lost Cabin	R4HTSMNRAH2O148	88	2.8					3.9	4.5
Upper Horse Springs	R4HTSMNRAH2O113	80	2.7				X	2.5	0
Unnamed 1 Spring	R4HTSMNRAH2O027	78	7.7					2.8	16.9
Two Springs	R4HTSMNRAH2O026	15	0					1.0	29.5
Upper Sawmill Spring	R4HTSMNRAH2O024	14	0	X		X		3.3	0
Upper Cougar Spring	R4HTSMNRAH2O080	12	0	X		X	X	N/A	0
Unnamed 56 Spring	R4HTSMNRAH2O048	5	0			X	X	2.6	48.1
Unnamed 21 Spring	R4HTSMNRAH2O126	1	Too small	X		X	X	Too small	Too small
Unnamed 41 Spring	R4HTSMNRAH2O062	1	Too small			X	X	Too small	Too small

Appendix D 4.1: Monitoring Question 53 – What is the ecological status of riparian areas? (Continued)

Site Name	Site ID	Size (m^2)	Introduced Species Cover (%)	Management Indicator Questions Relevant to Ecological Status				Prevalence Index (1= wetland; 5= upland)	Bryophyte Cover (%)
				Primarily Upland Plants	Encroachment of Upland Shrubs/Trees	Wetland Plants do not Exhibit Vigor	Inadequate Vegetation to Prevent Erosion		
Cane Spring 1	R4HTSMNRAH2O003	No evidence of spring, except for dying willows.							
Lower Horse Springs	R4HTSMNRAH2O115	No water; may be a dry spring.							
Mary Jane Falls	R4HTSMNRAH2O103	Waterfall, with possible springs on cliff.							
Pahrump Spring	R4HTSMNRAH2O020	No evidence of spring. Appears to be a valley that captures rainwater.							
Pipilo Unnamed Spring	R4HTSMNRAH20190	Very small hillslope spring; heavily trampled by ungulates.							
Unnamed 2 Spring	R4HTSMNRAH2O034	No evidence of water, except for some willows; could be ephemeral spring.							
Unnamed 37 Spring	R4HTSMNRAH2O039	No evidence of spring.							

Appendix D 4.2: Monitoring Question 57 – Are soil disturbing activities creating excessive sedimentation or soil loss?

Site Name	Site ID	Size (m^2)	Disturbances Observed			Management Indicator Questions Relevant to Soil Alteration			No Soil Cover by Veg, Litter, or Rock (%) (includes channel)
			Trampling or Compaction	Trails and Roads	Excavation or other Ground Disturbance	Altered Surface or Subsurface Flow Patterns	Excessive Erosion or Deposition	Bare Soil Greater than 10% (excludes channel)	
Macks Canyon 1	R4HTSMNRAH2O092	745	X	X	X	X			0.7
Willow Spring	R4HTSMNRAH2O084	462	X	X			X		0
Unnamed 67 Spring	R4HTSMNRAH2O095	352	X	X	X	X	X	X	12
Quartzite Wall Unnamed Spring	R4HTSMNRAH20191	270	X	X					1
Middle Mud Spring	R4HTSMNRAH2O090	233	X	X	X	X	X	X	5
Three Springs 1	R4HTSMNRAH2O122	180						X	0
Coal Spring	R4HTSMNRAH2O153	140	X	X	X	X	X		13.3
Wood Canyon Spring	R4HTSMNRAH2O078	137	X	X	X	X	X		3.8
Three Springs 2	R4HTSMNRAH2O123	101	X	X					1.1
Stanley B 3 Spring	R4HTSMNRAH2O100	95		X	X	X	X	X	7.8
Upper Lost Cabin	R4HTSMNRAH2O148	88	X	X					11.5
Upper Horse Springs	R4HTSMNRAH2O113	80	X	X	X	X	X		23.3
Two Springs	R4HTSMNRAH2O027	15	X	X	X	X			0
Unnamed 1 Spring	R4HTSMNRAH2O026	78							12.5
Upper Sawmill Spring	R4HTSMNRAH2O024	14	X	X	X	X	X	X	3.1
Upper Cougar Spring	R4HTSMNRAH2O080	12	X	X	X	X	X	X	3.1
Unnamed 56 Spring	R4HTSMNRAH2O048	5					X	X	0
Unnamed 21 Spring	R4HTSMNRAH2O126	1		X	X	X		X	N/A
Unnamed 41 Spring	R4HTSMNRAH2O062	1	X	X	X		X	X	20.8

Appendix D – 4.2: Monitoring Question 57 – Are soil disturbing activities creating excessive sedimentation or soil loss? (Continued)

Site Name	Site ID	Size (m^2)	Disturbances Observed			Management Indicator Questions Relevant to Soil Alteration			No Soil Cover by Veg, Litter, or Rock (%) (includes channel)
			Trampling or Compaction	Trails and Roads	Excavation or other Ground Disturbance	Altered Surface or Subsurface Flow Patterns	Excessive Erosion or Deposition	Bare Soil Greater than 10% (excludes channel)	
Cane Spring 1	R4HTSMNRAH2O003	No evidence of spring, except for dying willows.							
Lower Horse Springs	R4HTSMNRAH2O115	No water; may be a dry spring.							
Mary Jane Falls	R4HTSMNRAH2O103	Waterfall, with possible springs on cliff.							
Pahrump Spring	R4HTSMNRAH2O020	No evidence of spring. Appears to be valley that captures rainwater.							
Pipilo Unnamed Spring	R4HTSMNRAH20190	Very small hillslope spring; heavily trampled by ungulates.							
Unnamed 2 Spring	R4HTSMNRAH2O034	No evidence of water, except for some willows; could be ephemeral spring.							
Unnamed 37 Spring	R4HTSMNRAH2O039	No evidence of spring.							

Appendix D 4.3: MQ 59 – Is recreation use or grazing by wild horses/burros or recreational livestock impacting bank stability?

Site Name	Site ID	Size (m^2)	Disturbances Observed				Management Indicator Questions Relevant to Bank Stability	
			Recreation Use	Flow Extraction or Diversion	Grazing (wild or domestic)	Channel Erosion	Inadequate Vegetation to Prevent Erosion	Excessive Erosion or Deposition
Macks Canyon 1	R4HTSMNRAH2O092	745	X	X	X			
Willow Spring	R4HTSMNRAH2O084	462	X	X	X			X
Unnamed 67 Spring	R4HTSMNRAH2O095	352		X	X	X	X	X
Quartzite Wall Unnamed Spring	R4HTSMNRAH20191	270		X	X		X	
Middle Mud Spring	R4HTSMNRAH2O090	233		X	X	X		X
Three Springs 1	R4HTSMNRAH2O122	180					X	
Coal Spring	R4HTSMNRAH2O153	140		X	X	X	X	X
Wood Canyon Spring	R4HTSMNRAH2O078	137		X	X	X	X	X
Three Springs 2	R4HTSMNRAH2O123	101						
Stanley B 3 Spring	R4HTSMNRAH2O100	95				X	X	X
Upper Lost Cabin	R4HTSMNRAH2O148	88			X			
Upper Horse Springs	R4HTSMNRAH2O113	80			X		X	X
Unnamed 1 Spring	R4HTSMNRAH2O027	78						
Two Springs	R4HTSMNRAH2O026	15		X				
Upper Sawmill Spring	R4HTSMNRAH2O024	14			X	X		X
Upper Cougar Spring	R4HTSMNRAH2O080	12			X	X	X	X
Unnamed 56 Spring	R4HTSMNRAH2O048	5			X		X	X
Unnamed 21 Spring	R4HTSMNRAH2O126	1		X			X	
Unnamed 41 Spring	R4HTSMNRAH2O062	1			X	X	X	X
Cane Spring 1	R4HTSMNRAH2O003	No evidence of spring, except for dying willows.						
Lower Horse Springs	R4HTSMNRAH2O115	No water; may be a dry spring.						
Mary Jane Falls	R4HTSMNRAH2O103	Waterfall, with possible springs on cliff.						
Pahrump Spring	R4HTSMNRAH2O020	No evidence of spring. Appears to be valley that captures rainwater.						
Pipilo Unnamed Spring	R4HTSMNRAH20190	Very small hillslope spring; heavily trampled by ungulates.						
Unnamed 2 Spring	R4HTSMNRAH2O034	No evidence of water, except for some willows; could be ephemeral spring.						
Unnamed 37 Spring	R4HTSMNRAH2O039	No evidence of spring.						

References

Springer, A. E. and L. Stevens. 2008. Spheres of discharge of springs. Hydrogeology Journal 17:83-93.

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