



Final Program Report for 2010–2012

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



Spring Mountains National Recreation Area

Humboldt-Toiyabe National Forest

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1. Introduction

The Spring Mountains National Recreation Area (SMNRA) includes approximately 316,000 acres of National Forest System (NFS) lands managed by the Humboldt-Toiyabe National Forest in Clark and Nye Counties, Nevada (see fig. 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 (USDA Forest Service 1996) to the Toiyabe National Forest Land and Resource Management Plan (USDA Forest Service 1986), which is often referred to as the “General Management Plan” (GMP).

A 1998 Conservation Agreement (USDA Forest Service 1998) developed between the Forest Service, U.S. Fish and Wildlife Service (USFWS), and State of Nevada, Department of Conservation and Natural Resources affirmed 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 (USDA Forest Service 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 persisted in the approach to monitoring and evaluation, which led to the development of a comprehensive strategy for inventory and monitoring within the SMNRA.

The *Comprehensive Inventory and Monitoring Strategy for Conserving Biological Resources of the Spring Mountains National Recreation Area* (I&M Strategy) (USDA Forest Service 2008b) 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.

The I&M Strategy focuses on species identified in the *Spring Mountains National Recreation Area Landscape Analysis* (ENTRIX, Inc. 2008). Species and priorities are listed in table 1-1.

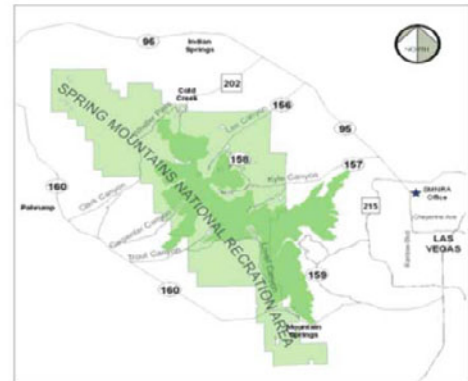


Figure 1-1: Spring Mountains National Recreation Area

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

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

Species included in this list are the focus of the 1998 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 (USDA Forest Service 2011a, p. 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 proposed revision of the 1998 Conservation Agreement. As a result, references to SOC/SOI from the I&M Strategy have been replaced with the term “CA Species” which refers to the species listed in table 1-1. Additional species have been added to table 1-1 based on the revised CA.

Monitoring questions and their priorities used to design the SMNRA I&M program in 2008 were established by SMNRA leadership and are documented in the I&M Strategy (USDA Forest Service 2008b), and are listed in appendix A. Within this document, the order of presentation for monitoring questions is based on the established priority, not numeric order or by resource topic.

The SMNRA inventory and monitoring program was initiated in June 2010. This is the final program report describing the cumulative analysis and evaluation of data collected during three years (2010–2012). The final report includes three major sections and five appendices. The report is organized into the following sections:

Section 2 – Inventory and Monitoring Data Collection

This section describes the initial inventory and monitoring data collection design, subsequent modifications, and data collection completed during 2010–2012. Known relationships between future data collection proposals are also described.

Intensified Forest Inventory and Analysis Plots - Data collection for intensified FIA plots occurred on a total of 187 plots of the original 350 plots established in the I&M program design. Work on installing the national FIA plots within Nevada began in 2011, providing the ability to link SMNRA intensified FIA plot data to other plots across the state.

Springs and Riparian Inventory – At the conclusion of the 2012 field season, inventory crews from Northern Arizona University visited 100 springs, and inventoried a total of 77 spring sites representing approximately 52% of the known springs within the SMNRA, which included 12 springs not previously identified in the *Spring Mountains National Recreation Area Landscape Analysis* (ENTRIX, Inc. 2008). Inventory of some sites was deferred because of law enforcement/safety concerns and inaccessibility.

Genetics Monitoring and Analysis – Collection of genetic material from Palmer’s chipmunks across the SMNRA occurred during 2010–2011. Analysis has concluded that the SMNRA has a robust and healthy population of Palmer’s chipmunk that is well distributed. This analysis has been accepted and will be published in a regional journal. Genetic material for springsnails was collected in conjunction with spring inventories. The University of Nevada at Las Vegas collected genetic material for butterflies for genetic analysis during 2012. Genetic analysis of springsnails and butterflies commenced in 2012 and has developed information needed to differentiate species, and research is underway to address the

status of these populations. The results of this analysis will also be proposed for publication in a regional journal.

Species-Specific and Project Surveys – In 2012, the autecology study of SMNRA butterflies and their host plants was concluded by scientists from the University of Nevada at Las Vegas. Their study identified new information regarding relationships between butterflies and their hosts and the distribution of habitat for these species in areas not previously considered habitat in the northern portions of the SMNRA. In addition to this study, few other project surveys were conducted during the 2010 – 2012 field seasons because of the backlog of pending project environmental analyses and decisions. Efforts to load data collected from previous years into the Natural Resource Manager (NRM)-Natural Resource Information System (NRIS) applications and to correct geo-reference errors within NRM-NRIS continued.

Implementation/Monitoring Audits – The IM Audits were conducted during 2010–2012 and provided the basis for developing the “management response frameworks” included in appendix E that represent best practices and their application within the SMNRA. IM Audit reports are published as separate stand-alone documents (METI, Inc. 2011, 2012a,b).

Section 3 – Data Evaluation

This section presents analysis and evaluation of inventory and monitoring data collected during 2010–2012 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.

Ecological Context – Information on the potential effects of climate change on species and their habitats within the SMNRA improved substantially during 2011 and 2012. A climate change vulnerability report for the Humboldt-Toiyabe National Forest was published by scientists from the Rocky Mountain Research Station (Howell 2011). This report provides the basis for identifying both mitigation and adaptation strategies for the SMNRA. Analysis of FIA data has provided a new baseline for existing vegetation within the SMNRA (see appendix C). Work is also progressing on an updated map of existing vegetation for the SMNRA using data from FIA plots and other sources. This map will be consistent with the National Vegetation Classification and will provide the basis of comparing and quantifying existing conditions to historical conditions described by Provencher (2008). Biological stressors are a major concern to the conservation and management of CA Species and their habitats. Of principal concern are population levels for wild horses and burros, which continue to exceed desired levels established in management plans and are estimated to be 2.5 times the appropriate management levels (AML) for territories within the SMNRA.

Species Conservation – Genetic analysis of Palmer’s chipmunk within the SMNRA provided one of the major findings for 2011. The study documenting the presence of a large healthy Palmer’s population within the SMNRA will be published in a regional journal in 2013. Genetic analysis of springsnails and the Spring Mountains Dark Blue Butterfly (*E. ancilla*) were initiated during 2012 and provide a basis for differentiating species and future analysis of these populations. Species Fact Sheets summarizing best available science for each CA Species have been developed and include potential habitat maps developed using information from the SMNRA Species Reference Database (see appendix B). Springs inventory information is beginning to provide a consistent basis for understanding the variation of spring types and their characteristics across the SMNRA (see appendix D). Springs inventories conducted in 2011 indicate that the effect of wild horses and burros on these sites is extensive; most disturbances noted were on the west side of the SMNRA. The riparian areas for the four perennial streams within the SMNRA were inventoried in 2012 (see appendix D).

Management Interactions – Implementation/Monitoring Audit findings provide important information regarding the effects of management actions and uses on CA Species habitats. Efforts to manage recreation (OHV) use are proving effective, but could be improved using a combination of public information (signing) and trail system development to encourage use in appropriate areas. An evaluation of springs/riparian management practices also concluded that many practices were effective, but required maintenance and monitoring. A framework for developing consistent management responses using a combination of recreation use levels and ecological significance was developed.

Section 4 – Recommendations and Need for Change

This section provides recommendations for: (a) changes in the Forest Plan/ General Management Plan (GMP), (b) management activities and programs, and (c) the design and continuation of the monitoring program.

Need for Change in Forest Plan Direction – Monitoring efforts have identified that the Forest Plan and SMNRA General Management Plan (Plan Amendment #4) monitoring requirements need to be updated to reflect a focus on CA Species and best available information and science. This update would be an administrative change under the revised Forest Service planning regulations. The need to develop a consolidated version of the Forest Plan and the GMP is also recommended to ensure all project proposals and analyses properly frame desired outcomes and management direction. Amendment or revision of the Forest Plan that relies on the agency’s policy framework for managing threatened, endangered, and sensitive (TES) species is needed to standardize species lists and replace locally developed procedural requirements with standard agency practices. Finally, amendment or revision of plan components (e.g., standards with specific timing restrictions) affected by climate change are identified.

Changes in Management Programs and Activities – Evaluation of monitoring data have identified the need for a number of changes in management programs and activities. These changes originate from an evaluation of monitoring questions and include:

Ecological Context:	Invasive species and insect and disease management Management of non-native species
Species Conservation:	Species conservation status Species-specific survey and monitoring design
Management Interactions:	Program considerations based on new information Development and application of SMNRA best practices

Monitoring Program – Evaluation of legacy datasets, new information and more detailed analysis of the monitoring questions used to design the SMNRA inventory and monitoring program has identified the need to eliminate some monitoring questions and address others using different techniques now that baseline data have been developed. This revised list of monitoring questions should be used to design any subsequent inventory or monitoring efforts to provide data continuity. Improved inventory and monitoring program coordination and authorization of studies and inventories by third-parties within the SMNRA will ensure data collected are available for use, and that third-party research activities do not compromise other resource management objectives, including Wilderness and the Carpenter Canyon Research Natural Area.

Appendices

The appendices include detailed data summaries and analyses and represent a growing body of information and data regarding CA Species located in the SMNRA. As noted below, some of these appendices may be published as stand-alone documents; therefore these appendices have a separate listing of literature cited.

Appendix A: Revised Monitoring Questions and Priorities – Among the monitoring questions originally identified in the SMNRA I&M Strategy (USDA Forest Service 2008b), several monitoring questions either no longer warrant consideration for monitoring or warrant modification; this appendix lists each monitoring question and includes rationale to support the change. The revised SMNRA monitoring questions can be addressed using landscape-scale assessments and planning assessments (see 36 CFR 219.6), Inventory and Monitoring Program Components, or project monitoring.

Appendix B: Species Fact Sheets and Potential Habitat Maps – Species Fact Sheets and potential habitat maps for all CA Species are included in this appendix. The Species Fact Sheets and potential habitat maps were developed using information in the SMNRA Species Reference Database. When complete, this appendix will be published as a stand-alone document representing the best available science and information for SMNRA CA Species.

Appendix C: Forest Inventory and Analysis Reports – Includes information for specific monitoring questions developed from intensified FIA plot data. Data collected will be available in an Access Database and can be migrated to NRM-FSVeg. A separate report regarding the analysis of these data may be published for the SMNRA.

Appendix D: Springs and Riparian Inventories – This appendix includes an analysis of springs and riparian data collected across the SMNRA during 2010-2012. Separate springs inventory reports have been prepared for each survey year by NAU and all data are loaded into the national Groundwater-Dependent Ecosystems Access Database. A separate report for the 2012 riparian inventory has also been prepared.

Appendix E: Management Response Frameworks – The results of each of the three IM Audits conducted in 2010–2012 have been published as separate reports. This appendix presents information developed during the IM Audits that can be applied to similar settings within the SMNRA. These “frameworks” represent best practices based on a review of design and mitigation practices for different projects and activities within the SMNRA.

2. Data Collection Methods, Accomplishments and Plans

Inventory and monitoring systems established in the I&M Strategy (USDA Forest Service 2008b) consist of multiple systematic sampling methods, species-specific surveys, genetic analysis, and structured observations. The inventory and monitoring component designs and relationships are summarized in table 2-1.

Table 2-1: Inventory and Monitoring Program Design Summary

Program Component	Inventory and Monitoring Design
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 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) Reduced from 10 years to 5 years between re-measurement 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 among 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, 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 include the following discussions regarding each of the inventory and monitoring program components: (1) a summary of the initial design, (2) modifications made and 2010 and 2011 accomplishments, (3) modifications and data collection planned in 2012, including coordination items discussed with SMNRA staff and leadership, (4) 2012 accomplishments, and, if known, (5) proposed plans for continuation of each program component.

Program funding for completion of the 4th and 5th year of the inventory and monitoring program described in the SMNRA I&M Strategy (USDA Forest Service 2008b) was not approved. As a result, a revised conservation initiative funding request ("Round 14" proposal) has been submitted by the Humboldt-Toiyabe National Forest and is being reviewed. The continuation of inventory and monitoring program components under the Round 14 proposal includes:

- Completion of the remaining spring surveys
- Development of the spring stewardship and restoration program
- Validation of potential habitat models of three species of milkvetch: Clokey's milkvetch (*Astragalus aequalis*), egg milkvetch (*Astragalus oophorus* var. *clokeyanus*), and Spring Mountains milkvetch (*Astragalus remotus*)
- Completion of the genetics analysis of selected butterflies and springsnails

a. Intensified Forest Inventory and Analysis

The Forest Inventory and Analysis (FIA) 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 both individual and 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 SMNRA. FIA provides the rigor and recurrent sampling framework necessary to develop information needed to effect adaptive management-based changes thereby promoting species conservation. This is the primary reason for selecting FIA as the foundation for subsequent evaluation and analysis.

Initial Design

The FIA intensification for the SMNRA was designed to address the need for data necessary to monitor trends within an 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

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

Since the initial design of the program, modifications were made to accommodate crew safety and to coordinate program implementation with changes in the *National FIA Field Manual* (USDA Forest Service 2010). These modifications are described and documented chronologically.

The intensified FIA program for the SMNRA includes the following principal modifications to the base Interior West FIA (IW-FIA) protocols:

- 1) **Increased sampling intensity** - To achieve acceptable statistical accuracy, the plot density within the SMNRA was increased on all lands by a factor of seven times the standard FIA sampling grid density. This means approximately 350 additional plots were to be located across the SMNRA using FIA protocols, resulting in roughly seven plots for every 6000 acres.
- 2) **Procedures applicable to SMNRA needs** - Sampling procedures and species lists for this survey were specifically designed to gather information on those species identified as CA Species (see table 1-1). All plots were to be sampled according to IW-FIA standard protocols. These include national FIA “core” protocols, and standard IW-FIA regional components that also measure downed woody material, understory plant cover, and presence of invasive species.
- 3) **Extension into non-forested lands** - FIA normally samples vegetation only on forested plots. On the SMNRA all plots were to be sampled for vegetation and downed woody material, regardless of land use/land cover.
- 4) **Shorter re-measurement cycle** - Shortening the timeframe for re-measurement from the standard 10 years to 5 years compresses the rate of collecting baseline information providing a basis for monitoring the ecological context for individual species evaluations and broad ecological trends.
- 5) **Collection of genetic material for analysis** – At the time the I&M program was designed it was thought that all plant species listed in table 1-1 were appropriate for genetic monitoring and would be found in conjunction with implementation of the intensified FIA program. These assumptions were not correct and modifications to the program were made as described below.

2010 Modifications and Accomplishments

Field data collection was deferred in 2010 to accommodate changes during late 2010 to the *National FIA Field Manual* (USDA Forest Service 2010) regarding protocols for inventory of understory species and invasive species.

Analysis of FIA data collected in 1997 on the base grid (51 forested plots) was used to construct data tables to address monitoring questions originating from Forest Plan standards or monitoring items. 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 vegetation cover classifications used in the Forest Plan and those used by the IW-FIA program. More information regarding these issues is available in the *2010 Annual Report on Monitoring and Evaluation for Conserving Biological Resources of the Spring Mountains National Recreation Area* (Solem et al. 2011).

2011 Modifications and Accomplishments

There were 126 plots scheduled for completion during the 2011 field season. These included the plots in the 2010 and 2011 inventory panels. During the threatened government shutdown and subsequent agencywide restrictions on travel budgets in late spring, several weeks of fieldwork were lost. As a result, low-elevation plots could not be visited during the projected flowering window for CA Species. Sampling of these low elevation plots occurred in the 2012 field season. In addition, some plots were

inaccessible due to hazardous conditions associated with law enforcement activities. Completion of these plots occurred during the 2012 field season.

In all, 91 plots were completed during 2011. Several CA Species were identified on some of the plots, as well as numerous butterfly host/nectar plants. Genetic material was not collected during the 2011 inventory program given the need to complete the equivalent of two years' worth of plots during the field season.

In November 2011, a post-season debriefing with SMNRA and I&M program personnel identified coordination improvements that were addressed and incorporated into 2012 program plans.

2012 Modifications and Accomplishments

Discussion with SMNRA staff identified the following coordination items and modifications to the 2012 program that included:

Collecting CA Species Occurrence Information – Observations during transit to and between inventory plots were recorded during the 2012 field season. These observations and locations were provided to the SMNRA at the conclusion of the field season.

Collection of Genetic Material – The collection of CA Species genetic material during the FIA plot inventory was dropped.

Crew Access in Recreation Sites Construction Areas – Access to and through these areas and developed sites was coordinated with SMNRA staff.

Training – Participation and training occurred and SMNRA staff accompanied the FIA crew to observe data collection procedures at an actual field plot.

Dispatch Notification – FIA crew schedules and locations were coordinated with dispatch.

The 2012 inventory panel included 63 plots and 35 plots from the 2011 field season that were not sampled. Inventories were conducted on plots at the time of year when the CA Species were most likely to be flowering. A total of 96 plots were installed in 2012 resulting in a total of 187 plots associated with the intensified FIA program.

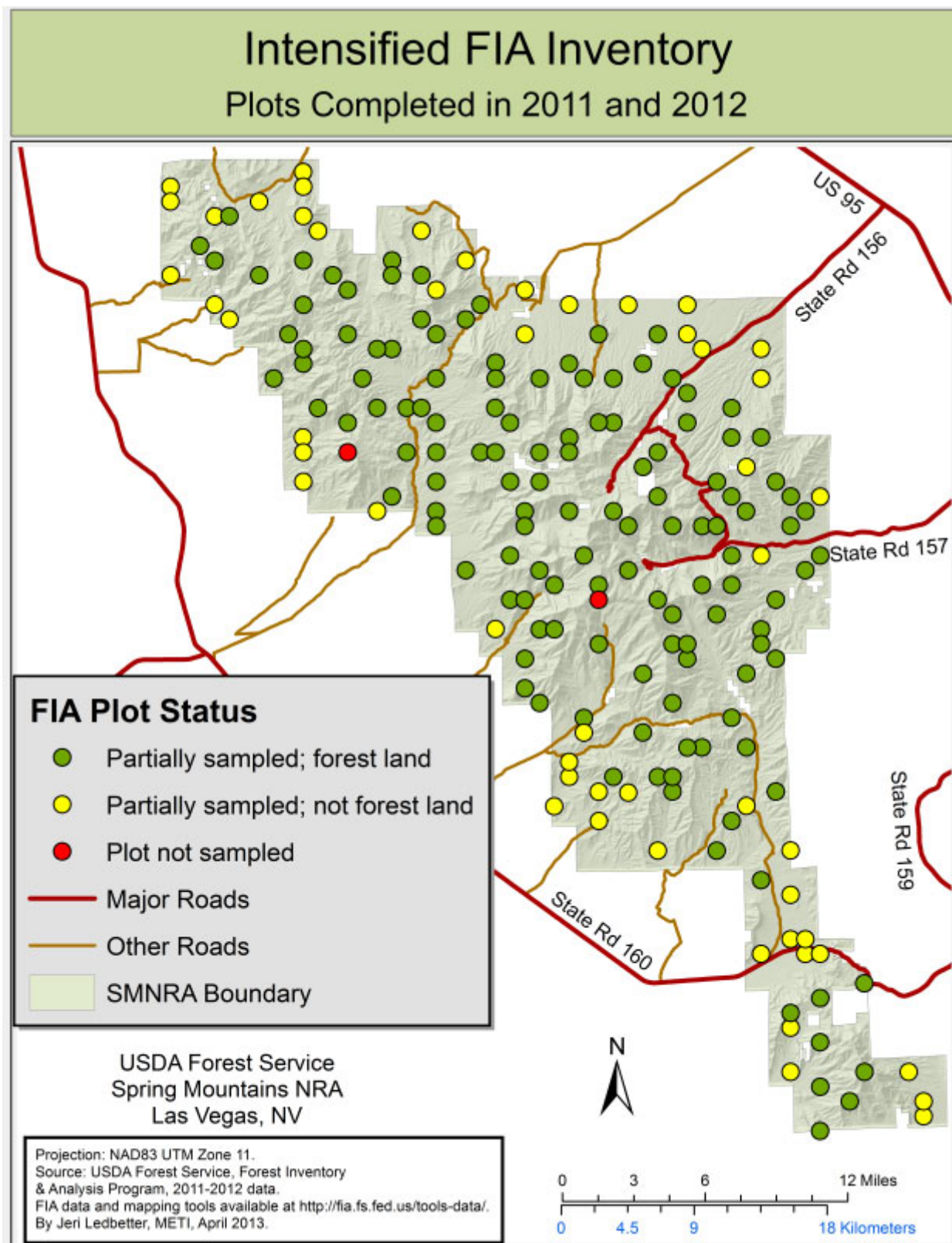
Program Continuation

The need for continuing the intensified FIA Program does not exist because the primary monitoring questions driving the program design and intensification level thought to have originated from Forest Plan standards do not, in fact, apply to the SMNRA. The 187 inventory plots installed as part of the 2010–2012 inventory and monitoring program results in an inventory that represents a 4.5 x intensification of the base Federal FIA program. This level of intensification provides the basis for addressing remaining monitoring questions and provides a valuable foundation for monitoring climate change effects on existing vegetation/land cover by establishing a link to the “base” FIA program within Nevada and Interior West FIA program.

Inventory and Analysis Data

Data collected in are being loaded into the National FIA Database and will also reside in the NRM-NRIS FSVeg application for use by SMNRA staff. Appendix C presents the analysis of inventory data relative to monitoring questions identified in the I&M Strategy (USDA Forest Service 2008b).

Figure 2-1. Intensified FIA Inventory Plots Completed in 2011 and 2012



b. Springs and Riparian Area Inventories

Springs and riparian areas within the 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 I&M Strategy (USDA Forest Service 2008b) focused additional attention on these areas.

Initial Design

The *Spring Mountains National Recreation Area Landscape Analysis* (ENTRIX, Inc. 2008) identified 149 known springs and associated riparian areas within the NRA. Since the initial design of the program, modifications were made to accommodate crew safety, minimize travel and access costs by sampling clusters of springs, due to springs being located on private land, and sites that were determined not to be springs. These modifications are described and documented chronologically.

- 1) **Sampling Program** - A 5-year sampling program was paired to the FIA re-measurement cycle to assist in the collection and compilation of SMNRA-wide baseline data as soon as possible.

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 (HUC) within the SMNRA.

Table 2-2: Initial Sampling Schedule – Number of Sites by 4th Hydrologic Unit Code (HUC)

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 was accomplished using the national Forest Service *Groundwater-Dependent Ecosystems: Level II Inventory Field Guide* (USDA Forest Service 2012a) with additional data elements for the SMNRA. Additional data collection focused on 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 was provided to all crew members and supervisors.
- b. Data was collected using field forms and transferred to a Microsoft (MS) Access database for eventual migration to the Forest Service NRIS database. Spot checks of data entry on the field forms and data transfer to the Microsoft Access database was 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 were to be resampled. The evaluation of observer variability was also included to indicate the

level of accuracy associated with data collection and identify needs for modifying the national protocol components or instructions.

- 4) **Species identification** - Collection of specimens for identification followed accepted procedures for collection. SMNRA and RMRS staff conducted species identification.
- 5) **Collection of genetic material** - This effort was designed to support the genetics analysis program. Collection of genetic material for analysis included springsnails and CA species listed in table 1-1.

2010 Modifications and Accomplishments

A Cost Reimbursable Agreement (September 2, 2010) between Northern Arizona University (NAU) and the SMNRA of the Humboldt-Toiyabe National Forest was established in September 2010. This not only utilized the expertise of NAU staff and students in conducting spring and riparian inventories, but also provided 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 II Inventory Field Guide* (USDA Forest Service 2012a). Field training for NAU and SMNRA staff was provided by the national team developing the groundwater-dependent ecosystem (GDE) inventory field guides and included a site visit to Mack's Spring. Training also included methods for collection of genetic material and collection of samples for identification.

The NAU survey team conducted spring inventories during September 11–13 and October 20–30, 2010, using the Forest Service *Groundwater-Dependent Ecosystems: Level II Inventory Field Guide* (USDA Forest Service 2012a). Of the 31 springs scheduled for inventory during 2010, 16 were not inventoried because they were not a spring or they were on private land. For safety reasons, the team did not inventory Rose's Spring as planned for 2010, and that site was moved to the 2011 schedule. Of the scheduled springs, 14 were inventoried and assessed, as well as 2 new springs found by the NAU team, and 3 springs from a future year (2013) -- because the survey team was near those somewhat difficult-to-reach sites it made sense to inventory them. Therefore the total number of springs inventoried in 2010 was 19 (see appendix D-1.2).

On-site quality control and quality assurance during site visits were provided by Marc Coles-Ritchie (METI, Inc.). Jeri Ledbetter (NAU survey team leader) provided spot checks of data entry and GDE database entries.

The NAU survey team provided recommendations regarding crew safety and operations to SMNRA staff at the conclusion of the 2010 season. These recommendations were approved and used to develop the 2011 field program.

2011 Modifications and Accomplishments

Recommendations, such as for safety and travel efficiency, identified by the NAU survey crew in 2010 were incorporated into the 2011 field work plans. Based upon the NAU team's recommendations, the inventory sample schedule was 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. This recommendation was approved by the SMNRA and NAU was directed to prepare a survey plan for future years that used the "cluster" approach while maintaining a balance of sampling across the four hydrologic units used in the original sampling design.

Spring inventories were conducted by the NAU inventory team from July 23 to August 8 and September 6 to 14, 2011. The survey team visited a total of 32 sites during these two field efforts and used the national *Groundwater-Dependent Ecosystems: Level II Inventory Field Guide* (USDA Forest Service 2012a) to inventory 28 of those sites. One site that could not be sampled due to hazardous weather in 2010 was sampled in 2011. Of the springs visited, six were dry, likely due to seasonal variability in flow. Two sites were determined to be secondary emergences from sites upslope and therefore were not inventoried. Six previously unmapped and unnamed springs were identified and inventoried.

The crew was unable to reach several springs on the 2011 inventory schedule: two at the top of a steep cliff; two with private ownership that the crew was not permitted to visit; two that the SMNRA requested not to be surveyed due to law enforcement security concerns; and four that the crew could not reach because of the very poor quality of roads. In place of these, the crew surveyed springs that were scheduled for future years, or that they discovered during 2010 and 2011 surveys.

2012 Modifications and Accomplishments

Recommendations, such as for safety and travel efficiency, identified by the NAU survey crew in 2011 were incorporated into the 2012 field work plans.

Discussions between NAU inventory teams and SMNRA staff identified the following coordination items and modifications to the 2012 program:

Supplemental Springsnail Collection for Genetics Analysis – During all subsequent surveys springsnails were collected for genetic analysis. During 2013, supplemental springsnail collection occurred at springs known to have springsnail populations that were inventoried in previous years but not collected for a variety of reasons.

QA/QC and Resampling – Marc Coles-Ritchie (METI, Inc.) and Abe Springer (NAU) have provided QA/QC during the course of each inventory year. One item that was not accomplished as part of QA/QC because funding for the 4th and 5th year of sampling was not approved, was resampling of a spring site previously sampled to provide an estimate of sampling error.

Spring inventories were conducted by the NAU field crew during May 21 to June 1 and June 24 to July 1, 2012. The NAU crew continued to use the methods in the *Groundwater-Dependent Ecosystems: Level II Inventory Field Guide* (USDA Forest Service 2012a). The crew collected data at 30 springs in the SMNRA during those two sessions (see fig. 2-2 below and appendix D-1.2). Five “new” springs were found by the NAU field crew that were not part of the original springs inventory schedule developed from the *Spring Mountains National Recreation Area Landscape Analysis* (ENTRIX, Inc. 2008). Four springs scheduled to be inventoried were dry at the time the NAU crew arrived at the sites, so data were not collected.

On-site quality control and quality assurance during site visits were provided by Marc Coles-Ritchie (METI, Inc.) during part of the May 2012 field session. Spot checks of data entry and GDE database entry was accomplished by Jeri Ledbetter (NAU survey team leader), resulting in the correction of less than 0.5% data entry errors and 1.5% field data entry errors.

Riparian surveys were conducted at the four perennial streams in the SMNRA (see fig. 2-3) using the draft *National Riparian Vegetation Monitoring Core Protocol: Western U.S.* (USDA Forest Service 2012b). Additional information on disturbance and management indicators was collected using the *Groundwater-Dependent Ecosystems: Level II Inventory Field Guide* (USDA Forest Service 2012a). The entire length of stream NFS land was walked, and two or three reaches were inventoried (primarily

vegetation data) at systematic points along each stream. A summary of these riparian surveys is provided in appendix D and a detailed summary of each stream reach and survey report was provided to the SMNRA.

Program Continuation

Development of a consistent inventory and understanding of springs and riparian areas within the SMNRA is a continuing need given the biodiversity associated with these sites and relationships of springs and riparian areas to upland species dependent on these water sources and habitats. If funded, the Round 14 proposal includes completion of the springs inventory program using protocols described in the national *Groundwater-Dependent Ecosystems: Level II Inventory Field Guide* (USDA Forest Service 2012a).

Inventory and Analysis Data

Each year a detailed report of work accomplished has been prepared by the NAU inventory team and provided to the SMNRA under the terms of the Cooperative Agreement. In addition, a report for each site surveyed has been provided to the SMNRA (see appendix D-2.2 for an example) and inventory data have been entered into the national GDE database. Appendix D-2 lists the attributes included in the site report and an example of a report that can be generated from the national GDE database.

Appendix D provides an analysis of inventory data collected for monitoring questions involving springs and riparian areas.

Figure 2-2. Springs Inventories Completed During 2010–2012.

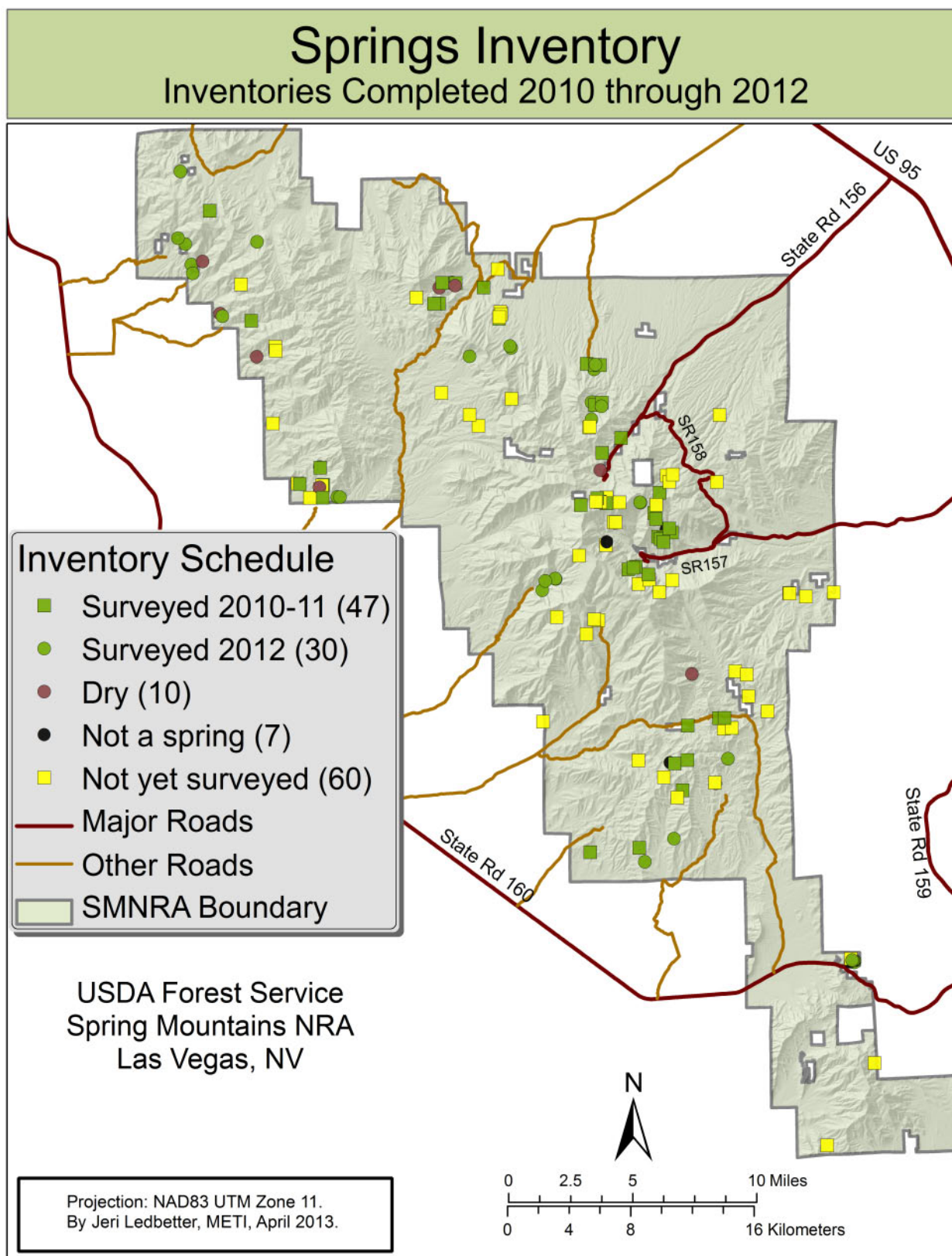
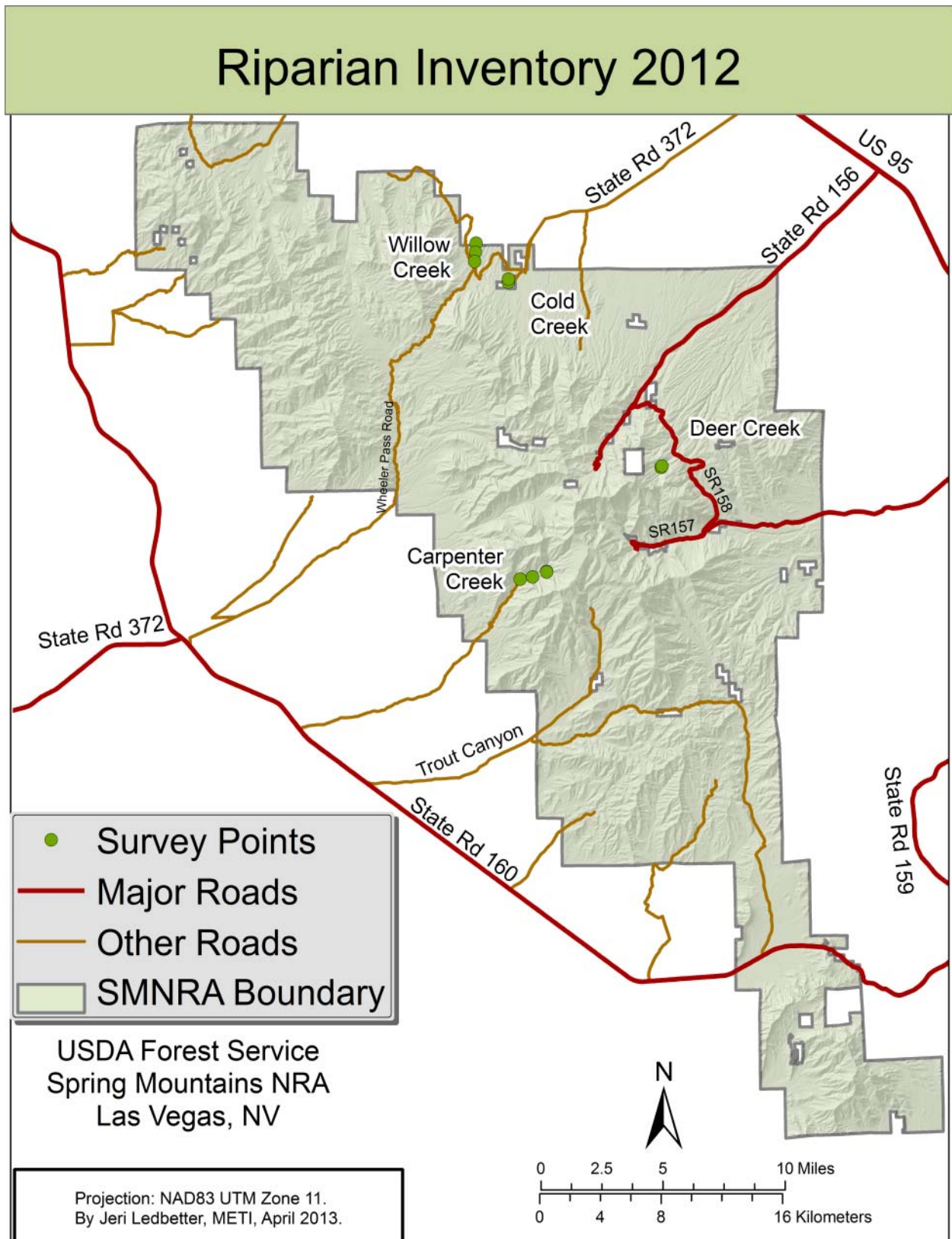


Figure 2-3. Riparian Surveys Conducted in 2012.



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 looks for genetic differences that are fixed within a species but differ between species. For genetic population monitoring, one looks for genetic differences that occur among individuals.

Genetic monitoring requires completion of three analysis stages. For species that have been previously genetically monitored, the first stage is “discovery,” in which interesting areas of DNA are located and analyzed, and inexpensive assays developed to identify differences using samples of the species being investigated. The second stage involves collecting samples from the target population’s range. During the third stage genetic assays developed during discovery are applied to collected materials and population metrics are 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. Coarse-scale genetic analyses such as analyses to identify species (e.g., to separate morphologically cryptic species) or sub-species can generally be performed using areas of mitochondrial DNA that are common to most organisms. For species that have not been previously genetically monitored, however, population level analyses will generally require some level of discovery prior to analysis. However, this process does not need to delay sample collection; samples, once stabilized, can endure years of storage. Monitoring for change can be done after the fact, a property unique to DNA monitoring.

Initial Design

Priorities for genetic analysis and assumptions made during development of the I&M Strategy (USDA Forest Service 2008b) resulted in the initial program design described in the following section. Since development of the program design, the basis for many of the assumptions has changed and modifications have occurred in both priorities for genetic analysis and in plans for the collection of genetic material. Changes in program priorities and rationale are documented chronologically.

- 1) Genetic analysis priorities** – Species prioritized for genetic monitoring and analysis include CA Species for which genetic analysis will be most beneficial, as depicted in table 2-3.

Of the species identified for genetic monitoring, the only one for which genetic studies exist on a similar population is the chipmunk. Thus, for Palmer’s chipmunk, the discovery phase was less intensive than for the rest of the species listed; for those species, discovery will need to begin with virtually no prior knowledge.

- 2) Collection of genetic material** - Obtaining genetic samples if the organism is “in hand” is almost always fast and easy, and samples can be stored compactly. Materials to stabilize sample DNA are generally very inexpensive – animal and plant tissues can be dried by placing them in air-tight dessicant-filled vials. If genetic samples can be obtained opportunistically while doing other surveys, the costs of sample acquisition are generally trivial.

Table 2-3. Genetic Analysis and Monitoring Species Priorities

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

- 3) **Sample distribution** - Genetic surveys should be spatially distributed, but otherwise many of the representative sampling rules do not apply. For each location where the organism is found, there is virtually never a reason to collect more than 30 samples. These two attributes, ability to preferentially sample and the need to collect relatively few samples at each location, greatly enhance the ability to obtain adequate samples for monitoring when the organisms are rare or very clumped in distribution. For this same reason, samples obtained through other non-standard mechanisms are generally useful.
- 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. Collection 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.
- 5) **Analysis and reporting** -Analysis and reporting of results is 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. Resulting genetics analysis reports will be submitted for publication in regional or national journals.

2010–2011 Accomplishments

The first year of implementation included providing an overview of data collection procedures for crews involved in the inventory and monitoring program. Genetic sampling and analysis were conducted in association with spring inventories and a trapping program was completed for Palmer's chipmunk (see fig. 2-4 for genetic sampling locations).

Springsnails were observed at five springs and genetic material was collected at four of those sites. Plant genetic material associated with spring inventories was collected at three sites for three plant species. Samples were archived and stored at the SMNRA office and have been provided to the RMRS Wildlife Genetics Lab in Missoula, MT for analysis.

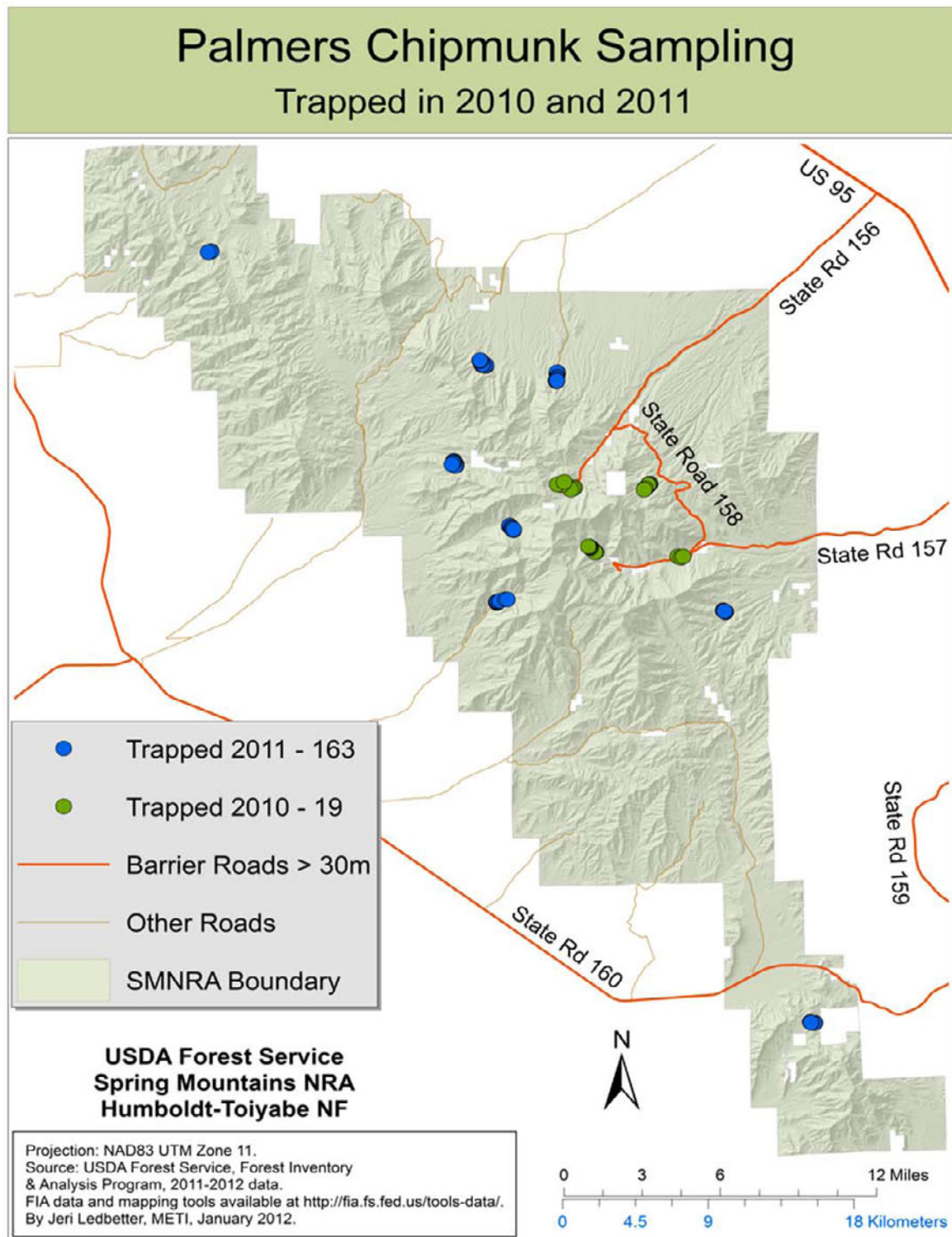
Palmer's Chipmunk - The goals of this study were to 1) verify the range of Palmer's chipmunk; 2) determine whether it co-occurs with the Panamint chipmunk, and if so where; 3) determine the population structure of Palmer's chipmunk across the Spring Mountains, specifically looking for the presence of isolated sub-populations; and 4) look for signs of potential hybridization between the two species.

The sampling was broken into two phases. In the first season (2010), the goals were 1) to develop an effective approach to trapping 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. Using DNA markers to distinguish the two species of chipmunk would allow reliable species identification without the need for extra genetic tests. In the second season (2011) the goals were to sample across the extent of the Spring Mountains to determine the range and population structure of Palmer's chipmunks. With this broader sample the SMNRA could evaluate the degree to which the two species overlap and look for signs of hybridization.

The results of the genetic analysis for Palmer's chipmunk were summarized in a separate report (McKelvey et al. 2012a), which was submitted to the Western North American Naturalist and is expected to be published in 2013. Key findings from the report include:

- Palmer's chipmunks appear to be limited to higher elevation areas in the central portion of the Spring Mountains. In this sample, no Palmer's were found at elevations below 7500 feet (ft) or 2300 meters (m), and for those three sites where both Panamint and Palmer's chipmunks were collected, the differentiation between Palmer's and Panamint appears to be elevational, closely approximating 2300 m.
- It appears the Panamint chipmunks are not limited to the piñon-juniper forests, but extend into the lower elevation ponderosa pine forests as well. The two chipmunk species, however, do not appear in the same areas: where samples were mixed, Panamint chipmunks were caught at the lower grids exclusively, Palmer's chipmunks at the upper ones. This may suggest that elevation, rather than habitat, better defines the limits between these species.
- Within the high elevation area where Palmer's chipmunks exist (greater than 2300 m; 7500 ft), populations of Palmer's chipmunk appear to be relatively well mixed, with low levels of spatial structuring. None of the populations appears to be isolated.
- Given the presumed long isolation of Palmer's from other closely related species, the well mixed nature of the population, and the lack of any signs of recent bottlenecks, it is reasonable to assume that the population is relatively close to the drift-mutation equilibrium.

Figure 2-4. Palmer's Chipmunk Genetic Sampling Locations



2011 Program Modifications

The rationale for selecting species for genetic analysis and the different priority groups listed in table 2-3 were not well documented. The following summarizes the rationale associated with these priority groups:

Genetics Priority Group 1

Palmer's chipmunk was selected early on in the I&M Strategy because out of all CA Species it was the only one with sufficient genetic discovery information to proceed with little or no cost.

Butterflies were the next group in Priority 1 based on their overall status and the work that was being set up with University Nevada – Las Vegas (UNLV) at the time the I&M Strategy was being developed. The UNLV study provides opportunities for collection of genetic material and recently has confirmed the need to verify the existence of subspecies of the Spring Mountains dark blue butterfly.

Genetics Priority Group 2

Springsnails (Spring Mountains pyrg (*Pyrgulopsis deaconi*) and Southeast Nevada pyrg (*Pyrgulopsis turbatrix*)), because of the collection being done by NAU and their status were determined to be the next priority. Collection of enough genetic samples during the 2010 and 2011 surveys was expected to serve as the foundation for genetics analysis of springsnails in 2012.

Milkvetches were included in this group using similar rationale. Efforts by FIA crews and crews conducting species-specific and project surveys were seen as the mechanism for collecting genetic material. Concerns regarding the FIA program's ability to collect enough genetic samples were noted and discussed with SMNRA staff (see Solem et al. 2011 p. 16, item 2). As a result, this places a greater emphasis on the collection of genetic material using a variety of collection opportunities for these species as opposed to relying on FIA as the sole source of collecting genetic material.

Moonworts, like the springsnails, were included because of they would likely be collected during the NAU springs surveys. However, NAU has collected few samples, but inventory and collection of this moonwort genetic material could be requested in addition to the standard inventory procedures.

Jones' Townsend Daisy was added to this priority group based upon the limited information regarding this species and the potential to determine its status using genetic analysis.

The resulting genetic analysis program priorities developed in 2011 included:

2010-2011 - Expanded spatial sample for Palmer's chipmunk and complete the genetic analysis.

2012-2013 - Initiate work on the springsnails and coordinate with UNLV on collection of genetic materials for butterflies to support subspecies differentiation and comparison to species outside the SMNRA. In 2012 collect additional genetic samples of butterflies and springsnails to ensure adequate spatial representation. Complete genetics analysis in 2013.

2013-2014 - Initiate work on the moonworts and milkvetches. Collect additional genetic samples to ensure spatial representation and complete analysis in 2014.

2012 Coordination Items and Program Modifications

Discussion with SMNRA staff identified the following coordination items and modifications to the 2012 program plans and the focus of future years:

2012-2013 Program Focus - Since the priorities developed in 2011 were established, additional sources have been reviewed regarding the availability of baseline genetic “discovery” information for plant species. Also, a petition to list two sub-species of the Spring Mountains dark blue butterfly (*Euphilotes ancilla*) under the provisions of the Endangered Species Act has been filed with the USFWS. Springsnails resident within the SMNRA have also been petitioned for listing.

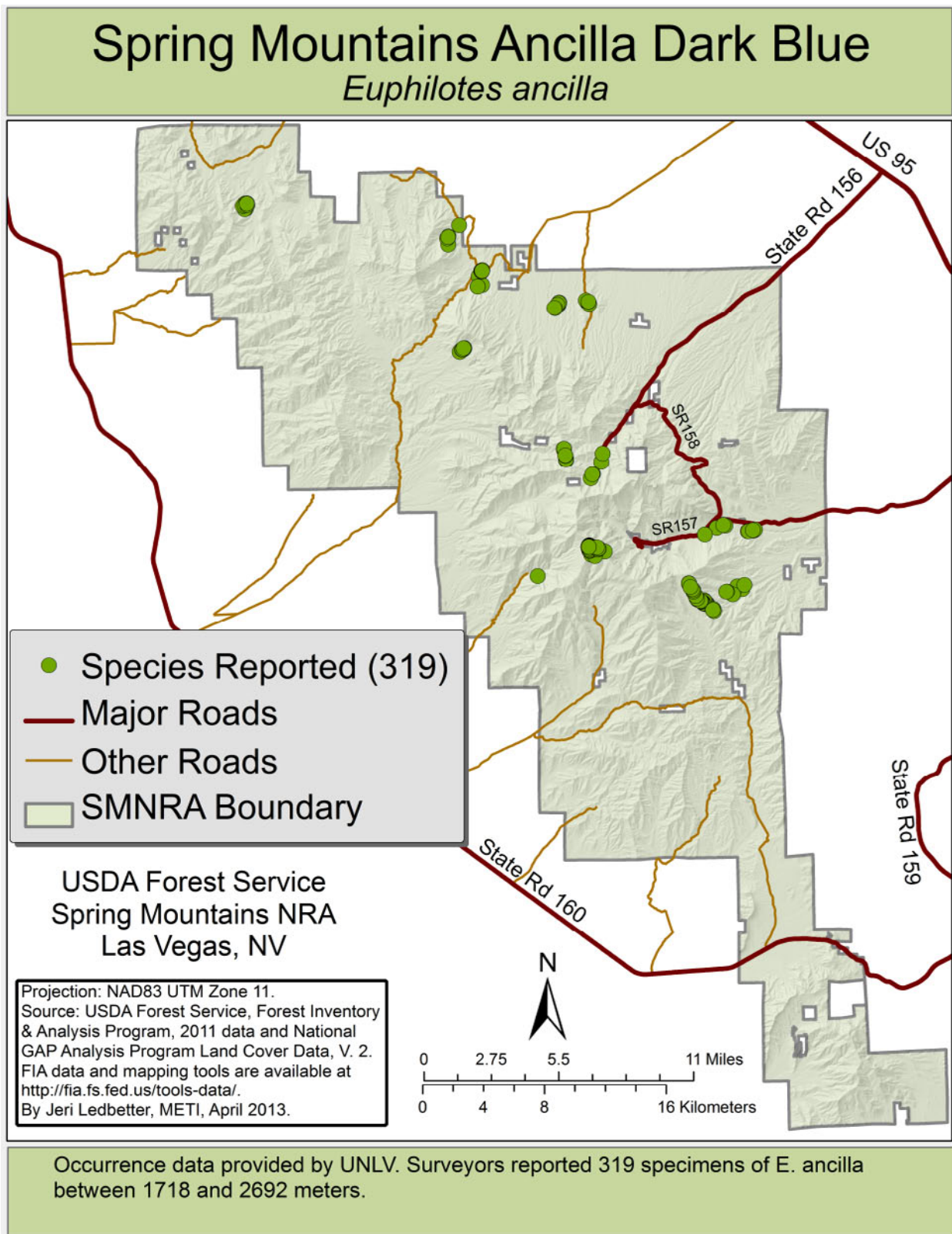
As a result SMNRA leadership determined that during these years the scope of the genetics analysis program should be focused on those species petitioned for listing to provide a foundation for developing appropriate species conservation measures.

Spring Mountains Dark Blue Butterfly - Discussions with principal investigators for the UNLV autecology study, Fish and Wildlife Service, RMRS scientists, and SMNRA staff identified the need to not only conduct genetic analysis to determine the ability to identify sub-species of the Spring Mountains dark blue butterfly (*Euphilotes ancilla*) but should also address whether their primary host plant *Eriogonum umbellatum* could be investigated.

A detailed study plan for this investigation was being prepared by UNLV and RMRS staff and will be reviewed by the USFWS and approved by SMNRA staff prior to implementation. In summary, the approach, which is described in greater detail in the study plan, includes two efforts:

- In conjunction with an autecology study being conducted by UNLV, samples were collected during 2012 across the known habitat range of the Spring Mountains Dark Blue Butterfly (*Euphilotes ancilla*) to provide the basis for determining species differentiation and genetic divergence of *E. a. purpurea* from *E. a. cryptica* (see fig. 2-5). Two sub-species are believed to occur based on distinctly different emergence and egg-laying time periods. DNA samples were taken from a total of 74 *E. ancilla* butterflies and larvae collected across both the early- and late-emergence periods and were analyzed using the cytochrome c oxidase subunit I (COI) region of mitochondrial DNA. Investigators obtained sequence data from 68 of the 74 samples tested. Fourteen unique haplotypes were found in these samples (designated as haplotypes A-N)
- There is significant variation among varieties of the primary butterfly host plant, *Eriogonum umbellatum*. Six varieties have been collected in or near southern Nevada, but only three, var. *juniporinum*, var. *subaridum*, and var. *versicolor* have been documented in the Spring Mountains. Seeds from these varieties and any other varieties encountered will be collected and cultivated in common gardens at Washington State University in Pullman, Washington, and the Plant Materials Center maintained by the USDA Agricultural Research Service in Los Lunas, New Mexico, to document phenological and morphological differences between the varieties. The working hypothesis is that the butterfly subspecies lifecycles correspond to early and late flowering varieties of *E. umbellatum*. Genetic analysis can then be conducted using samples from common garden plants once genetic discovery has been completed and a decision to proceed with this genetic analysis has been made.

Figure 2-5. Sampling locations where the Spring Mountains Dark Blue Butterfly (*E. ancilla*) was located within the Spring Mountains, Nevada.



Springsnails - Samples are being collected as a component of the springs inventory program using a stratified random sampling design. Samples collected in 2010 and 2011 have been collected from four of the five sites where springsnails were previously observed and have been provided to the RMRS Wildlife Genetics Lab for analysis. Protocol required 30 samples be collected from each spring where springsnails were observed to determine which species occur in each spring. Genetic samples were received from three springs: Spring #49, Upper Horse Spring, and Willow Spring. A total of 73 tissue samples collected in 2010 and 2011 were received.

Genetic analysis will focus on the ability to apply genetic discovery information for mollusks to these species. Once the ability to use these markers has been verified, occurrence information will be used to identify sites where supplemental springsnail collection should occur during future surveys.

2012 Program Accomplishments

The results of genetics analysis conducted in 2012 are detailed in a separate report *Genetics Report for the Spring Mountains National Recreation Area, 2012* (Mckelvey et al. 2012b). The following is a summary by species or species group of the findings described in the report:

Springsnails - The main goal for genetic analyses of springsnails was to determine which species occur in each spring where springsnails were found. Key findings of the analyses include:

- The springsnail communities at Willow Spring have apparently been introduced several times. Notably, 300 of each species were introduced in 2001, with *P. deaconi* was taken from Red Spring and *P. turbatrrix* from Lost Canyon Spring, which are approximately 7 kilometers and 1 kilometer away, respectively (Donald Sada, Desert Institute, personal communication). Investigators therefore assume that the current population of Southeast Nevada Springsnails is due to reintroduction.
- The 30 reference samples were insufficient to allow investigators to determine that an organism was absent, but the sample indicates at least scarcity in distribution.
- An absence of *P. deaconi* in Willow Spring may indicate that the introduction was unsuccessful, or that *P. turbatrrix* is perhaps better adapted to this spring and therefore occurs in higher of numbers.
- Prior to the survey, investigators were unable to determine whether springsnails were known to be associated with Spring #49 and Upper Horse Spring. However, populations of Spring Mountain Springsnails are thought to be limited to only a few springs. Interestingly, Spring #49 contains both *P. deaconi* and *P. turbatrrix* and most of the haplotypes. The reason for the high level of diversity in Spring #49 when compared to the other springs is unknown.

Spring Mountains Dark Blue Butterfly – Key findings of the genetic analyses to identify sub-species of the Spring Mountains dark blue butterfly (*Euphilotes ancilla*) include:

- There is no genetic evidence for sub-speciation in *E. ancilla* within the Spring Mountains. Investigators could not identify the causes for the diapause patterns observed by Austin and Leary (2008) but are reasonably sure that they are not due to genetic isolation between the early and late diapause groups.

- There may be isolated populations of *E. ancilla* in the Spring Mountains: haplotype H differs about 1.2 % from the other haplotypes. However, because the Spring Mountains have not been exhaustively surveyed, there may be other populations of *E. ancilla* that contain haplotypes intermediate between H and the other haplotypes. While H was located at the most topographically isolated site, its closest relative, L was found at Mud Springs, a fairly central location within the Spring Mountains.
- The genetic separation of *E. ancilla* in the Spring Mountains from other populations is currently unknown; there are no genetic samples of *E. ancilla* available from any of these populations. These haplotypes, when submitted to GenBank will be the first. There is, however, a fairly extensive (33) group of *E. ancilla* samples that have been genotyped and are held in a private collection (<http://www.barcodinglife.com/>). Investigators are currently attempting to obtain these samples from Dr. Paul Opler, Colorado State University. Analysis of these samples should determine the genetic distance between the Spring Mountains populations and other populations across the West.
- Populations of *E. ancilla* in the Spring Mountains have likely been separated from other related populations since the early Holocene (Austin et al. 2008). As such, levels of genetic diversity should be associated with the mutation-drift equilibrium (Kimura and Crow 1964). Diversity is lost due to drift and is increased due to mutation. Historically large populations therefore have higher equilibrium genetic diversity than do historically small ones. Based on the COI region, haplotype diversity within the Spring Mountains *E. ancilla* population is high, indicating large-equilibrium effective population size.
- There are many closely related haplotypes within the Spring Mountains *E. ancilla* population, and there is every indication that there are many more than were sampled. The high occurrence of closely related but rare haplotypes also argues against the presence of a small separate cryptica population. In nine samples of putative cryptica, four unique haplotypes were discovered, indicating that these samples were drawn from a large, highly diverse gene pool.
- Surveys conducted by UNLV during the summer of 2012 documented the flowering periods (phenology) of *Eriogonum umbellatum* var. *juniporinum* an early flowering variety reported to be the host of *Euphilotes ancilla purpurea* (Austin and Leary 2008) and *Eriogonum umbellatum* var. *subaridum* a late flowering variety reported to be the host for *Euphilotes ancilla cryptica*. The phenological separation between the two varieties of *Eriogonum* was not confirmed during the 2012 field season. Rather, there was significant overlap between the flowering periods the varieties. A common garden study was proposed to definitively demonstrate the phenological separation between *E. umbellatum* var. *subaridum* and *E. umbellatum juniporinum* but the garden is no longer needed since the separation hypothesis has been rejected. Consultation with RMRS Researcher Bryce Richardson indicates that a genetic analysis of the *Eriogonum* complex is possible and would shed light upon the relationships within this complex taxa.

Program Continuation

The genetics analysis program has proven to be very successful. Future efforts should be coordinated with the UNLV autecology project (see section 2.d below) and are proposed for continuation in the Round 14 proposal.

Although the focus is on completing the analysis of selected butterflies and springsnails, however other species monitoring may benefit from this approach. Genetic analysis may be the most appropriate method of assessing the status of those species associated with caves and cliffs because of the lack of established sampling protocols, the difficulty in sampling these locations, and risks associated with crew or contractor safety.

Inventory and Analysis Data

Genetics analysis results will be posted to GenBank and published in regional or local journals as separate reports. Findings detailed in the 2011 annual reports for Palmer's chipmunk were formalized into a scientific publication. This publication was submitted to the Western North American Naturalist and was accepted with minor revisions. It has been revised and resubmitted and is expected to be published in 2013.

d. Species-Specific Surveys

Species-specific surveys² and surveys conducted in association with project or activity analysis provide valuable information for understanding part of an individual species' life history and occurrence within the SMNRA. Additional information is needed to build a comprehensive understanding of species life history and the ecological context in which the species exists.

Initial Design

In addition to surveys conducted in association with projects and monitoring programs, five individual species monitoring efforts were underway within the SMNRA a decade prior to 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 CA Species, in partnership with The Nature Conservancy.
- Monitoring for egg milkvetch, in partnership with The Nature Conservancy.
- Monitoring for rough angelica, in partnership with The Nature Conservancy.
- Monitoring of Palmer's chipmunk, conducted by the U.S. 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 (USDA Forest Service 2008b) included recommendations listed in table 2-4 for ongoing species-specific surveys. Funding was recommended to remain constant during the first three program years and focused on the accomplishment of the tasks described in table 2-4.

Data evaluation may identify additional monitoring questions that should be considered for these species as a result of the 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 information developed by the 2010–2012 inventory and monitoring program.

² 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.
Rough 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.

- 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.

Table 2-5: Species-Specific Survey Priorities

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

- 2) **Survey methods and protocols** – Many protocols and methods for monitoring rare plants and animals have already been developed and published in peer reviewed publications. These methods have the statistical rigor that *ad hoc* methods often lack. In keeping with the philosophy of the SMNRA I&M Strategy (USDA Forest Service 2008b), previously developed and tested published methodologies should be the choice for individual species monitoring.
- 3) **Analysis and reporting** – Species-specific surveys are conducted to establish a baseline for trend analysis and to refine potential habitat models and identify habitat relationships. ArcGIS Spatial Analyst or the Terrestrial Ecological Unit Inventory (TEUI) Geospatial Toolkit can be used to link species occurrence data from all monitoring sources.

- 4) **Data management** – All monitoring efforts, including individual species monitoring, will be entered into Forest Service corporate databases, including NRM-NRIS-Terra and the Threatened, Endangered and Sensitive Plant (TESP) database (USDA Forest Service 2008a,b).
- 5) **Collection of genetic material for analysis** – All of the plant species listed in table 1-1 were thought to be appropriate for genetic monitoring. As noted previously, these assumptions proved to be incorrect and as a result collection of genetic materials for all CA plant species has been deferred until a sufficient genetic “discovery” foundation exists.

Program Accomplishments

Information on program accomplishments and plans in this section are presented by the type of survey (i.e., project surveys or species surveys) rather than separated by year. In some cases information gathered prior to 2010 is included to provide a comprehensive discussion for each species.

Project Survey Areas

Project survey areas and species-specific surveys conducted from 2005 to 2009 are shown on figure 2-6. 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 – General survey areas for Region 4 Sensitive, CA Species, and plant species included in the Multi-Species Habitat Conservation Plan (MSHCP) for Clark County, NV, not specific transect or observed locations.

Although a limited number of project surveys and species-specific surveys were conducted during 2010 to 2012, the results have been entered into the NRM-NRIS database. However, these data are not incorporated into the dataset used to generate figure 2-6.

2012 Program Plans

SMNRA staff identified the following project and species-specific surveys for the 2012 season:

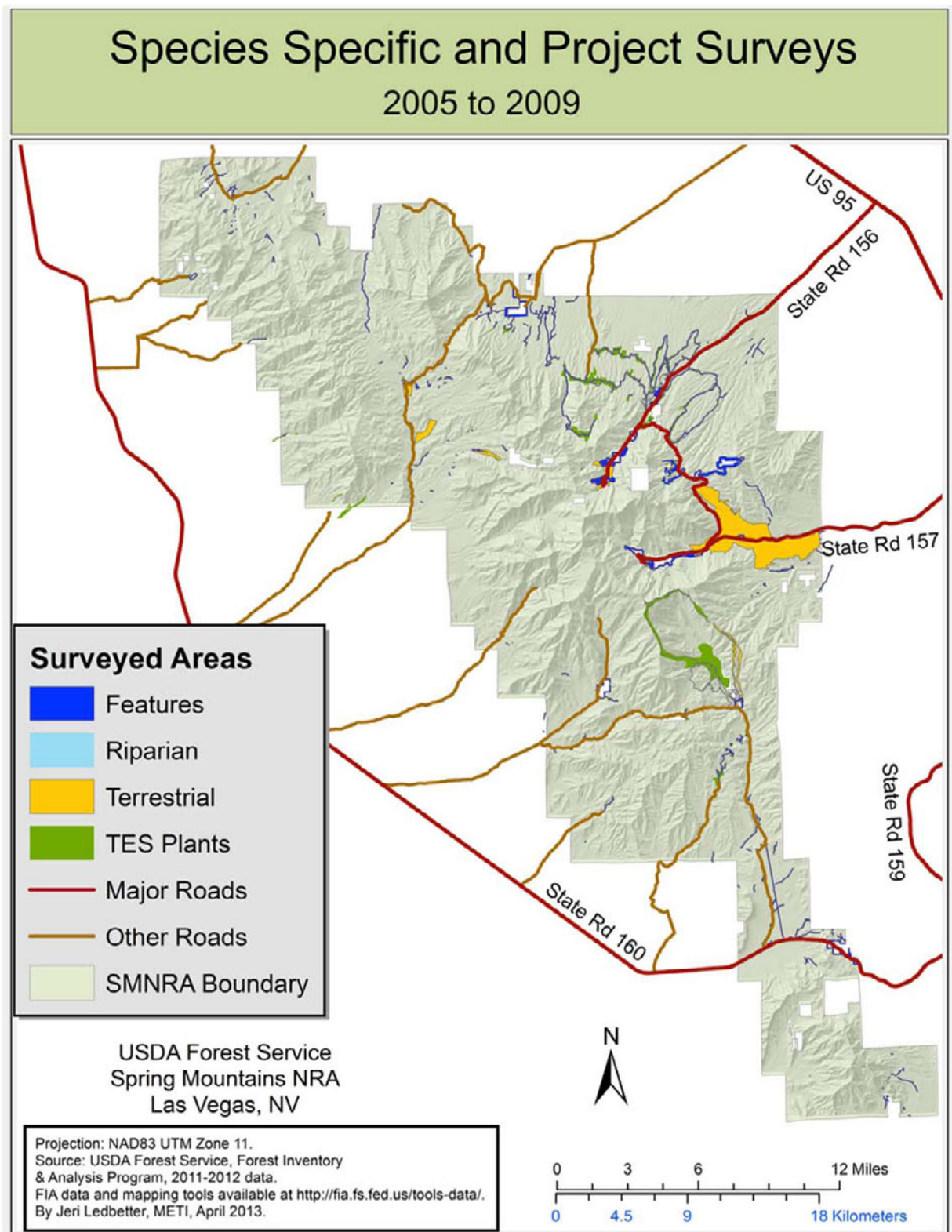
- Clark Canyon Restoration project proposal surveys
- Nesting and other surveys associated with mitigation measures for ongoing projects
- Surveys for rough angelica, including suspected habitats on the west side of the SMNRA
- Monitoring plots for milkvetch required in the Forest Plan/GMPSurveys within the boundaries of the Las Vegas Ski and Snowboard Resort

Discussion with SMNRA staff during review of the 2011 program results continued to emphasize concerns with the following:

- Availability of NRIS Survey and CA Species Occurrence Data – Survey locations and boundaries and observed CA Species locations are needed to facilitate completion of the habitat characteristic models and accuracy assessments of potential habitat models.
- Long-term Species Survey Sampling Design and Implementation - Long-term monitoring studies of rough angelica (*Angelica scabrida*), egg milkvetch (*Astragalus oophorus* var. *clokeyanus*) and the alpine plant communities were initiated in cooperation with the Nature Conservancy in 1996. They have been evaluated for: 1) sampling design, 2) adequacy of sample size, 3)

implementation of monitoring protocols, and 4) study results. Significant concerns have been identified with data resulting from these studies. The results of this evaluation are presented in section 3.b.

Figure 2-6. 2005 – 2009 Species-Specific and Project Surveys



Species-Specific Surveys or Monitoring

The role of individual or multiple species surveys is important in developing information necessary to address overarching questions related to CA Species occurrence, trend, and status. Equally important is that these surveys be conducted within a framework that allows for the development of information of sufficient data quality (known accuracy and precision) to identify and support changes in species management or proposed management actions.

Rather than deemphasize individual species monitoring, in later phases of the inventory and monitoring program it may be necessary to increase the amount of effort devoted to these surveys. However, individual species-specific surveys must be conducted using a statistically valid sampling design. Occurrence and distribution of the CA species within the SMNRA is a key information gap limiting the ability to address species status and trend.

2010–2012 Program Accomplishments

Accomplishments are described below by species rather than using the chronological approach used in other sections.

Charleston Ant

Determining the distribution and abundance of *Lasius 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) (Pendleton 2012a).

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:

- Develop 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 2012a). Events were held on July 17, July 25, and August 15, 2009. The Charleston Ant Picnic was held July 25 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 July 25–28, 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 Safari – The 2011 Charleston Ant Safari was held July 20, 2011, with approximately 30 participants. The Ant Safari was one of two Spring Mountain Science Safari events held during the summer of 2011. The other safari, the Pollinator Safari, was held at Lower Lee Meadow on August 16 and was attended by 35 people. Following the Ant Safari, collected ant specimens were sorted and potential *L. nevadensis* specimens were sent to the RMRS Albuquerque Laboratory for examination. Additionally, Dr. Larry Stevens of the Museum of Northern Arizona, while accompanying the spring inventory crew in July, collected specimens that were prepared and sent to Harvard University for identification. The specimens collected consisted of alate reproductives and workers, and the hive was swarming at the time of collection. These species were collected near Cathedral Rock in the drainage upslope from the type locality of *L. nevadensis* Cole (1956) near the community of Mt Charleston, Nevada located within the SMNRA.

2012 Charleston Ant Safari – The fourth annual Charleston Ant Safari was held July 2012. The format for the Spring Mountains Science Safaris has been standardized over the last three years. The safaris have developed into a successful education program that provides information on the flora and fauna of the SMNRA to the citizens of southern Nevada. Each safari includes a science discussion, science activity (ant collection is the science activity for the ant safari), games, and an art activity. Next year will be the fifth year of the Springs Mountain Science Safari.

The specimens of *Lasius* sp. ants collected during the 2011 field season by Dr. Larry Stevens were initially inspected by Dr. Gary Alpert, Harvard University Global Ant Coordinator, indicated that these were not *L. nevadensis*, although the species could not be determined without further comparison with related taxa, and may be new to science. Similar ants were found in other localities and specimens collected are being examined by the Harvard Ant Laboratory of E.O. Wilson.

Information derived from the SMNRA Species Reference Database was used to identify habitat characteristics described in the Charleston ant species fact sheet and to develop potential habitat map displayed in appendix B-6.

Alpine Plant Communities

Baseline studies for the three High Elevation Plant Communities were conducted in 1998 and 1999 (Nachlinger 2000b). The Biological Monitoring Plan for the three communities, bristlecone pine woodlands (2900–3450 meters), alpine and riparian spring-fed plant communities (2550–3150 meters) and the alpine herbaceous plant community (3350–3632 meters) was written by Nachlinger (2000a). Many CA Species are found in these three communities.

The objective of this study was to describe the natural patterns and the variation in the Spring Mountain high elevation communities, with a focus upon monitoring the health of these biologically important communities. Visitor use monitoring was an important component of the monitoring effort. Detailed objectives for each community monitored are listed in Nachlinger (2000a)

The methodology used included: One macroplot with ten associated transects was located in the herbaceous community. Two macro plots were located in the bristlecone pine community and two smaller macro plots were located in the riparian spring-fed community. Modified Whitaker plots were set up in the herbaceous and bristlecone macro plots. Sampling methodology for the Whitaker plots was the same for all long-term studies reported in this section. Qualitative sampling and photo points were used to sample springs and riparian macroplots, with a goal of reducing disturbance caused by the sampling effort. All of the data collected under the alpine plant community study are being compiled and analyzed. The evaluations of this study are reported in section 3.b.

Information derived from the species database and these studies was used to identify habitat characteristics, which were then used to develop the potential habitat maps displayed in appendices B-13, 26, 30, 31, 35, 37, 40, and 41.

Rough Angelica

In the mid-nineties, Rough angelica was a T&E candidate species and long-term studies were initiated to determine its appropriate listing status. The most detailed analysis of this species' status was completed 15 years ago by Nachlinger and Combs (1996a). Work by Walker (2005) provides an update.

Nachlinger and Combs (1996a) produced a Biological Monitoring Plan for this species. The design included 2 macroplots of unequal size, one at Mary Jane Falls trail site and the second at Stanley B Spring. The objective of the monitoring was to detect population changes at both sites , and to monitor community composition and visitor use. Seedling numbers were monitored at Mary Jane. Monitoring methods included photo points, visitor counts, 35 rectangular 1x20 meter quadrats at Mary Jane, and 10 rectangular 0.5x4 meter quadrats at Stanley B.A modified Whitaker plot was installed in each macroplot to quantify community composition.

Rough angelica occurs in a variety of ecosystems at elevations from 1128 to 3500 meters. The wide elevational range and the number of communities this species inhabits are not typical of most rare species. A map and species fact sheet for Rough angelica is included in appendix B. The Rough angelica long-term study data have been compiled, the statistical methods evaluated, and the implementation of the monitoring protocol evaluated. The results of the evaluation are reported in section 3.b.

Information derived from these studies and other published literature was used to identify habitat characteristics as described in the species fact sheet and to develop the potential habitat map, displayed in appendix B-25.

Egg Milkvetch

Smith (2001) produced a very comprehensive evaluation of the state of knowledge for this species. As described in this evaluation, egg milkvetch exhibits broader habitat tolerances than many rare species and inhabits a variety of ecosystems at elevations between 2070-2690 m. Smith (2001) and Anderson (1998) provide baseline location data upon which new location data, study and survey data collected during the last nine years, and the I&M program data can be added.

Nachlinger and Combs (1996b) produced a Biological Monitoring Plan for the species and a study based on that plan began in 1996. Two macroplots of equal size were established at the Bonanza Trail and Bristlecone Trail (one macroplot at each site). The monitoring objectives and data collection design was the same as that used for Rough angelica at Mary Jane Falls Trail.

Long-term study data for egg milkvetch has been compiled, the statistical methods evaluated, and the implementation the monitoring protocol evaluated. The results of the evaluation are reported in section 3.b.

Information derived from these studies was used to identify habitat characteristics as described in the species fact sheet and to develop the potential habitat map displayed in appendix B-10.

Butterfly Studies

There have been a number of butterfly studies conducted in the SMNRA and funded by the Forest Service and other government agencies. University scientists conducted a number of studies that are included in the published literature. The first study conducted for the Forest Service was completed in 1997 (Weiss et al. 1997). Subsequent studies by Boyd, along with several collaborators, made significant contributions to the knowledge base of Spring Mountain butterflies (Boyd and Austin 1999; Boyd 2005; Boyd and Austin 2000; Boyd and Murphy 2008). There are still knowledge gaps which need to be filled to fully understand the life history and distribution of the nine butterfly species listed in table 1-1. A study initiated in 2010 by Thompson and others (2011) is designed to fill in some of these knowledge gaps. Objectives of their study are given as follows:

The research was focused on the autecology, life history, and population biology of five subspecies of butterflies identified as priorities for conservation in the Spring Mountain National Recreation Area (SMNRA). The goal of this research was to establish basic autecological information about endemic subspecies of the SMNRA, recommendations for management of butterfly habitat, and methods for habitat restoration. The five focal taxa of interest were: Mt. Charleston blue (Plebejus (Icaricia) shasta charlestonensis; Austin 1980), Spring Mountains dark blue (Euphilotes ancilla pupura and E. a. cryptica; Austin et al. 2008), Morand's checkerspot (Euphydryas anicia morandi), and Spring Mountains Acastus checkerspot (Chlosyne acastus robusta). In addition, autecological information was collected on four additional taxa as time permitted: Plebejus (Icaricia) icarioides austinorum, Limenitis weidemeyerii nevadae, Speyeria carolae, and Hesperia comma mojavnensis.

Program Continuation

As envisioned in the I&M Program Strategy, species-specific surveys comprise a large segment of the future inventory and monitoring programs and are included in the Round 14 proposal. Specific recommendations regarding design of future species-specific surveys are described in section 4.b.3.

e. Implementation/Monitoring Audits

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

Organizational learning and continuous improvement is facilitated through incorporation of the Plan-Do-Check-Learn cycle established in Environmental Management Systems (ISO 2007). Figure 2-7 is adapted from this process.

Implementation/Monitoring Audit Process

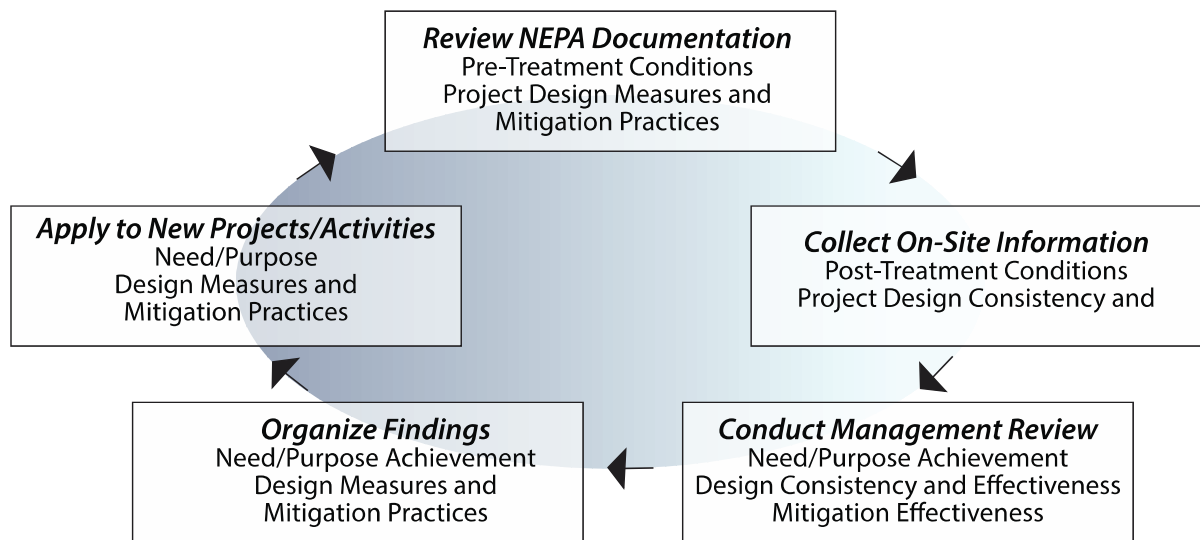


Figure 2-7: Implementation/Monitoring Audit Process

Initial Design

Project and activity areas are selected to address those monitoring questions where a qualitative assessment of conditions has been determined to be sufficient to address the issue, as determined by SMNRA leadership. Specific projects and activities audited are selected by SMNRA leadership (Deputy Forest Supervisor or SMNRA Manager). Management actions must be substantially complete or completed before conducting the IM Audit.

Since the initial design of the audit program, audit priorities were adjusted because management actions have not been taken that could be audited for many of the activities and projects identified for 2011 and 2012. Modifications are described and documented chronologically.

- 1. Audit priorities** - The SMNRA I&M Strategy (USDA Forest Service 2008b) set priorities for evaluating projects and activities using the Implementation and Monitoring Audit Program. Table 2-6 shows the initial projects and activities to be addressed during the first three years of the program.

Table 2-6: Initial Implementation/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 review of the completed (implemented) project’s NEPA, planning, and implementation documents. This allows reviewers to step back and look at a completed cycle of planning/doing. Audit procedures include the following basic steps:
- a. Review NEPA Analysis and Documentation**
 - 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 NEPA documentation examined in the first step.
 - c. Conduct Management Review** – Results of the document review and on-site information phases are presented to SMNRA leadership with the focus on project design consistency and mitigation practice effectiveness and identification of audit results to projects currently being planned.
 - d. Organize Findings/Prepare Audit Report**
 - 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 (see appendix E).
 - 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 is conducted to determine whether to make adjustments in future audits.

2010 Modifications and 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.

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. At the time of the 2010 IM Audit, these treatments were nearly complete, providing the audit team the opportunity to evaluate areas where treatments were in progress as well as those where treatment had been completed. Many of the same participants were involved in suppression of and restoration after the Cathedral Wildland Fire, which had also been selected for the 2010 IM Audit. This wildland fire was partially located within the same area as some of the hazardous fuel reduction treatments in Kyle Canyon, although the fire took place before the treatments were completed.

Table 2-7 identifies potential monitoring questions to be addressed at 2010 IM Audit sites.

Table 2-7: 2010 IM Audit Focus Areas by Site

Monitoring Questions	2010 Audit Sites	
	Cathedral Wildfire	2007 Fuel Reduction
<i>Wildland Fire and Fuel Management</i>		
MQ 31 – How effective are design feature and mitigation measure associated with mechanical fuel treatments in protecting/conserving CA Species habitats?		X
MQ 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?	X	
MQ 38 – What wildland fire suppression strategies and techniques can be used to minimize impacts to CA Species?	X	
MQ 36 – What actions can be taken to reduce wildland fire occurrences (severity) resulting in unwanted type conversion or unacceptable environmental effects?	X	X
MQ 37 –What is the rate of wildfire recovery on burned species? Is there a difference in recovery time for high vs. low intensity?	X	
MQ 39 – What wildland fire suppression techniques are most effective in setting the stage for post-fire restoration? (e.g., fire retardant use restrictions)	X	
<i>Soil and Water Conservation Best Management Practices</i>		
MQ 57 – Are soil disturbing activities creating excessive sedimentation or soil loss?	X	X
MQ 56 – Are soil and water conservation practices being implemented and are they effective?	X	X
<i>Invasive Species Prevention and Control</i>		
MQ 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?	X	

The *2010 Implementation and Monitoring Audit Report* (METI, Inc. 2011) documents the findings of the IM Audit workshop, addresses the implementation and effectiveness of wildland fire suppression and restoration strategies and techniques used in the Cathedral Wildland Fire, and the design features and mitigation measures employed in the hazardous fuel reduction treatments in Kyle Canyon, Deer Creek, and Lee Canyon. The report includes 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 Modifications and Accomplishments

The second round of IM Audits was conducted on projects selected by the Deputy Forest Supervisor during the management review held on January 19, 2011. Five sites listed below were selected for an analysis of a range of conditions and practices and their effectiveness over time. Decision documents reviewed ranged from a project file for West Mud Springs from the 1980s to a 2010 Decision Memo for actions at Cold Creek.

Table 2-8 identifies potential monitoring questions to be addressed at 2011 IM Audit sites.

Table 2-8: 2011 IM Audit Focus Areas by Site

Monitoring Questions	2011 Audit Sites				
	WMS	Cold Cr	WS	CC	Mtn. S
<i>Recreation Design and Management Practices</i>					
MQ 8 –how effective are efforts to reduce recreation effects to riparian and spring areas?	X	X	X	X	X
MQ 5 – How effective are efforts to manage motorized recreation (OHV) and limit other uses (outfitter and guides) to the protection and conservation of CA Species and their habitats?	X	X	X	X	X
MQ 51 – How effective is riparian fencing in protecting springs and riparian areas? What thresholds warrant this level of mitigation?	X	X	X		
<i>Soil and Water Conservation Best Management Practices</i>					
MQ 57 – Are soil disturbing activities creating excessive sedimentation or soil loss?	X	X	X	X	X
MQ 56 – Are soil and water conservation practices being implemented and are they effective?	X	X	X	X	X

The *2011 Implementation and Monitoring Audit Report* (METI, Inc. 2012a) documents audit findings and addresses the implementation and effectiveness of riparian, springs, and recreation management strategies at West Mud Springs (WMS), Cold Creek, Willow Creek/Spring (WS), Carpenter Canyon (CC), and Mountain Springs/Rainbow Mountain Wilderness (MS). The report concludes with draft frameworks for addressing springs/riparian management and motorized recreation management.

An evaluation of audit procedures was conducted in conjunction with the management review held on January 19, 2012. SMNRA leadership and staff were supportive of the audit approach and endorsed its continued use in 2012.

2012 Modifications and Accomplishments

The third and final IM Audit was conducted on three projects selected by the Acting SMNRA Manager during a meeting held January 19, 2012. The projects included developed recreation site reconstruction and watershed restoration. NEPA documentation reviewed for the projects included the Lee Meadows Restoration Project (LMRP) documented in a Decision Memo; Cathedral Rock Picnic Area Rehabilitation Project (CRPA) documented in a Decision Notice, FONSI, and Environmental Assessment (EA); and Kyle Canyon Picnic Area (KCPA) reconstruction documented in a Record of Decision (ROD) and Environmental Impact Statement (EIS), which also included two project-specific Forest Plan amendments.

Table 2-9 identifies potential monitoring questions to be addressed at the 2012 sites.

Table 2-9: 2012 IM Audit Focus Areas by Site

Monitoring Questions	2012 Audit Sites		
	LMRP	KCPA	CPA
<i>Soil and Water Conservation Best Management Practices</i>			
MQ 56 – Are soil and water conservation practices being implemented and are they effective?	X	X	X
MQ 57 – Are soil disturbing activities creating excessive sedimentation or soil loss?	X	X	X
MQ 51 – How effective is riparian fencing in protecting springs and riparian areas? What thresholds warrant this level of mitigation?	X		
MQ 59 – Is recreation use or grazing by wild horses/burros or recreational livestock impacting bank stability?	X		
<i>Recreation Site/Use Design and Management Practices</i>			
MQ 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?	X	X	X
MQ 8 How effective are efforts to reduce recreation effects to riparian and spring areas?	X		X
MQ 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?		X	X
MQ 18 – What are the direct and cumulative effects of woodcutting and gathering on CA species and their habitats?	X		X
MQ 5 – How effective are efforts to manage motorized recreation (OHV) and limit other uses to the protection and conservation of CA Species and their habitats?	X		
<i>Invasive Species Prevention and Control</i>			
MQ 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?	X	X	X
<i>Wildland Fire and Fuel Management</i>			
MQ 36 – What actions can be taken to reduce wildland fire occurrences (severity) resulting in unwanted type conversion or unacceptable environmental effects?		X	X
MQ 31 – How effective are design features and mitigation measures associated with mechanical fuel treatments in protecting/conserving CA species habitats?		X	X

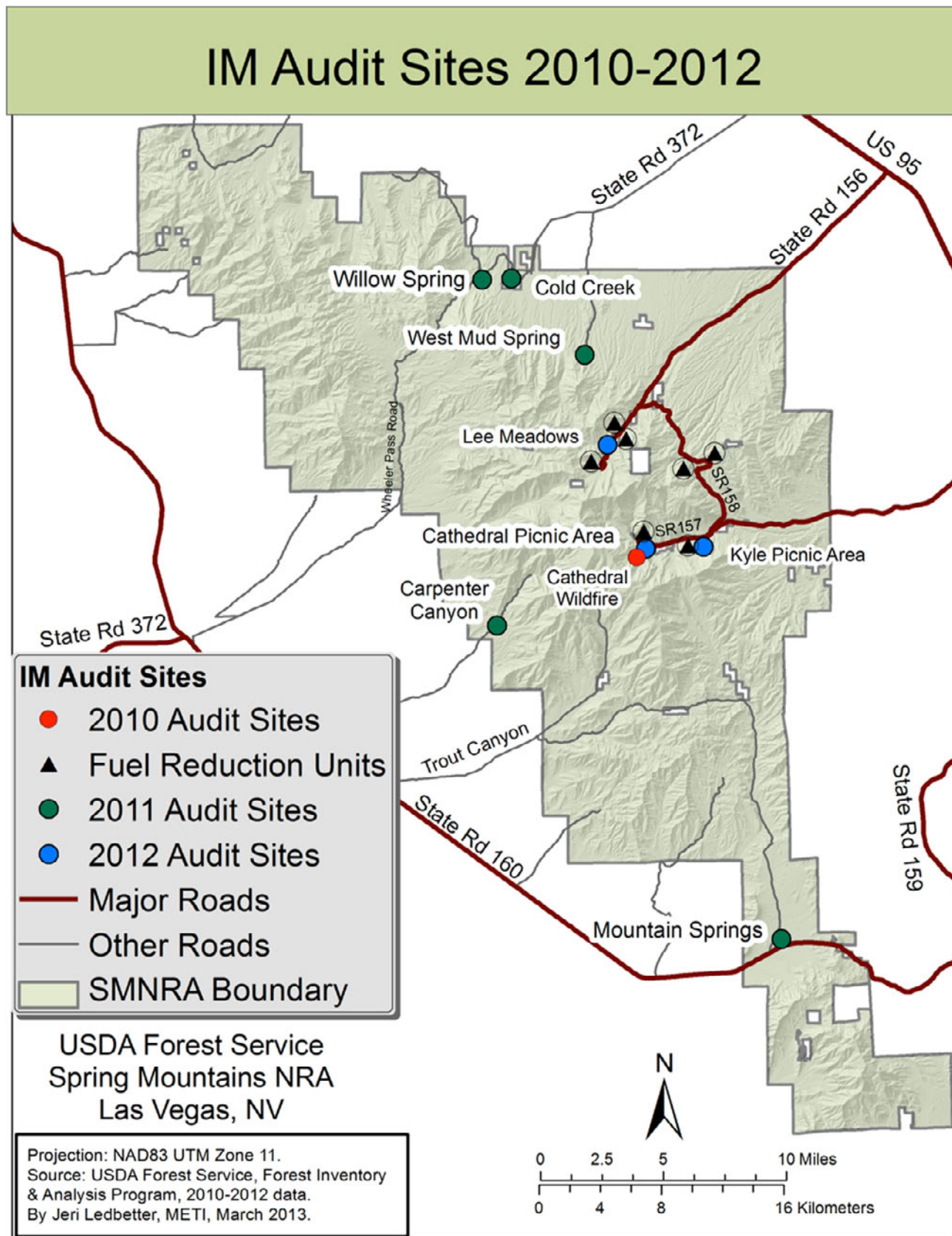
The *2012 Implementation and Monitoring Audit Report* (METI, Inc. 2012b) documents audit findings and evaluates the implementation and effectiveness of soil and water conservation practices (i.e., best management practices or BMPs), species protection and conservation design and mitigation measures, recreation site/use design and management practices, invasive species prevention and control, and wildland fire and fuel management. The report concludes by recommending a framework for noxious weed prevention and control to be used in designing future project proposals and NEPA analysis and documentation.

Figure 2-9 shows the locations of sites visited during the 2010–2012 IM Audits.

Program Continuation

Although these audits provided the SMNRA important information regarding the design and execution of ongoing and future projects, they were planned to become self-sustaining by SMNRA leadership. Continuation of the IM Audits or a similar approach to organizational learning by SMNRA leadership is recommended.

Figure 2-9. 2010– 2012 Implementation and Monitoring Audit Sites

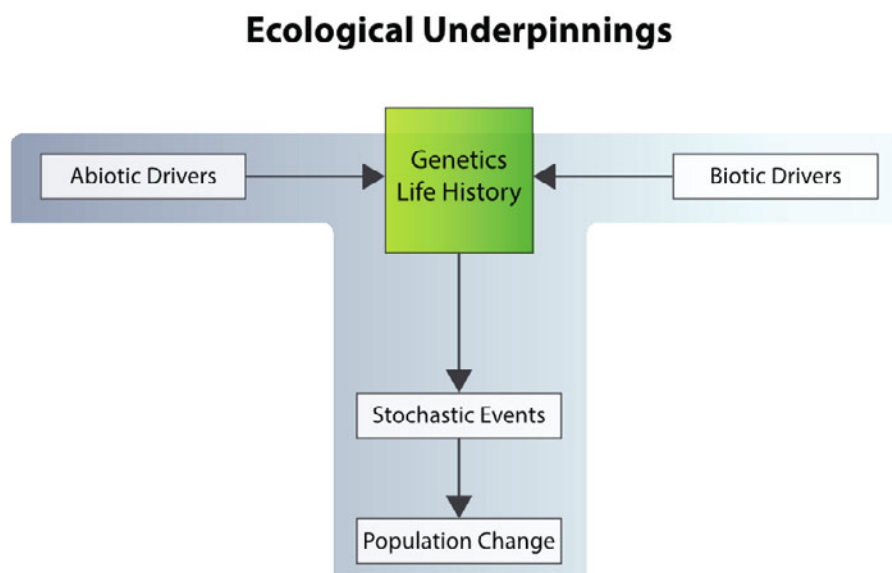


3. Data Analysis and Evaluation

Analysis and evaluation of inventory and monitoring data 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 with 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 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 (USDA Forest Service 2008b) (see fig. 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 sizes, random (stochastic) events, both biotic (e.g., ungulate grazing pattern) and abiotic (e.g., tornado path) factors, can have an enormous impacts on net population change. The SMNRA inventory and monitoring program collects both biotic and abiotic data at multiple scales. The combined dataset 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 ³
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 requires 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.

³Monitoring questions are listed in priority order as identified in the SMNRA I&M Strategy (USDA Forest Service 2008b), see appendix A.

Data analysis and discussions in the following subsections are organized under each of the monitoring focus items described in table 3-1. Data used to support these analyses are provided by the inventory components listed in table 3-2 for each of the outcomes associated with the monitoring focus items.

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. The SMNRA staff documents and monitors individual wildland fire occurrences and effects. This large dataset 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

Disturbances discussed in this section are all heavily influenced by changes in climate (Pendleton et al., in press). For example, drought induces bark beetle susceptibility in conifers. Fire frequency and severity are linked to precipitation timing, quantity, and drought severity and duration. Climate changes that have the most potential impact on Spring Mountain ecosystems include:

- Drought and changes in precipitation patterns are projected to result in a cascade of ecosystem changes including reduced snowpack and earlier runoff
- Warmer temperatures are producing changes in plant phenology, potentially leading to a decoupling of pollinator lifecycles with the availability of pollen and nectar resources, a situation which is disruptive to both plant and pollinator lifecycles
- Winter night time temperatures limit species distribution on an elevational gradient, and climate models predict a significant increase in winter night time temperatures
- Increased CO₂ levels may differentially affect vegetation community dynamics, invasive species, plant phenology, below-ground nutrient cycling and carbon cycling

Data on climate change is rapidly accumulating. Multiple climate change models predict a rapid rate of climate change in southern Nevada, with particularly rapid change at lower elevations and a somewhat slower rate of change at higher elevations (Rehfeldt et al. 2006; Loarie et al. 2009; Chen et al. 2011). The more frequent and longer periods of drought, predicted by most climate models, would result in tree die-offs, increases in invasive species, further changes in the fire cycle and would have a significant impact on CA species (Beshears et al. 2009; Gutzler and Robbins 2010; Pendleton et al., in press).

Climate-induced shifts in phenology (e.g., phenological events occurring earlier in the spring) have been documented for many species. Of particular concern in the SMNRA is the disruption of plant-pollinator interactions. Butterfly emergence and migration advancement is happening at a more rapid rate than advancement in plant flowering dates. This results in a reduction in availability of floral resources (Memmott et al 2007; Parmesan 2007). The large number of endemic and rare butterflies in the SMNRA will be impacted by this trend.

Ecotones are predicted to move up in elevation and north in latitude, tracking environmental conditions that control species distribution, e.g., a shift in the blackbrush/pinyon-juniper ecotone up the mountain slope (Esque et al. 2009), bristlecone pine movement into the alpine community (Clark County Nevada 2008), and conditions suitable for Mojave desert scrub communities in northern Nevada and southern Idaho in 2060 (Rehfeldt et al. 2006).

Forest Service managers have dealt with climate changes since the beginning of the agency. The challenge the agency now faces is managing forests and TES species during a period when climates are changing at an extremely rapid rate (Hannah et al 2002). Management guidance for climate change is available from Forest, Regional and Washington Offices. The Washington Office has a climate change group led by Climate Advisor to the Chief, Dr. David Cleaves that provides information to help facilitate management of forests and grasslands during an era of changing climate (<http://www.fs.fed.us/climatechange/>). The recently published *Effects of Climatic Variability and Change on Forest Ecosystems: a Comprehensive Science Synthesis for the U.S. Forest Sector* (Vose et al. 2012) is,

...a scientific assessment of the current and likely future conditions of forest resources in the United States relative to climatic variability and change. It serves as the U.S. Forest Service forest sector technical report for the National Climate Assessment and includes descriptions of key regional issues and examples of risk-based framework for assessing climate change effects.

The Intermountain Region has posted guidelines on its web page (<http://fsweb.r4.fs.fed.us/climate/index.shtml>) for incorporating climate change components into the project planning process. Howell (2011) prepared a climate change vulnerability report for the Humboldt-Toiyabe National Forest (<http://www.fs.usda.gov/land/htnf/landmanagement>). The report provides a comprehensive look at the projected effects of climate change on the National Forest. The report provides a synopsis of paleo-climates, present climate, and realized and projected impacts of climate upon forest ecosystems. The climate change and forest management section of the report provides a brief primer on management during an era of climate change.

The SMNRA maintains a network of climate monitoring stations. The data collected at these stations provide the context for examining changes in ecosystems and CA species' populations given that climate is an overarching driver of ecosystem change. The climate data collected will be a valuable asset to the I&M analysis process (James Hurja, personal communication 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 or understood. 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 history and behavior under different conditions helps managers effectively and efficiently manage future wildland fires and provides insight regarding the role of fire within the communities supporting CA Species.

Information on wildland fire effects in community types represented in the SMNRA has been the focus of recent research conducted under the auspices of the Joint Fire Sciences Research Program. Of particular note are Pinyon-juniper studies conducted by RMRS scientists (Chambers et al. 2005; Rau et al. 2012).

The Fire Effects Information System (FEIS) maintained by the Rocky Mountain Research Station's Fire Modeling Institute, located in Missoula, MT, contains current information regarding fire effects on vegetation, soils, hydrology and other resources. Information regarding the effects of fire exclusion in different community types is also available from the FEIS.

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 3-3 displays the percentage of area within each of the biophysical settings by seral stage or transition stage used in the LANDFIRE vegetation dynamics modeling.

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, data developed by Provencher do not use the same biological setting classes as those used by LANDFIRE, so a direct comparison cannot be made between historical and current vegetation patterns using a common typology. Maps of existing vegetation developed for the SMNRA use a different classification system and map legend, again making the comparison of historical vegetation patterns and composition to existing vegetation difficult.

Table 3-3: 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, open; 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.

Maps of existing vegetation developed for the SMNRA by Nachlinger and Reese (1996) use a different classification system and map legend, making the comparison of historical vegetation patterns and composition to existing vegetation difficult. Unfortunately, data developed by Provencher do not use the same biological setting classes as those used by LANDFIRE, so again a direct comparison cannot be made between historical and current vegetation patterns using a common typology.

A new existing vegetation/cover type map of the SMNRA is being developed using the recently updated National Vegetation Classification (FGDC 2011) and available plot information. The map and supporting information will be available in late 2013. Tabular information for existing vegetation types that can be directly compared to Provencher's data will also be available. These data can be used to evaluate and quantify departure from historical patterns, placement of current vegetation/cover upon the historical variability continuum, and provides a baseline for evaluating climate-induced changes to vegetation.

Insects and Disease

Plant and animal disease vectors 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 Beetles and Rusts

Bark beetle and rust in conifers are of greatest concern (Breshears et al. 2009) in the Spring Mountains as plant communities migrate upward in elevation. Warmer winter temperatures may also allow an increased number of pathogenic insects to overwinter and increase the intensity of future outbreaks. 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 edulis*. 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.

An Aerial Insect and Disease Detection Survey is conducted annually to quantify insect and disease outbreaks (http://www.fs.usda.gov/detail/r4/forest-grasslandhealth/?cid=fsbdev3_016163). Maps are generated for each forest in Region 4 and a report, which presents and analyzes the data. Bark beetle and rust in conifers are of greatest concern (Breshears et al. 2009) in the Spring Mountains as plant communities migrate upward in elevation. Warmer winter temperatures may allow an increased number of pathogenic insects to overwinter and increase the intensity of future outbreaks. Plants and pathogens that have not been in contact previously, due to separation by long distances, may come into contact as species migrate along climate gradients (Desert Research Institute 2008). The recent widespread mortality of pinyon, *Pinus edulis*, is an example of the disruption of ecosystems driven by insect and disease outbreaks. In 2002–2003, 40–80% of pinyons in a four-state region died following prolonged drought and unusually high temperatures (Breshears et al. 2005). The 2010 Aerial Survey mapped 23,874 acres of pinyon, mostly in the lower elevations of the Spring Mountains, infested with pinyon pine needle scale and sawfly. Regional mortality of key species has the potential to rapidly alter vegetation composition and associated ecosystem properties for decades.

The 2010 survey mapped 10 fir damaged or killed by fir engraver beetles and there was not a significant change in 2011 and 2012 in trees infected or acres effected. In 2010, Mountain Pine Beetles killed 15 trees in the white pine group (includes five-needle pines) on 13 acres. The trees were primarily located in the headwaters of Lee and Kyle Canyons. Six dead Ponderosa on three acres were mapped in 2010. They were located in drainage bottoms in the eastern Spring Mountains. The 2011 survey mapped 75 dead Ponderosa pine on 37 acres – a tenfold increase over the previous year's survey. Many of the deaths may be attributable to the western pine beetle. The 2012 Aerial Survey map pinpoints beetle infections at 15 sites and the number of trees infected is similar to 2011 (the report of the 2012 surveys was not available when this document was published).

During 2011, SMNRA staff observed large numbers of newly infected trees within the Kyle and Lee fuel treatment areas. In March 2013 John Guyon, plant pathologist with the Region 1/Region 4 State and Private Forestry Forest Health Protection program, confirmed this report. Damaged trees adjacent to state highways in Lee and Kyle Canyons also may be affected by road salt or deicing treatments. An evaluation of these effects is currently underway in a separate study being conducted by UNLV.

Bat White-Nose Syndrome

White-nose syndrome (WNS), 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 United States. The USFWS reported in January 2012 that more than 5.5 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 to limit the spread of the disease.

As of January 2013, the closest report to SMNRA of suspected white-nose syndrome is from western Oklahoma. The western distribution limit did not change in the last year. A WNS management plan developed for New Mexico (<http://whitenosesyndrome.org/white-nose-syndrome-planning>) provides a template that may be useful for other western states. Updated WNS information may be found at <http://whitenosesyndrome.org/>. In May 2011, the Northern Region of the Forest Service began considering potential restrictions for caves and abandoned mines to contain the spread of WNS and may provide a useful framework for addressing this issue.

The Forest Plan/GMP standards and guidelines regarding the management of abandoned mines and caves and recreation use associated with abandoned mines and caves provide direction that should be used as part of any management plan. The Humboldt-Toiyabe National Forest recently initiated an effort to close public access to abandoned mines, many of which provide bat habitat; however, the status of this effort was unknown at the time of publication.

Invasive Species

Drought can increase the susceptibility of ecosystems to invasion by non-native species, especially with elevated levels of CO₂ (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. Invasive 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 non-native plant species. Nachlinger and Reese (1996) documented 31 species of non-native plants in or adjacent to their plots. Glenne (2003) compiled a list of 120 non-native 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. The National Park Service (NPS) Exotic Plant Management Team has been performing weed surveys/treatments on the SMNRA since 2011 using restoration SNPLMA funding. This information is compiled in a geodatabase on file at the SMNRA.

The Intermountain Region implemented a weed free hay policy in 2003 and the Regional Forester issued a Special Order on February 11, 2003 (Weed Free Hay Special Order # 04-00-097). The intent of the policy and Special Order is to reduce the introduction of weed seed into the Region's forests. Since the policy was promulgated by the Region, enforcement of the prohibitions associated with the Special Order and public information regarding its requirements have not been emphasized within the SMNRA because of the lack of availability of weed-free feed in the vicinity of the SMNRA.

Weed surveys will be conducted and information will be added to the NRM 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 can be problematic at springs and other moist habitats (ENTRIX, Inc. 2008). The SMNRA has an agreement with the NPS Exotic Plant Management Team for the survey/monitoring of invasive species. The agreement also includes eradication services for newly discovered infestations and other control and containment activities. The Intermountain Region Invasive Species Management Plan is being revised and the next 5-year strategy will address continuing and emerging invasive species issues that can be used to identify potential stressors and management approaches that could be applied to the SMNRA.

Non-Native/Introduced Species

Five species of non-native wildlife – wild horses, burros, elk, chucker partridge, and the Lahontan cutthroat trout – are resident within the SMNRA and pose documented or potential impacts on CA species and SMNRA ecosystems. Populations of 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, Lahontan cutthroat trout, and chuckar partridge 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 three jointly managed horse management areas (HMA) listed in table 3-4, 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).

Table 3-4 - 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

The Spring Mountains HMA covers a total of 671,625 acres and includes both BLM public lands and National Forest System lands. 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 (USDA Forest Service 1998).

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 challenging. As a result, disturbances to vegetation at spring sites and other habitats have limited time for recovery before herd numbers again exceed target levels.

AMLs for wild horse and burro numbers are based on an estimated seven percent of available water and forage resources, which is intended to reduce, but does not eliminate, the potential for overgrazing and soil compaction. 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. The 2007–2008 estimated populations, by HMA, are listed in table 3-4. Horse numbers at that time were 2.5 times the recommended numbers and burros were over six times the recommended numbers.

Despite this roundup, the BLM estimates that numbers were still above sustainable levels. The next herd gather was scheduled for 2013 (James Hurja, personal communication 2012). There are no gathers scheduled in 2013 for the three Spring Mountains area HMA, however the Forest Service and BLM are currently developing a joint wild horse and burro management plan for these HMAs (Jim Hurja, personal communication 2013). Horse and burro numbers remain well above the levels listed in the HMA unit descriptions (NDOW 2012).

Current drought conditions and stocking levels within the Johnnie HMA require the transport of water for horses and burros. The BLM states the animals are in moderate thin to thin condition. The lack of water and native forage sufficient to maintain the animals in good condition strongly suggests that a negative impact on the plant communities is occurring as the result of excess herd numbers. In fact, the estimated AML for Johnnie has been reduced from the 50 horses and 50 burros listed in the BLM's description of Johnnie Herd Management unit to 16–27 horses and 29–49 burros. December 2012 population estimates are 58–70 horses and 73–100 burros. Chronic over population of the Spring Mountains area herds is particularly of increasing concern in light of the dryer and warmer conditions predicted by climate change models.

Wild horses and burros 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 (ENTRIX, Inc. 2008; Cummings 2010; BLM 2011; NDW 2012).

Elk

First introduced in 1935 with subsequent releases in the 1980s, elk populations within the SMNRA 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. An aerial survey, conducted in 2010, observed only 122 elk, and population estimates for 2011 approximate those observed in 2010 (NDOW 2011). A 2012 NDOW aerial survey recorded 80

elk; 64 cows, 15 calves and 1 spike bull. Degraded vegetative conditions on the McFarland burn, and competition for forage with wild horses and burros continues to depress elk populations (NDOW 2012). Drought is also a contributing factor to elk numbers and vegetative conditions.

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 (ENTRIX, Inc. 2008; Cummings 2010). Since alpine environments in the SMNRA did not evolve with large ungulate grazing, elk may negatively impact alpine CA species (Howell 2011). The NDOW (2012) report for Unit 262 by Patrick Cummings states

Severely degraded vegetative conditions on the McFarland Burn were noted in 10 aerial surveys conducted between 2002 and 2012, and likely the reason fewer elk were encountered in the area. Degraded habitat is largely the result of an over population of feral horses aggravated by the effects of drought conditions. ...In the near future, meaningful efforts to improve elk habitat must entail management of horse and burro numbers consistent with AMLs and completion of habitat improvements.

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. Since its introduction in the 1970s the population has become self-sustaining, but there is not any information on population numbers. NDOW regulations permit a daily limit of two trout from Carpenter Creek in Carpenter Canyon.

Riparian surveys conducted in 2012 (see section 2.b and appendix D-1.3) identified a population of trout in lower Willow Creek. It is not known whether these are introduced Lahontan cutthroat trout.

Chuckar Partridge

The chuckar partridge was introduced to the Spring Mountains as a game bird by the Nevada Department of Wildlife. During most of the year, their diet consists of seeds and leaves of grasses and forbs. In the spring, germinated seed and insects are additions to their diets. However, insects do not make up a large portion of the adult chuckar's diet (Christensen 1996). It is not known if chuckars consume enough seed of plants listed in table 1-1 to affect those plant's populations.

Monitoring Question Analysis and Evaluation

Table 3-5 presents the analysis of existing data and data collected during 2010–2012 for those monitoring questions related to ecological context (see table 3-1). The order of presentation corresponds to the priorities for monitoring questions established by in the SMNRA I&M Strategy (USDA Forest Service 2008b) (see appendix A).

Table 3-5: 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 (Provencher, 2008). • 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 (METI, Inc. 2011) 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 historical vegetation conditions and departure of existing vegetation from this baseline provides information needed to address this question and concludes that there are significant departures from historical conditions, affecting resiliency of these systems from disturbance events, possibly affecting CA Species and their habitats. The GMP identifies desired vegetation conditions by seral stage and land type association for the four management areas within the SMNRA. Desired conditions represented in the GMP were developed with limited information on historical vegetation conditions vs. existing vegetation cover. Information developed by the LANDFIRE program indicates a substantial departure from historical conditions in P-J and mixed-conifer types. LANDFIRE condition class determinations place much of this area in Condition Class 2 and 3 indicating a high likelihood that wildfires will adversely affect the function and condition of those lands should a fire event occur as a result of heavy fuel loading. The GMP recognizes the importance of natural disturbance events in helping restore disturbance processes and their function within these ecosystems. Projected climate change-related effects on low elevation communities such as those found in the Blackbrush and Creosote land type associations will increase the likelihood of wildfires that will promote type conversions in these systems. Similar effects will occur in the Alpine land type association as timing and forms of precipitation shift. The Intermountain Region is developing a common map of existing land cover types using FIA data and information from the SMNRA intensified FIA program. Once this new land cover type map is prepared, a crosswalk between the Forest Plan/GMP Cover Types, Land Type Association, and FIA/Group/Cover Types will need to be prepared. This will enable monitoring and project-planning efforts consistent between existing management direction, the new existing cover type map, and FIA cover types and data generated as part of the FIA program. • Treatment of hazardous fuels in areas with values at risk must be completed to allow effective use of wildland fire for resource benefits (METI, Inc. 2011). • The new Regional cover type map will provide the basis for comparing existing land cover with historical cover type information developed by Provencher (2008) to determine departure from historical conditions and to assess potential effects resulting from climate change modeling assumptions. This information can then be used to address restoration of fire-dependent ecosystems within the SMNRA. • The effect of climate change on desired vegetation patterns and distribution among seral stages needs to be considered in establishing desired conditions. The ability to maintain late seral stages conditions as described in the GMP for Blackbrush and Creosote Land Type Associations at lower elevations will become increasing difficult as climate changes begin to shift. Similar changes may also affect the maintenance of late seral stages in Alpine land type associations.

Table 3-5: Analysis and Evaluation of Monitoring Questions Related to Ecological Context (Cont.)

Monitoring Question 33 - How effective are fuels treatments in restoring fire to its natural role in the environment?
The 2010 IM Audit (METI, Inc. 2011) 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 (METI, Inc. 2011).
Monitoring Question 34 - How can we maintain the appropriate amounts of wildland fire to maintain healthy ecosystems?
The 2010 IM Audit (METI, Inc. 2011) 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. The GMP identifies desired vegetation conditions by seral stage and land type association for the four management areas within the SMNRA. Desired conditions represented in the GMP were developed with limited information on historical vegetation conditions vs. existing vegetation cover. Information developed by the LANDFIRE program indicates a substantial departure from historical conditions in P-J and mixed-conifer types. LANDFIRE condition class determinations place much of this area in Condition Class 2 and 3 indicating a high likelihood that wildfires will adversely affect the function and condition of those lands should a fire event occur as a result of heavy fuel loading. The GMP recognizes the importance of natural disturbance events in helping restore disturbance processes and their function within these ecosystems. Projected climate change-related effects on low elevation communities such as those found in the Blackbrush and Creosote land type associations will increase the likelihood of wildfires that will promote type conversions in these systems. Similar effects will occur in the Alpine land type association as timing and forms of precipitation shift. • Treatment of hazardous fuels in areas with values at risk must be completed to allow effective use of wildland fire for resource benefits. • The new Regional cover type map will also provide the basis for comparing existing land cover with historical cover type information developed by Provencher (2008) to determine departure from historical conditions and to assess potential effects resulting from climate change modeling assumptions. This information can then be used to address restoration of fire-dependent ecosystems within the SMNRA to determine the role of fire in maintaining healthy ecosystems. • The effect of climate change on desired vegetation patterns and distribution among seral stages needs to be considered in establishing desired conditions. The ability to maintain late seral stages conditions as described in the GMP for Blackbrush and Creosote Land Type Associations at lower elevations will become increasing difficult as climate changes begin to shift.

Table 3-5: Analysis and Evaluation of Monitoring Questions Related to Ecological Context (Cont.)

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 springs and stream/riparian areas inventoried is presented in appendix D 1.1. During the three years of sampling (2010 - 2012) approximately 60% of the springs of the SMNRA have been surveyed. A list of the 77 spring sites visited inventoried to date is provided in appendix D 1.2. The four streams and the associated 11 riparian inventory sites are listed in appendix D 1.3. Analysis of data collected at the spring and riparian sites in 2010, 2011, and 2012 are presented in appendix D 3.2 and D 3.3. Note: Measurement units are defined in appendix D.

- **Hydrology:** Flow was measured at 45 spring sites (58% of all sites), with a range of 0.002 to 1.9 L/second and a median flow of 0.13 L/second. At the other sites there was either no discernible flow or the flow was diffuse and could not be measured. There was a large range of spring water temperature (3.0 to 19.5°C) indicating a variety in spring recharge sources, including snowmelt emerging after a short flow path (colder temperatures); and karst, thermal, or from depth (higher temperatures). Values of pH had a moderate range (from 6.5 to 8.6) which likely contributes to high diversity of animals and plants at the springs. Specific conductance values ranged from 136.0 to 1,011.3 µS/cm, with higher values likely coming from karstic systems or areas with grazing ungulates that have added to the dissolved material. Oxygen-reduction potential ranged from -76.9 to 270.6 mV, with the higher values likely indicating well-aerated waters, discharge with more turbidity or geochemical composition similar to local precipitation; and lower values likely indicating a long flow path with no aeration. Dissolved oxygen values ranged from 1.9 to 10.3 mg/L, with low values likely from water with long, deep flow paths that have little to no access to oxygen. Additional discussion of hydrologic data is presented in appendix D 3.2.
- **Soil:** Most of the spring sites had rocky substrate and little soil development. Only five sites had a peat layer (1 to 50 cm thick) which might be considered fen-like, although it would probably not meet all the criteria of a fen. Among all the sites surveyed, the soil texture was commonly sand and silt and soil colors were 10Y, 10YR, 5G, 5Y, and 5YR. Redoximorphic features were detected at three sites (Mack's Canyon 1, Mountain Springs 3, and Unnamed 45). A hydrogen sulfide odor was detected in the soil at two sites (Mack's Canyon 1 and Unnamed 45). At one site (Mountain Springs 3) the soil reacted to HCL. Holes dug for sampling averaged 12.7 cm in depth. Additional information on the soils data is presented in appendix D 3.2.
- **Fauna:** Deer were observed most frequently (49% of sites) and horse (42% of sites). Other frequently observed terrestrial vertebrates were: hummingbird (species not recorded), elk, scrub jay, spotted towhee, northern flicker, and chipmunk. Many other species, particularly birds, were observed at a lower percentage of sites. The most frequently observed aquatic macroinvertebrates identified to family were caddisflies, order Trichoptera, family Limnephilidae (19% of sites); bee flies, order Diptera, family Bombyliidae (17% of sites); ground beetles, order Coleoptera, family Carabidae (16% of sites); and crane flies, order Diptera, family Tipulidae (16%). Other macroinvertebrate taxa that were identified to a more general level that were observed frequently were flatworms, class Turbellaria (26% of sites); flies, order Diptera (40% of sites); beetles, order Coleoptera (27% of sites); and caddisflies, order Trichoptera (26% of sites). It is noteworthy that springsnails (genus Pyrgulopsis, family Hydrobiidae) were found at 7 of 77 (9%) springs (suggesting that those 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 (primarily horses, elk and deer), which resulted in trails, trampling, grazing and browsing of vegetation, and various ground disturbances. Other commonly observed disturbances were fire, water extraction, vehicle trails and tracks, and tree cutting.

Table 3-5: Analysis and Evaluation of Monitoring Questions Related to Ecological Context (Cont.)

Monitoring Question 50 - What is the current riparian vegetation composition, structure and pattern associated with springs, fens, and streams?
Most spring and riparian sites were dominated by wetland and facultative vegetation, as indicated by the prevalence index below 3 at 74% of spring sites and two of the four stream/riparian areas. The prevalence index is a measure of the abundance of wetland vegetation, on a scale where “1” would be entirely wetland vegetation and “5” would be entirely upland vegetation. The other spring and riparian sites were dominated by facultative and upland species, which could be a concern given that these areas are associated with springs and streams. A few spring sites had very little vegetation, which could be a result of disturbance from animals. The vegetation data for each spring and riparian site were compared to riparian vegetation types described Manning and Padgett (1995), Nachlinger and Reese (1996), and Weixelman et al. (1996). • It is noteworthy that 244 vascular plant species were recorded at the 77 springs inventoried. The total number of plant species in the SMNRA is reported to be 1,015 by Niles and Leary (2007), therefore the springs contained 24% of all the species of the SMNRA. • The most commonly observed vegetation types for springs were: <i>Aquilegia formosa</i>-<i>Smilacina stellata</i>/<i>Rosa woodsii</i> var. <i>ultramontana</i> Association (Nachlinger and Reese 1996) at 22 sites; the <i>Baccharis sergiloides</i> Association (Nachlinger and Reese 1996) at 14 sites; the <i>Rosa woodsii</i> var. <i>ultramontana</i> Association (Nachlinger and Reese 1996) at 10 sites; and the <i>Salix lasiolepis</i>/<i>Rosa woodsii</i> var. <i>ultramontana</i> Community Type (Manning and Padgett 1995) at 10 sites. • The vegetation types observed for the riparian areas were: <i>Aquilegia formosa</i>-<i>Smilacina stellata</i>/<i>Rosa woodsii</i> var. <i>ultramontana</i> Association (Nachlinger and Reese 1996); <i>Artemisia tridentata</i>/<i>Elymus cinereus</i> Association (Nachlinger and Reese 1996); <i>Jamesia americana</i>/<i>Petrophytum caespitosum</i>-<i>Ivesia jaegeri</i> Association (Nachlinger and Reese 1996); <i>Rosa woodsii</i> var. <i>ultramontana</i> Association (Nachlinger and Reese 1996); <i>Poa pratensis</i> Community Type (Manning and Padgett 1995); <i>Salix lasiolepis</i>/<i>Rosa woodsii</i> var. <i>ultramontana</i> Community Type (Manning and Padgett 1995) Detailed summaries of the vegetation of the springs and riparian areas surveyed are presented in appendix D-3.2 (springs) and 3.3 (riparian areas).

Table 3-5: Analysis and Evaluation of Monitoring Questions Related to Ecological Context (Cont.)

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 associated riparian areas includes: vegetation composition, vegetation condition, faunal species presence, invasive species of flora and fauna, introduced plant species cover, the abundance of wetland vegetation (using the prevalence index), and the amount of bryophyte cover. A high ecological status will generally include the vegetation composition anticipated for the site, vegetation that is healthy and vigorous, faunal species anticipated for the site, a low amount of introduced plant species cover, an abundance of wetland plant species (low prevalence index), and some bryophyte cover. Disturbance is a natural part of some springs ecosystems, and many riparian plants can tolerate or even thrive in the presence of natural forms of 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. Disturbance from animals (particularly horses) was observed at over 88% of spring sites. Summaries of disturbances are presented in appendix D 3.2, as well as in the discussions for monitoring questions 40, 45, 57, and 59. A more complete assessment of ecological status could be performed 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. <u>Springs Data</u> Data used to address this question are summarized below and are presented in more detail in appendix D 4.1. • It is noteworthy that 244 vascular plant species were recorded at the 77 springs inventoried. The total number of plant species in the SMNRA is reported to be 1,015 by Niles and Leary (2007), therefore the springs contained 24% of all the species of the SMNRA. • 57% of sites had vegetation composition as anticipated, and 65% had healthy and vigorous vegetation, based on the responses to the management indicator questions. • 59% of sites had the anticipated faunal species, based on the response to the management indicator question. • 65% of sites did not have invasive species of flora and fauna established, based on the response to the management indicator question. • 48% of sites had no non-natives species cover recorded during the vegetation sampling. The average cover of introduced plants species at a site was 3.0%. • The prevalence index values ranged from 1.0 to 4.1 and the average value was 2.4, which is based on the cover data from vegetation sampling. The prevalence index is a measure of the abundance of wetland vegetation, on a scale where 1 would be entirely wetland vegetation and 5 would be entirely upland vegetation. 74% of sites were primarily wetland and facultative vegetation (prevalence index below 3). The other sites were dominated by facultative and upland vegetation (prevalence index of 3.0 to 4.1). More wetland vegetation would probably be associated with higher ecological status. Bryophytes (mosses) are non-vascular plants that include species with characteristics that allow them to thrive in wet soil conditions. Bryophytes are vulnerable to human disturbance and to changes in hydrology (Tousignant and Brisson 2010). • The SMNRA sampling data indicate that bryophyte cover averaged 5.4% and the median was 2%. • The majority of sites had at least some bryophyte cover, which is a good sign, although it is not clear what the cover should be for SMNRA sites in good ecological status (see appendix D.4.1). <u>Riparian Data</u> Riparian data collected in 2012 that can also be used to address this question are briefly summarized here (and are presented in more detail in appendix D 3.3): • 9% of sites had vegetation composition as anticipated, and 64% had healthy and vigorous vegetation, based on the responses to the management indicator questions. • 36% of sites did not have invasive species of flora and fauna established, based on the response to the management indicator question. • Introduced plant species cover averaged about 1%, based on vegetation sampling data that detected 3 non-native species. A few other species that are sometimes considered introduced were also observed. The prevalence index (described above) median value was 3.0, which is based on the cover data from vegetation sampling. 45% of sites were primarily wetland and facultative vegetation (prevalence index of below 3). The other sites were dominated by facultative and upland vegetation (prevalence index of 3.0 to 4.6).

Table 3-5: Analysis and Evaluation of Monitoring Questions Related to Ecological Context (Cont.)

Monitoring Question 40 - What is the current trend (distribution and abundance) of invasive species?
Invasive species data collected by the NPS in 2011 and 2012 have been entered into NRIS TESP-IS and FACTS. Steps are being taken to assure data collected by the Weed Sentry Program from 2004–2009 are entered into the NRM-NRIS database for the SMNRA. FIA data collection will provide information to address this question. Springs inventory data indicate the presence of non-native vegetation at spring sites (see appendix D 3.2) and tamarisk or saltcedar was observed at one spring site (see appendix D 3.2). The 2012 IM Audit (METI, Inc. 2012b) assessed best practices for noxious weed prevention and control used for recreation site reconstruction and watershed restoration. Both the 2011 and 2012 IM Audits (METI, Inc. 2012a,b) noted efforts to promote weed-free feed required by a Regional Forester’s Special Order and that public information regarding this requirement could be improved and enforcement measures increased. • Data regarding noxious and invasive species were compiled but not provided at a date that allowed sufficient time for analysis. • Vegetation sampling in 2010 and 2011 only showed one spring site with an invasive plant species: saltcedar (<i>Tamarix ramosissima</i>). • Responses from the management indicator tool indicated that 36% of sites had invasive species of flora and fauna established. That response may have been based on the presence of introduced plant species (observed at 39% of sites) rather than invasive species. The field crew may not have distinguished between introduced (non-native) and invasive (a designation made by each state) species. • The Noxious Weed Prevention and Control Management Response Framework (see appendix E) identifies best practices for ground-disturbing activities. These practices have been found to be effective in avoiding new infestations and controlling their introduction associated with these activities.
Monitoring Question 45 - Do wild horses adversely affect the habitats of some CA Species?
The annual population of wild horses increased approximately 18% since 2006 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 springs and riparian areas in the SMNRA. Excessive use of forage decreases the regeneration capability of these plants, resulting in a decrease in the ability of the vegetation to stabilize soil and prevent erosion. In addition, the horses and burros trample vegetation and disturb the ground, particularly in areas surrounding sensitive springs and seeps, which creates conditions favored by invasive or non-native species such as cheatgrass or red brome, or noxious weeds such as Russian knapweed. These weedy species can out-compete native species, further reducing native 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. Wild horses were likely a significant component of disturbances noted at springs, because 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. Additional data are presented in appendix D 3.2. • Horses were observed at 42% of spring sites between 2010 and 2012. Animal trails were observed at 88% of springs and 27% of riparian sites; grazing was observed at 69% of springs and 55% of riparian sites; and trampling at 52% of springs and 18% of riparian sites. • 53% of springs and 18% of riparian sites inventoried have been adversely affected by herbivory based on responses to the management indicator question “Herbivory is not adversely affecting the site.” An example of adverse impacts listed in the field guide is: where “Native or nonnative ungulates have caused excessive removal of vegetation, abnormally low height (including hedging of shrubs) or cover of vegetation, or major changes in species composition.”

Table 3-5: Analysis and Evaluation of Monitoring Questions Related to Ecological Context (Cont.)

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 and climate models are available to generate findings specific to CA Species.

Table 3-5: Analysis and Evaluation of Monitoring Questions Related to Ecological Context (Cont.)

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? The 2010 IM Audit (METI, Inc. 2011) identified that Wildland Fire Management Plan direction for the SMNRA does not exist and should properly reflect the objectives, standards and guidelines in the General Management Plan, which provide for the use of wildland fire for resource benefit. the 2010 IM Audit (METI, Inc. 2011) also identified that 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 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. TNC's evaluation (Provencher, 2008) of historical vegetation conditions and departure of existing vegetation from this baseline provides the information needed to address this question, and concludes that there are significant departures from historical conditions affecting resiliency of these systems from disturbance events, possibly affecting CA Species and their habitats. The GMP identifies desired vegetation conditions by seral stage and land type association for the four management areas within the SMNRA. Desired conditions represented in the GMP were developed with limited information on historical vegetation conditions vs. existing vegetation cover. Information developed by the LANDFIRE program indicates a substantial departure from historical conditions in P-J and mixed-conifer types. LANDFIRE condition class determinations place much of this area in Condition Class 2 and 3 indicating a high likelihood that wildfires will adversely affect the function and condition of those lands should a fire event occur as a result of heavy fuel loading. The GMP recognizes the importance of natural disturbance events in helping restore disturbance processes and their function within these ecosystems. Projected climate change-related effects on low elevation communities such as those found in the Blackbrush and Creosote land type associations will increase the likelihood of wildfires that will promote type conversions in these systems. Similar effects will occur in the Alpine land type association as timing and forms of precipitation shift. The Intermountain Region is developing a common map of existing land cover types using FIA data and information from the SMNRA intensified FIA program. Once this new land cover type map is prepared, a crosswalk between the Forest Plan/GMP Cover Types, Land Type Association, and FIA/Group/Cover Types will need to be prepared. This will enable monitoring and project-planning efforts consistent between existing management direction, the new existing cover type map, and FIA cover types and data generated as part of the FIA program. • 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. • The new Regional cover type map will provide the basis for comparing existing land cover with historical cover type information developed by Provencher (2008) to determine departure from historical conditions and to assess potential effects resulting from climate change modeling assumptions. This information can then be used to address restoration of fire-dependent ecosystems within the SMNRA. • The effect of climate change on desired vegetation patterns and distribution among seral stages needs to be considered in establishing desired conditions. The ability to maintain late seral stages conditions as described in the GMP for Blackbrush and Creosote Land Type Associations at lower elevations will become increasing difficult as climate changes begin to shift. Similar changes may also affect the maintenance of late seral stages in Alpine land type associations.
Monitoring Question 23 - What are the effects of air quality on vegetation? A 2007 study (St. Clair et al. 2007) established a baseline for the use of lichen for an air quality biomonitoring program within the SMNRA. A review of air quality research in Southern Nevada is underway being conducted by the USGS. FIA will collect information on ozone damage to lichens that can provide data on air quality effects to vegetation. • Insufficient data are available to generate findings.

Ecosystems of the SMNRA are affected by a number of drivers, including climate, fire, insect and disease, and invasive or introduced species. Understanding of how these factors have and are affecting the SMNRA can now be evaluated using the data collected by the SMNRA I&M program and linkages to broader datasets.

Once the Intermountain Region's new land cover map is available, an evaluation of the departure of existing vegetation composition from historical conditions described by LANDFIRE or Provencher (2008) can be conducted. Comparisons can now be made of both current and historical information to areas outside the SMNRA using FIA datasets. This improved understanding of the SMNRA's "ecological context" can be used to evaluate a variety of disturbance and climate change scenarios on population dynamics of CA Species that can inform future management decisions.

Regardless of information being gathered through this and other inventory and monitoring programs, in the near term the adverse effects of wild horses/burros and unmanaged recreation will continue to be the greatest sources of ecological stress. The rate of climate change and its effects on ecosystems within the SMNRA will become more pervasive, however, management attention to wild horse and recreation management will have the greatest benefit to CA Species and their habitats.

b. Species Conservation

As outlined in the CA (USDA Forest Service 2011a, p. 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 the best available science and current data for supporting species conservation management decisions. 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 (USDA Forest Service 2008b) recommended development of a Species Reference Database or repository 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. Based on consultation with SMNRA leadership, the Species Reference Database was developed in the spring of 2008 using the Region 4 Planning, Appeals, and Litigation System (PALS) as a framework. Initial entries into PALS database were made using a literature search conducted by the RMRS. Ongoing work by RMRS and SMNRA staff during 2011–2012 has located a number of reports and documents not previously included in the Species Reference Database. The published literature for the CA Species dated 2009–2012 has also been added to the Species Reference Database. The underlying database structure and content will be updated and delivered to the SMNRA in mid-summer 2013 as part of concluding the I&M Program.

The information within the Species Reference Database was used to develop a synthesis document, the **species fact sheet**, for each CA species included in appendix B. Appendix B is designed as a stand-alone document that may be published as an online RMRS General Technical Report. Species fact sheets summarize the best available science for each species and provide a concise overview of the biology, distribution and status of each CA species. Maps of potential habitat maps derived from this information and models of habitat characteristics are also included within the fact sheets. These habitat maps will need to be updated as new information becomes available. An establishment and maintenance record is included as part of the species fact sheet to document updates and rationale for determining species status.

Natural Resource Information System – Survey areas and occurrence data

The Forest Service maintains the Natural Resource Information System as an application within 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. Generation of data summaries, analyses, reports, and map products are supported through the NRM-NRIS Output tools: Enterprise Data Warehouse (EDW), Geospatial Interface (GI), and I-Web User Views. The EDW provides read-only, historical, and aggregated data using design that provides snapshots of the transactional (editable) data repository. Benefits of the EDW 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 EDW through various database connection methods including standard ArcMap, the GI, and, in the future, web services.

As noted above, occurrence and survey area data have 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 datasets for each species. The compilation and standardization of all available location data in NRM-NRIS is ongoing. Once this process is complete, potential habitat models can be constructed for all of the CA Species using known location data and site characteristics of those locations.

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

Systematic distribution surveys have not been conducted for CA Species. The lack of distribution information is the most significant knowledge gap in the dataset used to inform direct management decisions. 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.

Past and On-Going Long-term Monitoring Studies

Past monitoring studies of species listed in the Conservation Agreement of 1998 were initiated in the late 1990s and early 2000s. The monitoring program included rough angelica, egg milkvetch, alpine plant community, Spring Mountain's acastus checkerspot, Morands checkerspot, and Palmer's chipmunk (see section 2.d and table 2-4). The stated objective of these monitoring efforts was to track long-term population trends. The monitoring design for studies conducted in the late 1990s and early 2000s was based on the biological "hotspot" approach. With this approach, an area with a concentration of rare species is selected, monitored, and the "hotspot" data are considered representative of species populations outside of the hotspot. These data are used to determine the status and trends of the entire population of each species being monitored.

The hotspot model and subsequent monitoring designs using this approach have limitations that make it inappropriate for use in addressing the objective of tracking long-term population trends within the SMNRA. First, distribution of the species and population size within the SMNRA is not determined with this method (Ferrier 2002). Distribution and population size are the key variables needed to determine rarity and status and trend. Second, the hotspot approach is ineffective in dealing with ecological processes such as climate change and large-scale disturbance such as fire (Marcot and Flather 2007). Third, and probably most important, hotspot data has little statistical power when used to predict population trends outside the hotspot (Lindenmayer and Likens 2010).

The SMNRA long-term studies of the vegetation communities and plant species used very similar designs. The criteria used for selection of macroplot locations was "...Population which we felt was representative of the occurrence in 1995" (Nachlinger and Combs 1996a). The methods selection of *Angelica*, for example, states "...we will be able to make statistical inferences solely within the boundaries

of each macroplot, but we feel that the selected placements of the macroplot will allow sound management decisions to be made for Angelica as it occurs in the larger area..." (emphasis added). The first clause of the statement is accurate but the second (underlined) clause is not a supportable statement (Lindenmayer and Likens 2010). Data can be used to track the populations within the hotspot as long as the conclusions were not used to discuss trends outside of the hotspot. The monitoring program design did not provide guidance and detailed standard operating procedures. As a result a series of data quality problems have developed through time: loss of coordinates of some macroplots, trampling damage due to repeat sampling, and a change in statistical methods. Successful long-term monitoring requires precision to repeat the sampling procedures precisely year-after-year as a foundation for evaluating monitoring results and comparing data over time.

Species Status

Agency policy and criteria for the classification of species as threatened, endangered, candidate, or sensitive are well documented in Forest Service directives (FSM Chapter 2670 and FSM1920/FSH 1909.12) and are the primary source used for classification determinations for species that fall within the scope of the CA for the SMNRA (see section 4b-1).

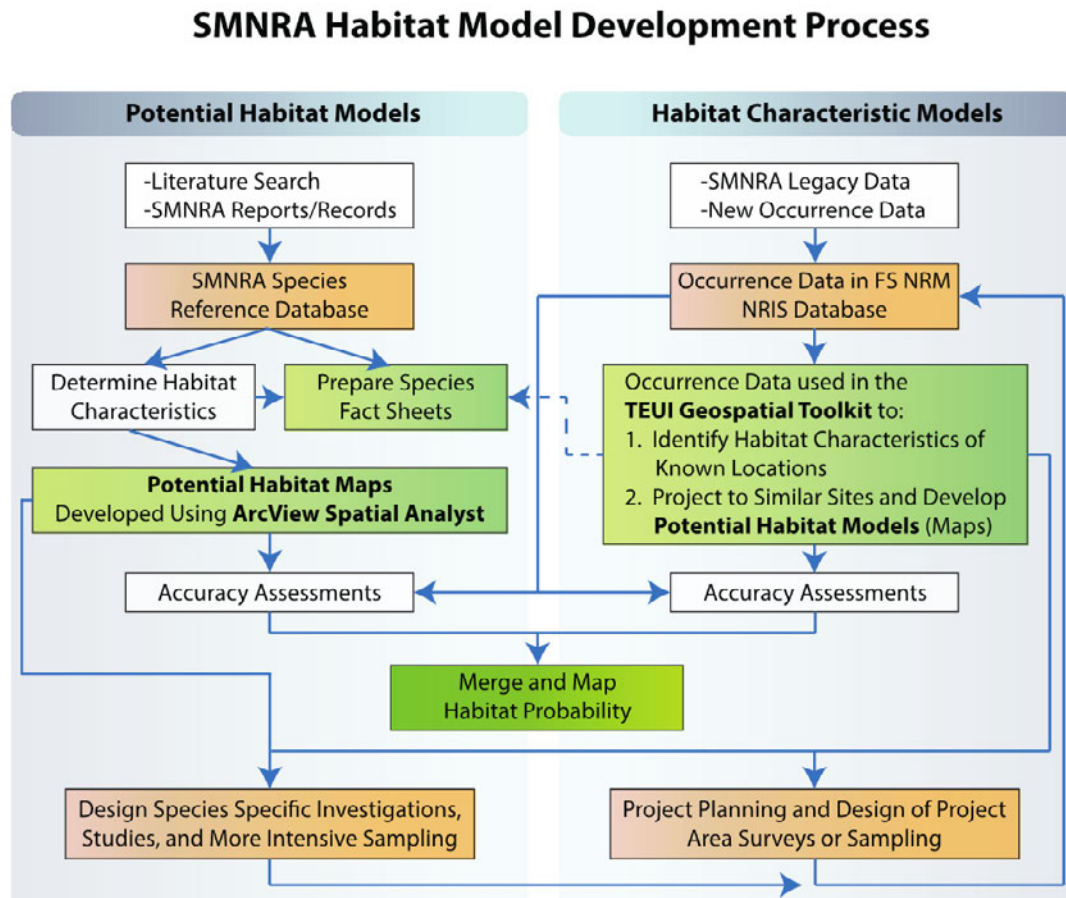
Species fact sheets for selected CA species are presented in appendix B and represent the best available science for each species. As information on species status is developed and compiled in appendix B, all species can be evaluated against the agency classification criteria and a determination of the species' status can be documented. As new information is accumulated, the status of a species can be updated using best available information and science.

The NatureServe fact sheets for CA Species do not, in most cases, contain all available information, and have not been updated for over 10 years. Species status fact sheets being developed as part of this effort will be provided to NatureServe and the Nevada Heritage Program. If there is a discrepancy between the status determination documented in the species status sheet report and the NatureServe status, a request to update the species status will be forwarded to Nevada Heritage Program/NatureServe by SMNRA staff. This information will also be entered into the NRM-NRIS TES Database application.

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. Figure 3-2 illustrates the relationships of these modeling processes, the data and information used to develop the models, and their potential application.

Figure 3-2. SMNRA Habitat Model Development Process



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 that 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 all CA Species, except springsnails and other species dependent at habitats located at springs.

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 data collected by the intensified FIA program, project and species specific surveys, and springs inventory program, the accuracy of these 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 geographic information system (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 are collected, the accuracy of the characteristic habitat map improves. The intensified FIA program will produce the first systematic inventory of the entire SMNRA and will provide information occurrence data that will significantly enhance the ability to identify habitat characteristics. Habitat characteristic models will be developed once data accuracy issues regarding species occurrence locations are resolved within NRM-NRIS. This work will not be completed as part of the I&M program. Potential Habitat models and species fact sheets for tier 1 butterflies (appendix B) were based upon literature reviews, known habitat characteristics, and incorporated information collected during the ongoing UNLV butterfly autecology study.

If and when species occurrence data accuracy issues within NRM-NRIS are resolved and habitat characteristic modeling using the TEUI Geospatial Tool Kit or similar analytical tools are complete, species status determinations can be reviewed with this improved understanding of how individual species relate to habitats found within the SMNRA.

Monitoring Focus – How well distributed and robust is the population of individual species?
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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 address the above management question. The sum of this information dictates, when compared against the criteria, the status of the CA Species (see criteria above). The status (T&E, candidate or sensitive) provides the direction for any future monitoring, studies or surveys that are needed for continued adaptive management of CA species. The FIA data provides a statistically sound and robust dataset, which will be used to track ecosystem changes and ecotone shifts that may affect CA species.

TES and candidate species are the first priority for species-specific studies. Sensitive species with significant knowledge gaps would be the next priority for individual species studies. This is particularly true if there is so little known about the species that there may not be confidence in the validity of its conservation status (for example, the Charleston ant or other little-known species).

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 conservation status priority than a species with a restricted distribution, low population numbers and a homogeneous gene pool. Species listed for genetic analysis in table 2-3 have been reevaluated in light of recent literature reviews. There is not sufficient background information in the various genetic databases to permit cost effective analysis of most CA plant species. The genetic analysis of Palmer's chipmunk is complete, and the analysis for butterflies and springsnails is ongoing (see section 2.c). Significant work remains to document the distribution and robustness of most CA species using genetic analysis and habitat characteristic modeling using occurrence data.

Monitoring Question Analysis and Evaluation

Table 3-6 presents the analysis of existing data and data collected during 2010–2012 for those monitoring questions related to species conservation (see table 3-1). The order of presentation corresponds to the priorities for monitoring questions established by in the SMNRA I&M Strategy (USDA Forest Service 2008b) (see appendix A).

Table 3-6: 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 (METI, Inc. 2011) 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, if warranted, provide a basis for remedial treatment design.
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 are available 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 are available 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 (METI, Inc. 2011) 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 are available to generate findings.

Table 3-6: Analysis and Evaluation of Monitoring Questions Related to Species Conservation (Cont.)

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?

Potential habitats for CA Species were mapped using information in the Species Reference Database and are displayed in appendix B.

- Intersecting potential habitat maps with recreation use areas and their footprints from the Landscape Analysis (ENTRIX, Inc. 2008) or from the NRM-Infra database can be used to address this issue at an NRA-wide scale.
- Individual project proposals can also be evaluated using these habitat models to identify potential concerns, design or mitigation needs, and site-specific survey requirements.
- The 2012 IM Audit (METI, Inc. 2012b) observed that surveys were conducted as part of project planning. Facilities are designed to avoid known populations and potential habitats

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?

Potential habitats for CA Species were mapped using information in the Species Reference Database and are displayed in appendix B.

- Intersecting potential habitat maps with areas where redistribution of recreation use is anticipated can be used to address this issue at an NRA-wide scale.
- Areas providing potential habitat for multiple species can be identified using the habitat models to identify areas where redistribution of use is not advisable.
- Individual project proposals can also be evaluated using these habitat models to identify potential concerns, design or mitigation needs, and site-specific survey requirements.

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. Information relative to both aspects of this monitoring question has been developed as part of the Fire Surrogate Studies supported by the Joint Fire Sciences Program. Studies specific to the Humboldt-Toiyabe National Forest are being conducted and results published by Rocky Mountain Research Station scientists located at the Reno Laboratory.

Table 3-6: Analysis and Evaluation of Monitoring Questions Related to Species Conservation (Cont.)

Monitoring Question 1 - What are the effects and impacts of dispersed recreation uses, including OHVs to CA Species and their habitats? The focus of the 2011 IM Audit (METI, Inc. 2012a) only addressed the component of this monitoring question associated with the management of motorized use, specifically off-highway vehicle (OHV) use. The Motorized Trail Designation Project (2004) and Motorized Vehicle Use Map (USDA Forest Service 2009) established the framework for managing motorized recreation use within the SMNRA. These decisions reflect the standards and guidelines established in the Forest Plan/GMP, however the IM Audit identified several areas where the implementation of these decisions have (1) not been fully implemented as designed, (2) not been maintained, or (3) program emphasis is not assuring compliance with established restrictions. The SMNRA has initiated the “Illegal Motorized Routes Restoration Project.” In 2012 over 94 miles of illegal routes were recorded on the SMNRA. In addition the SMNRA is hiring additional Forest Protection Officers and recreation technicians through the end of Calendar Year 2014 to patrol the backcountry areas. Key factors in managing motorized recreation use include: • <u>Understanding the Distribution and Ecological Significance of CA Species Habitats</u> – Information on CA Species habitats and their distribution are important factors in managing recreation use. This information needs to be considered in conjunction with the timing associated with key life history events. Information being developed as part of the I&M Strategy (USDA Forest Service 2008b) will address these needs by providing current life history information and potential habitat models. • <u>Visitor Education, Information and Signing</u> – Establishing and maintaining visitor information for motorized recreation is a difficult task requiring constant attention. The IM Audit (METI, Inc. 2012a) identified the following programmatic recommendations listed in section 3 of the IM Audit Report to address concerns identified. ○ Revision of the MVU Map ○ Wilderness Portal Management and Signing ○ Travel Management Signing ○ Partnerships and Visitor Education • <u>Route Closure and Restoration Practices</u> – As described in section 3 of the IM Audit Report, the SMNRA has an excellent starting point for developing and refining practices used for restoring and rehabilitating user-created routes and closed roads based on the work done at Mountain Springs. • <u>Monitoring and Enforcement</u> – Programmatic recommendations are listed in section 3 of the IM Audit Report regarding developing a cooperative law enforcement program associated with the motorized recreation management decisions reflected on the MVU Map. • Wilderness motorized trespass is a significant issue that must be addressed in the SMNRA law enforcement program. Statutory violations associated with this use warrant more attention than the regulatory violations associated with the MVU Map. Focusing on this problem can serve as a foundation for a comprehensive motorized recreation enforcement program.
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? Potential habitats for CA Species were mapped using information in the Species Reference Database and are displayed in appendix B. Modeling of potential habitats will be improved once soil type issues between the Nye and Clark County soil surveys are resolved and species occurrence location data in NRM-NRIS are validated and made available for analysis. Recreation reconstruction projects and recreation management in concentrated use areas were examined during the 2012 IM Audit (METI, Inc. 2012b). • Intersecting potential habitat maps with existing recreation sites and areas of concentrated use footprints can be used to identify and determine the nature of use conflicts and set the stage for evaluating the effectiveness of management efforts and potential mitigation measures. • The 2012 IM Audit (METI, Inc. 2012b) observed weed prevention and control measures in all project planning documents and appropriate clauses in all contracts.

Table 3-6: Analysis and Evaluation of Monitoring Questions Related to Species Conservation (Cont.)

Monitoring Question 24 - Where are opportunities for restoration and/or creation of habitat for CA Species located? A “Springs Restoration Framework” that can be applied forestwide is being developed to identify and prioritize springs for restoration activities. The Humboldt-Toiyabe National Forest springs restoration framework will provide guidance on how to evaluate data from springs inventories to assess their condition and their ecological significance. The framework will include guidance for the prioritization of spring restoration needs and the application of the management response frameworks identified in the 2011 IM Audit (METI, Inc. 2012a) (see appendix E). Restoration opportunities for other CA Species will require assessment of baseline data and current habitat conditions. In most cases, the preponderance of late seral stages in many cover types limits available habitats of many species reliant on early seral stages.
Monitoring Question 28 - What is the average number of downed woody logs per acre? A number of Forest Plan and GMP standards are related to retention down logs to provide cover and habitat for small mammals, amphibians, reptiles, and invertebrates. Forestwide Fish and Wildlife Standard 14 <i>“Retain an average of three down logs per acre as wildlife habitat. Minimum down log size will be 15 inches in diameter at the large end and at least 15 feet in length.”</i> applies to forested lands within the SMNRA. Other standards within the GMP (0.37, 0.91, and 0.38) focus on lands being managed for late seral stages within the Mixed Conifer and Pinyon/Juniper Land Type Associations or areas within fuel breaks or other treatment areas. As described in appendix C, GMP standards 0.37, 0.91, and 0.38 apply to specific treatment areas or developed recreation sites cannot be addressed with the FIA dataset. These standards can only be assessed as part of project-specific monitoring. Appendix C-2.3 displays information for the SMNRA from the 2010-2011 data panels for down woody material by cover type. • The number of down woody logs is not measured directly during the FIA inventory, however measurements are taken to estimate the volume of “coarse woody debris” are taken. Logs greater than 5 inches in diameter are measured and data compiled for 15 inches and larger diameters. In comparing the volume of “standing dead trees” per acre and their volumes with the volume/acre of coarse woody debris, an estimate of the number of logs greater than 15 inches in diameter can be derived. It is not possible to estimate the length of these logs using the FIA dataset. Using this approach the following estimates can be made: ○ All Forested Lands – Standing dead volume per acre is 94.1 cubic feet per acre with 3.1 standing dead trees per acre. This is a ratio of 1 standing dead tree per 30.4 cubic feet per acre of volume. Coarse woody debris associated with these sites includes 175.6 cubic feet per acre. Applying the same ratio of dead trees over 15 inches in diameter to volume, an estimated 5-6 logs per acre over 15 inches occurs within forested lands in the SMNRA, which exceeds Forest Plan Fish and Wildlife Standard 14 A further breakdown of these estimates by cover type or Land Type Association can also be derived. ○ Mixed Conifer Cover Type/Land Type Association – Standing dead volume per acre is 286.6 cubic feet with 6.3 standing dead trees per acre. This is a ratio of 1 standing dead tree per 45.5 cubic feet of volume. Coarse woody debris associated with these sites includes 787.7 cubic feet per acre. Applying the same ratio of dead trees over 15 inches in diameter to volume, an estimated 17 logs per acre over 15 inches occurs within all areas classified as the Mixed Conifer cover type. ○ Pinyon/Juniper Cover Type/Land Type Association – Standing dead volume per acre is 60.3 with 2.2 standing dead trees per acre. This is a ratio of 1 standing dead tree per 27.4 cubic feet of volume. Coarse woody debris associated with these sites includes 26.6 cubic feet per acre. Applying the same ratio of dead trees over 15 inches in diameter to volume, less than 1 log over 15 inches per acre occurs within all areas classified as the Pinyon/Juniper cover type. The potential to achieve Forest Plan Fish and Wildlife Standard 14 is limited because only 20 live trees per acre are larger than 15 inches with an average of 2.2 standing dead trees per acre. • This monitoring question should be revised to reflect the requirements of Forest Plan Fish and Wildlife Standard 14 (see appendices A-2 and C). GMP standards 0.37, 0.38 and 0.91 pertain to specific sites or project areas and should be monitored in conjunction with project-specific monitoring.

Table 3-6: Analysis and Evaluation of Monitoring Questions Related to Species Conservation (Cont.)

Monitoring Question 26 - How many snags per acre are present in mixed conifer, riparian areas, and in P-J?
This Forest Plan monitoring requirement does not apply to NFS lands within the SMNRA because they have been “reserved for timber” production by Congress and are not considered “available productive (capable) Forest land” (GMP, p. 1 and appendix C). GMP. Appendix C-2.1 displays information for the SMNRA from the 2010- 2012 data panels related to the number of snags by cover type. Appendix D-3.2 contains information from the springs inventory program. • FIA data analysis of snags is presented in appendix C. table 2. There are 16.26 snags per acre of mixed conifer and 21.76 snags per acre in the pinion/juniper forest type. • Only 19% of spring sites had live trees (greater than 5 cm in diameter) within the site, and each of those sites had just 1 to 11 individual trees. The tree species that were most abundant in terms of cover were white fir (<i>Abies concolor</i>) with 5.2% cover, Rocky Mountain juniper (<i>Juniperus scopulorum</i>) with 4.3% cover, ponderosa pine (<i>Pinus ponderosa</i>) with 2.4% cover, quaking aspen (<i>Populus tremuloides</i>) with 1.5% cover, and Gambel oak (<i>Quercus gambelii</i>) with 1.2% cover. • Standing dead trees were counted in 2011 (not 2010) and only two of those 28 sites (7%) had standing dead trees, and only one standing dead tree at each site.
Monitoring Question 27 - What percentage of mixed conifer is old growth habitat?
This Forest Plan monitoring requirement does not apply to NFS lands within the SMNRA because they have been “reserved for timber production” by Congress and are not considered “available productive (capable) Forest land” (GMP, p. 1 and appendix C). A crosswalk that allows comparison Forest Plan/GMP land type associations with the FIA Group/Cover type is presented in appendix C. On the Humbolt-Toiyabe NF, 150 or older is used as the definition of old growth stands. Appendix C-2.2 displays information for the SMNRA from the 2010-2011, and 2012 data panels. • 67% of SMNRA the Mixed Conifer Land Type Association meets the definition of old growth.
Monitoring Question 18 - What are the direct and cumulative effects of woodcutting and gathering on CA Species and their habitats?
Prohibitions and restrictions regarding woodcutting and gathering have been implemented as result of concerns regarding the effects of these activities on habitat for Palmer’s chipmunk site disturbance and potential for erosion and disturbance of CA species habitats. • Law enforcement records should provide an indicator of the effectiveness of the prohibitions and restrictions within the SMNRA. Specific monitoring related to this question should not be implemented unless law enforcement records indicate a need and only after additional law enforcement and public education measures are implemented.

The I&M program has produced a better understanding of CA species distributions and life histories. The perpetual issue facing parties to the CA has been the collection and organization of the best available science information for use in informing management decisions regarding species conservation. Some of these issues have been partially addressed but much work remains to be done including:

1. Developing and implementing a plan for maintaining and updating of the species reference database.
2. Integrating all occurrence data in the Forest Service’s Natural Resource Manager with the location data found in the database. This data provides the best picture of species distribution.
3. Integrating the merged location dataset into the habitat characteristic model to produce the species distribution map. The map can be updated and improved as more locations are documented.
4. Providing current information and maps and data to the Nevada Heritage/Nature Serve databases to support status reviews for each species. The updated status allows for improved science based on adaptive management.

Access to and maintenance of these datasets and tools will provide for effective and efficient conservation of the biological diversity of the Spring Mountains.

c. Management Interactions

In addition to external factors, management interactions directly and indirectly affect the ecological context of CA Species and their habitats. In those cases where CA Species habitat is of limited extent, the cumulative effects of management activities and 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 there is too much time elapsing 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 U.S. Geological Survey (USGS), the SMNRA instituted a monitoring study (Ostoja et al. 2010) 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 is no funding available 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, 2011, and 2012 addressed both focus areas associated with management interactions (METI, Inc. 2011 and 2012a,b).

Activities and projects audited were identified based on priorities identified in the I&M Strategy (USDA Forest Service 2008b). 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 the 2010 IM Audit (METI, Inc. 2011). The management of OHV and recreation use near springs and riparian areas and spring/riparian protection measures were selected as

priorities for the 2011 IM Audit (METI, Inc. 2012a). Construction and reconstruction of recreation areas, both developed and dispersed were selected as priorities for the 2012 IM Audit (METI, Inc. 2012b).

Monitoring Question Analysis and Evaluation

Table 3-7 presents the analysis of existing data and data collected during 2010–2012 for those monitoring questions related to management interactions with CA species and their habitats (see table 3-1). The order of presentation corresponds to the priorities for monitoring questions established by in the SMNRA I&M Strategy (USDA Forest Service 2008b) (see appendix A).

Table 3-7: 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 (METI, Inc. 2011) 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 limbs created 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 3-7: 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 (METI, Inc. 2011) 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 (Resource Concepts Inc. 2005) and the recently completed <i>Spring Mountains Multi-Jurisdictional 10-Year Hazardous Fuel and Fire Prevention Strategy</i> (USDA Forest Service, 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 the 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 to provide protection of values at risk are needed based upon the recently completed Interagency 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 (METI, Inc. 2011) 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 Incident Management Teams (IMTs) 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 constructed fire line 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 fire line were constructed on the east-side and top of the fire.

Table 3-7: Analysis and Evaluation of Monitoring Questions Related to Management Interactions (Cont.)

Monitoring Question 8 - How effective are efforts to reduce recreation effects to riparian and spring areas?
The 2011 IM audit (METI, Inc. 2012a) evaluated the effectiveness of efforts to reduce recreation effects to riparian and spring areas by examining the desired conditions and standards in the Forest Plan and SMNRA General Management Plan, the SMNRA Conservation Agreement/Multi-Species Habitat Conservation Monitoring Plan, and the SMNRA Landscape Analysis (ENTRIX, Inc. 2008)/I&M Strategy (USDA Forest Service 2008b) as well as environmental analysis and decision documents specific to each of the sites visited. All five sites visited during the 2011 IM Audit (METI, Inc. 2012a) provided information regarding efforts to reduce recreation effects to springs and riparian areas and their effectiveness. Willow Creek and Cold Creek illustrate sites with moderate to high use; both sites are easily accessible and are part of a larger use complex. West Mud Springs and Carpenter Canyon have limited accessibility via low standard roads where use is generally confined to a narrow corridor. Mountain Springs illustrates the management challenges associated with a combination of springs/riparian protection and motorized access to Wilderness adjacent to the roadway. The 2012 IM Audit (METI, Inc. 2012b) evaluated the effectiveness of efforts to reduce recreation effects to riparian areas by examining the watershed restoration efforts in Lee Meadows. Effects were partly due to runoff from a state highway, but also from recreationists crossing the drainage ditch. Kyle Canyon Campground was in the process of reconstruction for many reasons; a decision was made to change the facility to a picnic area in response to a change in National policy. At least some of the need for reconstruction included effects to the riparian area in which the site is located. Key components of effective recreation management practices include: • <u>Visitor Education, Information and Signing</u> – Establishing and maintaining visitor signing and information are difficult tasks requiring constant attention. The 2011 IM Audit (METI, Inc. 2012a) identified concerns associated with recreation management, particularly with design image, travel management signing, use of the standard sign plan, partnerships and visitor education, and interpretive signing. • <u>Physical Barriers and Trail Management</u> – The use of physical barriers to control access to and delimit use areas is an effective management practice. Coupled with route restoration practices used at Mountain Springs, practices employed at Cold Creek, Carpenter Canyon, and Willow Creek, the SMNRA has an excellent starting point for developing and refining practices used for managing use at springs/riparian areas and for restoring and rehabilitating user-created routes and closed roads. Lee Meadows restoration efforts included the placement of bridges to cross the drainage ditch, reducing or eliminating the effects of recreationists crossing through the ditch. • <u>Monitoring and Maintenance</u> – Similarly, the agreement between the SMNRA and Great Basin Institute provides a solid foundation for a monitoring and maintenance program for these areas.
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 (METI, Inc. 2011) 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 future IM Audits if suppression and restoration activities occur in the interim. The Forest Service recently completed an Environmental Impact Statement and issued a Record of Decision regarding the aerial application of fire retardant. The EIS/ROD and guidelines for aerial application of fire retardant are available at: http://www.fs.fed.us/fire/retardant/index.html • 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.

Table 3-7: Analysis and Evaluation of Monitoring Questions Related to Management Interactions (Cont.)

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? The focus of the 2011 IM Audit (METI, Inc. 2012a) addressed only the component of this monitoring question associated with the management of motorized use, specifically off-highway vehicle use. The Motorized Trail Designation Project (2004) and Motorized Vehicle Use Map (2009) established the framework for managing motorized recreation use within the SMNRA. These decisions reflect the standards and guidelines established in the Forest Plan/GMP, however the IM Audit has identified several areas where the implementation of these decisions have (1) not been fully implemented as designed, (2) not been maintained, or (3) program emphasis is not assuring compliance with established restrictions. The SMNRA has initiated the “Illegal Motorized Routes Restoration Project.” In 2012 over 94 miles of illegal routes were recorded on the SMNRA. In addition the SMNRA is hiring additional Forest Protection Officers and recreation technicians through the end of Calendar Year 2014 to patrol the backcountry areas. Key components of effective recreation management practices include: • <u>Understanding the Distribution and Ecological Significance of CA Species Habitats</u> – Information on CA Species habitat and distribution are important factors in managing recreation use. This information needs to be considered in conjunction with the timing associated with key life history events. Information developed as part of implementing the I&M Strategy is addressing these needs by providing current life history information and developing potential habitat models. • <u>Visitor Education, Information and Signing</u> – Establishing and maintaining visitor information for motorized recreation is a difficult task requiring constant attention. The 2011 IM Audit (METI, Inc. 2012a) identified programmatic recommendations for revision of the MVU Map, Wilderness Portal management and signing, travel management signing, and partnerships and visitor education to address concerns identified. • <u>Route Closure and Restoration Practices</u> – The SMNRA has an excellent starting point for developing and refining practices used for restoring and rehabilitating user-created routes and closed roads based on the work done at Mountain Springs. • <u>Monitoring and Enforcement</u> – The IM Audit report recommends development of a cooperative law enforcement program associated with the motorized recreation management decisions reflected on the MVU Map. • Wilderness motorized trespass is a significant issue that must be addressed in the SMNRA law enforcement program. Statutory violations associated with this use warrant more attention than the regulatory violations associated with the MVU Map. Focusing on this problem can serve as a foundation for a comprehensive motorized recreation enforcement program.
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 are available to generate findings.

Table 3-7: Analysis and Evaluation of Monitoring Questions Related to Management Interactions (Cont.)

Monitoring Question 51 - How effective is riparian fencing in protecting springs and riparian areas? What thresholds warrant this level of mitigation?
The 2011 IM Audit (METI, Inc. 2012a) investigated this question. The West Mud Springs enclosure and the Willow Creek enclosure fences illustrate differences in disturbance pressure, fence design and effectiveness of maintenance and monitoring. The Mountain Springs site illustrates a different situation – with no wild horse/burro use and low presence of elk. Factors affecting fencing design choices and effectiveness include: • <u>Ecological significance/CA Species habitat</u> – A primary difference among these sites is their ecological significance and presences of CA Species habitat. Willow Spring has historically been considered the most ecologically significant site within the SMNRA, providing habitat for a variety of <i>Pyrgulopsis turbatrix</i> springsnails. West Mud Springs and springs near Mountain Springs have a lower ecological significance warranting less investment in protection of those sites. • <u>Use by wild horses/burros, elk, and recreation livestock</u> – Both Willow Spring and the West Mud Springs are used by wild horses/burros, recreation livestock, and elk. Willow Spring/Creek appears to have higher levels of use, which are likely a function of the volume of flow from the spring and presence of a perennial stream. Mountain Springs has little to no wild horse/burro use and elk have only recently started to inhabit this area. • <u>Recreation use and access</u> – The Willow Creek site is accessed by a main road and numerous roads around the perimeter and as a result reduce material transportation and maintenance costs. However, this accessibility also increases recreation use and the amount of damage from vehicles to the fence. Spring sites within the vicinity of Mountain Springs have received low to moderate use by recreationists, with most use effects associated with OHVs. West Mud Springs does not have road access completely to the spring; increasing both transportation and maintenance costs, but lowers recreation use. Exclosure design elements and their effectiveness are discussed below: • <u>Fence perimeters</u> – At West Mud Springs and Willow Creek, fencing does not coincide with the full extent of the wetland area, exposing portions of the sites to continued use and impacts from horses/burros and recreation use. • <u>Fence type and maintenance</u> – Two types of exclosure fences were observed and both illustrate certain advantages: ○ <u>Metal t-posts and barbed wire</u> are relatively low cost to install, but have high maintenance costs. Snow loading and pressure from horse and elk use reduce the serviceable life of these fences. Replacement cycles are approximately 10 years. Effectiveness of this design to exclude horse use is moderate to high. This design is not effective in prohibiting use by elk. This design is effective in reducing the effects of recreation use. ○ <u>Post and wire rope</u> fences have higher initial costs and lower overall maintenance costs. The exceptions are illustrated in locations like Willow Spring, where fence posts have been struck and broken by vehicles traveling along access roads. In absence of any damage from vehicles, the replacement cycles for these fences could approach 20-25 years. Sections of the fence were designed to facilitate access by elk. When properly maintained, this design is highly effective in excluding horse use. When fences are not maintained, previous restoration efforts can be affected when horses or burros access these sites, as in the case of the horse observed inside the Willow Spring enclosure during the 2011 IM Audit (METI, Inc. 2012a). Design features accommodate use by elk and therefore compromise the efficacy of spring protection, to the extent that elk are encouraged to enter the riparian area. This design is, however, highly effective in reducing the effects of recreation use. Other fence types being used include <u>metal post/rail</u> fences to manage recreation use at Cold Creek ponds and <u>wooden rail/post</u> fences. These fence types were not examined during the IM Audit. • <u>External water sources</u> – These were not provided at West Mud Springs, creating continued pressure for wild horses/burros and elk to try to access the site for water and to a lesser extent forage and thermal relief. At Willow Creek, the lower portions of the creek provide water sources for recreation livestock and wild horses/burros. Access within the enclosure is provided for elk. • <u>Management of recreation use</u> – This included the use of physical barriers (fencing, gates, and boulders) to control access points and routes. Willow Creek used a combination of all of these methods and interpretive signing. Sites at Mountain Springs employed a combination of boulders and route obliteration/restoration. Use at West Mud Springs is managed by re-routing trail use and the enclosure fence. • <u>Monitoring</u> – Monitoring practices used and partnerships with Great Basin Institute are highly effective and provide a sound basis for making adaptive management decisions. The use of photo monitoring and frequency of monitoring are working well.

Table 3-7: Analysis and Evaluation of Monitoring Questions Related to Management Interactions (Cont.)

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 either the riparian protocol or the GDE protocol used at the spring sites. Information from the riparian and springs inventories that can be used to get a sense for the amount of disturbances to stream channels and stream banks are presented in appendix D 3.2 and 3.3, and are briefly summarized below. • Animal Trails: 88% of spring sites and 27% of riparian sites. • Channel Erosion: 56% of spring sites and 45% of riparian sites. • Runout Channel Substantially Altered: 50% of spring sites and 45% of riparian sites. • Flow Regulation Adversely Affects Site: 38% of spring sites and 18% of riparian sites. • Herbivores Adversely Affects Site: 53% of spring sites and 18% of riparian sites. • Recreation Uses Adversely Affects Site: 30% of spring sites and 18% of riparian sites.
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 are available to generate findings.
Monitoring Question 56 - Are soil and water conservation practices being implemented and are they effective? The 2010 IM Audit (METI, Inc. 2011) 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 (METI, Inc. 2011) 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 2011 IM Audit (METI, Inc. 2012a) also evaluated management activities to protect springs and riparian areas. The Audit evaluated decision and implementation documents for five projects, including fencing to limit access by elk, wild horses/burros, and recreationists; trail management; road/trail closures; and the use of signing. The 2012 IM Audit (METI, Inc. 2012b) evaluated management activities to protect springs and riparian areas. The Audit evaluated decision and implementation documents for three projects, including restoration activities to riparian areas and design measures to manage continued runoff from roads and parking areas. • Design measures for streambank protection in the 2007 Fuel Treatment EA were well described and effective. • No soil erosion or sedimentation was observed during the 2010 IM Audit. • Concerns regarding the movement of burn piles plugging drainage structures during high runoff events were experienced in the Mountain Springs area, but these situations were corrected and were not observed during the field portion of the Audit. • Although the Cathedral wildland fire was outside of 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. • Fencing and boulder protection is effective in limiting most access to springs and riparian areas. Monitoring and maintenance will be necessary to ensure continued effectiveness. • Re-routing trails away from springs and providing off-site water for recreation stock is effective, and may also limit effects from elk and wild horses/burros. • Visitor education, information, and signing are difficult to maintain and require constant attention. • The restoration actions in Lee Meadows are effective in treating past soil erosion and sedimentation. • The Lee Meadows upstream runoff from the state highway and a ski area will continue to be challenges until they are resolved. Monitoring and maintenance will be necessary to ensure continued effectiveness.

Table 3-7: Analysis and Evaluation of Monitoring Questions Related to Management Interactions (Cont.)

Monitoring Question 57 - Are soil disturbing activities creating excessive sedimentation or soil loss?
The 2010 IM Audit (METI, Inc. 2011) 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 (METI, Inc. 2011) 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 2011 IM Audit (METI, Inc. 2012a) evaluated management activities to protect springs and riparian areas. The Audit evaluated decision and implementation documents for five projects, including fencing to limit access by elk, wild horses/burros, and recreationists; trail management; road/trail closures; and the use of signing. The 2012 IM Audit (METI, Inc. 2012b) evaluated management activities to protect springs and riparian areas. The Audit evaluated decision and implementation documents for three projects, including restoration activities to riparian areas and design measures to manage continued runoff from roads and parking areas. Data from the spring surveys were used to evaluate sedimentation and soil loss (see appendix D 4.2). • 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. • In the spring of 2010 burn piles in the Mountain Springs area were washed into and consequently plugged drainage structures (culverts) but the location of burn piles in future treatments were planned to avoid these kinds of problems. This adjustment was observed during the field portion of the 2010 IM Audit. • The 2010 IM Audit noted that although the Cathedral 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. • The 2011 IM Audit noted that fencing and boulder protection are effective in limiting most access to springs and riparian areas and reducing soil erosion and sedimentation. Monitoring and maintenance will be necessary to ensure continued effectiveness. • The 2011 IM Audit also observed that re-routing trails away from springs and providing off-site water for recreation stock is effective, and may also limit effects from elk and wild horses/burros and resulting soil erosion and sedimentation. • A number of "disturbances" related to soil alteration were noted at the spring and riparian sites, such as trampling, trails, excavation and other ground disturbance. Of the sites inventoried in 2010–2012 the following disturbances were noted as being present or absent, by percentage sites surveyed: ○ Trails & Tracks: 88% of spring sites and 27% of riparian sites. ○ Erosion: 45% of spring sites and 45% of riparian sites. ○ Soil Integrity Altered: 55% of spring sites and 18% of riparian sites. ○ Excavation or Other Ground Disturbance: 45% of spring sites and 27% of riparian sites. ○ Landform Stability Altered: 38% of spring sites and 18% of riparian sites. ○ Recreational Uses Adversely Affecting Site: 30% of spring sites and 18% of riparian sites. ○ Construction and Roads Adversely Affecting Site: 16% of spring sites and 27% of riparian sites. ○ Deposition: 12% of spring sites (0% at riparian sites). ○ Bare Ground: averaged 13% at spring sites and 5% at riparian sites. • The 2012 IM Audit noted that restoration actions in Lee Meadows, including riprap in channels, site grading, construction protection methods (particularly the chip mat), and revegetation efforts are effective in reducing soil erosion and sedimentation. Monitoring and maintenance will be necessary to ensure continued effectiveness. • The 2012 IM Audit also observed that upstream runoff from the state highway and a ski area will continue to be challenges until they are resolved. • The 2012 IM Audit demolition activities in Kyle Canyon and Cathedral Rock Picnic Areas had effective measures to prevent soil erosion and sedimentation. Kyle Canyon had some new protective measures in place (bouldering and riprap), but the projects are not far enough along in implementation for further analysis.

Table 3-7: 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?					
Data on water quality are presented in the table below and additional detail is presented in appendix D 3.2. With these data, only minimal conclusions can be made about the relationship between management actions and water quality conditions of springs. A more rigorous study design would be needed to develop more detailed conclusions.					
Attribute	Minimum	Median	Average	Maximum	Sites Measured
Temperature (centigrade)	3.0	11.3	12.0	19.5	n=65
pH	6.5	7.5	7.5	8.6	n=67
Specific Conductance (microsiemens/centimeter)	136.0	496.0	533.2	1011.3	n=64
Oxygen-reduction potential (mV)	-76.9	147.0	139.7	270.6	n=48
Dissolved oxygen (mg/L)	1.9	6.0	5.8	10.3	n=36
- Temperature of spring water is an indirect indicator of flow path conditions and recharge events. It is not known how management actions are affecting water temperature, but management actions probably have minimal affect on the temperature of groundwater. Although removal of vegetation (by horses, elk or OHV's) at the spring emergence zone could lead to higher water temperatures after the water emerges. - It is not known how management actions are affecting pH of spring waters. The moderate range of values (close to neutral pH of 7) likely support greater species richness. - Specific conductance values may be higher where grazing ungulates have added to the dissolved material. - It is not known how management actions are affecting oxygen-reduction potential (ORP) and dissolved oxygen (DO), but both attributes may be higher at springs where there is turbidity caused by ungulates or OHVs.					
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?					
There were no opportunities to audit treatments of invasive species. Insufficient data are available to generate findings.					

IM Audits conducted during 2010 – 2012 (METI, Inc. 2011, 2012a,b) helped determine whether design measures and mitigation practices are being implemented and to evaluate their effectiveness. The results of the IM Audits were used to develop a management response framework (see appendix E) that can be used in the design of future proposals.

Studies designed to assess pre- and post-treatment effects from hazardous fuel treatments were initiated in partnership with the USGS in 2007. However, data on post treatment conditions are not currently funded or scheduled for collection. Collection and evaluation of data within treatment areas and control areas will be important to the design and implementation of future fuel treatments.

As stated earlier, in the near term the management of the adverse effects of wild horses/burros and unmanaged recreation will continue to be the greatest sources of ecological stress on CA Species and their habitats within the SMNRA.

4. Recommendations and Need for Change

Long-term conservation of species and their habitats within the SMNRA requires an adaptive management approach based on a combination of quantitative data and qualitative inventory and monitoring information. Understanding that these ecosystems function with complex interactions occurring at different temporal and spatial scales is an important consideration in any management intervention. However, no amount of data and information can help managers accurately predict the interplay of all of these factors. Therefore, continual monitoring and adaptive feedback are needed to tailor management actions over time to achieve desired conservation goals and outcomes.

Management adaptations often require adjustments to management plans, programs and activities or various combinations of responses. Analysis and evaluation of the inventory and monitoring results described in the previous sections serve as the basis for identifying the need for potential changes. The following “needs for change” and recommendations to address these needs have been identified.

a) Need for Change in Forest Plan Direction

The following changes were identified as a result of implementing the SMNRA I&M Strategy (USDA Forest Service 2008b) and an evaluation of monitoring results, particularly those identified during Implementation and Monitoring Audits (see section 2.e).

1. Monitoring Program Update

The GMP and Forest Plan contain monitoring items for species conservation and other management objectives. When these requirements were identified and incorporated into the GMP and Forest Plan, the focus of species conservation was linked to the concept of “biodiversity hotspots.” This conceptual approach has major limitations. When the distribution of a species is unknown (a limitation for most SMNRA CA species), the design of the “biodiversity hotspot” model will not provide the data to fill this critical knowledge gap, and the data from hotspot sampling do not have the power to predict changes in the status of the species across the SMNRA. Preserving the genetic diversity of a species requires a larger area than is contained in most “hotspots” (Raphael and Molina 2007). In addition, some species included in the monitoring program no longer warrant monitoring based on their status as documented in the 5-year evaluation of the CA (U.S. Forest Service (USFS), Intermountain Region, 2003; see appendix A-1). Other species’ status has changed and the plan’s monitoring program has not been updated or amended to reflect status changes.

The revised planning regulations (36 CFR 219) include provisions that require the plan monitoring program to be in place within four years of the effective date for the new rule (April 2016).

(c) Timing and process for developing the plan monitoring program and broader-scale strategies. (1) The responsible official shall develop the plan monitoring program as part of the planning process for a new plan development or plan revision. Where a plan’s monitoring program has been developed under the provisions of a prior planning regulation and the unit has not initiated plan revision under this part, the responsible official shall modify the plan monitoring program within 4 years of the effective date of this part, or as soon as practicable, to meet the requirements of this section. [36 CFR 219.12]

Unlike the 1982 planning rule, the language in 36 CFR 219.12 does not require an amendment of the Forest Plan/GMP to implement these changes [see 36 CFR 219.12 (a)(2)]. The monitoring results from implementation of the SMNRA I&M program provides a basis for updating the monitoring program

under the requirements of the new planning rule.

Recommendation: Update the SMNRA monitoring plan pursuant to revised 36 CFR 219.12 to eliminate species-specific requirements and replace monitoring items with a combination of continued implementation of the comprehensive program described in the SMNRA I&M Strategy for Conserving Biological Diversity (USDA Forest Service 2008b) and the use of statistically valid species-specific survey and monitoring designs based on projected species ranges in the potential habitat or habitat characteristic models. Remove monitoring items that (1) repeat existing agency policy requirements, (2) are achieved by established agency reporting programs, and (3) are the responsibility of other agencies or entities.

2. Consolidated Forest Plan Direction

Direction and requirements established in the Toiyabe Forest Plan as amended by the General Management Plan (GMP) are not consistently understood or accurately interpreted by SMNRA and Forest Staff. Several NEPA documents reviewed during the IM Audits referenced direction in the GMP, but failed to incorporate or discuss direction in the Toiyabe Forest Plan applicable to the proposed action. In some instances, references were made to statements in programmatic agreements such as the Conservation Agreement or Landscape Analysis (ENTRIX, Inc. 2008) as constituting management direction or requirements. In summary, discussions with SMNRA and Forest staff during the IM Audits identified a number of different aspects regarding inconsistent interpretations that should be addressed:

- **The relationship of the amendment (GMP) to the Toiyabe Forest Plan** - The SMNRA General Management Plan (Amendment # 4) and the Toiyabe Forest Plan set the management direction for the SMNRA. The GMP cannot be used as a stand-alone document and does not change some objectives, standards and guidelines, and monitoring requirements established at the Forest level.
- **The relationship of the Forest Plan/GMP direction and programmatic agreements and assessments** - The SMNRA Landscape Analysis (ENTRIX, Inc. 2008) and the Conservation Agreement are intended to coordinate priorities across program areas to achieve species conservation goals. They are not management direction but program coordination documents and expressions of management intent. It appears that in developing these program assessments and agreements some direction from the Toiyabe Forest Plan is not referenced or was not considered. Therefore, the foundation of these agreements may not fully consider applicable Forest Plan direction and, if interpreted as “direction,” may diverge from the Forest Plan/GMP without an appropriate amendment or revision to the Forest Plan.

Recommendation: Develop a consolidated version of the Forest Plan direction that applies to the SMNRA that assembles the combined direction from the Toiyabe Forest Plan and the GMP. Once the consolidated direction has been assembled:

- a) Ensure all project proposals and NEPA documentation (including active projects) reference and implement applicable direction in both the Toiyabe Forest Plan and GMP.
- b) Review the SMNRA Landscape Analysis (ENTRIX, Inc. 2008) and evaluate consistency with the consolidated Forest Plan and GMP management direction. Update the desired outcomes and program objectives resulting from this assessment to guide development of project proposals and resource management programs.

3. Forest Plan/GMP Needs for Change Identified Based on Monitoring and Evaluation

The SMNRA General Management Plan (Amendment #4 of the Toiyabe Forest Plan) was approved in 1996. As described above, management direction applicable to the SMNRA “resides” in both the parent text in the Toiyabe Forest Plan and GMP. Since the GMP was approved, well-intentioned efforts to establish and focus efforts to conserve biological resources within the SMNRA have drifted outside the Forest Service policy framework for the conservation of Threatened, Endangered and Sensitive Species described in FSM Chapter 2670 – Threatened, Endangered and Sensitive Plants and Animals. These efforts have also failed to keep pace with changing Forest Service policy regarding land management planning (e.g., revision of the National Forest Management Act planning regulations at 36 CFR 219 and FSM Chapter 1920 – Land Management Planning).

The Toiyabe Forest Plan and GMP both contain species-specific direction subject to change as new information and science regarding these species improves. The GMP contains a standard (GMP, 0.27) to treat species listed in the Conservation Agreement as Sensitive Species. The Forest Plan/GMP identifies specific species of concern and prescribes standards and guidelines that are out of sync with current information and the Intermountain Region’s Sensitive Species List signifying a need to amend or revise the Forest Plan/GMP.

The relationship among the Intermountain Region’s Sensitive Species list, the species list identified in the 1998 Conservation Agreement, which was subsequently modified by SMNRA Landscape Analysis (ENTRIX, Inc. 2008), and the revised species list associated with the current effort to update the Conservation Agreement is also a concern. There is no record of criteria used and how they were applied in developing these species lists. More importantly, neither the procedures nor the criteria applied in the Landscape Analysis and in developing the Conservation Agreements can unilaterally add or remove species from the Intermountain Region’s Sensitive Species list since that authority resides with the Regional Forester.

The following is an illustration of the differences between different species lists and the resulting confusion over which species should be the focus of the SMNRA’s conservation efforts:

- Forest Plan/GMP species no longer meeting Regional Sensitive Species Criteria - Several species identified in the Forest Plan/GMP no longer meet the criteria for inclusion on the Intermountain Region’s Sensitive Species list based on new information regarding species status. As a result, scarce funding is being used to continue monitoring or project mitigation and monitoring may no longer be appropriate. Examples include: Palmer’s chipmunk. A review of information included in the Species Fact Sheets derived from the species reference database (see appendix B) suggests that this may be the case for other species as well.
- Sensitive Species not included in the Landscape Analysis or Conservation Agreements - Several species included on the Region’s Sensitive Species list are not included within the Conservation Agreement or the Landscape Analysis lists and other Sensitive Species are not included in the draft revision of the Conservation Agreement. There is often little, if any, documentation of the rationale for adding or removing species from different lists and there are Sensitive Species that are not on any of these lists. Specific examples include: *Ericameria compacta* and *Lesquerella hitchcockii* from the Sensitive Species list that were added to the Landscape Analysis list but dropped from the draft CA list.
- Differences between the draft Conservation Agreement and the Landscape Analysis - Six species from the Landscape Analysis are not included in the draft revision of the Conservation Agreement (two Sensitive Species) and seven species were added (including four Sensitive Species).

- Species that should be added to the Regional Sensitive Species List - A number of species that are the focus of the Conservation Agreement, identified in the Landscape Analysis or proposed for species-specific surveys in the Round 14 proposal appear to meet the criteria for inclusion on the Region's list. Specific examples include: two species of spring snails petitioned for listing under the ESA and the Charleston ant.
- Species that do not appear to meet Sensitive Species list criteria - Several species identified for inclusion in the draft Conservation Agreement or proposed for species-specific monitoring in the Round 14 proposal do not appear to meet the criteria established by the Regional Forester for inclusion in the Region's Sensitive Species list or no rationale for their inclusion are documented. Specific examples include: Rough angelica, Clokey's egg milkvetch and Allen's big-eared bat (Round 14 proposal) and two species of land snails (draft CA) list but rationale for these additions are not documented.

By focusing on the "biodiversity hotspot" conservation model used to establish GMP direction and to focus past and some ongoing inventory and monitoring efforts, the result is that the distribution and abundance of the majority of CA species across the SMNRA is unknown. An accurate assessment of the rarity and status and trend of each species requires long-term monitoring which statistically samples the target population. The target population is the pool of members of a species located within the SMNRA. Historical collection and observation records along with implementation of the SMNRA I&M program has begun to reveal the distribution of species' target populations. The "hotspots" framework excludes sampling of population units outside the hotspot and therefore the data produced is not appropriate for addressing the status of a species or tracking changes in target populations

Direction in the GMP direction does not address this change in understanding. As described below in section 4.a.4, climate change will affect species distribution over time making the reliance on this approach less relevant over time and fail to provide for the conservation of these species.

Recommendation: Ensure consistency with Forest Service policy and changes resulting from recent revisions of the land management planning regulations (36 CFR 219.9 and 219.12) regarding conservation of biological diversity. Specific actions include:

- a) Rely on agency policy and procedures for establishment and maintenance of the Sensitive Species list. Amend or revise the Forest Plan/GMP to formalize the link to the Intermountain Region Sensitive Species List rather than include direction on specific species in the Forest Plan/GMP and maintenance of multiple lists and procedures. This amendment also eliminates the need for establishing additional procedures proposed in the revision of the Conservation Agreement by relying on existing agency policy and procedures for species conservation and by directly addressing issues stemming from Forest Plan/GMP direction needing amendment or revision.
- b) Amend or revise the Forest Plan to eliminate standards and guidelines that are no longer applicable based on new information and changed conditions. Modify standards and guidelines associated with the "biodiversity hotspot" conservation strategy. Specific examples include:
 - GMP Standard 0.31 – establishes buffer zones for selected species habitat and "biodiversity hotspots"
 - GMP Standard 0.91 – establishes requirements for retention of woody material for Palmer's chipmunk
 - GMP Standard 11.68 – establishes requirements to reduce or avoid equestrian impacts to "biodiversity hotspots"

- GMP Guideline 0.29 – provides a direct reference to the species list included in the 1998 Conservation Agreement
 - GMP Guideline 0.59 – provides guidelines related to fuelwood gathering restrictions for Palmer’s chipmunk
 - GMP Guideline 11.68 – limits biking trail opportunities in/near “biodiversity hotspots”
- c) Until such time as the Forest Plan is amended or revised, use the Region’s Sensitive Species list and established maintenance procedures to support development of the revised Conservation Agreement.

4. Forest Plan Changes Stemming From Climate Change Considerations

Climate change impacts have been an issue Forest Service managers have dealt with since the establishment of the agency. Extended droughts and extended cool wet periods have affected vegetative communities and the resident fauna of the SMNRA. In the last few decades, additional stressors have impacted southern Nevada. Among them, increases in invasive species and the resultant change in fire cycles, increases in atmospheric carbon dioxide and other greenhouse gases have led to warmer temperatures, drought which is often linked to insect and disease outbreaks, and increased nitrogen deposition which alters nutrient cycles. All of these stressors affect local flora (Pendleton et al., in press).

There are many drivers of climate change and most drivers are not influenced by SMNRA management actions. For example, air quality and nitrogen deposition are regional problems outside of the control of the Forest Service. The Forest Service could influence local air quality through regulation of motorized vehicle use within the SMNRA, however these actions will have a local impact, but local improvements will be swamped by larger regional forces.

Climate models discussed in section 3.a are consistent in their conclusions. As opposed to the slower change recorded by studies looking at change in the last few hundred years (using a variety of techniques), new models project change at an extremely rapid rate in the next one hundred years. A few of the measurable climate driven changes documented in published reports within the last three decades include earlier flowering dates (phenology), earlier migration, earlier emergence by insects, timberlines moving upward in elevation, higher carbon dioxide levels, and warmer daytime, nighttime, and average temperatures. Projected rates of these changes vary and decoupling of resource availability from the time when the resource is required has occurred. In short, rapid climate change has already begun. Faced with rapid change, adaptive management is required since managing for the status quo has a limited chance of long-term success (Chambers et al., in press).

Scientifically rigorous baseline data are necessary to allow tracking climate driven changes in the flora and fauna through the coming decades, while providing management the data needed for a sound adaptive management program. The datasets discussed in section 3 include the following:

- 1) Provencher’s dataset (2008) provides a historical perspective of vegetation patterns and that is also represented in the LANDFIRE database and as fire regime and condition class.
- 2) FIA data collected during this project provides a comprehensive look at current vegetation, ecosystem patterns and plant community composition,
- 3) Springs and riparian surveys conducted over the last three years document conditions at these important sites and associated riparian areas,

- 4) A new regionally consistent land cover/existing vegetation map will be available in late 2013 providing the ability to compare existing cover types to FIA and other datasets and establishes a common cover type baseline across the Region.
- 5) Climate monitoring stations established throughout the SMNRA (James Hurja, personal communication 2011) provides local climate data.

These datasets when used collectively provide a detailed picture of the SMNRA today.

CA species are integrated into plant communities and ecosystems and are therefore significantly affected by changes in community structure no matter what drives the change. Climate change models project significant disruption of southwestern ecosystems and ecosystem processes. The effect on individual species will vary and largely depends upon the life history of each species. Climate change may result in unique assemblages of species as species move up in elevation and, or, northward at different rates (Chambers et al., in press).

Management direction (standards and guidelines) and objectives in the Forest and GMP affected by climate change include:

- **Management Area Objectives for Seral Class Distribution by Land Type Association (LTA) in the GMP** – Desired vegetation composition objectives by land type association and seral stage are established by the GMP for each management area. Land types associations include: creosote, blackbrush, pinyon/juniper, mixed conifer, bristlecone pine, and upper and lower washes. Within management areas 11, 12, 13, and 14, objectives for blackbrush, creosote, and bristlecone pine land type associations emphasize late seral stages (90% or more of the land type association). Objectives for upper and lower wash land type associations located in management areas 11, 12, and 13 also emphasize late seral stages (90% or more of the land type association).

The following factors affect the SMNRA's ability to achieve these objectives in the face of climate change:

- Blackbrush and creosote are not resilient (Chambers et al., in press) and are particularly susceptible to fire. Blackbrush does not re-sprout after fire and is extremely difficult to restore after large fires, especially at the lower two third of its elevation range (Brooks and Matchet 2006; Pendleton and Pendleton 2012). Creosote will re-sprout under some conditions but recovery is slow and repeated fires further retard recovery.
- Creosote and blackbrush communities represented by these land type associations are expected to move up in elevation with a warming climate. Protection from fire and other disturbances is the most successful method for maintaining the blackbrush and creosote vegetation type (mixed desert shrub ecosystem).
- Bristlecone pine ecosystems have low resilience to disturbance (Holtmeier and Broll 2007). This species exhibits increased growth rates as temperatures have warmed (Salzera et al. 2009). Increased growth rates, movement of the timberline upward in elevation, and warmer temperatures are reported to make bristlecone pine susceptible to several diseases and more susceptible to insect infestations (Chambers et al., in press).

The GMP also establishes objectives for the mix of seral stages for the pinyon/juniper and mixed-conifer land type associations. The mixed conifer land type association includes white fir, ponderosa pine and ponderosa pine/mountain shrub communities. Ponderosa pine covers the greatest area.

The following factors affect the SMNRA's ability to achieve these objectives in the face of climate change:

- The interaction among climate, fire and bark beetles affects the structure and composition of the mixed conifer ecosystems (Chambers et al., in press). Protection, fuels reduction, and fire are management methods used to maintain this vegetation community represented in these land type associations.
- Pinyon/juniper is subject to large-scale die off when subject to water stress and prolonged drought. Water stressed trees are susceptible to bark beetles and a secondary pathogen infection. This ecosystem is also expanding and infilling in some areas. Fuels reduction to open up the ecosystem and maintain shrub and herbaceous understory assists in maintaining diversity in this ecosystem (Pyke 2011).

As the effects of climate change accelerate, the ability to manage natural disturbances and their effects will decrease and the ability to achieve desired seral classes established by these management area objectives becomes increasingly unfeasible and cannot be maintained without significant changes in management priorities and investments.

- **Timing Restrictions Established by Standards in the GMP** – Restrictions on activities that may adversely affect rare or sensitive species are often established to avoid these effects during reproductive periods or times when sensitive lifecycle activities occur.

Among the lifecycle activities that are documented as occurring earlier are nesting, flowering, insect emergence, and migrations. The problem with the fixed time window approach, during an era of climate change, is that the protected activity, nesting for example, will occur at a progressively earlier time. Therefore, as the climate warms, management or other disruptive activities could occur before the fixed time window creating risks to successful reproduction or other stresses to populations. The challenge is to develop methods linked to current climatic conditions that provide for both species protection and adjustment as the climate changes occur.

Specific timing restrictions are not included in the Toiyabe Forest Plan; key lifecycle activities that warrant protection and limitations on adverse effects are the basis for adopted standards and guidelines. The GMP includes standards that preclude specific activities during a fixed period of time to accomplish species protection. Furthermore, some programmatic decisions like the Vehicle Use Map perpetuate these standards and often add additional timing restrictions that could also be affected by climate change.

In the nearly two decades since the GMP was approved (1996), some shifts in key lifecycle activities have already occurred. The rate at which these changes are projected to occur is expected to increase based on current models. The GMP, includes the following standards that may need to be adjusted base on climate-related effects:

GMP Standard 0.51 - Allow access to all caves only from the beginning of March through the end of May; and from the beginning of September through the end of October.

GMP Standard 0.57 - Rock climbing within 100 yards of known active or recently active peregrine falcon nests will be allowed only from the beginning of July through the end of January. Specific routes may be signed as necessary to inform of seasonal closures if nests are identified. Monitor peregrine nesting success to determine if the 100-yard closure is effective. (Standard)

GMP Standard 0.61 - Allow collection of snags only between the months of October and the end of February.

Recommendation: Assess the need to revise or amend the Forest Plan/GMP to reflect information on climate change and make necessary adjustments to account for the effect of climate-related changes on plan components.

- a) Amend or revise vegetation/land cover objectives for management areas within the SMNRA to reflect an appropriate range of seral stages based on projected changes in climate and use the land cover types or aggregations of those the types used in the new Intermountain Region land cover map.
- b) Evaluate timing restrictions established by standards with respect to climate change information. Consider amending the Forest Plan accordingly or use this information to make site-specific amendments associated with individual project decisions.

b) Changes in Management Programs or Activities

The following recommendations were identified based on the analysis and evaluation described in section 3:

1. Ecological Context: Invasive Species/Insect and Disease Management

Invasive species and insects and diseases are important stressors to any biological system. These stressors play a critical role in SMNRA ecosystems. Risks associated with noxious weeds originating from recreationists enjoying the SMNRA and its resources are also a continuing concern. Monitoring and early detection of these stressors are the primary and often the only effective method of control.

Recommendation: Key invasive species and insect and diseases potentially affecting the SMNRA and monitoring and detection procedures include:

- a) Noxious Weeds - The Intermountain Region has implemented a Weed Free Hay Policy on National Forest Lands in Utah, Nevada and Idaho. On February 11, 2003, the Regional Forester signed a Weed Free Hay Order # 04-00-097 to establish this policy. Implementation and enforcement of this requirement is critical to minimize vectors for infestations and resulting control measures within the SMNRA and warrants immediate management attention. A management response framework and best practices are described in appendix E.
- b) Whitenose Bat Syndrome – Westward movement of this disease stopped in 2011 as documented by the FWS. As a result, no specific monitoring within the SMNRA is warranted at this time. If westward movement restarts, information regarding this disease would likely originate from FWS or Regional staff and monitoring or detection can be considered at that time.
- c) Insect and Disease Detection and Practices – The Intermountain Region Forest Health Protection staff conduct aerial detection surveys and are available to investigate infestations. Insects and disease vulnerability for juniper and Pinyon pine can be reduced by following IM Audit recommendations (see appendix E) by avoiding creating wounds to trees that attract or provide entry points for beetles and disease. Do not prune or remove lower branches of pinyon or juniper trees to reduce ladder fuels during fuels reduction, provided fuel continuity and fire behavior objectives can be achieved by thinning.
- d) Tamarisk Beetle – Originally introduced as a form of biological control, Tamarisk beetle is effectively attacking and reducing tamarisk populations. However, the loss of vegetation is affecting nesting sites for birds and other species in adjacent areas such as the Grand Canyon

and Lake Mead. Spread of this beetle into the SMNRA should not be an issue because tamarisk are only known to be present at one springs and control of this tamarisk populations is desired.

- e) Cowbirds – Populations of this species continue to be an issue (see Forest Plan guideline 0.30). There appears to be a relationship between the spread of this species native to the eastern US and horse and burro populations that may warrant investigation.

2. Ecological Context: Management of Non-Native Species

Introduced non-native species (1982 NFMA planning regulation at 36 CFR 219.19) within the SMNRA affect biological systems and CA species and their habitats. Section 3.a provides a description of the status of these species and their effects on SMNRA species and their habitats.

Because management of horse/burro and elk management populations are the responsibility of the Bureau of Land Management and Nevada Division of Wildlife, coordination with these agencies is needed to address the effect of these populations on Sensitive Species and their habitats within the SMNRA. Horse numbers will remain high since no gathers are scheduled and budgets will dictate less frequent gathers in the future. The combination of too many horses and too many elk will continue to negatively affect springs and riparian areas, vegetation and CA species and their habitats.

The primary concern associated with Lahontan cutthroat and rainbow trout is the interactions of these introduced species with mollusks and invertebrate species in Willow and Carpenter Creeks. Because there were no pre-introduction baseline surveys conducted, effects on springsnails and invertebrates are unknown.

Recommendation: Management of non-native species within the SMNRA and the consequences to Sensitive Species must address the following concerns:

- a) Aggressive action to remove horses from areas where they are adversely affecting Sensitive Species must be taken as soon as possible. Establishment and maintenance of exclosures or drift fences to prohibit movements into key sites or areas should continue to be a high priority. Proposals to increase elk populations through habitat improvements do not appear warranted until horse population numbers are at adopted AML's within each HMA.
- b) Consider a focused monitoring effort to determine the relationships between fish populations and springsnails within Willow Creek and invertebrate species resident in Carpenter Creek.

3. Species Conservation: Species Conservation Status

Information on species status including life history information, population distribution and status are constantly changing. Applying this information within the Forest Service policy framework and locally promulgated procedures make keeping pace with new information especially difficult. Two primary issues that need to be addressed include: (a) maintaining a repository of best available science and information regarding species and (b) keeping various species lists consistent with this information.

As part of the SMNRA I&M Strategy (USDA Forest Service 2008b), the Species Reference Database was established (see section 3.b) to serve as a repository for current research, literature, and information on surveys and observations of those species identified in the SMNRA Landscape Analysis. This database used the Intermountain Region's Planning, Appeals, and Litigation Access database platform to allow the use of this information to link to individual project administrative records. The Species Reference Database was a contract deliverable associated with the SMNRA I&M Strategy development effort.

An agreement with the Rocky Mountain Research Station provides for the maintenance of the database during the course of the monitoring program and development of species fact sheets, including potential habitat modeling for each species (see appendix B). This agreement will lapse at the end of FY 2013.

As described in section 4.a.3, information that resides in the Species Reference Database serves as the foundation for developing potential habitat models and other information presented in the individual Species Fact Sheets included in appendix B.

Recommendation: Use information in the Species Reference Database summarized in the Species Fact Sheets as the basis for applying and documenting application of the Region's Sensitive Species List criteria. To ensure this information reflects current information and knowledge regarding these species the following actions are recommended:

- a) Establish a formal process for maintaining and keeping the Species Reference Database current.
- b) Update and revise the Species Reference Database to improve data entry and report generation as well as its utility across the Humboldt-Toiyabe National Forest.
- c) Establish procedures for forwarding recommended updates to the Region's Sensitive Species List to ensure the list accurately reflects new information and changed conditions.

4. Species Conservation: Species-Specific Survey and Monitoring Design

The role of individual or multiple species surveys is crucial in addressing overarching questions regarding species occurrence, trend, and status. Information from these surveys must be of sufficient data quality to identify and support changes in management.

Review of species-specific survey design and reports conducted within the SMNRA since the late 1990s, has identified a number of concerns related to data quality and quality assurance associated with the data resulting from these surveys. As designed, these long-term studies did not provide data that can address the management questions associated with species population size and distribution and track changes in these variables across the SMNRA (L. Scott Baggett, RMRS Statistician, personal communication). In all cases, implementation of the long-term study design reduced the statistical power needed to make valid inferences about the local population structure and to track changes in the sampled populations through time (Lindmeyer and Likens 2010).

Recommendation: Species-specific survey and monitoring design should be developed and address the following points:

- a) Define survey boundaries and establish sampling intensity and locations using maps of potential habitat developed using best available science included in the Species Fact Sheets (see appendix B). Sampling design should rely on published design methodologies such as the Generalized Random Tessellation Stratified (GRTS) method developed by the U. S. Environmental Protection Agency (Olsen 2005; U.S. EPA 2008) or the random pixel point method used by FIA.
- b) Protocols for data collection within potential habitats should utilize standardized, published methodologies and, when possible, use methodologies consistent with other protocols used in the SMNRA inventory and monitoring program such as the sub-plots used in the intensified and base FIA programs. Use of a common plot system provides the ability to compare and evaluate data collected over time to address continuing or new conservation issues regardless of the purpose of the original survey or inventory.

- c) Conduct and document an evaluation of whether the selected protocols and sampling design can develop data of sufficient quality to address identified monitoring questions associated with species-specific surveys (see section 4.c.2).
- d) Quality control and assurance procedures should be described and information on data quality and QA/QC included in the metadata for specific survey reports and entries into NRM-NRIS or local data systems.

5. Management Interactions: Conservation Program Considerations Based on New Information

Adaptive management requires a response to new information and science resulting from the Southern Nevada Area Partnership (SNAP), Forest Service Research and Development, other research organizations, and inventory and monitoring programs. New information affects conservation programs in two primary ways:

- (a) Conservation Conceptual Framework – the “biodiversity hotspots” conceptual model used as the underlying conservation framework in both the GMP and Conservation Agreement developed in the late 1990s is a prime example of how conceptual frameworks used to design conservation programs need to change or adapt. As a result of using this approach in the SMNRA, conservation efforts were primarily focused in the developed east-side canyons. Research and experience have clearly demonstrated this “insular” conservation approach has little utility in large area conservation efforts and fails to account for and investigate species habitat and distribution outside defined “hotspots.”
- (b) Species Focus (i.e., Species Lists) - Species lists, which help focus conservation programs, are by their nature dynamic and must be maintained based on current and new information (see section 4.b.3 above) to ensure limited funding for species conservation is appropriately applied. Improved understanding of population dynamics, habitat relationships, life history, and/or the distribution of species is a product of local species-specific surveys and published research. This “data stream” should result in a continual refocusing of conservation efforts as new information becomes available.

New information or changed circumstances often prompts changes in management direction (see 4.a above) or the focus of programs or design of projects and activities. Agency guidance and procedures for consideration of new information and changed conditions are described in FSH 1909.15, section 18. Specific examples of the need for adaptation and response in management programs resulting from new information generated by the I&M program include:

- New information on the extent and distribution of Spring Mountains Dark Blue Butterfly (petitioned for listing under ESA) and host species in the West Mud Springs/Cold Creek/Willow Springs portion of the SMNRA developed in cooperation with UNLV indicate the potential need for action to avoid disruption of these species during egg-laying periods within this geographic area located outside “biodiversity hotspots.”
- Concerns regarding the effectiveness of OHV management practices and their enforcement in Willow Creek and the Cold Springs area were identified in the Willow Creek Watershed Assessment (Otis Bay Ecological Consultants 2007) and these needs were verified during the 2011 IM Audit. The *2011 Implementation and Monitoring Audit Report* also confirmed continuing concerns with erosion and sedimentation upstream from Willow Creek Spring that need to be addressed (METI, Inc. 2012a).

- Information resulting from the genetic analysis of Palmer's chipmunk reveals the presence of a healthy and robust population within the SMNRA. Direction in the Toiyabe Forest Plan and GMP, including standards and guidelines and monitoring requirements, was established based on a different understanding of this species' status and should be revisited (see sections 4.a.1 and 4.a.3 above).

Recommendation: New information developed during the SMNRA I&M program has helped identify the following changes in management:

- a) Address needed changes in conservation programs or management activities in the Mud Springs/Cold Creek/Willow Creek area regarding OHV trail systems, management, and enforcement associated with new information regarding butterfly habitats and continuing watershed restoration and protection.
- b) Address needed changes regarding changes in species status (see 4.b.3 above) and changes needed in Forest Plan direction (see 4.a.3 above).

6. Management Interactions: Development and Application of Best Practices

Review of management actions during the IM Audits identified concerns associated with project design and mitigation practices for species conservation and protection. Over time, decisions on similar projects have resulted in a variety of project design and mitigation measures as well as different monitoring approaches. The purpose of the IM Audits is to assist with organizational learning and application of "lessons learned" from different management actions. Use of a consistent framework for design measures and monitoring protocols over time provides managers the ability to practice adaptive management and improve effectiveness by applying information gathered through monitoring programs and a critical evaluation of management design measures and their effectiveness in similar situations. The results of the 2010-2012 IM Audits demonstrate these opportunities within the SMNRA.

Recommendation: Adopt, apply and maintain the management response frameworks developed during the IM Audits described in appendix E. Application and maintenance of these SMNRA best practices requires the following specific actions:

- a) Apply the management response frameworks described in appendix E to ongoing projects and future project proposals. Improve these design features and mitigation practices and the management framework over time.
- b) Develop, adopt, and apply consistent monitoring protocols for identifying the effectiveness of design and mitigation practices across multiple projects. Use of a consistent monitoring methodology will ensure the ability to compare monitoring results between projects and over time. An added benefit of this approach is the reduction of monitoring costs that must be accomplished with appropriated funds.

c) Changes in the SMNRA Inventory and Monitoring 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, program funding decisions, and management determinations that monitoring is no longer warranted or that new monitoring questions need to be addressed.

1. Continuation of Inventory and Monitoring Program Components

Program funding for completion of the 4th and 5th year of the inventory and monitoring program described in the SMNRA I&M Strategy (USDA Forest Service 2008b) was not approved. As a result, a revised conservation initiative funding request ("Round 14" proposal) has been submitted by the Humboldt-Toiyabe National Forest and is being reviewed as part of the SNPLMA.

Continuation of inventory and monitoring program components under the Round 14 proposal was informed by the following conclusions:

- Intensified FIA Program - The need for continuing the intensified FIA Program does not exist because the primary monitoring questions driving the program design and intensification level thought to have originated from Forest Plan standards do not, in fact, apply to the SMNRA. The 187 inventory plots installed as part of the 2010–2012 inventory and monitoring program results in an inventory that represents a 4.5 x intensification of the base Federal FIA program. This level of intensification provides the basis for addressing remaining monitoring questions and provides a valuable foundation for monitoring climate change effects on existing vegetation/land cover by establishing a link to the "base" FIA program within Nevada and Interior West FIA program. The sub-plots installed as part of the program also provide valuable context and a dataset that can be easily linked to species-specific monitoring and surveys and the larger network associated with the base FIA program.
- Springs and Riparian Surveys - Development of a consistent inventory and understanding of springs and riparian areas within the SMNRA is a continuing need given the biodiversity associated with these sites and relationships of springs and riparian areas to upland species dependent on these water sources and habitats. The Round 14 proposal includes completion of the inventory program using the national *Groundwater-Dependent Ecosystems: Level II Inventory Field Guide* (USDA Forest Service 2012a). Monitoring questions addressed by this program component have not substantially changed since they were originally identified.
- Genetics Analysis - The genetics analysis program has proven to be very successful. Future efforts should be coordinated with the UNLV autecology project and continuation in the Round 14 proposal. The focus is on completing the analysis of selected butterflies and springsnails, however other species monitoring may benefit from this approach.
- Species-Specific Surveys - As envisioned in the I&M Program Strategy, species specific surveys comprise a large segment of the Round 14 proposal. Potential habitat maps developed as part of this effort provide the framework for survey design that will improve understanding of species distribution and habitats within the SMNRA.
- Implementation/Monitoring Audits – These audits have provided the SMNRA important information regarding the design and execution of ongoing and future projects. Although not proposed as part of the Round 14 request, continuation of the IM Audits or similar approach to organizational learning by SMNRA leadership is recommended.

Recommendation: Several monitoring questions identified in the SMNRA I&M Strategy (USDA Forest Service 2008b) either no longer warrant consideration for monitoring or warrant modification for a variety of reasons. Appendix A-1 includes a summary of the rationale for dropping or modifying specific monitoring questions and the revised list of monitoring questions.

Appendix A-2 identifies the appropriate method for addressing the revised list of monitoring questions. The following is a brief description of each of the methods:

- Assessment – includes landscape-scale assessments and planning assessments (see 36 CFR 219.6) used to compare desired and existing conditions. These assessments are used to identify potential changes in land management plan direction or the need and purpose for proposed actions.
- Inventory and Monitoring Program Components – includes inventory and monitoring activities identified in the SMNRA I&M Strategy that would continue under the “Round 14” conservation initiative proposal.
- Project Monitoring – identifies those monitoring questions that could be monitored at the project-scale. Standardization of monitoring approaches applied to multiple projects is recommended to provide the ability to compare monitoring results between projects and over time (e.g., plots installed by USGS to monitor pre- and post-habitat conditions in fuel reduction treatment areas or noxious weed monitoring as identified in the 2012 IM Audit, see Ostoja et al. 2010).

Table 4-1 displays which specific inventory and monitoring program components would generate data needed to address specific monitoring questions.

Table 4-1: Relationship of Monitoring Questions to Continuing Program Components

Question Number	Monitoring Question	Base FIA Program	Springs/Riparian	Species Surveys	Genetics Analysis
40	What is the current trend (distribution and abundance) of invasive species?	X			
49	Where are springs, fen, and streams distributed and how are baseline conditions, including water quality and yield being affected?		X		
50	What are the current riparian vegetation composition, structure and pattern associated with springs, fens, and streams?		X		
51	How effective is riparian fencing in protecting springs and riparian areas? What thresholds warrant this level of mitigation		X		
53	What is the ecological status of riparian areas?		X		
59	Is recreation use or grazing by wild horses/burros or recreational livestock impacting bank stability?		X		
55	How are management actions and human uses affecting water quality and quantity?		X		
45	Do wild horses adversely affect the habitats of some Sensitive Species?		X	X	
8	How effective are efforts to reduce recreation effects to riparian and spring areas?		X	X	
35	What effects has wildland fire had on the conditions in key Sensitive Species habitats and should these and other areas be protected from wildland fire?			X	
4	Are recreational climbing activities affecting Sensitive Species plants in cliff areas or disrupting roosting areas for Sensitive bat Bat Species and other nesting Sensitive Species?			X	X
7	Are management actions to limit effects to Sensitive Species from recreational climbing activities effective?				X
9	How effective are management efforts in reducing negative effects to Sensitive Species dependent on caves?				X

The following is an assessment of design considerations associated with each program component:

- The ability of nationally adopted inventory and monitoring protocols and survey designs used in the base FIA program and the springs/riparian inventories to address the specific monitoring questions identified below have been reviewed and verified as part of the SMNRA I&M Strategy.
- The monitoring questions associated with Species-Specific Surveys should be explicitly addressed during survey design and the design reviewed by a biometrician or statistician to ensure data are of sufficient quality needed to address these monitoring questions. As described above (see section 4.b.4) survey design should be linked to the potential habitats described in the Species Fact Sheets (appendix B). Data collection should use the established protocols for FIA sub-plots. This will allow comparison of data collected during species-specific surveys with (a) the broader dataset developed during the intensified FIA program and those sub-plots maintained by the national FIA program and (b) sub-plots established across all species-specific surveys. (see appendix C-2.4 for a demonstration of occurrence information developed using data from these plots).
- In addition to continuing work on spring snails and butterflies, genetic analysis may be the most appropriate method of assessing the status of those species associated with caves and cliffs because of the lack of established sampling protocols, the difficulty in sampling these locations, and risks associated with crew, volunteer, or contractor safety.

Inventory and monitoring activities associated with the Round 14 proposal will not be conducted in isolation. Monitoring information generated by other programs and efforts (e.g., invasive species monitoring, the national FIA program, etc.) will also contribute to addressing some of these monitoring questions.

2. Improved Inventory and Monitoring Program Coordination

Numerous inventory and monitoring projects or activities by multiple entities are occurring within the SMNRA. 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 and activities are coordinated and monitored through the Southern Nevada Agency Partnership (SNAP). There is no equivalent process to review proposals, coordinate efforts, and apply results of inventory and monitoring conducted outside the scope of the SNAP research program. 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 ensure information gathered by research projects enters the SMNRA inventory and monitoring “data stream” and is available to support management and conservation decision making.

Recommendations: The need to ensure capture of information on species inventory and monitoring in the SMNRA is becoming more critical as financial resources supporting these efforts become more restricted.

- a) Investigate approaches to improve coordination of inventory and monitoring activities within the SMNRA, including data capture and application. Processes used by the USFWS and Forest Service 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. In particular, inventory and monitoring activities within Wilderness must be authorized as consistent with establishment legislation and employ minimum impact techniques (see FSM 2324.42). A national agreement between FIA and the NFS addresses requirements for conducting this inventory within Wilderness, program coordination and inventory requirements are coordinated at the Regional level. As a result, the base FIA program is consistent with these requirements.
- c) Ensure inventory and monitoring activities and authorizations for inventory and monitoring activities within the Carpenter Creek Research Natural Area are reviewed and approved by the Director of the Rocky Mountain Research Station (see FSM 4063).

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Appendices - Monitoring Observation and Analysis Reports

Appendix A – Monitoring Questions and Priorities

Appendix B – CA Species Fact Sheets and Potential Habitat Models

Appendix C – Forest Inventory and Analysis Report Tables

Appendix D – Springs and Riparian Inventory Data Reports

Appendix E – Management Response Frameworks

Appendix A-1 – Revised Monitoring Questions and Priorities

Among the monitoring questions originally identified in the SMNRA I&M Strategy (USDA Forest Service 2008b), several monitoring questions either no longer warrant consideration for monitoring or warrant modification based on the following rationale:

MQ 18 – What are the direct and cumulative effects of woodcutting and gathering on CA Species and their habitats? • This question originated from concerns with the effects of woodcutting and gathering on Palmer’s chipmunk, which has now been determined to have a self-sustaining and healthy population within the SMNRA. • Prohibitions on woodcutting in the developed canyons, and restrictions within the SMNRA, have been implemented. Monitoring of the effectiveness of prohibitions and restrictions should rely on a review of law enforcement records in the LEMARS database to determine if monitoring is needed. • If it is determined that monitoring is warranted, the focus should be directed toward the an evaluation of site disturbance and soil erosion potential associated with woodcutting/gathering.
MQ 26 – How many snags per acre are present in mixed conifer, riparian areas, and in P-J? • This Forest Plan monitoring requirement does not apply to NFS lands within the SMNRA because they have been “reserved for timber production” by Congress and are not considered “available productive (capable) Forest land” (GMP, p. 1). See appendix C for more detail.
MQ 27 - What percentage of mixed conifer is old growth habitat? • This Forest Plan monitoring requirement does not apply to NFS lands within the SMNRA because they have been “reserved for timber production” by Congress and are not considered “available productive (capable) Forest land” (GMP, p. 1). See appendix C for more detail.
MQ 42 – What role should wildland fire play in areas with invasive plant species? What are the consequences and threats by invasive species that typically follow fire such as cheatgrass in lower elevations? MQ 37 – What is the rate of wildfire recovery on burned species? Is there a difference in recovery time for high vs. low intensity? • Information relative to both monitoring questions is being developed as part of the Fire Surrogate Studies supported by the Joint Fire Sciences Program. Studies specific to the Humboldt-Toiyabe National Forest are being conducted with results published by Rocky Mountain Research Station scientists located at the Reno Laboratory. • The RMRS Fire Modeling Institute maintains the Fire Effects Information System, which is a database containing the best available information and science regarding fire effects to vegetation, soils, hydrology and other resources.
MQ 23 – What are the effects of air quality on vegetation? • Information collected as part of the FIA inventory will provide a baseline for evaluating this question relative to ozone damage, but the question is best evaluated as part of a specific research project.
MQ 44 – What are the consequences of climate change and drought on CA Species and their habitats? • Climate change models produce data that is best used to assess the direction of community change (Rehfeldt, 2006). Due to the large number of variables used to compute climate models, the data is much less useful for predicting fine scale results, e.g., individual species response to climate change. There are some generalizations with regard to the life history features of species that relate to climate change and detailed individual species studies might provide some insight. • Statewide data gathered as part of the base FIA program provides the most reliable dataset for monitoring vegetation changes over time.
MQ 28 – What is the average number of downed woody logs per acre? • Forest Plan Fish and Wildlife Standard 14 requires three down logs peracre with a minimum size of 15 inches in diameter at the large end and at least 15 feet in length. GMP standard 0.37 requires a minimum of 50 linear feet/acre of downed trees with a minimum 12-inch diameter on sites being managed for late seral stage of the Pinyon/Juniper and Mixed Conifer Land Type Associations to provide ground cover for small mammals, amphibians, reptiles, and invertebrates. • GMP standard 0.38 GMP standard 0.91 applies to within areas being managed as shaded fuelbreaks located in the Mixed Conifer or Pinyon-Juniper Land Type Associations. • To reflect Forest Plan Fish and Wildlife Standard 14, Monitoring Question 28 would be revised to read – “How many logs per acre 15 inches in diameter occur within the Pinyon/Juniper and Mixed Conifer Land Type Associations?” (see appendix C for more detail.)

The following table identifies the revised monitoring questions by priority ranking and the priority groups identified in the SMNRA I&M Strategy.

Question Number	Priority Group A – Resiliency to Wildland Fire
29	How does current wildland fire management affect Sensitive Species ⁴ and habitats compared to historical fire patterns? What are the consequences of wildland fire on Sensitive Species and their habitats?
31	How effective are design features and mitigation measures associated with mechanical fuels treatments in protecting/conserving Sensitive Species habitats?
32	What are the effects (positive/negative) on Sensitive Species habitats from mechanical fuel treatments?
35	What effects has wildland fire had on the conditions in key Sensitive 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 Sensitive Species?

Question Number	Priority Group B – Resiliency to Wildland Fire/Recreation Management
4	Are recreational climbing activities affecting Sensitive Species plants in cliff areas or disrupting roosting areas for Sensitive bat Species and other nesting Sensitive Species?
3	How do recreation activities affect Sensitive Species and habitats? Which types and locations of recreation activities are having more substantial effects on Sensitive 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 Sensitive Species habitats where recreation impacts to habitat should be avoided?
1	What are the effects and impacts of dispersed recreation uses, including OHVs to Sensitive 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 Sensitive Species and their habitats?
7	Are management actions to limit effects to Sensitive Species from recreational climbing activities effective?
9	How effective are management efforts in reducing negative effects to Sensitive Species dependent on caves?
16	How can the effects of existing recreation developments and uses be managed to minimize effects on Sensitive Species and their habitats? What are the effects of concentrated uses and their overlap with Sensitive Species and their habitats?

⁴ **Note:** References to Species of Concern and Species of Interest used in the SMNRA I&M Strategy have been converted to Sensitive Species per Recommendation 4.a.3.

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?
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./ Sensitive Species Habitat Mgmt./Other Disturbances & Uses
24	Where are opportunities for restoration and/or creation of habitat for Sensitive 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 Sensitive Species?
28	How many logs per acre 15 inches in diameter occur within the Pinyon/Juniper and Mixed Conifer Land Type Associations ?
25	Are the landscapes being managed within a range of variability that promotes resiliency for Sensitive Species and their habitats? Have ecological systems been altered – therefore, affecting Sensitive Species and their habitats?

Appendix A-2 – Appropriate Methods for Addressing Revised SMNRA Monitoring Questions

The following table identifies the appropriate method of addressing the revised SMNRA monitoring questions. The following is a brief description of each of the methods:

- Assessment – includes landscape-scale assessments and planning assessments (see 36 CFR 219.6) used to compare desired and existing conditions. These assessments are used to identify potential changes in land management plan direction or the need and purpose for proposed actions.
- Inventory and Monitoring Program Components – includes inventory and monitoring activities identified in the SMNRA I&M Strategy (USDA Forest Service 2008b) that would continue under the “Round 14” conservation initiative proposal.
- Project Monitoring – identifies those monitoring questions that could be monitored at the project-scale. Standardization of monitoring approaches applied to multiple projects is recommended to provide the ability to compare monitoring results between projects and over time (e.g., plots installed by USGS to monitor pre- and post-habitat conditions in fuel reduction treatment areas or noxious weed monitoring as identified in the 2012 IM Audit (METI, Inc. 2012b)).

Question Number	Monitoring Question	Assessment	I&M Program	Project Monitoring
29	How does current wildland fire management affect Sensitive Species and habitats compared to historical fire patterns? What are the consequences of wildland fire on Sensitive Species and their habitats?	X		
31	How effective are design features and mitigation measures associated with mechanical fuels treatments in protecting/conserving Sensitive Species habitats?			X
32	What are the effects (positive/negative) on Sensitive Species habitats from mechanical fuel treatments?	X		X
35	What effects has wildland fire had on the conditions in key Sensitive Species habitats and should these and other areas be protected from wildland fire?	X	X	X
36	What actions can be taken to reduce wildland fire occurrences (severity) resulting in unwanted type conversion or unacceptable environmental effects?	X		
30	How do we restore fire dependent ecosystems where it has been excluded? What are the consequences of wildland fire suppression?	X		
33	How effective are fuels treatments in restoring fire to its natural role in the environment?	X		
34	How can we maintain the appropriate amounts of wildland fire to maintain healthy ecosystems?	X		
38	What wildland fire suppression strategies and techniques can be used to minimize impacts to Sensitive Species?			X
4	Are recreational climbing activities affecting Sensitive Species plants in cliff areas or disrupting roosting areas for Sensitive bat Species and other nesting Sensitive Species?		X	
3	How do recreation activities affect Sensitive Species and habitats? Which types and locations of recreation activities are having more substantial effects on Sensitive Species and habitats?	X		
8	How effective are efforts to reduce recreation effects to riparian and spring areas?	X	X	X

Question Number	Monitoring Question	Assessment	I&M Program	Project Monitoring
17	What are the consequences of distributing recreation use outside presently developed canyons and increasing disturbance in previously undisturbed areas? Are there Sensitive Species habitats where recreation impacts to habitat should be avoided?	X		
1	What are the effects and impacts of dispersed recreation uses, including OHVs to Sensitive Species and their habitats?	X		X
39	What wildland fire suppression techniques are most effective in setting the stage for post-fire restoration? (e.g., fire retardant use restrictions)			X
5	How effective are efforts to manage motorized recreation (OHV) and limit other uses (outfitters and guides) to the protection and conservation of Sensitive Species and their habitats?	X		
7	Are management actions to limit effects to Sensitive Species from recreational climbing activities effective?			X
9	How effective are management efforts in reducing negative effects to Sensitive Species dependent on caves?			X
16	How can the effects of existing recreation developments and uses be managed to minimize effects on Sensitive Species and their habitats? What are the effects of concentrated uses and their overlap with Sensitive Species and their habitats?	X		
49	Where are springs, fen, and streams distributed and how are baseline conditions, including water quality and yield being affected?	X	X	
50	What are the current riparian vegetation composition, structure and pattern associated with springs, fens, and streams?	X	X	
51	How effective is riparian fencing in protecting springs and riparian areas? What thresholds warrant this level of mitigation		X	X
53	What is the ecological status of riparian areas?	X	X	
59	Is recreation use or grazing by wild horses/burros or recreational livestock impacting bank stability?		X	
40	What is the current trend (distribution and abundance) of invasive species?	X	X	
43	Are P-J treatments being invaded by cheatgrass?			X
56	Are soil and water conservation practices being implemented and are they effective?	X		X
57	Are soil disturbing activities creating excessive sedimentation or soil loss?			X
55	How are management actions and human uses affecting water quality and quantity?	X	X	
24	Where are opportunities for restoration and/or creation of habitat for Sensitive Species located?	X		
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?	X		
45	Do wild horses adversely affect the habitats of some Sensitive Species?	X	X	X
28	How many logs per acre 15 inches in diameter occur within the Pinyon/Juniper and Mixed Conifer Land Type Associations ?	X		
25	Are the landscapes being managed within a range of variability that promotes resiliency for Sensitive Species and their habitats? Have ecological systems been altered – therefore, affecting Sensitive Species and their habitats?	X		

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Appendix C – Forest Inventory and Analysis Report Tables

The *Comprehensive Inventory and Monitoring Strategy for Conserving Biological Resources of the Spring Mountains National Recreation Area* (I&M Strategy) (USDA Forest Service 2008b) identified three monitoring questions to be addressed using FIA data as a primary source. These questions were derived from the list of monitoring requirements identified in the Toiyabe Forest Plan.

Down/Large Woody Material (Monitoring Question 28)

Standards in the Forest Plan and General Management Plan (GMP) address habitats provided by Down/Woody Material for small mammals, reptiles, amphibians, and insects. Monitoring question 28, which is derived from Forest Plan monitoring requirements, addresses the number of downed woody logs/acre and is related to the following Forest Plan standard:

Toiyabe NF LRMP Wildlife and Fish Standard 14. Retain an average of three down logs per acre as wildlife habitat. Minimum down log size will be 15 inches in diameter at the large end and at least 15 feet in length.

The GMP establishes the following standard that cannot be monitored using FIA data by cover type and seral classes within these cover types:

GMP Standard 0.37 - (0.37) Retain a minimum of 50 linear feet/acre of downed trees with a minimum 12 inch diameter on sites being managed for late seral stage of the Pinyon/Juniper and Mixed Conifer Land Type Associations, provide ground cover for small mammals, amphibians, reptiles, and invertebrates. Trim branches and limbs as necessary. Place downed trees in such a way as to not affect drainage patterns; impede traffic or use of recreation facilities; create a public safety problem; and where consistent with "defensible space."

The following standard cannot be monitored using FIA data because it is intended to apply within shaded fuelbreaks and must be monitored at the project-scale. However, the need for this standard based on the results of the genetics analysis for Palmer's chipmunk (see section 2.c) should be assessed.

GMP Standard 0.91 - (0.91) Develop and maintain a network of shaded fuelbreaks to interrupt continuous stands of fuel. Maintain 50 linear feet/acre of downed trees with a 12 inch dbh within the shaded fuelbreak (if fuel break is being managed ecologically for the late seral stage of Pinyon/Juniper and Mixed Conifer Land Type Associations, or if managed for other seral stages within Palmer's chipmunk habitat). Use existing road corridors and natural barriers.

The following standard related to down and dead wood material in recreation sites cannot be monitored using FIA data and is more appropriately monitored for individual projects or sites:

GMP Standard 0.38 - (0.38) Provide a minimum of 5 wildlife cover sites per acre within developed or primitive recreation sites by maintaining or adding dead and down wood material or rocks at appropriate locations.

It is not clearly stated in the planning records whether the GMP standards are intended to supersede Forest Plan Wildlife and Fish Standard 14. However, data collected on down woody material by FIA can be used to monitor conditions related to Forest Plan Standard 14. Although measurements and volume calculations for down woody pieces are quite different from those for live and standing dead trees, volume is still the most

consistent comparison between them, given the inability to calculate numbers of down logs. Analysts should keep in mind the comparisons are rough at best.

For this analysis the following down woody pieces are included:

- Pieces in large end diameter class 1 (3.0 to 4.9 inches) are not included. This is because 5.0 inches is the minimum diameter that is measured in all three categories (live trees, standing dead trees, and down woody pieces).
- Pieces in decay class 5 (most advanced decay class) are not included because large end diameter on these logs is not estimated, given the difficulty (neither is species assigned to the log). This is the instruction from the field manual:

Decay class 5 pieces can be difficult to identify because they often blend into the duff and litter layers. They must still resemble a log, therefore, the first rule is that they must be ≥ 5.0 inches in diameter, ≥ 5.0 inches from the surface of the ground, and at least 3.0 feet long. Decomposed logs that are slightly elevated 'humps' on the ground are not counted.

A crosswalk between FIA cover types and Pinyon/Juniper and Mixed Conifer Land Type Associations is required to facilitate comparison of FIA data to the definitions associated with these standards (see below). Since no map of seral stages is available, the analysis is limited to the basic cover type and information on size classes, which generally correspond to seral stages.

Because of these limitations in available data, Monitoring Question 28 can only be addressed to the following degree of specificity: How many logs per acre 15 inches in diameter occur within the Pinyon/Juniper and Mixed Conifer Land Type Associations?

Snags (Monitoring Question 26) and Old Growth (Monitoring Question 27)

The Humboldt-Toiyabe Forest Plan identifies monitoring requirements associated with snags and old growth that were included in the *Comprehensive Inventory and Monitoring Strategy for Conserving Biological Resources of the Spring Mountains National Recreation Area* (I&M Strategy) (USDA Forest Service 2008b) as monitoring questions 26 and 27. These questions are linked to standards in the Toiyabe Forest Plan for the management of old growth habitat and habitat for cavity dwelling species using snags, which are defined as follows:

Toiyabe NF LRMP Wildlife and Fish Standard 1. "Snag management minimum requirement *on available productive (capable) Forest Land, when vegetative manipulation is done...*" [emphasis added]

Toiyabe NF LRMP Wildlife and Fish Standard 2. The following standards apply to old growth habitat. Ten percent of the *available productive (capable) forest land* will be managed as old growth habitat (by timber type-Jeffrey pine, mixed conifer, and lodgepole pine). [emphasis added]

Available productive (capable) forest land is defined in the Forest Plan to include all lands capable of producing forest products (20 cubic feet per acre per year) that are not "reserved for timber production" (not available) by Congress or other designation. All lands within the SMNRA, including Wilderness, are reserved from timber production by statute and are not considered available for timber harvest (Toiyabe NF Plan, p. C-2 and GMP, pp. 1 and 72). Therefore, these standards do not apply to the SMNRA, therefore, monitoring questions 26 and 27 are not applicable to the SMNRA (see section 3.b and appendix A-1).

However, plot data gathered by FIA have been analyzed and expanded to represent the conditions on the SMNRA. The results illustrate the status of old growth (see appendix C 2.1) and snags (see appendix C 2.2) within the SMNRA using definitions of these characteristics consistent with the Toiyabe Forest Plan.

GMP/Forest Plan Cover Type – FIA Cover Type Crosswalk

National and regional FIA field guides and definitions do not allow for a direct comparison of cover types used by FIA and those used in the Toiyabe Forest Plan and GMP. The following discussion provides the basis for making interpretations of cover types used in the Forest Plan and GMP standards to datasets generated using FIA inventory data.

Land Type Associations and Cover Types

The descriptions and the definitions of the different vegetation communities and Land Type Associations (LTAs) mentioned in the Toiyabe Forest Plan and GMP can be found on pages 24–26 in the 1995 *Analysis of the Management Situation: Spring Mountains National Recreation Area*. Review of planning records and files has not identified the existence of a crosswalk between the GMP's Land Type Associations and the vegetation communities described in other documents including vegetation classification by Nachlinger and Reese (1996), The Nature Conservancy (Provencher 2008), Clark County's 2000 MSHCP habitat models and Clark County's current work to revise their habitat models.

The following discussion and information is excerpted from the 1995 *Analysis of the Management Situation: Spring Mountains National Recreation Area*:

We have identified eight major LTA's on the Spring Mountains [see the following table]. These are characterized by elevation and major plant community components.

We have identified eight major LTA's on the Spring Mountains [see the following table]. These are characterized by elevation and major plant community components. There are differences in slopes, soils and suitabilities within each LTA. Suitability for development or use could be a component of the Desired Future Condition for each LTA, as suitability is not only a function of soils, landforms, plant communities, and sensitive sites (threatened, endangered and sensitive species locations and heritage resource locations), but of public perceptions and demands.

Land Type Associations (LTAs)		
LTA	Elevation	Vegetation
<i>Creosote</i>	<i>4000' - 5000'</i>	<i>Creosote, Bursage, Red Brome</i>
<i>Blackbrush</i>	<i>5000' - 6500'</i>	<i>Blackbrush, Joshua Tree, Mountain Big Sagebrush, Mormon Tea, Spiny Mendora</i>
<i>Pinyon/Juniper</i>	<i>6000' - 8500'</i>	<i>Pinyon Pine, Single-seed Juniper, Utah Juniper, Cliffrose, Gambels Oak</i>
<i>Mixed Conifer</i>	<i>7500' - 9500'</i>	<i>Ponderosa Pine, Limber Pine, White Fir, Silk Tassel, Manzanita</i>
<i>Bristlecone Pine</i>	<i>9000' - 11000'</i>	<i>Bristlecone Pine, Common Juniper, Golden Currant</i>
<i>Alpine</i>	<i>11,000' +</i>	<i>Sandberg Bluegrass, Spike Trisetum, Charleston Tansy, Hitchcock Bladder Pod, Hidden Ivesia</i>
<i>Lower Wash</i>	<i>4500' - 7000'</i>	<i>Basin Big Sagebrush, Rabbitbrush, Desert Almond</i>
<i>Upper Wash</i>	<i>6000' - 11000'</i>	<i>Woods Rose, Golden Currant, Desert Peach, Aspen</i>

Source: Analysis of the Management Situation – page 24a

Creosote (LATR) - Total Acreage in the SMNRA- 3,295. These lands are at the lowest elevations, between 4,000 and 5,000 feet on the Spring Range. They are described by a dominance of white bursage (*Ambrosia dumosa*) and creosote bush (*Larrea tridentata*). The LTA has gentle to moderate slopes (0–20%). The dominant parent material is limestone/dolomite alluvial deposits, most typically conglomerates with gravelly soils. Erosion hazard is moderate to low. The soils are typically gravelly with a desert pavement surface that protects the soil particles underneath it. If the desert pavement is disturbed, erosion increases significantly.

Blackbrush (CORA) - Total Acreage- 87,882. These lands are between 5,000 and 6,500 feet elevation. The type is described by a dominance of blackbrush (*Coleogyne ramosissima*) and Joshua tree (*Yucca brevifolia*). Other plants include mountain big sagebrush (*Artemisia tridentata* ssp *vaseyana*), mormon tea (*Ephedra nevadensis*, *E. viridis*), and spiny menodora (*Menodora spinescens*). The predominant underlying geologic materials are limestone/dolomite bedrock and limestone/dolomite conglomerates with gravelly, shallow soils. The LTA includes gentle rolling hills and terraces (0–20% slope) with moderate erosion potential, as well as steeper slopes (>30%) with high erosional potential if the desert pavement is disturbed.

Pinyon/Juniper (PIMO) - Total Acreage - 161,979. These lands are between 6,000 and 8,500 feet elevation. The type is described by pinyon pine (*Pinus monophylla*) and single-seed [Utah] juniper (*Juniperus osteosperma*) trees. Shrubs in the type include mountain big sagebrush (*Artemisia tridentata* ssp *vaseyana*), cliffrose (*Cowania mexicana*), Gambel oak (*Quercus gambelii*) and mountain mahogany (*Cercocarpus ledifolius*). The underlying geologic material is predominantly limestone/dolomite bedrock and gravels. The LTA has well-drained, loamy soils on steep slopes (>20%) with highly dissected canyon bottoms. Erosion potential is moderate to high. It also includes gentle rolling hills (5–20%) with low to moderate erosion potential.

Mixed Conifer (PIPO) - Total Acreage- 25,861. This LTA occurs between 7,500 and 9,500 feet, especially in sheltered canyons. Ponderosa pine (*Pinus ponderosa*) and white fir (*Abies concolor*) predominate at the lower elevations. As the elevation increases, limber pine (*Pinus flexilis*) replaces ponderosa. The predominant underlying geologic material is limestone/dolomite bedrock on the hillsides, and gravels in the canyon bottoms. Slopes tend to be moderate to steep (15–40%), with moderate to high erosion potential. Soils are usually dark in color with welldeveloped horizons and covered by dead plant material.

Bristlecone (PILO) - Total Acreage- 26,942. This LTA is found between 9,000 and 11,000 feet elevation. Bristlecone pines (*Pinus longaeva*) predominate in this community. Herbaceous and shrub ground cover is almost lacking. Near timberline, the soils are usually shallow and slopes are extremely steep (>25%), therefore there is a high erosion potential. The underlying geologic material is predominantly limestone bedrock and gravels.

Alpine (ALPN) - Total Acreage- 6,802. This community is found above 11,000 feet to the top of Charleston Peak. Grass species include Sandberg bluegrass (*Poa secunda* ssp. *secunda*), spike trisetum (*Trisetum spicatum*) and bottlebrush squirreltail (*Elymus elymoides*). This area has the highest proportion of endemism. Conspicuous endemic plants are Hitchcock bladderpod (*Lesquerella hitchcockii*), hidden ivesia (*Ivesia cryptocaulis*), and Jaeger draba (*Draba jaegeri*). The underlying geologic material is limestone bedrock and gravels. Slopes tend to be steep (>25%) and soils tend to be shallow and highly erosive.

Upper Wash (UPWS) - Total Acreage - 1,200. This community is found at elevations from 6,000 to 11,000 feet. The soils are derived from limestone/dolomite gravels. The soils are cobbly and have a

*high erosional and depositional potential, especially during flood events. The washes tend to be steep and narrow. Water is present on an intermittent basis, especially during spring runoff from snowmelt. Water also tends to be closer to the surface in these washes and may surface as a perennial spring. The four perennial streams in the Spring Mountains are all in the Upper Wash LTA, at varying elevations. This community is characterized by woods rose (*Rosa woodsii*), golden currant (*Ribes aureum*), and desert peach (*Prunus andersonii*). Surrounding plant communities include the mixed conifer community with ponderosa pine, white fir and aspen, and the pinyon/juniper community.*

*Lower Wash (LWWS) - Total Acreage - 1,500. This community is found in washes from 4,500 to 7,000 feet elevation. It has gravelly to cobbly soils that have a high erosional and depositional potential. The underlying geologic material is limestone/dolomite gravels. Lower washes tend to be broad and fairly flat. Water is only present during floods. This community is characterized by basin big sagebrush (*Artemisia tridentata* ssp *tridentata*) and rabbitbrush (*Chrysothamnus nauseosus*). Surrounding communities include the blackbrush and creosote communities.*

FIA Cover Types

FIA cover types suspected to occur within the SMNRA on lands capable of timber production (20 cubic feet/acre/year) or in the Pinyon/Juniper, LTA include the following groups and types:

Pinyon / Juniper Group

182 Rocky Mountain juniper: Rocky Mountain juniper comprises the majority of stocking. Associates – ponderosa pine, Douglas-fir, other junipers, pinyons, and oaks. Sites – often found on calcareous and somewhat alkaline soils.

183 Western juniper: Retired – see code 369.

184 Juniper woodland: Includes Pinchot juniper, redberry juniper, Ashe juniper, California juniper, alligator juniper, Utah juniper, one seed juniper. Pinyon is NOT present. Associates - various woodland oaks and cercocarpus, ponderosa pine, Arizona cypress, and Douglas-fir. Sites – lower elevation with low annual precipitation.

185 Pinyon-juniper woodland: Includes all pinyons and all junipers except Rocky Mountain and western juniper. Must have pinyon present. Associates - various woodland oaks and cercocarpus, ponderosa pine, Arizona cypress, and Douglas-fir. Sites – occurs at lower elevations with low annual precipitation.

Ponderosa Pine Group

221 Ponderosa pine (includes Arizona pine): Associates – Douglas-fir, lodgepole pine, grand fir, western larch, quaking aspen, Utah juniper, Gambel oak. Sites – this forest type is distributed over vast areas in the West and therefore can have great differences in environmental conditions.

225 Jeffrey pine: Associates - Incense-cedar, ponderosa pine, sugar pine, Douglas-fir, Port-Orford-cedar, western white pine, knobcone pine, Digger pine, red and white fir. Sites - Thrives in fairly harsh environments throughout most of its range, and is cold hardy, drought tolerant, adapted to short growing seasons, and tolerant of infertile sites. The majority of trees are found in California, although its range extends into southwest Oregon and western Nevada.

Fir/Spruce/Mountain Hemlock Group

261 White fir: Associates – Douglas-fir, sugar pine, ponderosa pine, Jeffrey pine, incense-cedar, California red fir, blue spruce, limber pine, and aspen. Sites – deep well-drained sandy loam-covered slopes and benches with a northerly exposure.

265 Engelmann spruce: Associates – western white pine, western redcedar, western hemlock, Douglas-fir, western larch, grand fir, subalpine fir, and lodgepole pine. For this type to be used, if subalpine fir is at least 5% of the total stocking, the stocking of Engelmann spruce must be at least 75% of the total stocking.

Lodgepole Pine Group

369 Western juniper: Associates – ponderosa pine and Jeffrey pine. Sites – found on dry sites and Ranges in elevation from just above sea level to 6,500 feet.

Aspen/Birch Group

901 Aspen: Associates – Engelmann spruce, lodgepole pine, ponderosa pine, Douglas-fir, subalpine fir, white fir, white spruce, balsam poplar, and paper birch. Sites – aspen has the capacity to grow on a variety of sites and soils, ranging from shallow stony soils and loamy sands to heavy clays.

Cover Type Comparison

Based on the descriptions of Land Type Associations present within the SMNRA, the following table provides information regarding the relationship of LTAs and cover types used in the Forest Plan or GMP and cover types used by FIA. This “crosswalk” is used in the following appendices.

Forest Plan/GMP Cover Types	Land Type Association	FIA Group/Cover Type
Jeffrey pine/mixed conifer/red fir	Mixed Conifer	<u>Ponderosa Pine Group</u> 221 Ponderosa pine 225 Jeffrey pine <u>Fir/Spruce/Mountain Hemlock Group</u> 261 White fir: 265 Engelmann spruce <u>Lodgepole Pine Group</u> 369 Western juniper <u>Aspen/Birch Group</u> 901 Aspen
Pinyon/Juniper	Pinyon/Juniper	<u>Pinyon/Juniper Group</u> 182 Rocky Mountain juniper 184 Juniper woodland 185 Pinyon-juniper woodland <u>Other Western Softwoods Group</u> 369 Western juniper

The Intermountain Region is developing a common map of existing land cover types using FIA data and information from the SMNRA intensified FIA program. Once this new land cover type map is prepared, a crosswalk between the Forest Plan/GMP Cover Types, Land Type Association, and FIA/Group/Cover Types will need to be prepared. This will enable monitoring and project-planning efforts consistent between

existing management direction, the new existing cover type map, and FIA cover types and data generated as part of the FIA program.

The new Regional cover type map will also provide the basis for comparing existing land cover with historical cover type information developed by Provencher (2008) to determine departure from historical conditions and to assess potential effects resulting from climate change modeling assumptions.

Appendix C-2.1: Monitoring Question 26 – How many snags per acre are present in Mixed Conifer and Pinyon-Juniper Cover Types?

Monitoring Question: How many snags per acre are present in mixed conifer and P-J?
Measure: Standing dead meeting specific dbh requirements by cover type.

Table 1: Number of standing dead trees (snags) (5 inches diameter and greater) on SMNRA forest land by forest type and elevation, 2012.

Forest type	Elevation						Total
	5001-6000 feet	6001-7000 feet	7001-8000 feet	8001-9000 feet	9001-10000 feet	10000-20000 feet	
	<i>number of trees</i>						
Rocky Mountain juniper	-	-	126,396	10,533	-	-	136,929
Juniper woodland	92,672	-	-	-	-	-	92,672
Pinyon / juniper woodland	133,859	769,760	1,148,095	179,061	-	-	2,230,775
Ponderosa pine	-	-	21,066	21,066	25,645	-	67,777
White fir	-	-	31,599	136,929	111,129	-	279,656
Foxtail pine / bristlecone pine	-	-	-	-	68,387	264,999	333,386
Limber pine	-	-	-	44,726	25,645	-	70,372
Aspen	-	-	-	-	25,645	-	25,645
Deciduous oak woodland	-	188,177	105,330	-	-	-	293,507
Cercocarpus (mountain brush) woodland	-	-	63,198	73,731	34,193	-	171,122
Nonstocked	41,188	115,863	368,654	-	42,742	-	568,446
All types	267,719	1,073,800	1,864,337	466,046	333,386	264,999	4,270,287

Table 2: Area of SMNRA forest land by forest type and elevation, 2012.

Forest type	Elevation						Total
	5001-6000 feet	6001-7000 feet	7001-8000 feet	8001-9000 feet	9001-10000 feet	10000-20000 feet	
	<i>acres</i>						
Rocky Mountain juniper	-	-	1,750	1,313	-	-	3,063
Juniper woodland	5,133	-	-	-	-	-	5,133
Pinyon / juniper woodland	14,543	63,177	54,053	11,377	-	-	143,150
Ponderosa pine	-	-	1,313	1,750	1,420	-	4,483
White fir	-	-	1,750	4,813	4,261	-	10,825
Foxtail pine / bristlecone pine	-	-	-	-	4,972	6,037	11,009
Limber pine	-	-	-	3,171	1,420	-	4,591
Aspen	-	-	-	-	2,841	-	2,841
Deciduous oak woodland	1,390	5,211	7,001	-	-	-	13,602
Cercocarpus (mountain brush) woodland	-	-	5,251	4,813	355	-	10,419
Nonstocked	3,422	1,750	3,500	-	1,420	-	10,093
All types	24,488	70,139	74,618	27,236	16,690	6,037	219,209

Table 3: Standing dead trees (snags) (5 inches diameter and greater) per acre on SMNRA forest land by forest type and elevation, 2012.

Forest type	Elevation						Total
	5001-6000 feet	6001-7000 feet	7001-8000 feet	8001-9000 feet	9001-10000 feet	10000-20000 feet	
	<i>trees/acre</i>						
Rocky Mountain juniper	-	-	72.2	8.0	-	-	44.7
Juniper woodland	18.1	-	-	-	-	-	18.1
Pinyon / juniper woodland	9.2	12.2	21.2	15.7	-	-	15.6
Ponderosa pine	-	-	16.0	12.0	18.1	-	15.1
White fir	-	-	18.1	28.4	26.1	-	25.8
Foxtail pine / bristlecone pine	-	-	-	-	13.8	43.9	30.3
Limber pine	-	-	-	14.1	18.1	-	15.3
Aspen	-	-	-	-	9.0	-	9.0
Deciduous oak woodland	-	36.1	15.0	-	-	-	21.6
Cercocarpus (mountain brush) woodland	-	-	12.0	15.3	96.3	-	16.4
Nonstocked	12.0	66.2	105.3	-	30.1	-	56.3
All types	10.9	15.3	25.0	17.1	20.0	43.9	19.5

Table 4. Number of standing dead trees (snags) (5 inches diameter and greater) on SMNRA forest land by species and diameter class, 2012.

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	21.0-22.9	23.0+	
	----- number of trees -----										
white fir	86,858	76,325	40,147	25,645	-	8,548	19,081	-	-	19,081	275,687
Utah juniper	196,821	104,621	166,639	135,748	145,809	41,660	41,660	42,132	31,599	-	906,689
limber pine	27,630	27,630	29,614	8,548	19,081	8,548	8,548	8,548	-	-	138,149
ponderosa pine	21,066	-	10,533	-	10,533	8,548	10,533	8,548	10,533	50,680	130,975
singleleaf pinyon	334,930	439,788	304,276	178,825	83,792	115,391	31,363	10,533	10,533	31,599	1,541,029
Great Basin bristlecone pine	59,839	59,839	42,742	42,742	17,097	34,193	17,097	34,193	-	25,645	333,386
curlleaf mountain-mahogany	383,766	299,503	124,175	63,198	31,599	31,599	10,533	-	-	-	944,373
Total	1,110,910	1,007,706	718,126	454,706	307,911	248,488	138,815	103,955	52,665	127,006	4,270,287

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

Monitoring Question: What percentage of mixed conifer is old growth habitat?
 Measure: Acres/percentage of area meeting old growth definitions.

Table 1: Area of SMNRA forest land by forest type and stand-age class, 2012.

Forest type	Stand-age class							Total
	0 to 20 years	41 to 60 years	61 to 80 years	81 to 100 years	101 to 150 years	151 to 200 years	201+ years	
	----- acres -----							
Rocky Mountain juniper	-	-	-	1,750	-	-	1,313	3,063
Juniper woodland	-	-	428	1,283	1,283	2,139	-	5,133
Pinyon / juniper woodland	4,803	3,909	10,501	14,526	57,577	34,489	17,345	143,150
Ponderosa pine	-	-	-	-	-	4,483	-	4,483
White fir	-	-	3,063	-	-	3,171	4,591	10,825
Foxtail pine / bristlecone pine	1,420	-	-	-	1,420	-	8,168	11,009
Limber pine	-	-	-	-	1,420	3,171	-	4,591
Aspen	2,841	-	-	-	-	-	-	2,841
Deciduous oak woodland	13,602	-	-	-	-	-	-	13,602
Cercocarpus (mountain brush) woodland	-	-	1,750	-	5,168	1,750	1,750	10,419
Nonstocked	10,093	-	-	-	-	-	-	10,093
All types	32,760	3,909	15,742	17,559	66,870	49,202	33,167	219,209

Appendix C-2.3: Revised Monitoring Question 28 - How many logs per acre 15 inches in diameter occur within the Pinyon/Juniper and Mixed Conifer Land Type Associations?

Monitoring Question: What is the average number of downed woody logs per acre?
 Volume per acre of down logs (course woody debris) compared to volume per acre and number per acre of both live and standing dead trees.

Measure:

Table 1: Volume per acre and number per acre of large trees/logs (15 inches diameter and greater) for live trees, standing dead trees, and downed logs on SMNRA forest land by cover type and diameter class, 2012.

Cover type	Diameter class	Live trees		Standing dead trees		Coarse woody debris	
		Volume/acre	Number/acre	Volume/acre	Number/acre	Volume/acre	Number/acre
Mixed conifer	15.0 - 20.9	493.1	16.0	147.4	4.3	282.4	?
	21.0 +	1,667.3	17.8	139.1	2.1	485.3	?
	Total 15.0+	2,160.4	33.8	286.6	6.3	767.7	?
Pinyon-juniper	15.0 - 20.9	198.1	14.5	22.2	1.7	26.6	?
	21.0 +	202.7	5.5	38.1	0.6	0	?
	Total 15.0+	400.8	20.0	60.3	2.2	26.6	?
Other types	15.0 - 20.9	75.3	4.9	53.9	2.9	126.9	?
	21.0 +	41.6	1.1	17.7	0.9	163.6	?
	Total 15.0+	116.9	6.1	71.7	3.8	290.5	?
All types	15.0 - 20.9	219.0	13.1	45.2	2.2	79.6	?
	21.0 +	382.0	6.5	48.9	0.8	96.0	?
	Total 15.0+	601.0	19.6	94.1	3.1	175.6	?

Table 2: Volume per acre and number per acre of smaller trees/logs (5 to 14.9 inches diameter) for live trees, standing dead trees, and downed logs on SMNRA forest land by cover type and diameter class, 2012.

Cover type	Diameter class	Live trees		Standing dead trees		Coarse woody debris	
		Volume/acre	Number/acre	Volume/acre	Number/acre	Volume/acre	Number/acre
Mixed conifer	5.0 - 8.9	159.5	82.1	20.6	10.9	129.2	?
	9.0 - 14.9	478.5	41.3	65.0	7.1	328.4	?
	Total 5.0 - 14.9	637.9	123.4	85.6	18.0	457.6	?
Pinyon-juniper	5.0 - 8.9	95.7	70.2	8.3	8.0	47.5	?
	9.0 - 14.9	254.3	45.4	22.1	6.0	84.3	?
	Total 5.0 - 14.9	350.0	115.6	30.3	14.0	131.8	?
Other types	5.0 - 8.9	31.4	30.4	17.1	15.4	72.0	?
	9.0 - 14.9	87.9	22.6	48.8	9.5	125.2	?
	Total 5.0 - 14.9	119.3	53.0	66.0	24.9	197.2	?
All types	5.0 - 8.9	93.9	65.2	11.5	9.7	63.1	?
	9.0 - 14.9	257.8	41.0	32.6	6.8	125.6	?
	Total 5.0 - 14.9	351.7	106.2	44.1	16.4	188.8	?

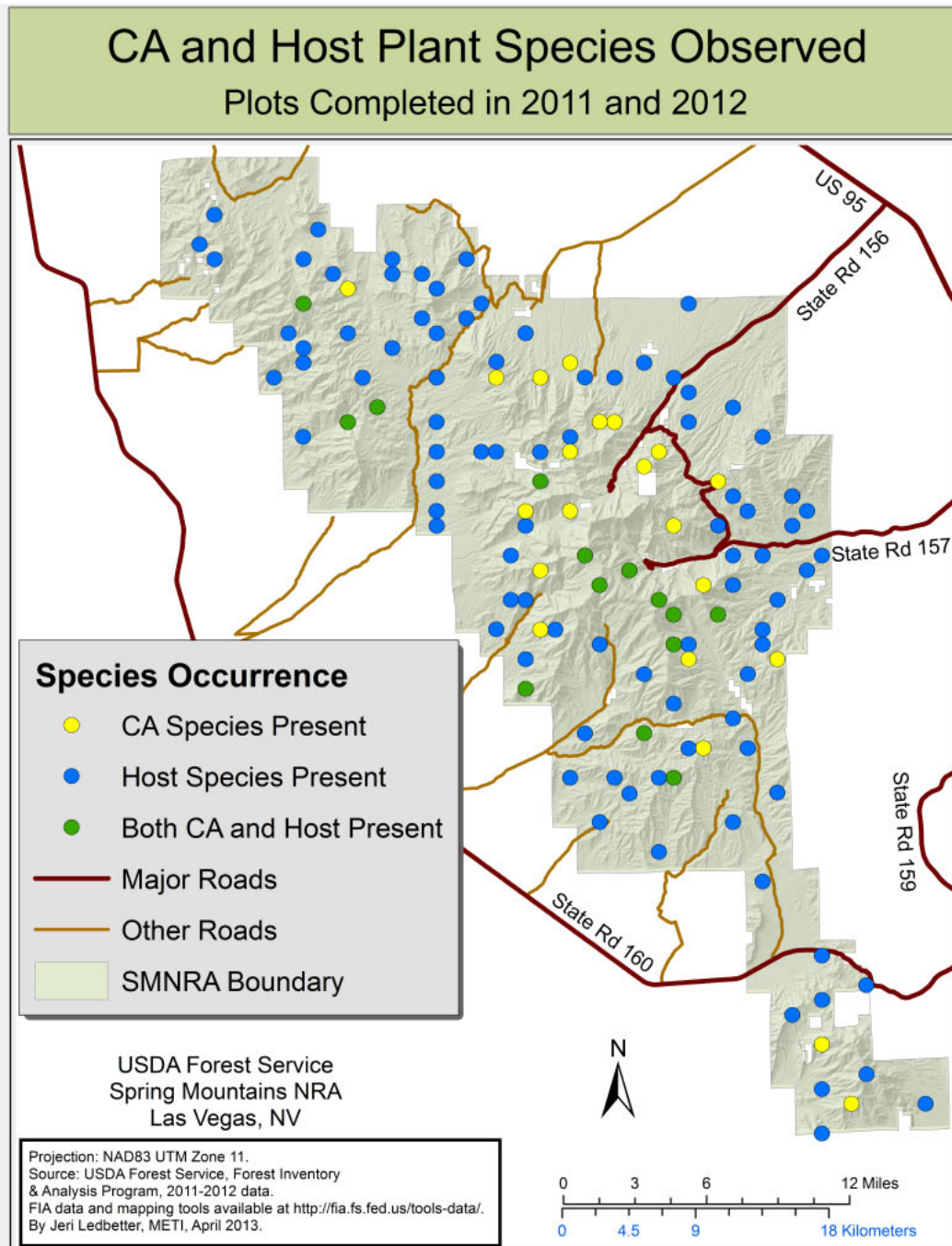
Table 3: Volume per acre and number per acre of all size classes of trees/logs (5 inches diameter and greater) for live trees, standing dead trees, and downed logs on SMNRA forest land by cover type and diameter class, 2012.

Cover type	Diameter class	Live trees		Standing dead trees		Coarse woody debris	
		Volume/acre	Number/acre	Volume/acre	Number/acre	Volume/acre	Number/acre
Mixed conifer	ALL	2,798.3	157.2	372.2	24.3	157.2	?
Pinyon-juniper	ALL	750.7	135.6	90.6	16.3	135.6	?
Other types	ALL	236.3	59.1	137.6	28.6	59.1	?
All types	ALL	952.7	125.7	138.2	19.5	125.7	?

Appendix C-2.4 Spring Mountain CA Species and Butterfly Host plants Observed on FIA Subplots

In an effort to assess the occurrence of CA Species plants and butterfly host plant distribution observations of these species were recorded on the subplots associated with each intensified FIA plot. Figure 1 shows the results of these observations.

Figure 1. CA and Butterfly Host Plants Observed on FIA Subplots



The use of a standard sampling “frame” or grid for these observations provides the basis for better understanding both where CA and butterfly host plant species occur and do not occur within the

SMNRA. This understanding does not evolve from typical project and species-specific surveys because they sample a smaller area of interest often using different sampling protocols that are not comparable.

As a demonstration, it is possible to project the potential acres represented within the SMNRA as shown in table 1 based on FIA subplot observations. However, this projection is not statistically accurate because of the sample size, but can be improved by installing additional subplots for project or species-specific surveys by (1) using these same sampling grid and (2) subplot sampling protocols.

Table 1. Acres of CA or Butterfly Host Plants Represented by FIA Subplot Observations

Species	Number of Subplots from Plots	Acres Represented
Charleston pussytoes (<i>Antennaria soliceps</i>)	5/4	2,003 acres
Clokey eggvetch (<i>Astragalus oophorus</i> var. <i>clokeyanus</i>)	3/2	1,148 acres
Spring Mountains rockcress (<i>Boechera nevadensis</i> = <i>Arabis nevadensis</i> = <i>A. pendulina</i> var. <i>pendulina</i>)	3/2	1,065 acres
Clokey paintbrush (<i>Castilleja martinii</i> var. <i>clokeyi</i> = <i>C. applegatei</i> ssp. <i>martinii</i>)	13/7	5,111 acres
Clokey thistle (<i>Cirsium clokeyi</i>)	4/2	1,420 acres
Wasatch draba (<i>Draba brachystylis</i>)	1/1	355 acres
Jaeger whitlow-grass (<i>Draba jaegeri</i>)	3/1	1,065 acres
Charleston draba (<i>Draba paucifructa</i>)	7/3	2,568 acres
Nevada willowherb (<i>Epilobium nevadense</i>)	1/1	438 acres
Spring Mountains goldenbush (<i>Ericameria compacta</i>)	18/9	6,804 acres
Clokey buckwheat (<i>Eriogonum heermannii</i> var. <i>clokeyi</i>)	4/3	1,731 acres
Hidden ivesia (<i>Ivesia cryptocaulis</i>)	3/1	1,065 acres
Hitchcock bladderpod (<i>Lesquerella hitchcockii</i>)	1/1	355 acres
Charleston pinewood lousewort (<i>Pedicularis semibarbata</i> var. <i>charlestonensis</i>)	12/6	4,921 acres
Charleston beardtongue (<i>Penstemon leiophyllus</i> var. <i>keckii</i>)	10/9	4,007 acres
Clokey mountain sage (<i>Salvia dorrii</i> var. <i>clokeyi</i> = <i>S. dorrii</i> ssp. <i>dorrii</i> var. <i>clokeyi</i>)	14/7	5,549 acres
Charleston tansy (<i>Sphaeromeria compacta</i>)	3/1	1,065 acres
Charleston kittentails (<i>Synthyris ranunculina</i>)	1/1	355 acres
Charleston grounddaisy (<i>Townsendia jonesii</i> var. <i>tumulosa</i>)	5/3	2,168 acres
Charleston violet (<i>Viola charlestonensis</i>)	10/6	4,046 acres

Two factors contribute to differences in estimated acres represented with the same number of plots and subplots.

1. Mapped plots: where conditions are mapped on a plot, the area represented by a plot is variable.
2. Post-stratification of the plots: the area expander for a plot depends on the strata assigned to the plot.

The calculation of area is the sum of condition proportions multiplied by area expanders. Condition proportions are affected by the first factor, and the area expanders are affected by the second factor.

This information could be improved as noted above by increasing the number of plots, but also by adjustments in queries and other analysis parameters used to generate the estimates of acres represented.

Appendix D – Springs and Riparian Inventory Data Reports

D-1: Springs and Riparian Inventory Program

- D 1.1: Distribution of Springs within the SMNRA
- D 1.2: Springs Inventoried and Inventory Status
- D 1.3: Riparian Areas Inventoried

D-2: Site Reports

- D 2.1: Site Report Attributes List
- D 2.2: Spring Site Report Example
- D 2.3: Riparian Site Report Example

D-3: SMNRA-wide Summary Reports

- D 3.1: SMNRA-wide Report Attributes List
- D 3.2: Springs Inventory Data (all years)
- D 3.3: Riparian Inventory Data (2012)

D-4: Monitoring Question Reports

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

References

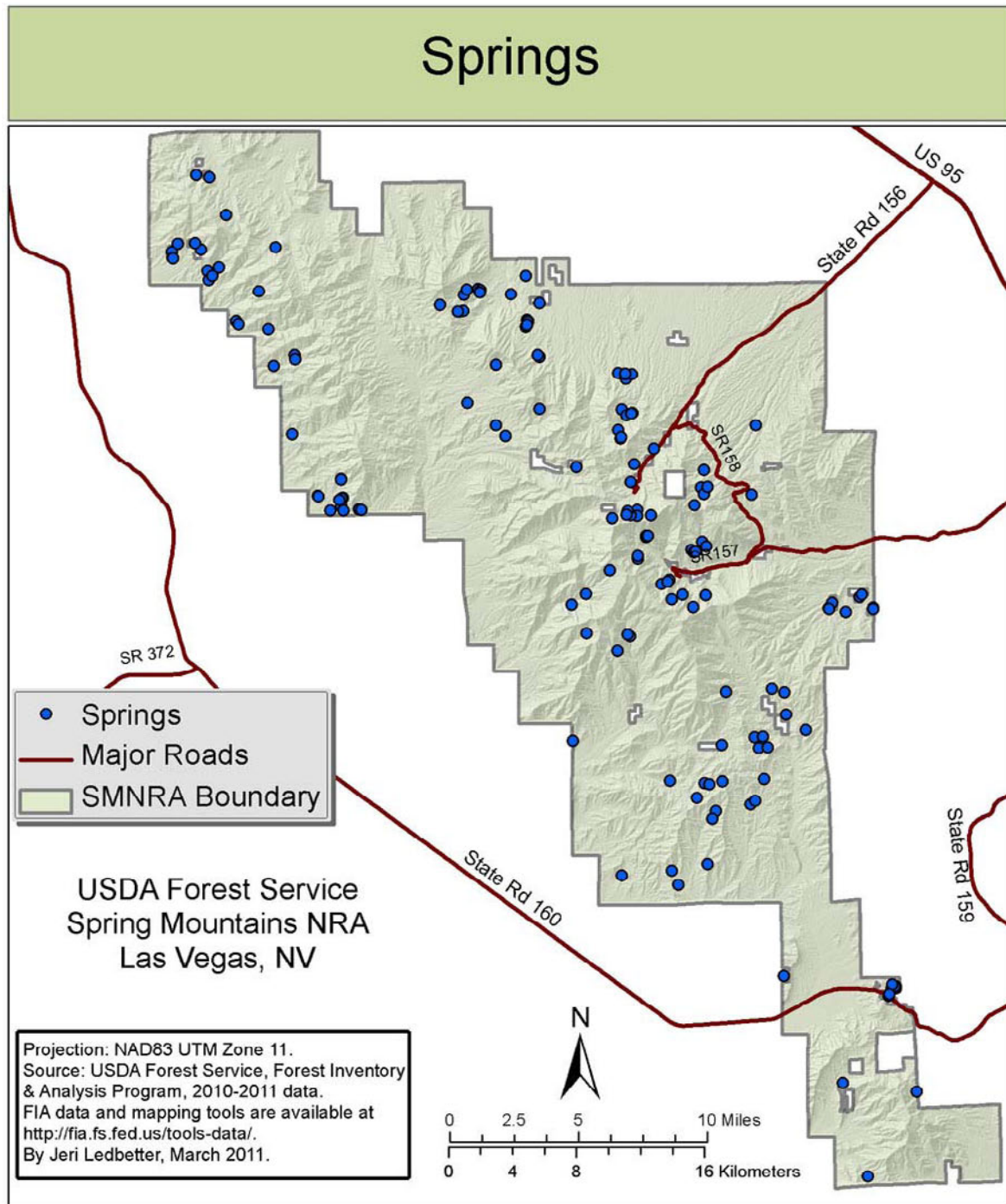


Figure 1. Springs (142) proposed for sampling during the 2010-2015 inventory program

Appendix D 1.2: Springs Inventoried and Inventory Status

A total of 77 spring sites (listed in the table below) were inventoried during the 2010–2012 sampling seasons. Most of those sites were on the schedule to be sampled because they were known to be springs from the *Spring Mountains National Recreation Area Landscape Analysis* (ENTRIX, Inc. 2008). Some additional springs (12) were found during the inventory fieldwork and are indicated in a separate column in the table below. A number of additional sites were visited and determined not to be springs and were not inventoried (a total of 21 sites listed in the table below). Two spring sites could not be visited because they were on private land as noted in the table.

Site Name	Site ID	Status of Scheduled Sites (date indicates when inventoried)	Unscheduled Sites Inventoried
Big Timber Spring	R4HTSMNRAH2O073	5/31/12	
Bill Smith Spring	R4HTSMNRAH2O065	5/27/12	
Cane Spring 1 (No Name 165)	R4HTSMNRAH2O003	Not a spring	
Carpenter Canyon 2	R4HTSMNRAH2O005	6/26/12	
Cathedral Chute Spring	R4HTSMNRAH2O199		7/26/11
Cave Spring	R4HTSMNRAH2O206		7/1/12
Cave Spring 1	R4HTSMNRAH2O136	8/1/11	
Cave Spring 2	R4HTSMNRAH2O135	8/3/11	
Cave West Spring	R4HTSMNRAH2O207		7/1/12
CC Spring	R4HTSMNRAH2O138	5/24/12	
Coal Spring	R4HTSMNRAH2O153	10/29/10	
Crow Spring (Jeff's)	R4HTSMNRAH2O007	6/30/12	
Crystal Springs	R4HTSMNRAH2O074	5/26/12	
East Mud Spring	R4HTSMNRAH2O091	7/30/11	
Edna Grey Spring	R4HTSMNRAH2O009	7/26/11	
Elbow Spring	R4HTSMNRAH2O204		9/7/11
ENE of Lost Cabin Spring	R4HTSMNRAH2O010	5/30/12	
Falls (No Name 108)		Not a spring	
Fletcher Spring	R4HTSMNRAH2O098	7/28/11	
Gold Spring	R4HTSMNRAH2O072	9/11/11	
Guzzler		Not a spring	
Jaybird Spring	R4HTSMNRAH2O013	6/1/12	
Lees Spring	R4HTSMNRAH2O015	6/25/12	
Lees Spring upper	R4HTSMNRAH2O208	6/25/12	
Lost Cabin Spring	R4HTSMNRAH2O147	5/28/12	
Lower Cougar Spring	R4HTSMNRAH2O081	9/9/11	
Lower Horse Springs (No Name 88)	R4HTSMNRAH2O115	Not a spring	
Macks Canyon 1	R4HTSMNRAH2O092	9/8/10	
Macks Canyon 2	R4HTSMNRAH2O093	6/30/12	
Mary Jane Falls	R4HTSMNRAH2O103	Not a spring	
McFarland Spring	R4HTSMNRAH2O088	6/28/12	
McWilliams	R4HTSMNRAH2O018	Not surveyed (2012) -- dry	
Middle Mud lower spring	R4HTSMNRAH2O194		6/29/12

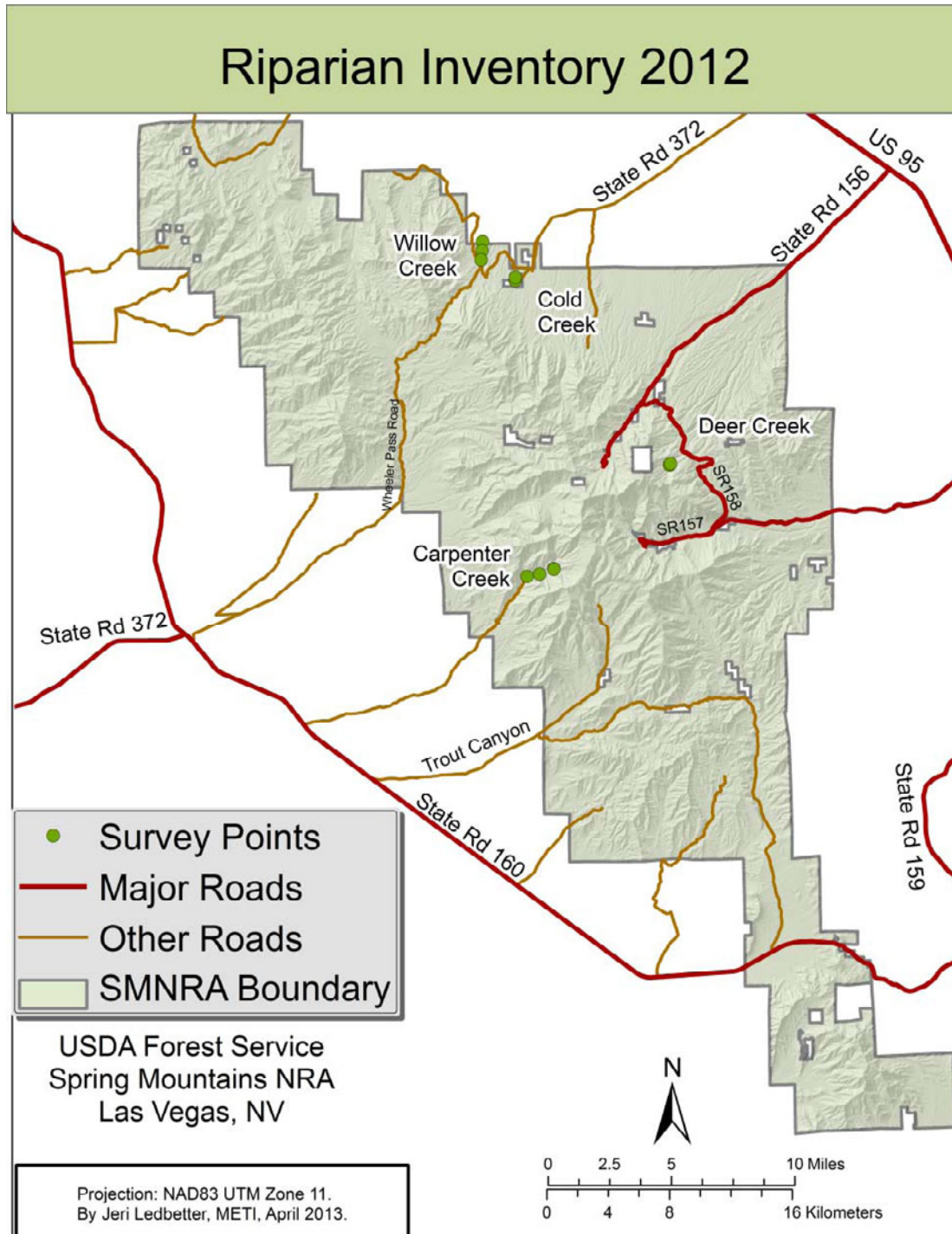
Site Name	Site ID	Status of Scheduled Sites (date indicates when inventoried)	Unscheduled Sites Inventoried
Middle Mud Spring	R4HTSMNRAH2O090	10/28/10	
Mossfoot Seep	R4HTSMNRAH2O202		9/8/11
Mountain 1	R4HTSMNRAH2O140	Not surveyed (2012) -- dry	
Mountain Man One Spring	R4HTSMNRAH2O205		5/22/12
Mountain Springs 2	R4HTSMNRAH2O029	5/22/12	
Mountain Springs 3	R4HTSMNRAH2O141	5/22/12	
Mountain Springs 4	R4HTSMNRAH2O142	5/23/12	
Mummy Spring	R4HTSMNRAH2O012	7/25/11	
Mummy View Spring	R4HTSMNRAH2O201		9/8/11
No Name 114 (falls)		Not a spring	
No Name 12		Not surveyed -- not on map	
No Name 81 (Tank)		Not surveyed - not a spring	
North Rainbow	R4HTSMNRAH2O076	Not surveyed (2012) -- dry	
Pahrump Spring (No Name 48)	R4HTSMNRAH2O020	Not a spring	
Pipilo Unnamed Spring	R4HTSMNRAH2O190		9/9/11
Quartzite Wall Unnamed Spring	R4HTSMNRAH2O191		10/26/10
Rock Spring	R4HTSMNRAH2O071	Not surveyed -- private land	
Roses Spring	R4HTSMNRAH2O137	8/2/11	
South Rainbow Spring	R4HTSMNRAH2O077	5/25/12	
Stanley B 1 Spring	R4HTSMNRAH2O099	7/24/11	
Stanley B 2 Spring	R4HTSMNRAH2O100	7/24/11	
Stanley B 3 Spring	R4HTSMNRAH2O101	9/13/10	
Stanley B Wet Wall	R4HTSMNRAH2O200	7/24/11	
Star Mound	R4HTSMNRAH2O209		6/26/12
Steller Spring	R4HTSMNRAH2O203		9/8/11
Tank (No Name 126)		Not a spring	
Three Springs 1	R4HTSMNRAH2O122	9/11/10	
Three Springs 2	R4HTSMNRAH2O123	9/11/10	
Trough Spring	R4HTSMNRAH2O086	6/27/12	
Two Springs	R4HTSMNRAH2O026	9/11/10	
Unnamed 31	R4HTSMNRAH2O070	Not surveyed (2012) -- dry	
Unnamed 1 Spring	R4HTSMNRAH2O027	10/21/10	
Unnamed 10 Spring	R4HTSMNRAH2O028	7/1/12	
Unnamed 19 Spring	R4HTSMNRAH2O033	Not surveyed -- secondary emergence of upstream spring	
Unnamed 20 Spring	R4HTSMNRAH2O035	9/7/11	
Unnamed 21 Spring	R4HTSMNRAH2O126	9/12/10	
Unnamed 27 Spring	R4HTSMNRAH2O121	9/10/11	
Unnamed 28 Spring	R4HTSMNRAH2O036	5/27/12	
Unnamed 32 Spring	R4HTSMNRAH2O038	5/26/12	
Unnamed 34 Spring	R4HTSMNRAH2O082	Not surveyed -- dry	
Unnamed 41 Spring	R4HTSMNRAH2O062	10/23/10	

Site Name	Site ID	Status of Scheduled Sites (date indicates when inventoried)	Unscheduled Sites Inventoried
Unnamed 45 Spring	R4HTSMNRAH2O112	9/14/11	
Unnamed 47 Spring	R4HTSMNRAH2O111	Not surveyed -- dry	
Unnamed 49 Spring	R4HTSMNRAH2O117	9/13/11	
Unnamed 50 Spring	R4HTSMNRAH2O109	5/29/12	
Unnamed 51 Spring	R4HTSMNRAH2O110	5/29/12	
Unnamed 55 Spring	R4HTSMNRAH2O119	9/13/11	
Unnamed 56 Spring	R4HTSMNRAH2O048	9/13/10	
Unnamed 59 Spring	R4HTSMNRAH2O050	7/27/11	
Unnamed 67 Spring	R4HTSMNRAH2O095	9/12/10	
Unnamed 74 Spring	R4HTSMNRAH2O056	Not surveyed -- secondary emergence of upstream spring	
Unnamed 75 Spring	R4HTSMNRAH2O057	8/2/11	
Unnamed 80 Spring	R4HTSMNRAH2O060	6/29/12	
Unnamed 9 Spring	R4HTSMNRAH2O061	7/29/11	
Unnamed Spring 2 (No Name 146)	R4HTSMNRAH2O034	Not a spring	
Unnamed Spring 35 (No Name 15)	R4HTSMNRAH2O069	Not surveyed -- private land	
Unnamed Spring 37 (No Name 30)	R4HTSMNRAH2O039	Not a spring	
Upper Cougar Spring	R4HTSMNRAH2O080	10/27/10	
Upper Horse Springs	R4HTSMNRAH2O113	10/23/10	
Upper Lost Cabin Spring	R4HTSMNRAH2O148	10/20/10	
Upper Sawmill Spring	R4HTSMNRAH2O024	10/27/10	
West Mud Spring	R4HTSMNRAH2O089	7/30/11	
Wheeler Well		Not a spring	
Whiskey Spring	R4HTSMNRAH2O127	6/28/12	
Willow Spring	R4HTSMNRAH2O084	9/9/10	
Wood Canyon Spring	R4HTSMNRAH2O078	10/24/10	
Younts Spring	R4HTSMNRAH2O149	9/12/11	

Appendix D 1.3: Riparian Areas Inventoried

Surveys were conducted of the riparian areas associated with the four perennial streams in the SMNRA – Carpenter, Cold, Deer and Willow Creeks (see fig. 2). The field work was done by Marc Coles-Ritchie and George Walker Johnson (both of METI, Inc.) during September 10–13, 2012.

Figure 2. Locations of the riparian inventories



Appendix D 2.1: Site Report Attributes List

Springs

A site report (see appendix D 2.2) with the attributes listed in table 1 was generated for each spring surveyed. Detailed descriptions of these attributes, their meaning, and potential uses can be found in the *Groundwater-Dependent Ecosystems: Level II Inventory Field Guide* (USDA Forest Service 2012a).

After each field season the Northern Arizona University (NAU) field team created a report with a site report for each spring surveyed. To date there have been three of those reports; one for the 2010 field season (Springer et al. 2010); one for the 2011 field season (Springer and Ledbetter 2011); and another for the 2012 field season (Springer et al. 2012). Table 1 below presents an example of one spring site report from the 2012 field season. That site report was generated by an Access database designed for the groundwater-dependent ecosystem (GDE) data, which is where the SMNRA springs data are stored and managed.

Riparian Areas

A similar site report (see appendix D 2.3) was generated for each riparian reach inventoried. The riparian reports are based on data collected using the Forest Service's draft *National Riparian Vegetation Monitoring Core Protocol: Western U.S.* (USDA Forest Service 2012b). For each stream, the field crew walked to the upstream point where surface water began, as long as that was on National Forest System lands, and collected data for stream reaches at systematic points over the full extent of the stream as far as the surface water continued. Transects were systematically established within each reach and the line-point-intercept method was used to record the following attributes: herbaceous and woody vegetation, ground cover class, and fluvial surface class. In addition, any disturbances and management indicators observed at the stream reach were recorded using the form from the *Groundwater-Dependent Ecosystems: Level II Inventory Field Guide* (USDA Forest Service 2012a). The riparian data collection did not include data on soils, hydrology, or fauna.

Table 1: List of attributes described in each spring site report.

Category	Attributes Summarized
Vegetation	Plant species cover Prevalence Index (based on wetland indicator status) Count of trees Basal area of trees Bryophyte cover Ground cover (bare, gravel, litter, etc.)
Soil	Depths and thicknesses of organic and mineral layers List of redoximorphic features observed Texture and color Fen characteristics present
Hydrology	Water table depth Flow (for springs and channels) Water quality – pH – Conductivity – Oxygen-reduction potential (ORP) – Dissolved oxygen – Temperature
Fauna	Species list of animals (vertebrates and invertebrates)
Disturbance	Lists of disturbances observed in these categories: – Hydrologic alteration – Soil alteration – Structures – Recreation effects – Animal effects – Other disturbances
Management Indicator Tool	List of indicators of management activities affecting site

Appendix D 2.2: Spring Site Report Example

Mountain Springs 4

ID# R4HTSMNRAH2O142

Survey Date: 5/23/2012
 Ownership: USFS
 Region, Forest: 4, Humboldt-Toiyabe
 District: SMNRA
 State, County: NV, Clark

GDE Type(s): hillslope, rheocrene

Aspect (TN): 196

Elevation (m): 1684

Coordinates 36 1 29 Latitude
 -115 30 13.11 Longitude

Area: 8100 square meters

Surrounding Vegetation Tree dominated

Surficial Material: Colluvium, Alluvium

Lithology: Sedimentary, Limestone



Ground Cover	% Cover
Bare soil	9.1
Basal vegetation	3.4
Bedrock	0.0
Boulder	0.0
Bryophyte	0.0
Cobble	0.0
Gravel	8.0
Litter	78.4
Stone	1.1
Water	0.0
Wood	0.0

Vegetation Attribute	Results			
Prevalence Index (based on wetland indicator status)	1.93			
Prevalence Index Scale				
1	2	3	4	5
Wetland Vegetation				Upland Vegetation
Tree basal area - live (sq m)	0.00			
Tree basal area - dead (sq m)	0.00			
Woody line intercept percent	8.3			
Site total species count	47			
Bryophyte percent cover	0.0			

Hydrologic Attribute	Results
Water table type	Ponding
Inflow pattern	Groundwater inflow dominated
Outflow pattern	Surface water outflow dominated
Surface water	Patches of standing water; Some developing channels;
Water table avg depth (cm)	Undetermined
Flow estimate (L/sec)	0.02
Water Quality (Site Average)	
pH	7.40
Specific conductance (uS/cm)	696.0
Dissolved oxygen (mg/L)	6.76
Dissolved oxygen saturation (%)	
Oxygen-reduction potential (mV)	177.30
Temperature (C)	15.2

Appendix D 2.2: Spring Site Report Example (Continued)

Mountain Springs 4 (continued)

Vegetation

Quadrat Species

Species, USDA Symbol	Native Status	% Cover
Anemopsis californica, ANCA10	N	2.5
Carex praegracilis, CAPR5	N	4.3
Cirsium neomexicanum, CINE	N	2.8
Eleocharis rostellata, ELRO2	N	2.7
Juncus balticus, JUBA	N	15.8
Muhlenbergia asperifolia, MUAS	N	18.1
Rhus trilobata, RHTR	N	0.3
Sisyrinchium radicum, SIRA3	N	0.5
Solidago spectabilis var. confinis, SOSPC	N	1.1
Sporobolus airoides, SPAI	N	4.6

Additional Plants

Species, USDA Symbol
Leymus cinereus, LECI4
Gaura coccinea, GAC05
Bromus rubens, BRRU2
Aristida purpurea, ARPU9
Comandra umbellata ssp. californica, COUMC
Ceanothus greggii, CEGR
Thelypodium integrifolium ssp. affine, THINA
Bromus tectorum, BRTE
Taraxacum officinale ssp. officinale, TAOF
Carex aurea, CAAU3
Artemisia tridentata, ARTR2
Argemone munita, ARMU
Purshia stansburiana, PUST
Unk shrub 1,
Elymus elymoides, ELEL5
Gutierrezia sarothrae, GUSA2
Erodium cicutarium, ERIC6
Descurainia pinnata, DEPI
Marrubium vulgare, MAVU
Lappula occidentalis var. occidentalis, LAOCO
Dactylis glomerata, DAGL
Poa pratensis ssp. pratensis, POPRP2
Distichlis spicata, DISP
Lepidium, LEPID
Penstemon rostriflorus, PERO10
Mahonia fremontii, MAFR3
moss, 2MOSS
Lactuca serriola, LASE
Castilleja linariifolia, CALI4
Melilotus, MELIL

Quadrat Plant Species 10 Average % Cover/Quadrat 52.7

Woody Line-Intercept

Species, USDA Symbol	% Cover
Amelanchier utahensis, AMUT	0.2
Artemisia tridentata, ARTR2	0.3
Juniperus osteosperma, JUOS	0.6
Pinus monophylla, PIMO	1.1
Quercus gambelii, QUGA	0.5
Rosa woodsii, ROWO	4.9
Yucca baccata, YUBA	0
Yucca schidigera, YUSC2	0.8

Tree Belt Transects

Species, USDA Symbol	Status	Count	Mean DBH (cm)
Pinus monophylla, PIMO	live	1	3.0

Mountain Springs 4 (continued)**Fauna**

Vertebrate Species	Detection	Comments
ash-throated flycatcher, <i>Myiarchus cinerascens</i>	obs	
black-chinned hummingbird, <i>Archilochus alexan</i>	obs	
black-throated sparrow, <i>Amphispiza bilineata</i>	call	
brown-headed cowbird, <i>Molothrus ater</i>	obs	
elk, <i>Cervus canadensis</i>	sign	scat
horse, <i>Equus caballus</i>	sign	scat
lesser goldfinch, <i>Carduelis psaltria</i>	obs	
mule deer, <i>Odocoileus hemionus</i>	sign	
northern flicker, <i>Colaptes auratus</i>	obs	
scrub jay, <i>Aphelocoma californica</i>	obs	
sparrow, <i>Passer</i> sp	call	
spotted towhee, <i>Pipilo maculatus</i>	call	
turkey vulture, <i>Cathartes aura</i>	obs	
western tanager, <i>Piranga ludoviciana</i>	obs	
western wood-pewee,	obs	

Invertebrate Species	Detection	Comments
COL Buprestidae	spot	
COL Chrysomelidae	spot	
LEP Hesperidae <i>Heliopetes ericetorum</i>	obs	
LEP Nymphalidae <i>Nymphalis antiopa</i>	obs	
NEU Chrysopidae	spot	
ODO Aeshnidae	obs	

Mountain Springs 4 (continued)

Disturbance

Hydrology: Water diversion (permanently diverted); Downgradient capture of surface water or groundwater (post-spring emergence); Extraction of water within a wetland; Extraction of water at spring source;

Soil alteration: Channel erosion; Compaction; Debris flow; Deposition; Excavation; Ground disturbance (general); Gully erosion; Pedestals or hummocks (by people or animals); Pipes; Ruts (from vehicle tread); Trails (by people or animals);

Structures: Road (includes construction and maintenance);

Recreational effects: Camp sites; Tracks or trails by vehicles (ATV, 4WD, etc);

Animal effects: Feral animals; Grazing or browsing (by ungulates); Wild animals; Trails by animals and people; Trampling (by ungulates, native or nonnative);

Miscellaneous effects: Fire;

Disturbance Notes

Soils

Soil pits were dug only at odd transects. Of 7 randomized pits, 3 were at locations where there was no soil and it was not possible to dig pits. Of the other 4, hole depths were 26 cm (2), 14 cm, and 20 cm. There was no peat, mucky peat, or muck in any of the pits. Depth to the mineral layer was 0 cm at all locations. Textures were silty clay (2), silt and fine sand, and 70% silt, 20% fine sand, 10% medium sand. Color of the mineral soil was 10YR 2/2, 5 YR 2/2, 10 YR 5/4, and 10 YR 4/2. There were no redoximorphic features, no hydrogen sulfide odor, and no reaction to HCL.

Appendix D 2.2: Spring Site Report Example (Continued)

Mountain Springs 4 (continued)

Management Indicators

1) Aquifer (groundwater) not altered	False	Groundwater pumping in the area.
2) Watershed (surface water) not altered	True	
3) Water quality changes not affecting site	True	
Geomorphology and Soils		
4) Landform stability not altered	False	Road across top of the site.
5) Runout channel functioning naturally	False	Heavily disturbed.
6) Soil integrity not altered	False	Erosion present
Biology		
7) Vegetation composition as anticipated	True	True
8) Vegetation condition is healthy	True	
9) TES, SOI/SOC, focal flora as anticipated	True	
10) Faunal species as anticipated	True	
11) TES, SOI/SOC, focal fauna as anticipated	True	
12) Invasive species not established	False	Bromus tectorum, B. rubens
Disturbances		
13) Flow regulation not adversely affecting site	False	Some flow regulation
14) Construction, Roads not adversely affecting	False	Road at top of site
15) Fencing functions properly	NA	No fencing
16) Herbivory not adversely affecting site	False	Grazed and trampled
17) Recreation not adversely affecting site	False	Road at top of site.
18) Other disturbance not adversely affecting	True	
Administrative Context		
19) Cultural values do not affect site mgmt	False	All SMNRA springs are culturally significant.
20) Land ownership is FS in and around site	False	Adjacent landowner piping water
21) Other landowner actions not affecting site	True	Adjacent landowner piping water
22) Land Management Plan provides protection	True	
23) Environmental compliance occurring	True	
24) Water uses not adversely affecting site	True	
25) Water rights filed and not outstanding	True	

Plant codes and native status are from the USDA PLANTS database web page: <http://plants.usda.gov>

Appendix D 2.3: Riparian Site Report Example

Stream Name: Carpenter

Reach Number: 2

Relation to other reaches: middle of three reaches

Survey Date: September 13, 2012

Elevation (m): 2,226

Coordinates (easting and northing): 0614854 4011748

Notes: Bedrock constrains the channel and riparian area on the left (facing downstream) side. There is not a spring inventoried by the NAU crew near this reach.



Plant Species	Common name	Cover		
		Understory (< 1.5 m)	Mid layer (1.5-5 m)	Upper layer (>5 m)
<i>Jamesia americana</i>	Five-petal cliffbush	29%	3%	
<i>Salix lasiolepis</i>	arroyo willow	3%		
<i>Platanthera sparsiflora</i>	canyon bog orchid	2%		
<i>Abies concolor</i>	white fir	2%	2%	
<i>Frangula betulifolia</i>	birch-leaf false buckthorn		3%	

Additional Species Observed	Common Name
<i>Acer glabrum</i>	Rocky Mountain maple
<i>Aquilegia formosa</i>	crimson columbine
<i>Bromus ciliatus</i>	fringed brome
<i>Carex</i> sp.	sedge (species undetermined)
<i>Cirsium arizonicum</i>	arizona thistle
<i>Epilobium halleanum</i>	glandular willowherb
<i>Thinopyrum intermedium</i>	intermediate wheatgrass

Appendix D 2.3: Riparian Site Report Example (continued)

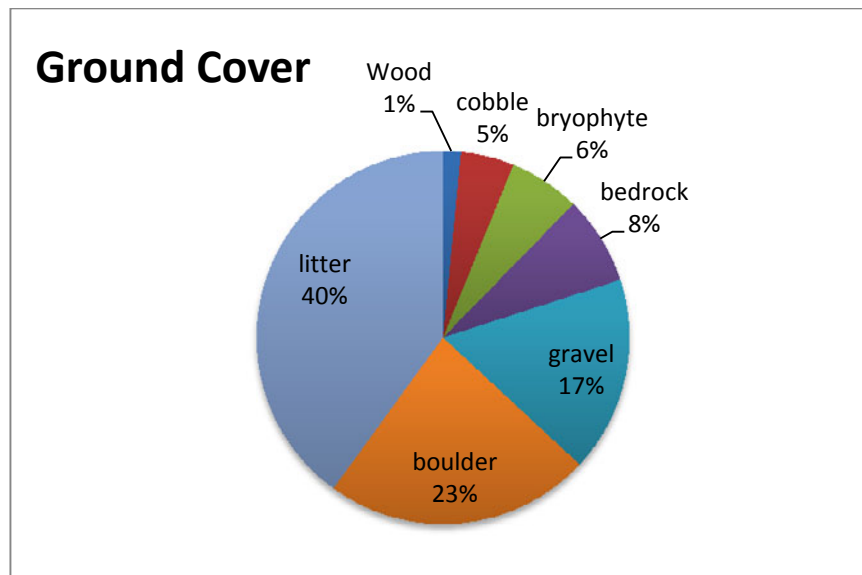
The prevalence index (based on plant species “Wetland Indicator Status” of U.S. Fish & Wildlife Service, 2012) for this reach is 3.8.



Non-native plant species: *Thinopyrum intermedium*

Width of riparian area and stream combined (average of transect lengths): 10.6 meters

Fluvial Setting	Percent of Area
Terrace	38%
Channel	31%
Bank	28%
Floodplain	3%



Disturbance and Management

- Disturbances observed:
 - debris flow
 - mass wasting
 - natural dams
 - refuse
 - trails (people and animals)
- Management Indicator Tool negative responses:
 - Vegetation condition
 - Vegetation composition

Appendix D 3.1: SMNRA-wide Report Attributes List

Data from all the spring sites surveyed in the SMNRA were used to calculate the summary attributes listed in table 2 and presented in the next section. The *Groundwater-Dependent Ecosystems: Level II Inventory Field Guide* (USDA Forest Service 2012a) describes data definitions and attributes.

Table 2. List of attributes summarized for all spring sites sampled in the SMNRA.

Category	Attributes Summarized
Vegetation	List of all species observed Species cover (averages) Non-Native (introduced) species cover (average) Prevalence Index (average) Species count per site (average) Byrophyte cover (average) Ground cover (averages)
Soil	Average depths and thicknesses of organic layer Percent of sites with each redoximorphic feature List of soil texture and color
Hydrology	Water table depth (average) Flow (range and 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

Similar summaries are reported for the riparian areas in the SMNRA. However, since vegetation was the focus of the riparian data collection, there are no summaries of soils, hydrology, and fauna for riparian sites.

Appendix D 3.2: Springs Inventory Data (all years)

This section presents summarized data for all 77 springs surveyed during 2010–2012. The 2010 and 2011 Annual Reports for the SMNRA summarized the 2010 and 2011 data.

For all spring sites inventoried from 2010–2012, the average size was 487 square meters (m²), the median was 117 m², and the size range was from 0.75 m² (Unnamed 41 Spring) to 8,100 m² (Mountain Springs 4).

Eight different spring types were observed in the surveys, as well as an “unknown” category. Many sites (44) had just one spring type, while 30 sites had two spring types recorded, and three sites were listed as "unknown" because the sites had been so impacted by human activities that it was not possible to determine the spring type (see table 3). For example, Gold Spring was likely a hillslope spring, but it was excavated to form a pool. Younts Spring was likely a helocrene, but water was pumped and diverted, and there was a huge amount of earth movement. Unnamed Spring 21 was probably a hillslope spring, but now it is a culvert.

The most common spring types observed were hillslope (spring and/or wetland on a hillslope, generally 20- to 60-degree slope, often with indistinct or multiple sources of groundwater) which was observed at 40 sites, and rheocrene (a flowing spring that emerges directly into one or more stream channels) which was observed at 39 sites. Those two spring types (hillslope and rheocrene) were often observed at the same site (in 16 cases) and was the most frequently observed combination of spring types.

Table 3. Spring types (based on Springer and Stevens 2008) observed between 2010 and 2012.

Spring Types (at a site)	Sites
Cave	1
Cave, Hanging garden	1
Gushet, Hillslope	1
Hanging garden	7
Hanging garden, Rheocrene	2
Helocrene, Hillslope	4
Helocrene, Rheocrene	2
Hillslope	18
Hillslope, Hypocrene	1
Hillslope, Rheocrene	16
Hypocrene	1
Hypocrene, Rheocrene	3
Mound-form	1
Rheocrene	16
Unknown	3
TOTAL	77

Vegetation

This summary of the vegetation of springs of the SMNRA uses the combined data from the 2010–2012 inventories. There were 244 vascular plant species recorded during the sampling of the 77 spring sites. The total number of species in the SMNRA is reported to be 1,015 by Niles and Leary (2007). That would indicate that the springs contained 24% of all the species of the SMNRA. An additional small number of plants could not be identified to species, primarily because of limited plant material (including a lack of flowers or fruits) often because of grazing by horses. There were an average of 8.5 species observed per site.

Herbaceous species that were most abundant were scented shootingstar (*Primula fragrans*, also known as *Dodecatheon redolens*) with 4.6% cover, Western Columbine (*Aquilegia formosa*) with 2.7% cover, baltic rush (*Juncus balticus*) with 1.2% cover, stinging nettle (*Urtica dioica*) with 0.8% cover, desert baccharis (*Baccharis sergiloides*) with 0.8% cover, and scratchgrass (*Muhlenbergia asperifolia*) with 0.7% cover. Moss (bryophyte) cover averaged 5.4%.

The shrub species that were most abundant were Woods' rose (*Rosa woodsii*) with 7.2% cover, arroyo willow (*Salix lasiolepis*) with 4.9% cover, desert baccharis (*Baccharis sergiloides*) with 4.3% cover, fivepetal cliffbush (*Jamesia americana*) with 2.0% cover, canyon grape (*Vitis arizonica*) with 1.9% cover, stretchberry (*Forestiera pubescens*) with 1.3% cover, and narrowleaf willow (*Salix exigua*) with 1.1% cover. The woody vine western white clematis (*Clematis ligusticifolia*) had 0.8% cover.

The tree species that were most abundant were white fir (*Abies concolor*) with 4.5% cover, ponderosa pine (*Pinus ponderosa*) with 4.2% cover, Rocky Mountain juniper (*Juniperus scopulorum*) with 3.4% cover, Utah juniper (*Juniperus osteosperma*) with 1.6% cover, quaking aspen (*Populus tremuloides*) with 0.9% cover, and Gambel oak (*Quercus gambelii*) with 0.7% cover. In terms of tree counts, 20 sites (26%) had trees (greater than 5 cm in diameter-at-breast-height or DBH) within the site, and each of those sites had 1 to 21 individual trees. The average DBH of trees observed was 26.8 centimeters and the largest DBH was 107 centimeters. Sites with individual tree species smaller than 5 centimeters DBH were not included in these calculations. The total basal area of trees, at sites with trees, ranged from 0.0007 m² to 1.8 m². Some sites had cover from trees that were just outside the site, but had no trees within the site. Eight sites had a standing dead tree (the maximum was two trees). Every site that had standing dead trees also had live trees.

Woody vegetation (shrub or tree) cover was recorded at 90.0% of sites. The average amount of canopy cover of shrubs and trees was 41.6%. A few sites averaged over 100% canopy cover because of multiple layers of woody vegetation (i.e., different species). The maximum canopy cover value was 141.2%.

Non-native species were recorded at 52% of sites. There were a total of 29 non-native plant species observed. The average cover of non-native species at a site was 3.0%. A different but related category of plants are invasive species, which are determined by states or other entities. The only plants observed from the State of Nevada Noxious Weed List were saltcedar (*Tamarix ramosissima*) and tamarisk (*Tamarix chinensis*). Other observed species that are considered invasive in other administrative jurisdictions were: red brome (*Bromus rubens*), cheatgrass (*Bromus tectorum*), dandelion (*Taraxicum officianale*), yellow sweetclover (*Melilotus officianalis*), water speedwell (*Veronica anagallis aquatica*), common reed (*Phragmites australis*), annual rabbitsfoot grass (*Polypogon monspeliensis*), and common mullein (*Verbascum thapsus*).

The only CA species encountered during the 2010–2012 springs surveys were Charleston Mountain angelica (*Angelica scabrida*) and trianglelobe moonwort (*Botrychium ascendens*).

Vegetation data were used to calculate a “prevalence index” which is a commonly used method to describe the abundance of wetland vegetation for a site and to determine if a site is a wetland (National Research Council 1995). The prevalence index has been described as a way of characterizing the “wetlandness” of a site (Tiner 1999). The prevalence index is calculated using a weighted average of the species abundance (cover in this case) and the wetland indicator status value (Reed 1988) to characterize a site's vegetation on a scale of 1 (all obligate wetland species) to 5 (all upland species). A value below three is generally considered to be a wetland. For the 77 SMNRA spring sites where vegetation data were collected, the range in the prevalence index values was 1.0 to 4.1, and the average for all sites was 2.4.

Vegetation data for each site were compared to community type classifications described by Manning and Padgett (1995), Nachlinger and Reese (1996), and Weixelman et al. (1996). The dominant vegetation for each site matched relatively well with a community types described in these classifications. The number of sites with each community types is presented in table 4.

Table 4. Vegetation types of the springs inventoried in the SMNRA during 2010–2012.

Vegetation Type	2010	2011	2012	Total
<i>Aquilegia formosa</i> - <i>Smilacina stellata</i> / <i>Rosa woodsii</i> var. <i>ultramontana</i> Association (Nachlinger and Reese 1996)	4	10	8	22
<i>Baccharis sergiloides</i> Association (Nachlinger and Reese 1996)	4	4	6	14
<i>Cirsium clokeyi</i> / <i>Juniperus communis</i> var. <i>depressa</i> Association (Nachlinger and Reese 1996)	3	3		6
<i>Jamesia americana</i> / <i>Petrophytum caespitosum</i> - <i>Ivesia jaegeri</i> Association (Nachlinger and Reese 1996)			1	1
<i>Juncus balticus</i> Community Type (Manning and Padgett 1995)			3	3
<i>Juniperus scopulorum</i> / <i>Epilobium ciliatum</i> Habitat (Nachlinger and Reese 1996)		1		1
Conifer/ <i>Rosa woodsii</i> Community Type (Manning and Padgett 1995)			2	2
<i>Rosa woodsii</i> var. <i>ultramontana</i> Association (Nachlinger and Reese 1996)	1	5	4	10
<i>Salix exigua</i> - <i>Peraphyllum ramosissimum</i> Habitat (Nachlinger and Reese 1996)			1	1
<i>Salix lasiolepis</i> / <i>Rosa woodsii</i> var. <i>ultramontana</i> Community Type (Manning and Padgett 1995)	2	4	4	10

Note: Seven sites had little or no vegetation, and are not included in these totals.

Ground Cover

Ground cover data describe what is on the ground surface and is summarized here as litter and wood (dead plant material, including leaves and branches), rock and gravel (including gravel, cobble, boulder and bedrock), bryophytes, water, or basal vegetation (where the plant emerges from the ground). If there was none of those ground cover types then it was recorded as bare ground. Significant bare ground at a spring could be an indicator of excessive disturbance. The average ground cover for the springs of the SMNRA is represented in figure 3, with litter and wood being the most abundant type.

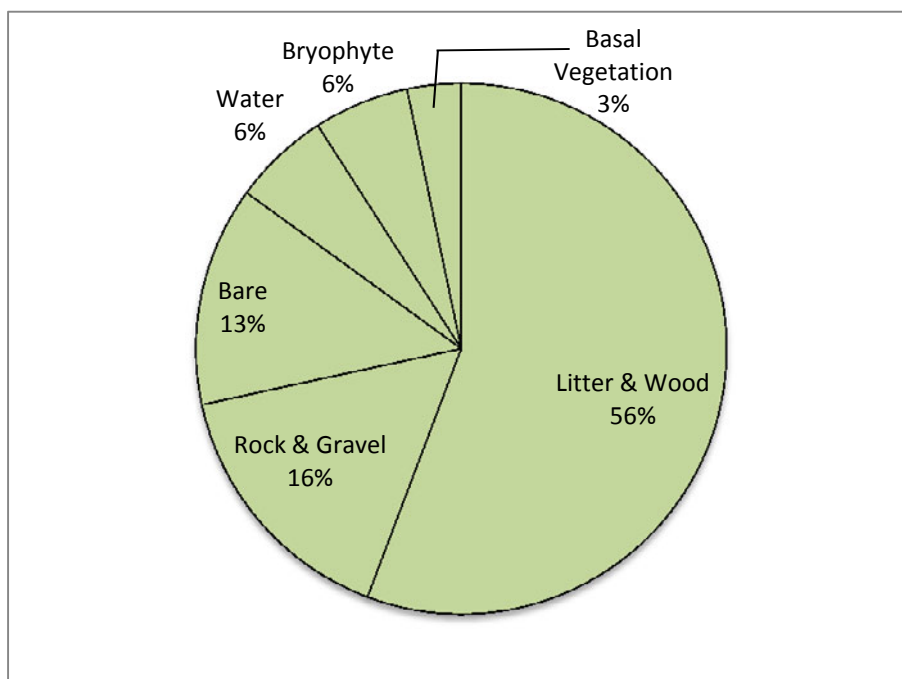


Figure 3. Average ground cover data for the 77 spring sites sampled from 2010–2012.

Soil

Most spring sites in the SMNRA did not have organic soil. At five sites a peat layer was recorded that was 1 to 50 centimeters thick. Among all the sites surveyed, the soil texture was commonly sand and silt and soil colors were 10Y, 10YR, 5G, 5Y, and 5YR. Redoximorphic features were detected at three sites (Mack's Canyon 1, Mountain Springs 3, and Unnamed 45). A hydrogen sulfide odor was detected in the soil at two sites (Mack's Canyon 1 and Unnamed 45). At one site (Mountain Springs 3) the soil reacted to HCL. Holes dug for soil sampling averaged 12.7 centimeters in depth.

Hydrology

Measurement of water table depth is primarily intended for wetlands, not for springs, therefore that was generally not measured at the SMNRA sites. At the 10 sites where a water table depth was measured, the average was 6.6 cm.

Flow was measured at springs or runout channels of wetlands at 45 sites (58% of all sites). The average flow was 0.32 L/second, the median flow was 0.13 L/second, with a range of 0.002 to 1.9 L/second. At the other sites there was either no discernible flow or the flow was diffuse and could not be measured.

Table 5 presents data on water quality and various box and whisker plots (see figures 4 through 8) show the distribution of the hydrologic data for all spring sites sampled during 2010–2012.

Table 5. Water quality data from springs sampled in 2010, 2011 and 2012

Attribute	Minimum	Median	Average	Maximum	Sites Measured
Temperature (centigrade)	3.0	11.3	12.0	19.5	n=65
pH	6.5	7.5	7.5	8.6	n=67
Specific Conductance (microsiemens/centimeter)	136.0	496.0	533.2	1011.3	n=64
Oxygen-reduction potential (mV)	-76.9	147.0	139.7	270.6	n=48
Dissolved oxygen (mg/L)	1.9	6.0	5.8	10.3	n=36

Note: Not all of the 77 sites had measurements, primarily because of a lack of standing or flowing water.

Temperature of spring water can be an indirect indicator of flow path conditions and recharge events. The large range of spring water temperatures, from 3.0 to 19.5°C (see fig. 4), indicates there is a significant variety in spring recharge sources. The coldest springs are likely snowmelt emerging after a short flow path, whereas the highest temperature springs are likely karst or thermal springs – where the water has been transported very rapidly (karst systems) or was brought up from depth where temperatures are much higher.

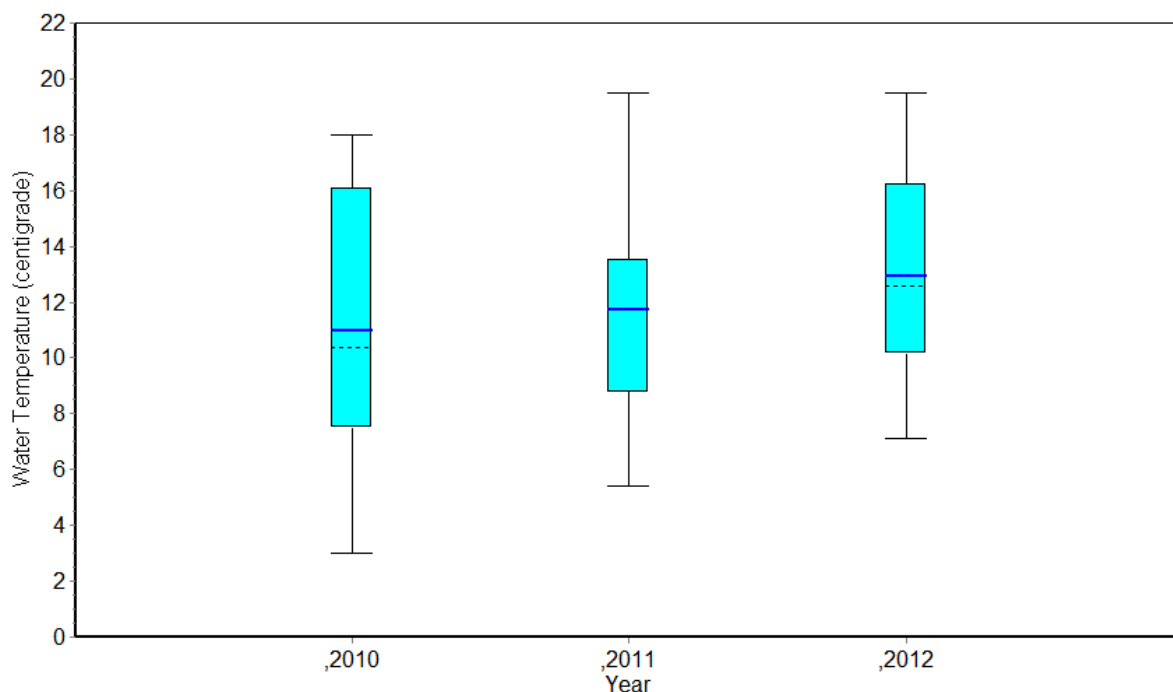


Figure 4. Distribution of the water temperature (centigrade) for springs sampled during 2010–2012. Mean value is solid blue line and median value is dashed blue line.

Values of pH are an indicator of the acidic/basic condition of the water and explain some variability in the life supported at a site. The moderate range of pH values, from 6.5 to 8.6 (see fig. 5) could be one reason for the high diversity of animals and plants at the springs in the SMNRA.

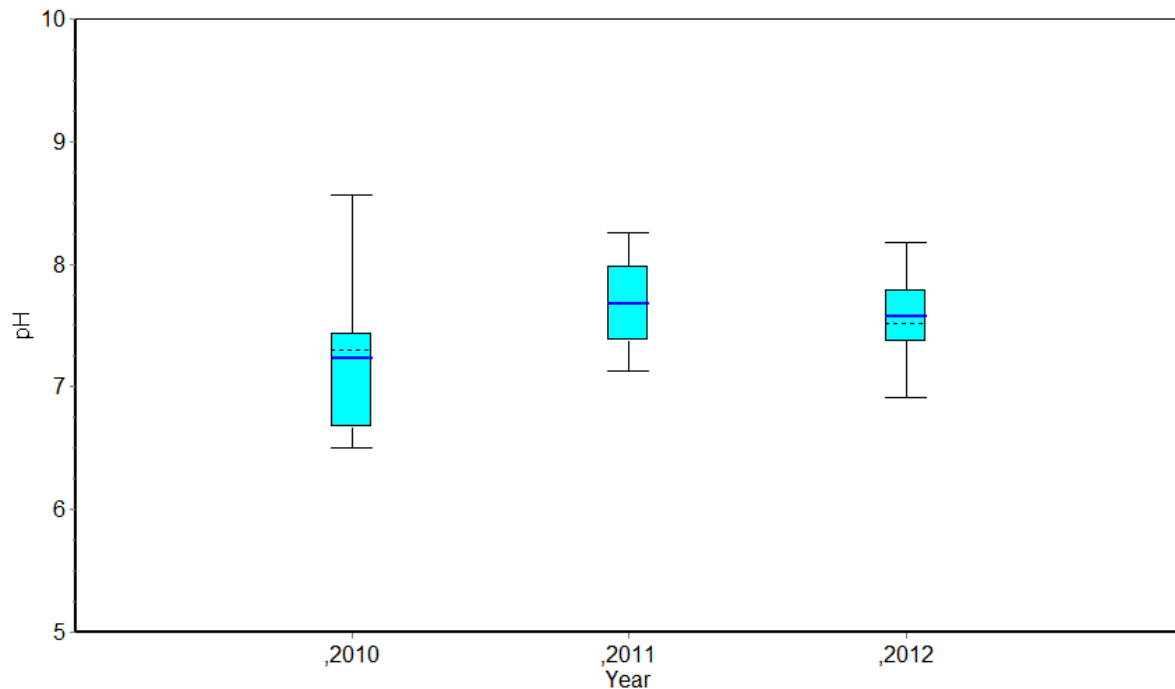


Figure 5. Distribution of pH values for springs sampled during 2010–2012. Mean value is solid blue line and median value is dashed blue line.

Specific conductance estimates total dissolved solids, and is an indicator of water quality. The range of specific conductance values was 136.0 to 1011.3 $\mu\text{S}/\text{cm}$ (see fig. 6). Values of specific conductance can differ greatly from spring to spring because of the contributing groundwater “shed,” regional characteristics, and surficial inputs. The springs with high specific conductance values were likely discharging from karstic systems or in areas with grazing ungulates that have added to the dissolved material.

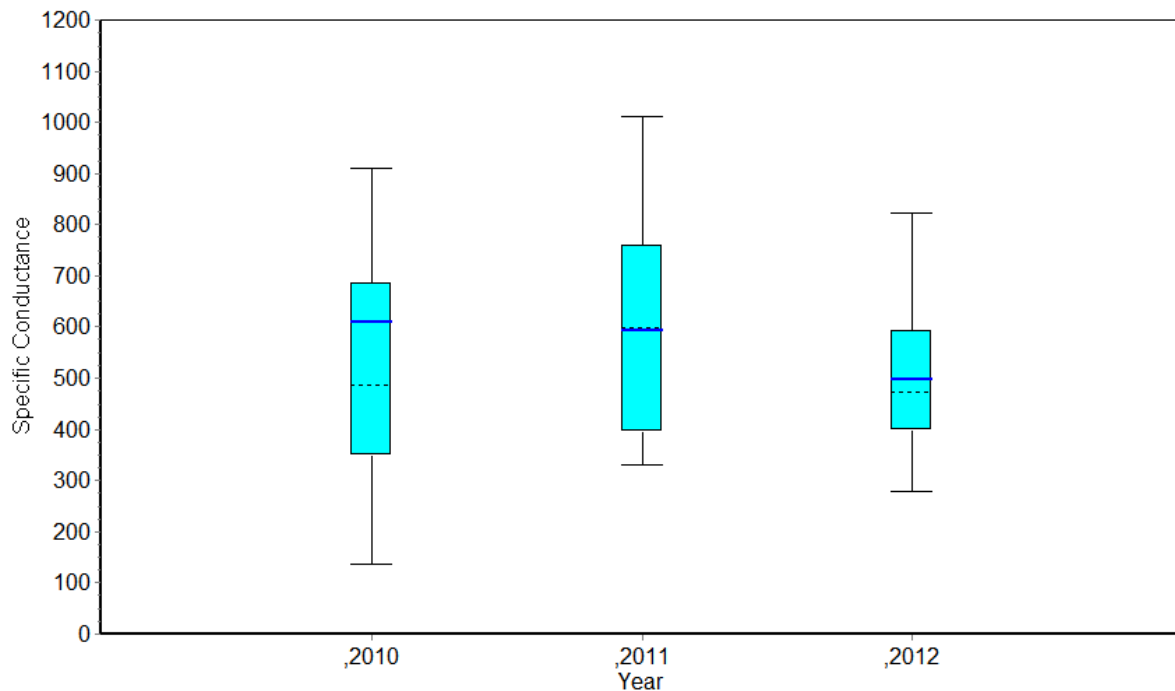


Figure 6. Distribution of specific conductance (microsiemens/centimeter) in water sampled at springs during 2010–2012. Mean value is solid blue line and median value is dashed blue line.

Oxygen-reduction potential (ORP) measures the water's ability to acquire electrons and, therefore be reduced, which is an indicator of water quality. Values for ORP ranged from -76.9 to 270.6 mV (see fig. 7). The springs with higher values likely have well-aerated waters, discharge with more turbidity or have a geochemical composition similar to local precipitation. The springs with lower values are likely those discharging at the end of a long flow path with no aeration.

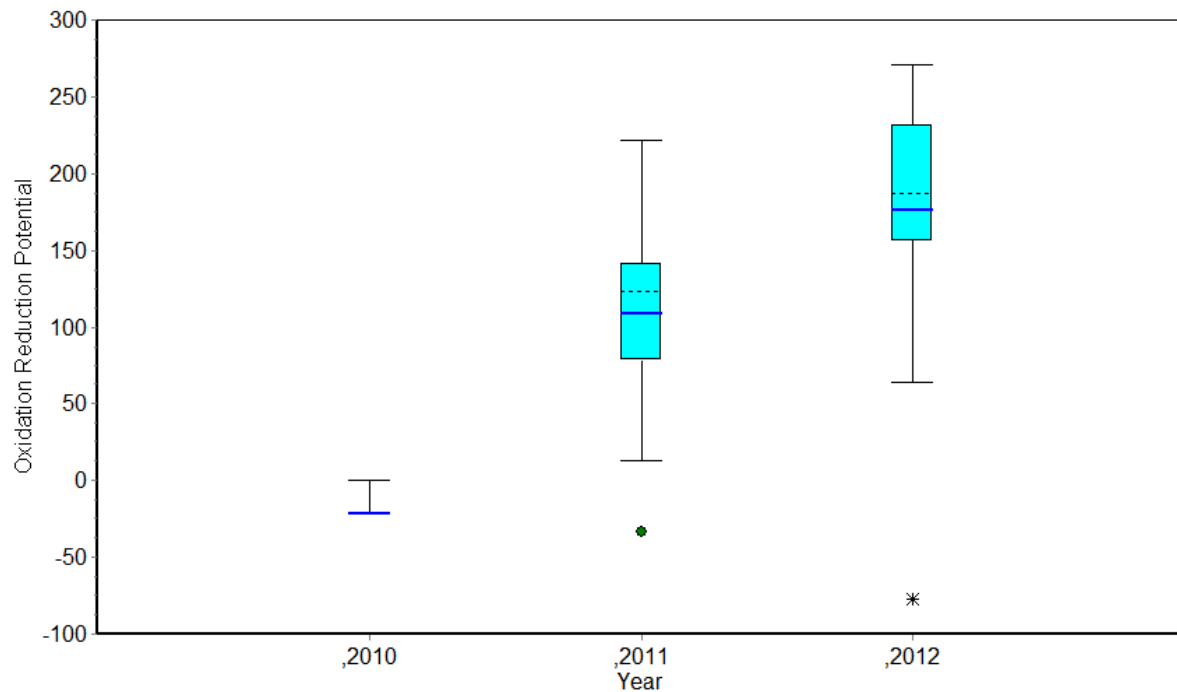


Figure 7. Distribution of oxidation-reduction potential (ORP) in water sampled at springs during 2010–2012 (in 2010 only one site had ORP data). Mean value is solid blue line and median value is dashed blue line.

Dissolved oxygen (DO) affects the types of organisms that can survive in that water. DO values ranged from 1.9 to 10.3 mg/L. Low values of DO are likely from water with long, deep flow paths that have little to no access to oxygen (such waters can even be anoxic). Some spring waters are first exposed to oxygen at the spring emergence zone. The level of turbidity at the site also has a strong effect on the amount of DO.

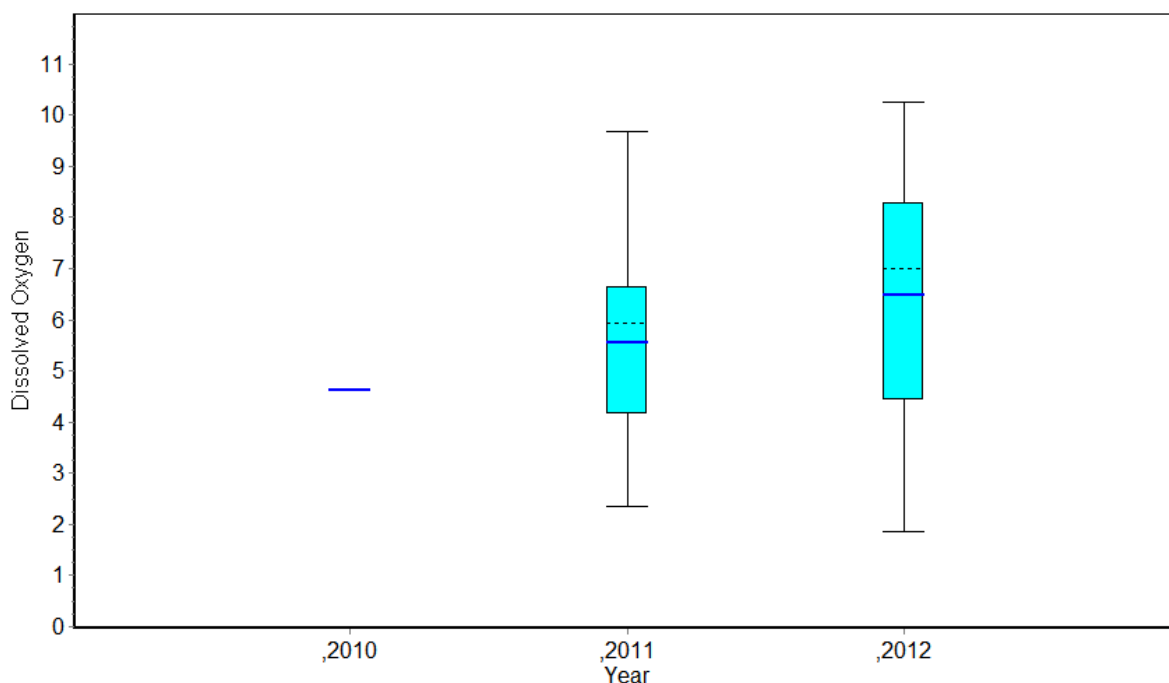


Figure 8. Distribution of dissolved oxygen for springs sampled during 2010–2012 (in 2010 only 1 site had dissolved oxygen data). Mean value is solid blue line and median value is dashed blue line.

Fauna

Aquatic macroinvertebrates were found through spot searches at the spring sites. The macroinvertebrates identified to family that were observed most frequently were the following families: caddisflies, order Trichoptera, family Limnephilidae (19% of sites); bee flies, order Diptera, family Bombyliidae (17% of sites); ground beetles, order Coleoptera, family Carabidae (16% of sites); and crane flies, order Diptera, family Tipulidae (16%). Other macroinvertebrate taxa that were identified to a more general level that were observed most frequently were flatworms, class Turbellaria (26% of sites); flies, order Diptera (40% of sites); beetles, order Coleoptera (27% of sites); and caddisflies, order Trichoptera (26% of sites). It is noteworthy that springsnails (genus *Pyrgulopsis*, family Hydrobiidae) were found at 7 of 77 (9%) springs (genetic samples were collected unless noted): Crystal Springs (only a few; no genetic sample), Unnamed 49 Spring, Unnamed 50 Spring (many, but group of horses interfered with collection of genetic sample), Standley B 3 Spring (no genetic sample), Upper Horse Springs, Willow Spring, and Wood Canyon Spring. Through genetic analyses it was determined that both CA species of springsnails, Spring Mountains pyrg (*Pyrgulopsis deaconi*) and Southeast Nevada pyrg (*Pyrgulopsis turbatrrix*) were present at the spring sites.

Terrestrial vertebrates were observed at a number of spring sites, through observation and spot searches. Over 70 species of animals were observed during the inventories of the 77 sites during 2010–2012. The animals that were most commonly observed (greater than 9% of sites) are listed in the figure 9, while many additional species (mostly birds) were observed at less than 9% of sites. CA terrestrial animal species observed at spring sites were Acastus checkerspot (*Chlosyne acastus robusta*), Spring Mountains common skipper (*Hesperia colorado mojavenis*) and Nevada admiral (*Limenitis weidemeyerii nevadae*).

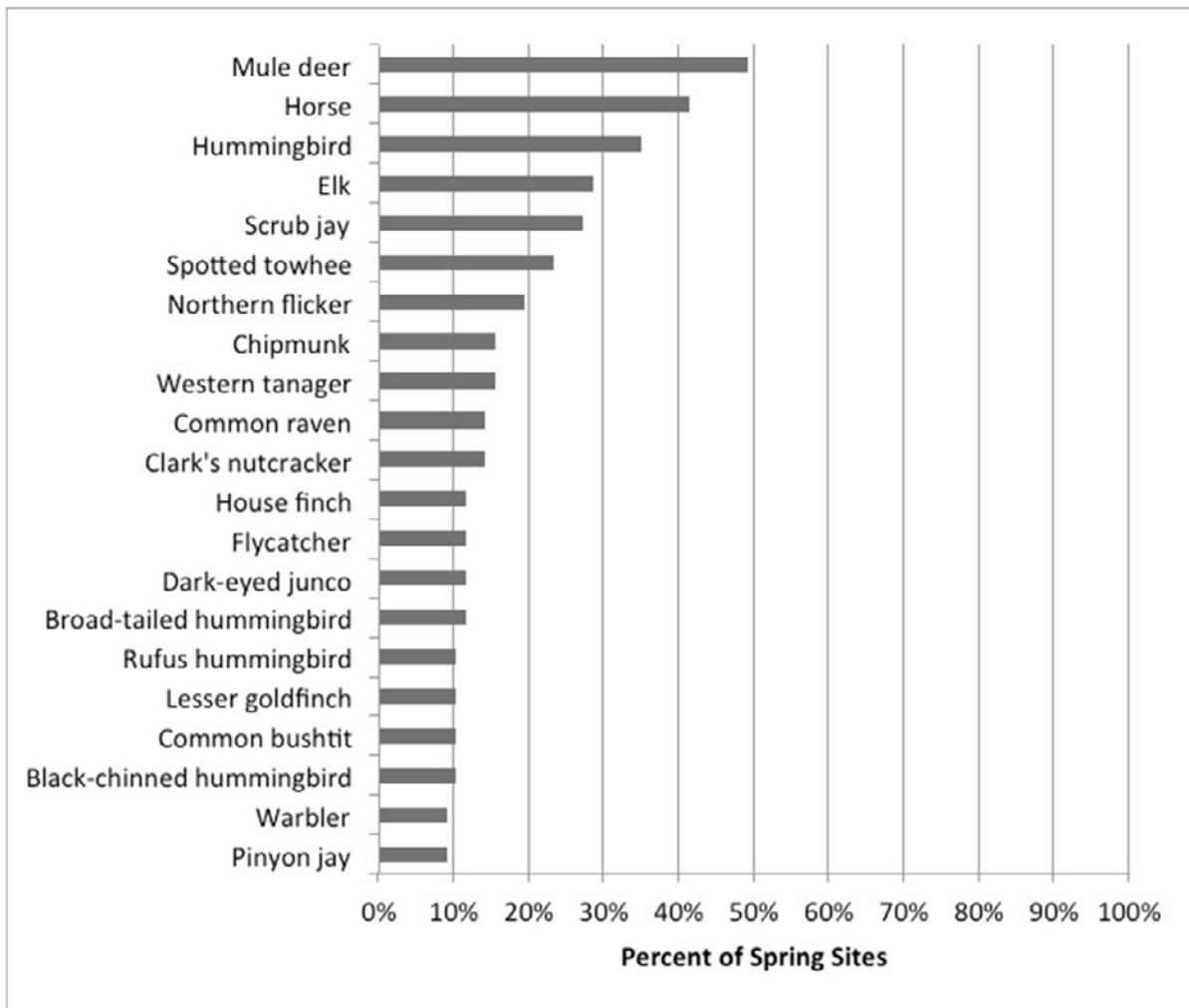


Figure 9. Percentage of spring sites (n = 77) where the most common terrestrial vertebrates were observed during surveys during 2010–2012. Note: Species observed at less than 9% of sites are not included in this figure.

Disturbances

At each site disturbances observed were noted and a summary of the most commonly observed disturbances is presented in figure 10. An additional 27 disturbance types were observed at less than 12% of sites.

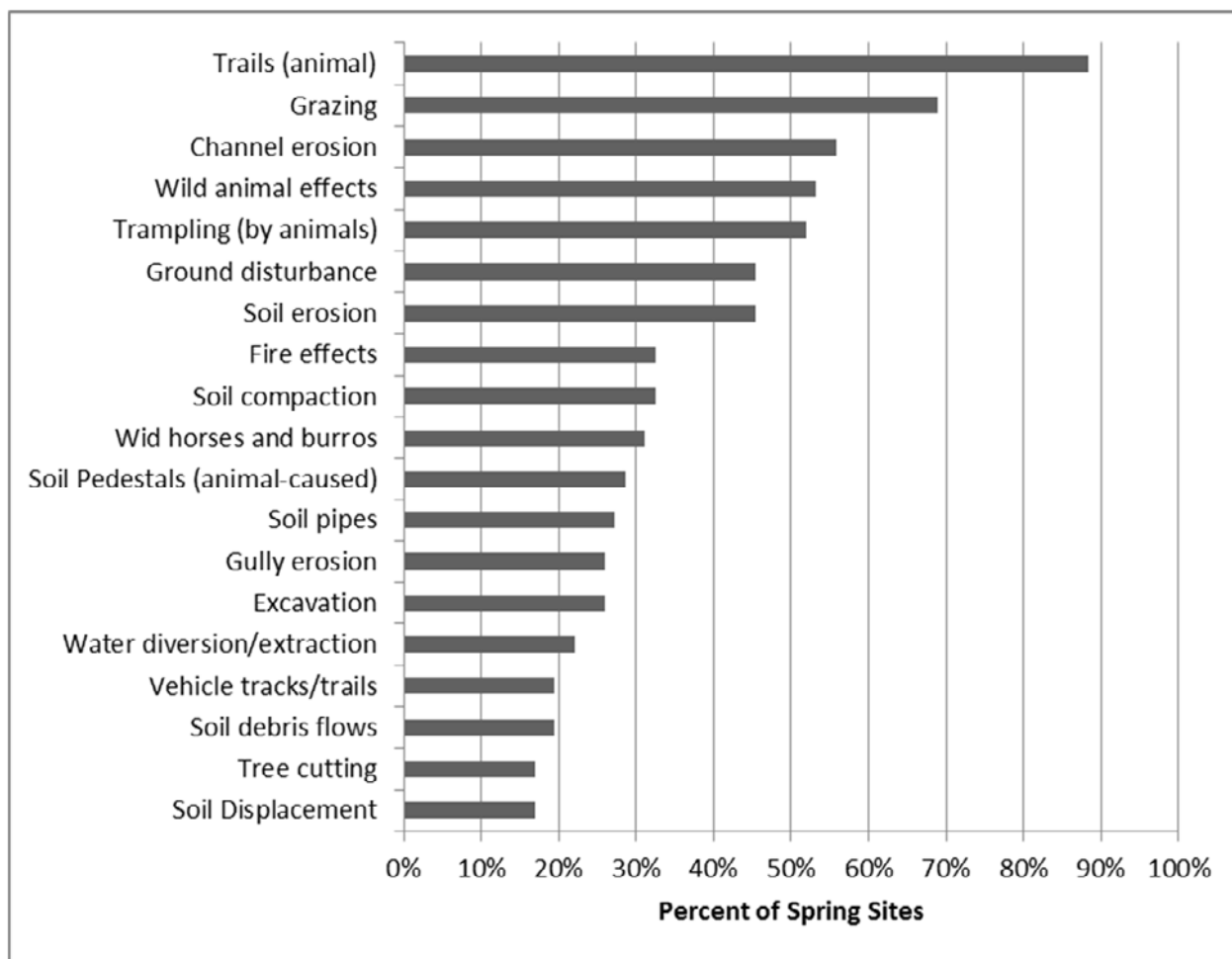


Figure 10. Percentage of spring sites (n = 77) where the listed disturbances were observed during sampling in 2010 through 2012. Note: Disturbances observed at less than 12% of sites are not included in this figure.

Management Indicator Tool

A summary of the responses to the 25 questions in the Management Indicator Tool are presented in figure 11 (in the order they appear in the *Groundwater Dependent Ecosystems: Level II Inventory Field Guide* USDA Forest Service 2012a). The responses represented by the bars generally indicate adverse alteration to spring sites. The categories in the lower part of the graph relate to the “administrative context” which was considered to be the same for nearly all sites in the SMNRA.

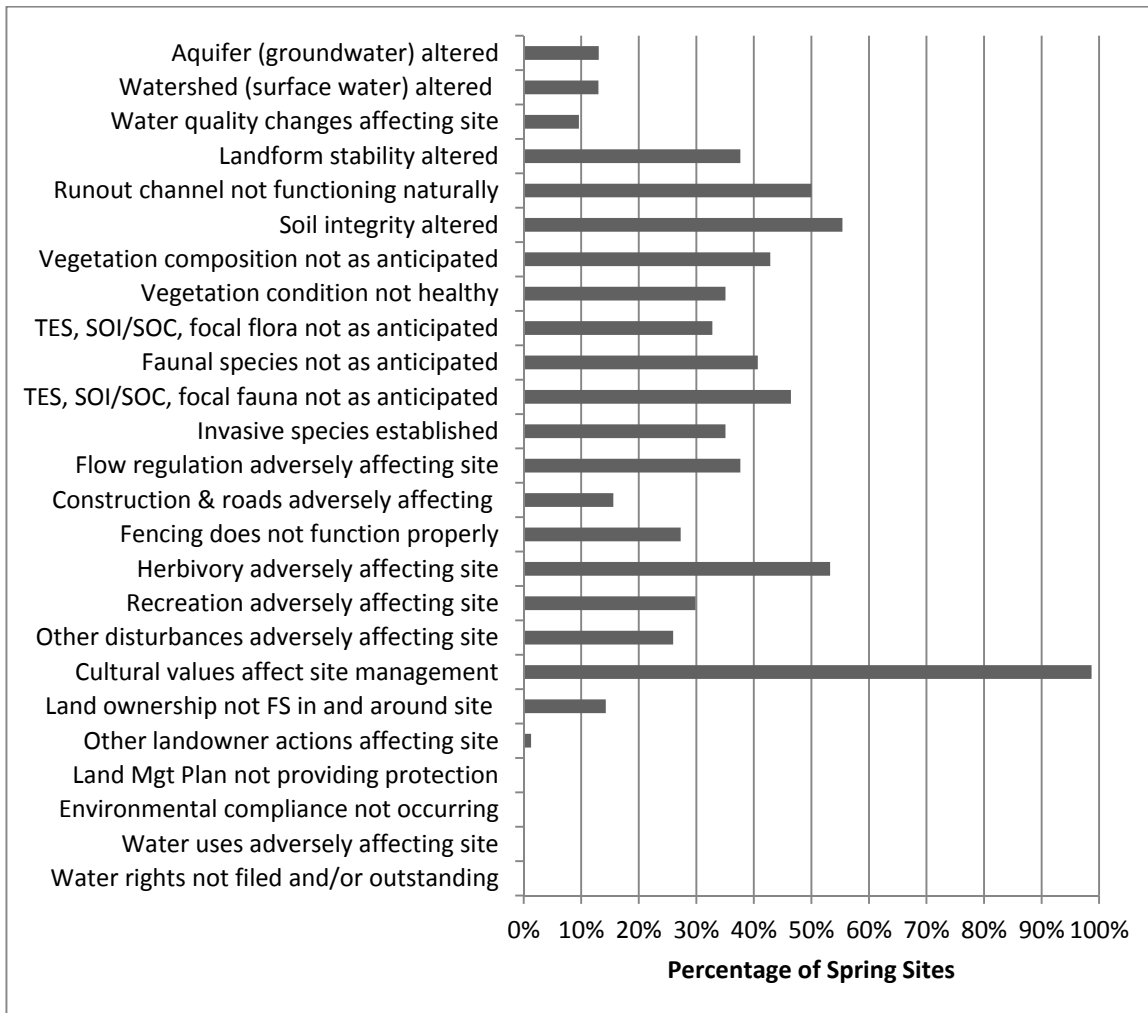


Figure 11. Percentage of spring sites (n = 77) where management indicators were observed based on the sampling of spring sites during 2010–2012.

Appendix D 3.3: Riparian Inventory Data

This section presents summarized data for all four of the stream/riparian areas surveyed in 2012.

Vegetation

The average plant species cover values for the riparian areas of all four streams are presented in the tables below. About 50% of the area along the riparian transects had no vegetation cover. The other 50% of the area had cover of the species listed below.

Understory (less than 1.5 meters) species cover averaged for all SMNRA stream reaches.

Species	Common Name	Cover
<i>Salix lasiolepis</i>	arroyo willow	11.6%
<i>Jamesia americana</i>	five-petal cliffbush	6.4%
<i>Ericameria nauseosa</i>	rubber rabbitbrush	4.6%
<i>Dodecatheon redolens</i>	scented shootingstar	4.5%
<i>Cirsium eatonii</i>	Eaton's thistle	3.0%
<i>Poa pratensis</i>	Kentucky blue grass	2.3%
<i>Fallugia paradoxa</i>	Apache plume	1.9%
<i>Pinus flexilis</i>	limber pine	1.6%
<i>Aquilegia formosa</i>	crimson columbine	1.5%
<i>Rorippa nasturtium-aquaticum</i>	watercress	1.3%
<i>Clematis ligusticifolia</i>	western white clematis	1.3%
<i>Abies concolor</i>	white fir	1.3%
<i>Rosa woodsii</i>	woods' rose	1.0%
<i>Artemisia ludoviciana</i>	white sagebrush	1.0%
<i>Ribes aureum</i>	golden currant	0.9%
<i>Ranunculus cymbalaria</i>	alkali buttercup	0.9%
<i>Rhus trilobata</i>	skunkbush sumac	0.8%
<i>Artemisia tridentata</i>	big sagebrush	0.7%
<i>Castilleja linariifolia</i>	Wyoming Indian paintbrush	0.7%
<i>Catabrosa aquatica</i>	water whorl grass	0.7%
unknown species		0.6%
<i>Dactylis glomerata</i>	orchard grass	0.5%
<i>Pinus ponderosa</i>	ponderosa pine	0.5%
<i>Sambucus nigra</i>	black elderberry	0.5%
<i>Purshia stansburiana</i>	Stansbury cliffrose	0.4%
<i>Prunus fasciculata</i>	desert almond	0.4%
<i>Angelica kingii</i>	basin angelica	0.3%
<i>Penstemon palmeri</i>	Palmer's penstemon	0.3%
<i>Verbascum thapsus</i>	common mullein	0.3%
<i>Bromus carinatus</i>	California brome	0.2%
<i>Bromus ciliatus</i>	fringed brome	0.2%
<i>Cirsium arizonicum</i>	Arizona thistle	0.2%

Species	Common Name	Cover
<i>Acer glabrum</i>	rocky mountain maple	0.2%
<i>Carex</i> sp.	sedge (species undetermined)	0.2%
<i>Petrophyton caespitosum</i>	mat rockspirea	0.1%
<i>Platanthera sparsiflora</i>	canyon bog orchid	0.1%
<i>Cercocarpus ledifolius</i>	curl-leaf mountain mahogany	0.1%
<i>Thinopyrum intermedium</i>	intermediate wheatgrass	0.1%

Mid-layer (1.5 meters to 5 meters) species cover averaged for all SMNRA stream reaches.

Species	Common Name	Cover
<i>Salix lasiolepis</i>	arroyo willow	11.7%
<i>Abies concolor</i>	white fir	1.5%
<i>Pinus flexilis</i>	limber pine	1.3%
<i>Populus tremuloides</i>	quaking aspen	0.8%
<i>Jamesia americana</i>	five-petal cliffbush	0.5%
<i>Rosa woodsii</i>	woods' rose	0.5%
<i>Juniperus scopulorum</i>	Rocky Mountain juniper	0.5%
<i>Prunus fasciculata</i>	desert almond	0.4%
<i>Acer glabrum</i>	Rocky Mountain maple	0.4%
<i>Ribes aureum</i>	golden currant	0.4%
<i>Pinus longaeva</i>	Great Basin bristlecone pine	0.3%
<i>Fallugia paradoxa</i>	Apache plume	0.3%
<i>Frangula betulifolia</i>	birch-leaf false buckthorn	0.3%
<i>Clematis ligusticifolia</i>	deciduous traveler's-joy	0.1%
<i>Pinus ponderosa</i>	ponderosa pine	0.1%

Overstory (greater than 5 meters) species cover averaged for all SMNRA stream reaches.

Species	Common Name	Cover
<i>Abies concolor</i>	white fir	3%
<i>Pinus flexilis</i>	limber pine	1%

Additional species observed along SMNRA streams that were not included in lists above.

Species	Common Name
<i>Artemisia dracunculus</i>	tarragon
<i>Bromus</i> sp.	brome (species undetermined)
<i>Carex aurea</i>	golden-fruit sedge
<i>Epilobium halleianum</i>	glandular willowherb
<i>Garrya flavescens</i>	ashy silktassel
<i>Glyceria</i> sp.	mannagrass (species undetermined)
<i>Juncus ensifolius</i>	dagger-leaf rush
<i>Lepidospartum latisquamum</i>	Nevada broomsage

Species	Common Name
<i>Medicago</i> sp.	alfalfa (species undetermined)
<i>Melilotus</i> sp.	sweetclover (species undetermined)
<i>Mentha</i> sp.	mint (species undetermined)
<i>Muhlenbergia andina</i>	fox-tail muhly
<i>Oenothera longissima</i>	long-stem evening-primrose
<i>Pinus monophylla</i>	singleleaf pinyon
<i>Poa fendleriana</i>	mutton grass
<i>Ribes montigenum</i>	gooseberry currant
<i>Rumex</i> sp.	dock (species undetermined)
<i>Symphoricarpos</i> sp.	snowberry (species undetermined)
<i>Taraxacum officinale</i>	common dandelion
<i>Urtica dioica</i>	stinging nettle

Vegetation types

Vegetation data for each riparian site were compared to the vegetation community types classified by Manning and Padgett (1995), Nachlinger and Reese (1996), and Weixelman et al. (1996). The vegetation community types for the different stream/riparian areas is listed in table 6.

Table 6. Vegetation types of the riparian areas inventoried in the SMNRA in 2012.

Vegetation Community Type	Stream/Riparian Area
<i>Aquilegia formosa</i> - <i>Smilacina stellata</i> / <i>Rosa woodsii</i> var. <i>ultramontana</i> Association (Nachlinger and Reese 1996)	Deer
<i>Artemisia tridentata</i> / <i>Elymus cinereus</i> Association (Nachlinger and Reese 1996)	Carpenter; Willow
<i>Jamesia americana</i> / <i>Petrophytum caespitosum</i> - <i>Ivesia jaegeri</i> Association (Nachlinger and Reese 1996) (not riparian per se)	Carpenter
<i>Rosa woodsii</i> var. <i>ultramontana</i> Association (Nachlinger and Reese 1996)	Cold
<i>Poa pratensis</i> Community Type (Manning and Padgett 1995)	Cold
<i>Salix lasiolepis</i> / <i>Rosa woodsii</i> var. <i>ultramontana</i> Community Type (Manning and Padgett 1995)	Carpenter; Willow

Prevalence index

Vegetation data were used to calculate a "prevalence index" which is a commonly used method to describe the abundance of wetland vegetation for a site and to determine if a site is a wetland (National Research Council 1995). The prevalence index has been described as a way of characterizing the "wetlandness" of a site (Tiner 1999). The prevalence index is calculated using a weighted average of the species abundance (cover in this case) and the wetland indicator status value (Reed 1988) to characterize a site's vegetation on a scale of 1 (all obligate wetland species) to 5 (all upland species). A value below three is generally considered to be a wetland. For the 11 riparian sites where vegetation data were collected the range in the prevalence index values was 1.7 to 4.6, and the average for all

reaches was 3.0. For the different streams the average prevalence index values were 3.5 for Carpenter Creek reaches; 2.6 for the Cold Creek reaches; 2.5 for the Deer Creek reaches; and 3.4 for the Willow Creek reaches.

Prevalence Index for vegetation of SMNRA riparian areas, sorted wettest to driest.

Stream Reach	Prevalence Index
Deer1	1.7
Willow3	2.2
Cold1	2.5
Cold2	2.7
Deer2	2.8
Deer3	3.0
Carpenter1	3.0
Carpenter3	3.5
Willow1	3.5
Carpenter2	3.8
Willow2	4.6

Plant Species Notes

A few non-native species were encountered, including:

- *Dactylis glomerata* (orchard grass)
- *Thinopyrum intermedium* (intermediate wheatgrass)
- *Verbascum thapsus* (common mullein)

Species encountered that are sometimes considered non-native were:

- *Poa pratensis* (Kentucky blue grass)
- *Taraxacum officinale* (common dandelion)
- *Urtica dioica* (stinging nettle)

Some interesting species that were not observed very often were:

- *Angelica kingii* (basin angelica)
- *Cirsium eatonii* (Eaton's thistle)
- *Carex aurea* (golden-fruit sedge)
- *Frangula betulifolia* (birch-leaf false buckthorn); formerly called *Rhamnus betulifolia*
- *Platanthera sparsiflora* (canyon bog orchid)

The vine *Clematis ligusticifolia* (western white clematis, or virgin's bower) was growing on much of the shrub vegetation at the lower part of Carpenter Creek, and in some parts of Willow Creek.

Disturbance

Observations of disturbances were noted at each site. A count of the disturbances by type for all of the sites is presented in the figure 12.

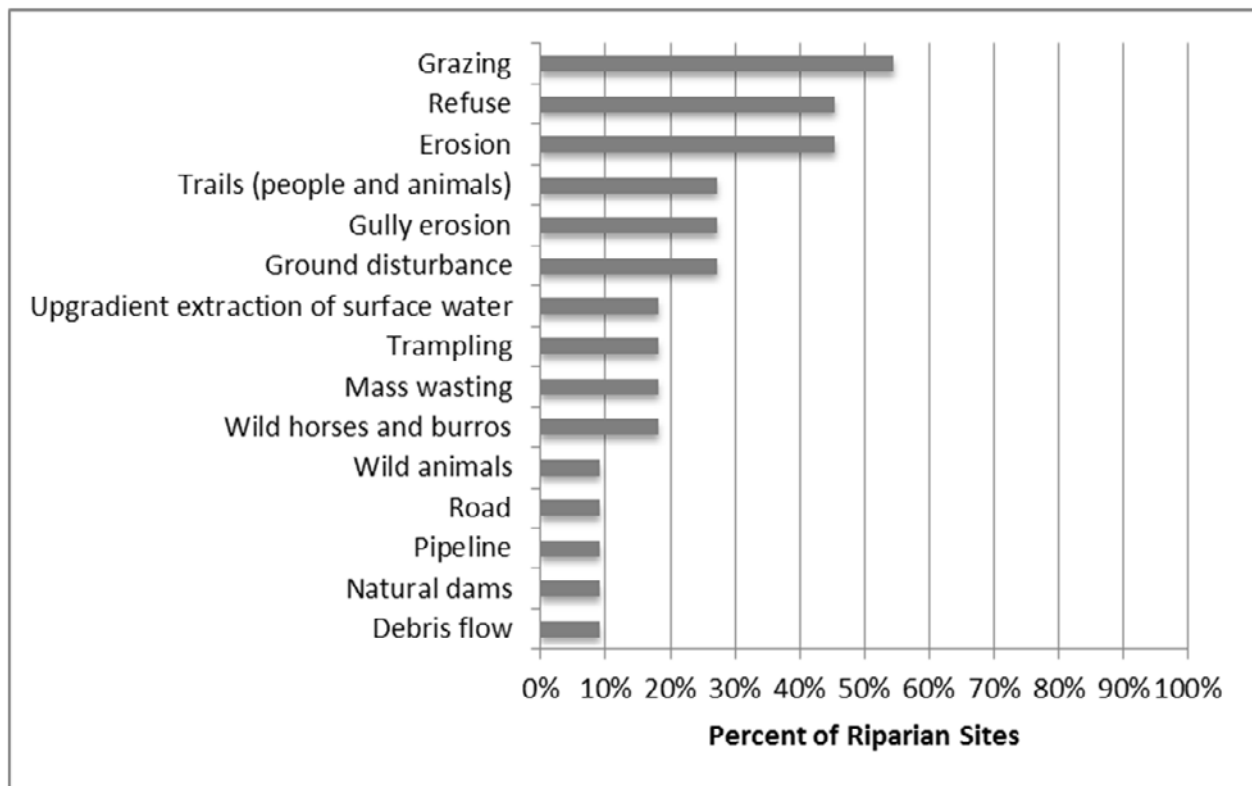


Figure 12. Percentage of riparian sites (n = 11) where the listed disturbances were observed.

Responses to questions in the “Management Indicator Tool” (from the *Groundwater-Dependent Ecosystems: Level II Inventory Field Guide*, USDA Forest Service 2012a) for the riparian areas and streams of the SMNRA are summarized in figure 13. The figure shows all of the negative management indicators, which indicate a management concern.

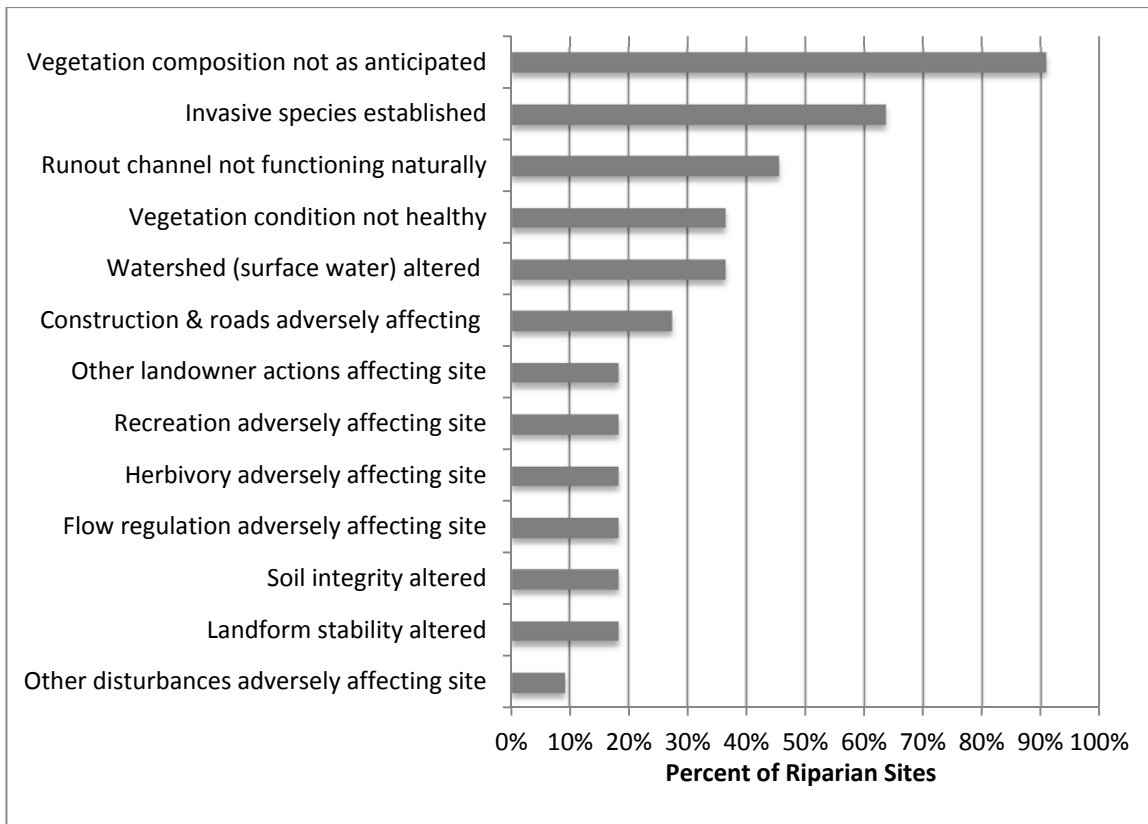


Figure 13. Percentage of riparian sites (n = 11) where the listed management indicator had a negative response, or one that could be of concern.

For the following Management Indicator Tool questions the crew was either unable to assess the question or it did not apply at any of the stream reaches:

- Aquifer functionality
- Water Quality
- TES focal floral species
- Faunal species
- TES focal faunal species
- Fencing Effects
- Cultural Values
- Land Ownership
- Land Management Plan
- Environmental Compliance
- Water Uses
- Water Rights

Issues related to roads were noted at a few sites, as indicated in the graphs above:

- At Willow Creek there was a culvert that was blocked causing water to flow over and down the road and causing erosion (photos are in a separate report submitted to the SMNRA).

- At Deer Creek there was material from the road (gravel) and wood chips that have been pushed from the road into the stream, which seems to have buried the flow (caused it to go subsurface) at that point.
- Roads impinge on the riparian area and stream along lower Carpenter Creek and Deer Creek.
- Horses, or impacts from horses, were observed at Cold and Willow Creeks.

Riparian and Channel Area

The average length of transects sampled at the various streams provides an estimate of the width of the riparian area, including the stream. The largest average riparian area and stream width was at Carpenter Creek, where there was extensive riparian vegetation adjacent to the channel (see chart below). The narrowest riparian and stream width was at Cold Creek, where there is little riparian vegetation along a small channel.

Stream	Width of Riparian area and Stream (in meters)
Carpenter	9.4
Willow	6.8
Deer	4.8
Cold	3.9

A major portion of the riparian and stream width was the stream channel as shown in the table below. The percentage of transects that were over "channel" was the largest portion of the area. The stream bank and floodplain would be the largest portion if they were combined.

Fluvial Setting	Average Area
Channel	35%
Bank	32%
Floodplain	25%
Terrace	6%
Island	2%

Fish were observed at multiple spots (particularly pools below knick points) at Willow Creek.

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

2010 Sites

Site Name	Site ID	Size (m ²)	Vegetation composition not as anticipated	Vegetation condition not healthy and vigorous	Faunal species not as anticipated	Invasive flora and fauna established	Introduced Species Cover (%)	Prevalence Index (1=wetland ; 5=upland)	Bryophyte Cover (%) (more is generally good)	Vegetation Cover (%) in herbaceous layer	Vegetation Cover (%) in shrub and tree layer
Coal Spring	R4HTSMNRAH20153	140			Unavailable		41	1.5	1	60	10
Macks Canyon 1	R4HTSMNRAH20092	745	X		Unavailable		0	1.8	30	81	20
Middle Mud Spring	R4HTSMNRAH20090	233	X	X	X	X	0	1.9	0	38	21
Quartzite Wall Unnamed Spring	R4HTSMNRAH20191	270			Unavailable		0	3.1	10	39	3
Stanley B 3 Spring	R4HTSMNRAH20101	95			Unavailable		0	3.2	3	14	95
Three Springs 1	R4HTSMNRAH20122	180	X		Unavailable		0	3.0	18	4	0
Three Springs 2	R4HTSMNRAH20123	101			Unavailable		1	1.1	17	45	2
Two Springs	R4HTSMNRAH20026	15			Unavailable		0	1.0	30	25	0
Unnamed 1 Spring	R4HTSMNRAH20027	78			Unavailable	X	10	2.8	17	36	5
Unnamed 21 Spring	R4HTSMNRAH20126	1	X	X	Unavailable		cement tank (no data)	Unavailable	Unavailable	Unavailable	Unavailable
Unnamed 41 Spring	R4HTSMNRAH20062	1		X	Unavailable		0	3.9	22	30	0
Unnamed 56 Spring	R4HTSMNRAH20048	5		X	Unavailable		0	2.6	48	7	0
Unnamed 67 Spring	R4HTSMNRAH20095	352		X	Unavailable		0	2.9	3	34	11
Upper Cougar Spring	R4HTSMNRAH20080	12	X	X	Unavailable		hardly any veg	0.0	0	0	9
Upper Horse Springs	R4HTSMNRAH20113	80			Unavailable		3	2.5	0	63	0
Upper Lost Cabin	R4HTSMNRAH20148	88			Unavailable		3	3.9	5	37	4
Upper Sawmill Spring	R4HTSMNRAH20024	14	X	X	Unavailable		0	3.3	0	23	11
Willow Spring	R4HTSMNRAH20084	462			Unavailable		0	3.0	0	43	68
Wood Canyon Spring	R4HTSMNRAH20078	137			UA		1	3.3	0	72	20

2011 Sites

Site Name	Site ID	Size (m ²)	Vegetation composition not as anticipated	Vegetation condition not healthy and vigorous	Faunal species not as anticipated	Invasive flora and fauna established	Introduced Species Cover (%)	Prevalence Index (1=wetland; 5=upland)	Bryophyte Cover (%) (more is generally good)	Vegetation Cover (%) in herbaceous layer	Vegetation Cover (%) in shrub and tree layer
Cathedral Chute Spring	R4HTSMNRAH2O199	444					0	2.2	8	48	71
Cave Spring 1	R4HTSMNRAH2O136	202	X			X	0	1.4	2	23	109
Cave Spring 2	R4HTSMNRAH2O135	508				X	2	2.2	2	45	24
East Mud Spring	R4HTSMNRAH2O091	1104	X		X	X	0	2.6	3	59	21
Edna Grey Spring	R4HTSMNRAH2O009	320		X	X	X	0	2.5	3	29	53
Elbow Spring	R4HTSMNRAH2O204	18					0	1.7	0	43	29
Fletcher Spring	R4HTSMNRAH2O098	288				X	0	2.3	15	36	8
Gold Spring	R4HTSMNRAH2O072	25	X	X	X		0	0.0	0	0	39
Lower Cougar Spring	R4HTSMNRAH2O081	24	X	X	X	X	0	4.1	10	4	37
Mossfoot Seep	R4HTSMNRAH2O202	45					0	1.0	26	2	0
Mummy Spring	R4HTSMNRAH2O012	975					0	1.5	5	19	23
Mummy View Spring	R4HTSMNRAH2O201	56					0	1.0	0	19	35
Pipilo Unnamed Spring	R4HTSMNRAH2O190	102				X	12	2.3	0	45	58
Roses Spring	R4HTSMNRAH2O137	36	X		X	X	2	2.3	1	5	29
Stanley B 1 Spring	R4HTSMNRAH2O099	60					0	3.2	2	7	63
Stanley B 2 Spring	R4HTSMNRAH2O100	16					0	2.8	0	2	127
Stanley B Wet Wall	R4HTSMNRAH2O200	222					0	2.8	19	7	12
Steller Spring	R4HTSMNRAH2O203	169					0	1.3	2	51	16
Unnamed 20 Spring	R4HTSMNRAH2O035	332					0	1.6	9	73	14
Unnamed 27 Spring	R4HTSMNRAH2O121	25		X	X	X	7	3.5	5	11	100
Unnamed 45 Spring	R4HTSMNRAH2O112	552	X	X	X	X	0	1.3	0	15	27
Unnamed 49 Spring	R4HTSMNRAH2O117	846	X	X		X	2	1.7	0	22	48
Unnamed 55 Spring	R4HTSMNRAH2O119	2952				X	0	4.0	0	1	96
Unnamed 59 Spring	R4HTSMNRAH2O050	122					0	2.0	12	41	17

Site Name	Site ID	Size (m ²)	Vegetation composition not as anticipated	Vegetation condition not healthy and vigorous	Faunal species not as anticipated	Invasive flora and fauna established	Introduced Species Cover (%)	Prevalence Index (1=wetland; 5=upland)	Bryophyte Cover (%) (more is generally good)	Vegetation Cover (%) in herbaceous layer	Vegetation Cover (%) in shrub and tree layer
Unnamed 75 Spring	R4HTSMNRAH2O057	188	X			X	8	3.2	4	27	3
Unnamed 9 Spring	R4HTSMNRAH2O061	15					0	4.0	13	2	40
West Mud Spring	R4HTSMNRAH2O089	1940		X	X	X	0	2.4	4	66	7
Younts Spring	R4HTSMNRAH2O149	638	X		X	X	26	3.1	0	46	1

2012 Sites

Site Name	Site ID	Size (m ²)	Vegetation composition not as anticipated	Vegetation condition not healthy and vigorous	Faunal species not as anticipated	Invasive flora and fauna established	Introduced Species Cover (%)	Prevalence Index (1=wetland; 5=upland)	Bryophyte Cover (%) (more is generally good)	Vegetation Cover (%) in herbaceous layer	Vegetation Cover (%) in shrub and tree layer
Big Timber Spring	R4HTSMNRAH2O073	169	X	X			0	1.2	3	4	52
Bill Smith Spring	R4HTSMNRAH2O065	80					10	1.5	1	18	85
Carpenter Canyon 2	R4HTSMNRAH2O005	2104					0	3.0	0	2	108
Cave Spring	R4HTSMNRAH2O206	28	X				0	1.0	3	6	101
Cave West Spring	R4HTSMNRAH2O207	3	X	X	X		0	4.0	10	8	27
CC Spring	R4HTSMNRAH2O138	33.5	X	X	X	X	19	2.4	0	40	22
Crow Spring (Jeff's)	R4HTSMNRAH2O007	75					0	1.9	4	20	37
Crystal Springs	R4HTSMNRAH2O074	35	X				1	1.5	0	4	65
ENE of Lost Cabin Spring	R4HTSMNRAH2O010	800	X	X	X	X	15	3.2	0	24	115
Jaybird Spring	R4HTSMNRAH2O013	101	X	X	X	X	9	4.0	0	9	43
Lees Spring	R4HTSMNRAH2O015	42					0	3.1	5	2	141
Lees Spring upper	R4HTSMNRAH2O208	134					0	2.8	10	3	102
Lost Cabin Spring	R4HTSMNRAH2O147	222	X			X	10	2.4	0	17	62
Macks Canyon 2	R4HTSMNRAH2O093	400	X		X		0	1.9	6	50	25
McFarland Spring	R4HTSMNRAH2O088	1274			X		17	3.1	1	30	64
Middle Mud lower spring	R4HTSMNRAH2O194	272	X	X	X		0	1.2	3	35	35
Mountain Man One Spring	R4HTSMNRAH2O205	1900	X	X		X	1	1.8	0	34	17

Site Name	Site ID	Size (m ²)	Vegetation composition not as anticipated	Vegetation condition not healthy and vigorous	Faunal species not as anticipated	Invasive flora and fauna established	Introduced Species Cover (%)	Prevalence Index (1=wetland; 5=upland)	Bryophyte Cover (%) (more is generally good)	Vegetation Cover (%) in herbaceous layer	Vegetation Cover (%) in shrub and tree layer
Mountain Springs 2	R4HTSMNRAH2O029	2216				X	2	1.8	0	59	24
Mountain Springs 3	R4HTSMNRAH2O141	164	X		X		1	2.2	0	41	20
Mountain Springs 4	R4HTSMNRAH2O142	8100				X	0	1.9	0	53	8
South Rainbow Spring	R4HTSMNRAH2O077	225	X	X	X	X	0	1.3	0	3	34
Star Mound	R4HTSMNRAH2O209	380					0	2.2	4	67	23
Trough Spring	R4HTSMNRAH2O086	138	X		X	X	7	2.9	2	23	81
Unnamed 10 Spring	R4HTSMNRAH2O028	900			X		0	2.0	8	48	33
Unnamed 28 Spring	R4HTSMNRAH2O036	800					0	4.0	0	9	130
Unnamed 32 Spring	R4HTSMNRAH2O038	724	X	X	X	X	2	2.3	0	6	71
Unnamed 50 Spring	R4HTSMNRAH2O109	105					1	1.3	1	7	26
Unnamed 51 Spring	R4HTSMNRAH2O110	1.2	X	X			No veg	No veg	No veg	No veg	No veg
Unnamed 80 Spring	R4HTSMNRAH2O060	718	X	X	X		0	2.8	0	26	63
Whiskey Spring	R4HTSMNRAH2O127	117	X	X	X		0	2.7	0	2	98

Note on bryophyte (moss) cover: Bryophytes are non-vascular plants that include species with characteristics that allow them to thrive in wet soil conditions. Bryophytes are vulnerable to human disturbance and to changes in hydrology (Tousignant and Brisson 2010). The majority of spring sites in the SMNRA had at least some bryophyte cover, which is a good sign, although it is not clear what the cover should be for SMNRA sites in good ecological status. A study by Nachlinger and Reese (1996) found comparable bryophyte cover for spring community types of the SMNRA: 10% for *Dodecatheon redolens*⁵-*Aquilegia formosa* Series; 2.4% for the *Rosa woodsii* var. *ultramontana* Association; 0.7% for the *Baccharis sergiloides* Association; and 1.6% for the *Jamesia americana*/*Petrophytum caespitosum*-*Ivesia jaegeri* Association. In other regions some wetland and riparian community types have higher bryophyte cover: the *Carex luzulina* Plant Association described by Crowe and Clausnitzer (1997) for eastern Oregon had an average of 54% bryophyte cover (that community type was selected because it was the community type with the highest cover of *Dodecatheon jeffreyi*, which is similar to *Dodecatheon redolens* [aka, *Primula fragrans*] of the SMNRA). A riparian classification for Utah by Padgett et al. (1989) had multiple communities with greater than 20% cover of bryophytes.

⁵ This species is also described as *Dodecatheon jeffryi*

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

2010 Sites

Site Name	Site ID	Size (m ²)	Disturbances				Management Indicators				Bare Ground (%)
			Erosion	Deposition	Trails & Tracks	Excavation or Other Ground Disturbance	Soil Integrity Altered	Landform Stability Altered	Construction and Roads Adversely Affecting Site	Recreational Uses Adversely Affecting Site	
Coal Spring	R4HTSMNRAH2O153	140	X		X			X		X	13
Macks Canyon 1	R4HTSMNRAH2O092	745			X		X			X	1
Middle Mud Spring	R4HTSMNRAH2O090	233	X		X	X	X	X	X		5
Quartzite Wall Unnamed Spring	R4HTSMNRAH2O191	270			X		X				1
Stanley B 3 Spring	R4HTSMNRAH2O101	95	X		X	X		X			8
Three Springs 1	R4HTSMNRAH2O122	180					X				0
Three Springs 2	R4HTSMNRAH2O123	101			X						1
Two Springs	R4HTSMNRAH2O026	15			X	X			X	X	0
Unnamed 1 Spring	R4HTSMNRAH2O027	78	Unavail able	Unavailable	Unavaila ble	Unavailable					13
Unnamed 21 Spring	R4HTSMNRAH2O126	1			X	X	X		X		UA
Unnamed 41 Spring	R4HTSMNRAH2O062	1			X		X	X			21
Unnamed 56 Spring	R4HTSMNRAH2O048	5					X	X		X	0
Unnamed 67 Spring	R4HTSMNRAH2O095	352	X		X	X	X	X	X	X	12
Upper Cougar Spring	R4HTSMNRAH2O080	12	Unavail able	Unavailable	Unavaila ble	Unavailable		X	X	X	3
Upper Horse Springs	R4HTSMNRAH2O113	80			X			X			23
Upper Lost Cabin	R4HTSMNRAH2O148	88			X						12
Upper Sawmill Spring	R4HTSMNRAH2O024	14	X		X		X	X			3
Willow Spring	R4HTSMNRAH2O084	462			X		X	X	X	X	0
Wood Canyon Spring	R4HTSMNRAH2O078	137			X	X	X	X	X		4

2011 Sites

Site Name	Site ID	Size (m ²)	Disturbances				Management Indicators				Bare Ground (%)
			Erosion	Deposition	Trails & Tracks	Excavation or Other Ground Disturbance	Soil Integrity Altered	Landform Stability Altered	Construction and Roads adversely affecting site	Recreational uses adversely affecting site	
Cathedral Chute Spring	R4HTSMNRAH2O199	444		X	X			X		X	4
Cave Spring 1	R4HTSMNRAH2O136	202			X						0
Cave Spring 2	R4HTSMNRAH2O135	508	X		X						3
East Mud Spring	R4HTSMNRAH2O091	1104	X		X	X					20
Edna Grey Spring	R4HTSMNRAH2O009	320	X		X	X	X				22
Elbow Spring	R4HTSMNRAH2O204	18									8
Fletcher Spring	R4HTSMNRAH2O098	288			X					X	4
Gold Spring	R4HTSMNRAH2O072	25	X		X	X	X	X			46
Lower Cougar Spring	R4HTSMNRAH2O081	24			X						4
Mossfoot Seep	R4HTSMNRAH2O202	45			X		X	X		X	25
Mummy Spring	R4HTSMNRAH2O012	975	X		X					X	4
Mummy View Spring	R4HTSMNRAH2O201	56			X		X				7
Pipilo Unnamed Spring	R4HTSMNRAH2O190	102			X	X					28
Roses Spring	R4HTSMNRAH2O137	36			X	X	X				25
Stanley B 1 Spring	R4HTSMNRAH2O099	60	X	X	X	X				X	9
Stanley B 2 Spring	R4HTSMNRAH2O100	16	X	X	X	X		X			6
Stanley B Wet Wall	R4HTSMNRAH2O200	222			X	X					1
Steller Spring	R4HTSMNRAH2O203	169			X						13
Unnamed 20 Spring	R4HTSMNRAH2O035	332			X						7
Unnamed 27 Spring	R4HTSMNRAH2O121	25			X		X				0
Unnamed 45 Spring	R4HTSMNRAH2O112	552	X	X	X	X	X				36
Unnamed 49 Spring	R4HTSMNRAH2O117	846	X		X	X	X	X			33
Unnamed 55 Spring	R4HTSMNRAH2O119	2952	X	X	X						2
Unnamed 59 Spring	R4HTSMNRAH2O050	122			X	X	X				2
Unnamed 75 Spring	R4HTSMNRAH2O057	188	X		X	X					14
Unnamed 9 Spring	R4HTSMNRAH2O061	15	X		X	X	X				0
West Mud Spring	R4HTSMNRAH2O089	1940	X		X	X	X	X			19

Site Name	Site ID	Size (m ²)	Disturbances				Management Indicators				Bare Ground (%)
			Erosion	Deposition	Trails & Tracks	Excavation or Other Ground Disturbance	Soil Integrity Altered	Landform Stability Altered	Construction and Roads adversely affecting site	Recreational uses adversely affecting site	
Younts Spring	R4HTSMNRAH2O149	638	X	X	X	X	X	X			50

2012 Sites

Site Name	Site ID	Size (m ²)	Disturbances				Management Indicators				Bare Ground (%)
			Erosion	Deposition	Trails & Tracks	Excavation or Other Ground Disturbance	Soil Integrity Altered	Landform Stability Altered	Construction and Roads Adversely Affecting Site	Recreational Uses Adversely Affecting Site	
Big Timber Spring	R4HTSMNRAH2O073	169	X		X	X	X	X			33
Bill Smith Spring	R4HTSMNRAH2O065	80			X	X	X				7
Carpenter Canyon 2	R4HTSMNRAH2O005	2104									0
Cave Spring	R4HTSMNRAH2O206	28			X	X	NA			X	3
Cave West Spring	R4HTSMNRAH2O207	3			X	X	X			X	21
CC Spring	R4HTSMNRAH2O138	33.5	X		X	X					4
Crow Spring (Jeff's)	R4HTSMNRAH2O007	75	X	X	X						21
Crystal Springs	R4HTSMNRAH2O074	35			X						8
ENE of Lost Cabin Spring	R4HTSMNRAH2O010	800	X	X	X	X	X	X			2
Jaybird Spring	R4HTSMNRAH2O013	101	X		X	X	X	X	X	X	35
Lees Spring	R4HTSMNRAH2O015	42			X						6
Lees Spring upper	R4HTSMNRAH2O208	134	X		X						2
Lost Cabin Spring	R4HTSMNRAH2O147	222	X		X		X				15
Macks Canyon 2	R4HTSMNRAH2O093	400	X		X	X	X		X	X	14
McFarland Spring	R4HTSMNRAH2O088	1274	X		X	X	X	X			3
Middle Mud lower spring	R4HTSMNRAH2O194	272			X	X	X				8
Mountain Man One Spring	R4HTSMNRAH2O205	1900	X		X	X	X	X	X	X	15
Mountain Springs 2	R4HTSMNRAH2O029	2216			X						6
Mountain Springs 3	R4HTSMNRAH2O141	164			X	X			X		5
Mountain Springs 4	R4HTSMNRAH2O142	8100		X	X	X	X	X	X	X	9
South Rainbow Spring	R4HTSMNRAH2O077	225	X		X	X	X				76

Site Name	Site ID	Size (m ²)	Disturbances				Management Indicators				Bare Ground (%)
			Erosion	Deposition	Trails & Tracks	Excavation or Other Ground Disturbance	Soil Integrity Altered	Landform Stability Altered	Construction and Roads Adversely Affecting Site	Recreational Uses Adversely Affecting Site	
Star Mound	R4HTSMNRAH2O209	380			X						14
Trough Spring	R4HTSMNRAH2O086	138	X		X	X	X	X			14
Unnamed 10 Spring	R4HTSMNRAH2O028	900			X		X	X			7
Unnamed 28 Spring	R4HTSMNRAH2O036	800			X						0
Unnamed 32 Spring	R4HTSMNRAH2O038	724	X		X	X	X				44
Unnamed 50 Spring	R4HTSMNRAH2O109	105	X		X		X				16
Unnamed 51 Spring	R4HTSMNRAH2O110	1.2			X		NA				NA
Unnamed 80 Spring	R4HTSMNRAH2O060	718	X		X	X					2
Whiskey Spring	R4HTSMNRAH2O127	117	X		X	X	X	X		X	28

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

2010 Sites

Site Name	Site ID	Size (m ²)	Disturbances		Management Indicators			
			Animal Trails	Channel Erosion	Runout Channel Substantially Altered	Flow Regulation Adversely Affects Site	Herbivores Adversely Affects Site	Recreational Uses Adversely Affects Site
Coal Spring	R4HTSMNRAH2O153	140	X	X	X	X	X	X
Macks Canyon 1	R4HTSMNRAH2O092	745	X		X	X	X	X
Middle Mud Spring	R4HTSMNRAH2O090	233	X	X	X	X	X	
Quartzite Wall Unnamed Spring	R4HTSMNRAH2O191	270	X			X	X	
Stanley B 3 Spring	R4HTSMNRAH2O101	95	X	X	X		X	
Three Springs 1	R4HTSMNRAH2O122	180						
Three Springs 2	R4HTSMNRAH2O123	101	X				X	
Two Springs	R4HTSMNRAH2O026	15	X		X	X	X	X
Unnamed 1 Spring	R4HTSMNRAH2O027	78	Unavailable	Unavailable				
Unnamed 21 Spring	R4HTSMNRAH2O126	1	X		X	X	X	
Unnamed 41 Spring	R4HTSMNRAH2O062	1	X	X	X		X	
Unnamed 56 Spring	R4HTSMNRAH2O048	5					X	X
Unnamed 67 Spring	R4HTSMNRAH2O095	352	X	X	X	X	X	X
Upper Cougar Spring	R4HTSMNRAH2O080	12	Unavailable	Unavailable	X		X	X
Upper Horse Springs	R4HTSMNRAH2O113	80	X		X		X	
Upper Lost Cabin	R4HTSMNRAH2O148	88	X				X	
Upper Sawmill Spring	R4HTSMNRAH2O024	14	X	X	X		X	
Willow Spring	R4HTSMNRAH2O084	462	X			X	X	X
Wood Canyon Spring	R4HTSMNRAH2O078	137	X	X	X	X	X	

2011 Sites

Site Name	Site ID	Size (m ²)	Disturbances		Management Indicators			
			Animal Trails	Channel Erosion	Runout Channel Substantially Altered	Flow Regulation Adversely Affects Site	Herbivores Adversely Affect Site	Recreational Uses Adversely Affect Site
Cathedral Chute Spring	R4HTSMNRAH2O199	444	X	X				X
Cave Spring 1	R4HTSMNRAH2O136	202	X					
Cave Spring 2	R4HTSMNRAH2O135	508	X					
East Mud Spring	R4HTSMNRAH2O091	1104	X	X	X	X	X	
Edna Grey Spring	R4HTSMNRAH2O009	320	X	X	X	X	X	
Elbow Spring	R4HTSMNRAH2O204	18		X				
Fletcher Spring	R4HTSMNRAH2O098	288	X					X
Gold Spring	R4HTSMNRAH2O072	25	X	X	X	X	X	
Lower Cougar Spring	R4HTSMNRAH2O081	24	X	X				
Mossfoot Seep	R4HTSMNRAH2O202	45	X					X
Mummy Spring	R4HTSMNRAH2O012	975	X					X
Mummy View Spring	R4HTSMNRAH2O201	56	X	X				
Pipilo Unnamed Spring	R4HTSMNRAH2O190	102	X	X	X		X	
Roses Spring	R4HTSMNRAH2O137	36	X	X	X		X	
Stanley B 1 Spring	R4HTSMNRAH2O099	60	X	X		X		X
Stanley B 2 Spring	R4HTSMNRAH2O100	16	X		X			
Stanley B Wet Wall	R4HTSMNRAH2O200	222	X		Unavailable			
Steller Spring	R4HTSMNRAH2O203	169	X					
Unnamed 20 Spring	R4HTSMNRAH2O035	332	X	X				
Unnamed 27 Spring	R4HTSMNRAH2O121	25	X	X		X		
Unnamed 45 Spring	R4HTSMNRAH2O112	552	X	X	X		X	
Unnamed 49 Spring	R4HTSMNRAH2O117	846	X	X	X	X	X	
Unnamed 55 Spring	R4HTSMNRAH2O119	2952	X	X				
Unnamed 59 Spring	R4HTSMNRAH2O050	122	X		X			
Unnamed 75 Spring	R4HTSMNRAH2O057	188	X	X				
Unnamed 9 Spring	R4HTSMNRAH2O061	15	X	X				
West Mud Spring	R4HTSMNRAH2O089	1940	X	X	X		X	

Site Name	Site ID	Size (m ²)	Disturbances		Management Indicators			
			Animal Trails	Channel Erosion	Runout Channel Substantially Altered	Flow Regulation Adversely Affects Site	Herbivores Adversely Affect Site	Recreational Uses Adversely Affect Site
Younts Spring	R4HTSMNRAH2O149	638	X	X	X	X		

2012 Sites

Site Name	Site ID	Size (m2)	Disturbances		Management Indicators			
			Animal Trails	Channel Erosion	Runout Channel Substantially Altered	Flow Regulation Adversely Affects Site	Herbivores Adversely Affect Site	Recreational Uses Adversely Affect Site
Big Timber Spring	R4HTSMNRAH2O073	169	X	X	X	X	X	
Bill Smith Spring	R4HTSMNRAH2O065	80	X					
Carpenter Canyon 2	R4HTSMNRAH2O005	2104						
Cave Spring	R4HTSMNRAH2O206	28	X		X			X
Cave West Spring	R4HTSMNRAH2O207	3	X		X	X		X
CC Spring	R4HTSMNRAH2O138	33.5	X	X		X		
Crow Spring (Jeff's)	R4HTSMNRAH2O007	75	X	X		X		
Crystal Springs	R4HTSMNRAH2O074	35	X	X			X	
ENE of Lost Cabin Spring	R4HTSMNRAH2O010	800	X	X	X			
Jaybird Spring	R4HTSMNRAH2O013	101	X		X	X	X	X
Lees Spring	R4HTSMNRAH2O015	42	X					
Lees Spring upper	R4HTSMNRAH2O208	134	X					
Lost Cabin Spring	R4HTSMNRAH2O147	222	X	X	X		X	
Macks Canyon 2	R4HTSMNRAH2O093	400	X	X	X	X	X	X
McFarland Spring	R4HTSMNRAH2O088	1274	X	X	X	X		
Middle Mud lower spring	R4HTSMNRAH2O194	272	X	X	X	X	X	
Mountain Man One Spring	R4HTSMNRAH2O205	1900	X	X	X	X	X	X
Mountain Springs 2	R4HTSMNRAH2O029	2216	X		X			
Mountain Springs 3	R4HTSMNRAH2O141	164	X		X		X	
Mountain Springs 4	R4HTSMNRAH2O142	8100	X	X	X	X	X	X
South Rainbow Spring	R4HTSMNRAH2O077	225	X	X	X		X	
Star Mound	R4HTSMNRAH2O209	380	X			X		
Trough Spring	R4HTSMNRAH2O086	138	X	X	X	X	X	
Unnamed 10 Spring	R4HTSMNRAH2O028	900	X				X	

Site Name	Site ID	Size (m2)	Disturbances		Management Indicators			
			Animal Trails	Channel Erosion	Runout Channel Substantially Altered	Flow Regulation Adversely Affects Site	Herbivores Adversely Affect Site	Recreational Uses Adversely Affect Site
Unnamed 28 Spring	R4HTSMNRAH2O036	800	X					
Unnamed 32 Spring	R4HTSMNRAH2O038	724	X	X			X	
Unnamed 50 Spring	R4HTSMNRAH2O109	105	X	X			X	
Unnamed 51 Spring	R4HTSMNRAH2O110	1.2	X	X				
Unnamed 80 Spring	R4HTSMNRAH2O060	718	X				X	
Whiskey Spring	R4HTSMNRAH2O127	117	X	X	X	X	X	X

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Appendix E – Management Response Frameworks

The 2010–2012 IM Audits (METI, Inc. 2011, 2012a,b) provide a basis for evaluating the effectiveness of management practice design and mitigation that can serve as a foundation for future management proposals. The following management response frameworks can be used as a starting point for the development of future project proposals and the identification of modifications to on-going actions. They define the management situation (current conditions/desired outcomes or objectives) and best practices for achieving those outcomes/objectives based on evaluation of the application and effectiveness of those practices in the SMNRA. Priorities for action can also be used to integrate proposed actions into resource management and conservation program budget requests.

E-1: Wildland Fire Suppression and Restoration Framework

The following recommendations apply to future wildland fire suppression and restoration actions and are based on observations noted in both the implementation and effectiveness monitoring discussions described in the 2010 IM Audit (METI, Inc. 2011).

1. Suppression Planning and Direction

- a) State the specific direction for suppression and fire impacts described in the Forest Plan and the Fire Management Plan. Clearly identify the important values needing protection and the specific expectations of the agency administrator(s) to help the Incident Management Team (IMT) successfully accomplish all objectives.
- b) Adopt and describe modified Minimum Impact Suppression Technique (MIST) guidelines outside wilderness. Use of MIST guidelines outside wilderness may be required to protect sensitive sites and resources.
- c) Prepare templates for the Delegation of Authority that are specific to the SMNRA and support the General Management Plan (Forest Plan Amendment) and Forest Fire Management Plan. Properly reflect the full range of fire management options available (protection & beneficial objectives). 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. Every wildland fire is different so direction, objectives, and expectations need to be specifically thought out, developed and communicated to the responsible fire management organization for each incident.
- f) Analyze past fire history in the Spring Mountains. There have been numerous large fires throughout the area. Understanding fire history in the area helps to effectively and efficiently manage future wildfires.

2. Coordination

- a) Improve communication, operational understanding, and relationships among all the entities involved in wildland fire suppression by developing patterned and rehearsed responses. Focus on understanding responsibilities for decisions on evacuations, suppression activities, communications with agencies at other levels/locations and the public, and interagency requirements. 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.
- b) 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.

3. Resource Protection

- a) Provide more trained Resource Advisors and include them in more fire training to improve their skills. Hold a pre-season meeting or some other session to discuss what they are looking for and what is important. Along with this, brainstorm any other issues that might be a problem in managing a fire, such as situations where springs might be used as water sources. Build a GIS layer showing this information and make it available to incoming IMTs.
- b) Develop GIS layers for all values at risk that can be readily accessed at the time of a fire. This should be put on a disk or portable drive that could be given to in-coming IMTs to help them understand location of all values at risk within and surrounding the planning area on a wildfire. An example of values at risk includes (not intended to be all inclusive): Sensitive plant habitat or known locations, critical habitat for any important species, past and present fuel/fire breaks, private and Forest Service structure location, any improvements or infrastructure that needs protection (cell towers, power transmission lines, campgrounds, picnic areas, organization sites and camps, heritage sites, trailheads, bridges, etc.). This information would also greatly assist in the development of WFDSS and incident specific letters of delegation.

4. Managing Fire Behavior

- a) 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.
- b) 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.

E-2: Hazardous Fuel Treatment Prescription Framework

Design measures used in the 2007 Spring Mountains Hazardous Fuels Reduction Project EA provided the basis for developing a consistent approach or framework for developing hazardous fuel reduction treatment prescriptions. References to specific design measures refer to those used in the 2007 EA.

1. Design Features Common to All Treatment Proposals

With regard to specific design measures or groups of design measures, future proposals should consider the results of this audit and consensus of participants. 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. Its size and fire behavior are within fire behavior objectives. Retention of mountain mahogany should use clumps similar to those used in the “Old Kyle” fuel break treatment example.
- b) Design measures better addressed through proposed treatment design:
 - 1) Visual Effects (V 1 through V18) - Visual design measures should be built into 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.

2. Potential Treatment Prescriptions

SMNRA Staff identified six potential treatment sites and discussed current conditions, need and purpose of treatments, desired outcomes, and the type of treatment associated with different vegetation cover types. The following tables describe the treatment prescriptions for different treatment areas based upon current vegetation and need/purpose associated with each site. (see the 2010 IM Audit Report for specific treatment area locations and past treatment areas referenced).

Area A - Treatment Prescription A (North Lee Canyon)

Current vegetation	Mixed conifer on moist north-facing slopes; Pinyon-juniper, brush, and mountain mahogany on dry south-facing slopes
Desired Condition	Fuel loading (crown spacing, ladder fuels, and surface continuity) should be reduced to allow for direct attack by hand crews. Flame lengths reduced to 2 feet or less.
Need and purpose	- Slow fire spread - Facilitate reintroduction of fire into Wilderness, by preventing spread of fire from the west into Lee Canyon, which could threaten private land. -No ingress/egress issue
Treatment	Mixed conifer: - Favor ponderosa pine - Thin to preferred spacing, do not prune Pinyon/Juniper: - Shaded fuel break similar to the "Old Kyle" fuel break - Whole tree removal - Leave individual trees and mountain mahogany clumps - No pruning - Retain some low-height brush in between retained trees, do not remove black brush - Hand pile and burn activity fuels. Chip and masticate only when needed to protect structures or key CA Species habitats.

Area B - Treatment Prescription (Deer Creek Road - Lee Canyon Grade)

Current vegetation	Pinyon/juniper and mountain mahogany, some mixed conifer on lower end
Desired Condition	Fuel loading (crown spacing, ladder fuels, and surface continuity) should be reduced to allow for direct attack by hand crews. Flame lengths reduced to 2 feet or less.
Need and purpose	- Ingress/egress - Reducing the rate of spread to allow for more effective and efficient response time, reducing fire intensity to allow for safer fire control operations.
Treatment	Same as recent Stimson/LDS Camp treatment without pruning Hand pile and burn activity fuels. Chip and masticate only when needed to protect structures or key CA Species habitats.

Area C - Treatment Prescription (Angel Peak Road – north side of road)

Current vegetation	Pinyon/juniper and mountain mahogany
Desired Condition	Fuel loading (crown spacing, ladder fuels, and surface continuity) should be reduced to allow for direct attack by hand crews. Flame lengths reduced to 2 feet or less.
Need and purpose	- Provide for the protection of workers and residents at the Angel site to safely shelter in place and for ingress and egress to the Deer Creek road. - Coordinate treatment with power line right of way fuel treatment for protection of air traffic control and youth camp facilities and operations.
Treatment	Same as recent Stimson/LDS Camp treatment without pruning Hand pile and burn activity fuels. Chip and masticate only when needed to protect structures or key CA Species habitats.

Area D - Treatment Prescription (Deer Creek-Kyle Canyon Grade)

Current vegetation	Pinyon/juniper or brush
Desired Condition	Fuel loading (crown spacing, ladder fuels, and surface continuity) should be reduced to allow for direct attack by hand crews. Flame lengths reduced to 2 feet or less.
Need and purpose	- Buy time to get resources on site - Prevent and/or slow spread from starts along the road - Provide for ingress/egress for residents
Treatment	- Shaded fuel break similar to the “Old Kyle” fuel break - Whole tree removal, leave individual trees and clumps - No pruning - Some low-height brush in between retained trees - Consider multiple entry treatments - Hand pile and burn activity fuels. Chip and masticate only when needed to protect structures or key CA Species habitats.

Area E - Treatment Prescription (Fletcher Fire)

Current vegetation	Chaparral, mesquite, scattered pinyon trees
Desired Condition	Fuel loading (crown spacing, ladder fuels, and surface continuity) should be reduced to allow for direct attack by hand crews. Flame lengths reduced to 2 foot or less.
Need and purpose	- Reintroduction of fire - Moderate to low intensity fire behavior
Treatment	- Tie into Robbers Fire/topographic barrier - Shaded fuel break similar to the “Old Kyle” fuel break - Whole tree removal, leave individual trees and clumps - No pruning - Some low-height brush in between retained trees - Hand pile and burn activity fuels. Chip and masticate only when needed to protect structures or key CA Species habitats.

Area F -Treatment Prescription (Forest Service Corridor Road behind NDF Station)

Current vegetation	Mixed conifer, ponderosa pine
Desired Condition	Fuel loading (crown spacing, ladder fuels, and surface continuity) should be reduced to allow for direct attack by hand crews. Flame lengths reduced to 2 feet or less.
Need and purpose	- Provide for ingress/egress for resident
Treatment	- Similar to the Lee/Foxtail fuel break - No pruning - Hand pile and burn activity fuels. Chip and masticate only when needed to protect structures or key CA Species habitats.

E-3: Springs/Riparian Area Management Framework

A key factor in determining when and how to establish riparian enclosure fences and initiating other management actions is the ecological significance of the spring/riparian area. Ecological significance is determined by a combination of factors and can be determined using the information and data being collected in the springs inventory program. Preliminary discussions indicate the following elements should contribute to the determination of ecological significance:

- Spring Type
- Riparian Area/Feature Size
- Surface Flow
- Vegetation Community
- Presence of CA Species

The potential for disturbance or damage by wild horses/burros, elk and recreation use are other factors to be considered. In some instances, drift fences established in lower portions of canyons are a more effective alternative to reducing potential effects from wild horses/burros and should be considered before fencing individual sites.

Elk use effects at springs are related to the distribution of the elk population across the SMNRA. Fences that effectively exclude elk are expensive to build and maintain. Use of external water sources is likely more effective in reducing use by elk than more elaborate fencing designs.

Recreation use effects can often be effectively managed by a combination of restricting use by establishing physical barriers and designation of access routes and interpretive signing/visitor education.

Forest Plan/GMP Standards

Forest Plan standards and guidelines provide a starting point for developing a framework for managing recreation use at springs and in riparian areas. They also provide guidance for determining when fencing should be used to protect CA species and their habitats, as well as enclosure design. The following Forest Plan/GMP standards apply design elements included in this framework:

- If a riparian area within a wild horse and burro territory is fenced, pipe water out of riparian areas for wild horse and burro use. (GMP 0.2)
- When developing water sources, pipe water from a point downstream of the source if snails or other sensitive species are present, or if the spring source has not been previously developed. (GMP 0.8)
- Remove existing water developments and debris from springs, providing they no longer serve their original purpose, are not critical to wildlife, and the items are not of historical significance. (GMP 0.13)
- Prohibit parking and camping within riparian areas. (GMP 0.3)
- MA 11 - Provide protection of the riparian areas (in accordance with NV Revised Statute 503.660) at Cold and Willow Creeks through the use of new road alignments, vehicle barriers, and/or signage. Redirect parking and camping away from riparian corridors. Allow only day-use, walk-in activities to occur within the riparian corridor. (GMP 11.1)
- MA 13 - Develop low standard recreation facilities, including small campsites or restrooms, in Carpenter Canyon as a resource protection measure. Close the last section of road to prevent vehicle access through the stream and riparian area. Make campsites walk-in access only. (GMP 13.17)

The following decision framework is recommended to determine proposed actions associated with springs/riparian management and is designed to reduce the effects of uses and disturbance on springs and riparian areas.

Springs/Riparian Management Framework

Common Design Features • <u>Drift Fences</u> – Evaluate opportunities to establish drift fences to control access to springs by wild horses/burros before proposing fencing at individual sites. • <u>Perimeter</u> – Consider fencing areas larger than the spring riparian area to provide better anchor points and screening. At a minimum, enclosure fences and management efforts should approximate the perimeter of the spring riparian area. Slope breaks and vegetation should be the primary factors used to determine the perimeter and location of fences and delimiting areas of use. • <u>Existing Developments</u> - Remove existing water developments and debris from springs, providing they no longer serve their original purpose, are not critical to wildlife, and the items are not of cultural significance. Restore and re-vegetate areas associated with these improvements. • <u>Maintenance and Monitoring</u> – Adhere to maintenance schedules established for each fencing design and associated monitoring schedules and focus.	
High Ecological Significance Wild Horses & Burros Present/Elk Use High – Moderate Recreation Use	High Ecological Significance No Wild Horses & Burros/Elk Use High – Moderate Recreation Use
<u>Priority A</u> • Establish and maintain a post/wire rope enclosure • Exclude <u>all</u> wild horses and burros • Do not allow elk access • Provide external water source(s) • Restrict and manage recreation use/access using physical barriers/trail locations • Provide interpretive and recreation signing	<u>Priority C</u> • Restrict and manage recreation use/access using physical barriers/trail locations • Interpretive and recreation signing
Moderate Ecological Significance Wild Horses & Burros Present/Elk Use Moderate – Low Recreation Use	Moderate Ecological Significance No Wild Horses & Burros/Elk Moderate – Low Recreation Use
<u>Priority B</u> • Establish and maintain a t-post/barbed wire enclosure • Provide external water source • Restrict and manage recreation use/access using physical barriers/trail locations • Provide interpretive and recreation signing	<u>Priority D</u> • Restrict and manage recreation use/access using physical barriers/trail locations • Provide interpretive signing
Low Ecological Significance Wild Horses & Burros Present Low Recreation Use	Low Ecological Significance No Wild Horses & Burros/Elk Low Recreation Use
<u>Priority D</u> • No enclosure fence warranted. Site-specific exceptions may occur • Provide interpretive signing	<u>Priority E</u> • No enclosure fence warranted • No interpretive or recreation signing

E-4: Motorized Recreation Management Framework

Given the complexity associated with the management of motorized use within the SMNRA and limited staff resources available, it is essential that management actions be focused on those areas where they are necessary to minimize effects to CA Species and their habitats. Key factors in setting management priorities include:

Level and Type of Recreation Use – The level and type of use potentially affecting CA Species and their habitats needs to be described and mapped using a qualitative approach to assist in setting management priorities.

Ecological Significance of CA Species Habitats and Life Cycle Events – Information on CA Species habitat and information on the species' life history are important factors in managing recreation use. A combination of habitat extent and timing associated with key life history events need to be considered. Information being developed as part of the I&M program will address these needs by providing current life history information and potential habitat models. A current example is provided by the UNLV study of the Mount Charleston Blue Butterfly, which has identified limited habitat for this species located in the vicinity of West Mud Springs, Cold Creek and Willow Spring. These habitats are critical during key life cycle stages and may warrant seasonal restrictions on some uses.

Forest Plan/GMP Standards

Forest Plan/GMP standards provide a starting point for developing a framework for managing motorized recreation. The following apply to design elements included in this framework:

- Prohibit parking and camping within riparian areas. (GMP 0.3)
- Existing roads and trails should remain open to current use unless site-specific constraints dictate a need for closure or seasonal restrictions. (GMP 0.24).
- Provide for public safety in management of recreation. Cooperate with and support other agencies to ensure safety. (GMP 0.28).
- Work cooperatively with Federal, State, local agencies, Tribal governments, and others to increase public education and awareness of resource values and interpretation opportunities throughout the SMNRA. (GMP 0.30).
- Manage for a variety of road types, including limited maintenance roads that offer recreational opportunities for OHV's and other users. (GMP 0.36).
- Allow motorized vehicle use only on designated roads and trails, except for snowmobile use in approved areas. Close washes to motorized use. (GMP 0.65).
- Sign all designated forest system roads to identify the route names/number and to indicate the ends of roads and parking areas. (GMP 0.120).
- MA 11 - Provide protection of the riparian areas (in accordance with NV Revised Statute 503.660) at Cold and Willow Creeks through the use of new road alignments, vehicle barriers, and/or signage. Redirect parking and camping away from riparian corridors. Allow only day-use, walk-in activities to occur within the riparian corridor. (GMP 11.1)
- MA 13 - Develop low standard recreation facilities, including small campsites or restrooms, in Carpenter Canyon as a resource protection measure. Close the last section of road to prevent vehicle access through stream and riparian area. Make campsites walk-in access only. (GMP 13.17)

Management practices and techniques appropriate for managing motorized recreation use in the SMNRA that have been proven to be effective serve as a basis for future proposals.

The following management framework is a recommended for determining proposed actions associated motorized recreation management designed to reduce the effects on CA Species and their habitats.

Motorized Recreation Management Framework

Common Design Features • <u>Visitor Education, Signing and Maps</u> – Improve and maintain visitor information/signing, update and improve the Motorized Vehicle Use Map, and increase partnership programs. • <u>Wilderness Trespass Enforcement</u> – Monitor and enforce prohibitions on motorized travel within designated Wildernesses. • <u>Route Closure and Restoration Practices</u> – Develop and refine practices used for restoring and rehabilitating user-created routes and closed roads based on the work done at Mountain Springs. • <u>Monitoring and Enforcement</u> – Implement programmatic recommendations listed in section 3 of the 2011 IM Audit report (METI, Inc. 2012a) regarding monitoring and cooperative law enforcement.		
High Ecological Significance High Motorized Recreation Use	High Ecological Significance Mod. Motorized Recreation Use	High Ecological Significance Low Motorized Recreation Use
<u>Priority A</u> • Restrict and manage recreation use/access using physical barriers/trail locations • Site designation in Infra • Site Master Plan and OHV Trail System Plan • Interpretive and recreation signing	<u>Priority B</u> • Restrict and manage recreation use/access using physical barriers/trail locations • Evaluate “connections” with other OHV system components • Interpretive and recreation signing	<u>Priority C</u> • Restrict and manage recreation use/access using physical barriers/trail locations • Evaluate “connections” with other OHV system components • Interpretive and recreation signing
Moderate Ecological Significance High Motorized Recreation Use	Moderate Ecological Significance Mod. Motorized Recreation Use	Moderate Ecological Significance Low Motorized Recreation Use
<u>Priority B</u> • Restrict and manage recreation use/access using physical barriers/trail locations • Evaluate “connections” with other OHV system components • Provide interpretive and recreation signing	<u>Priority C</u> • Restrict and manage recreation use/access using physical barriers/trail locations • Evaluate “connections” with other OHV system components • Provide interpretive signing	<u>Priority D</u>
Low Ecological Significance High Motorized Recreation Use	Low Ecological Significance Mod. Motorized Recreation Use	Low Ecological Significance Low Motorized Recreation Use
<u>Priority C</u> • Restrict and manage recreation use/access using physical barriers/trail locations • Evaluate “connections” with other OHV system components • Provide interpretative signing	<u>Priority D</u>	<u>Priority E</u>

E-5: Noxious Weed Control and Prevention Framework

The SMNRA is sensitive to noxious weed establishment and spread for a variety of reasons:

- Risk of new introductions – There are vectors for noxious weeds associated with the SMNRA. Recreation users and other visitors, including equipment and animals used for recreation use and contractors and cooperator equipment causing ground disturbance are the principle sources of concern. Landownership and management involving multiple agencies and inholdings further complicate noxious weed prevention and control activities.
- Risks to the viability of endemic species – Endemic species resident within the SMNRA are of limited extent, population numbers, etc, at risk from noxious weeds and may be out-competed by these introduced species
- Difficulty of treatment and eradication of new populations – Prevention is the primary management objective since detection and early control costs increase exponentially once populations are established. New populations may be well-established before they are discovered, may be in areas that are difficult to treat (such as in and around surface water), or because the treatment itself may be harmful to sensitive endemic species.

Best management practices (BMPs) for noxious weed prevention and control reflect policy established in the Forest Service Manual, the Forest Plan, including the GMP Amendment, and Regional policy. The 2012 IM Audit (METI, Inc. 2012b) provides observations based on their application in noxious weed prevention and control associated with the design and mitigation practices used in the reconstruction of developed recreation sites and watershed restoration.

Forest Plan/GMP Standards

Noxious weed prevention and control is addressed in several Forest Plan/GMP standards that provide a starting point for developing a management response framework. The following apply to design and mitigation practices included in this framework:

- Use seed mixtures or seedlings for site rehabilitation, fire rehabilitation, or permit requirement, in order of preference: GMP (0.16)
 - 1) Native plants
 - 2) No seeding (only if erosion is not a serious concern and there is no cheatgrass invasion);
 - 3) Non-persistent (sterile) exotics;
 - 4) Persistent exotics.
- Develop a seed bank of native species produced from seed sources on the SMNRA. (0.17)
- American Indians may gather or tend traditional native plants or materials for personal use without obtaining a special use permit. Non-native plants may not be introduced. (0.73)
- MA 12 - Encourage the use of weed-free feed. (12.19)

Amendment #8 to the Humboldt-Toiyabe NF FP addresses herbicide use for noxious weed control. This Forest Plan amendment primarily provides for herbicide use to control noxious weeds but also has the following provisions:

- Continuation of a prevention and education program designed to stem the further spread of noxious weeds on the Humboldt-Toiyabe National Forest and adjacent areas.

- Continuation of ongoing survey programs to document the occurrence of noxious weeds on National Forest System lands.
- A monitoring program to evaluate and document effectiveness of noxious weed treatments.

Regional and Forest Direction

The management framework for noxious weed prevention and control also reflects Regional and Forest management direction including:

Regional Forester's Special Order – Weed Free Hay

The Intermountain Region has established a Weed Free Hay Policy on National Forest System lands in Utah, Nevada, western portions of Wyoming and southern Idaho. On February 11, 2003, the Regional Forester signed a Weed Free Hay Order # 04-00-097 to establish the requirements associated with this policy. Full implementation of this and its enforcement was directed to occur within five years (i.e., by February 15, 2008).

On March 25, 2003, the Spring Mountain NRA staff mailed 104 letters to individuals and groups informing them of the weed free hay policy. The letter also provided information on where to purchase certified hay. On April 3, 2003, a Media Advisory was issued to electronic and print media with a total of 33 press contacts on the Intermountain Region's Weed Free Hay Policy. Also, the Forest released a statewide press release. The Humboldt-Toiyabe National Forest website provides information on the policy and a flyer about weed free hay and why the policy has been implemented.

In 2003, weed free hay road signs were being made and were to be installed throughout the Spring Mountain NRA, focusing on areas where equestrian use is prevalent (USDA Forest Service 2003).

FSM 2080 Forest Supplement

On September 10, 2004, the Forest Supervisor approved Manual Supplement 2000-2004-1, to FSM Chapter 2080, Noxious Weed Management¹. Among other things, this Supplement addresses guidelines for:

- prevention of introduction of noxious weeds during rehabilitation activities. These precautions include addressing prevention in the rehabilitation plan, testing seed used, replanting promptly after disturbance, maintaining microhabitats, cleaning equipment, and others.
- prevention of new infestations through recreation activities. The measures described include use of certified weed-free hay or pelleted feed, cleaning of animal hooves, cleaning of recreation vehicles, using education and interpretation activities, and others.
- prevention of infestations from road maintenance activities. These guidelines include minimizing removal of road-side vegetation, treatment of existing infestations before maintenance begins, re-establishing vegetation, testing seed used, cleaning and inspecting equipment, and others.

¹ As of December 2011, noxious weed direction has been moved to FSM 2090

HTNF Noxious Weed Control Program Environmental Assessment

In 2001, the Forest completed a Forestwide Environmental Assessment . The decision also contains a project-specific amendment of the Spring Mountains National Recreation Area, Management Plan Standard 0.39, to read:

Allow use of herbicides for controlling noxious weed populations. When applied, use only formulation registered by the EPA for the intended use, at minimum effective rates, and using selective methods. Avoid use in habitat for threatened, endangered, or sensitive species, or species of concern whenever possible.

The decision also provides for:

- The use of all available control methods (including selected herbicides) to provide the most effective and cost efficient means to address noxious weed management objectives. Mitigation measures will guide the appropriate control methods to be used on a site by site bases (sic).
- Continuation of a prevention and education program designed to stem the further spread of noxious weeds on the Humboldt-Toiyabe National Forest and adjacent areas.
- Continuation of ongoing survey programs to document the occurrence of noxious weeds on National Forest System lands.
- A monitoring program to evaluate and document effectiveness of noxious weed treatments.

Noxious Weed Control and Prevention Management Framework

Common Design Features

Education

- Maintain a prevention and education program designed to stem the further spread of noxious weeds on the Humboldt-Toiyabe National Forest and adjacent areas.
- Develop and distribute information on noxious weed prevention and control for SMNRA recreation users.
- Install signs and information at kiosks/bulletin boards informing recreation users of prevention and control objectives and requirements.
- Provide training to all SMNRA employees and contractors to alert them to noxious weed prevention procedures, species likely to be encountered, health and safety issues associated with different species and their control, and their role in reporting and taking immediate control action when it can be safely accomplished.

Monitoring

- Continuation of ongoing survey programs to document the occurrence of noxious weeds on National Forest System lands.
- Develop and implement a standardized approach to for implementation and effectiveness monitoring of noxious weed control and prevention.

Restoration

- Use seed mixtures or seedlings for site rehabilitation, fire rehabilitation, or permit requirement, in order of preference: native plants, no seeding (only if erosion is not a serious concern and there is no cheatgrass invasion); non-persistent (sterile) exotics; or persistent exotics.
- Develop a seed bank of native species produced from seed sources on the SMNRA.

Recreation Use – Livestock and Recreation vehicles

Policy/Direction	Design/Mitigation Practice(s)	Implementation Actions
<u>Regional Forester's Special Order (Number 04-00-097, February 11, 2003)</u> requires the use of weed-free feed for all recreational livestock use on NFS lands within the Intermountain Region requiring use of weed-free feed.	• Develop and distribute a weed free policy for equestrians on Federal lands. • Work with adjacent land owners/managers to encourage implementation of corresponding requirements where movement between ownerships is likely. • Coordinate with the BLM and other agencies to use a common signing and notices at all major portals to the SMNRA. • Develop an information program for OHV users focused on noxious weed prevention and control.	• Implement signing at all entrance points to the SMNRA. • Establish enforcement guidelines and schedules for fully implementing this Special Order. • Encourage all OHV users to clean all vehicles prior to entry and use within the SMNRA.

Construction/Reconstruction Design and Mitigation Measures

<u>HTNF Supplement to FSM 2080</u> (see Section 7 a-m) for noxious weed prevention and control for ground disturbing activities <u>Forest Plan Amendment #8 – Herbicide Use for Noxious Weed Control</u>	• Apply the HTNF BMPs for Road Construction and Heavy Equipment Use Prevention Guidelines for all ground-disturbing activities.	• Incorporate the use of R4 and HTNF standard contract specs for noxious weed prevention and control in all contracts and in crew instructions for ground disturbing activities.
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