Cascade-Siskiyou National Monument

Study of Livestock Impacts on the Objects of Biological Interest

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Summary of Revisions to the *Draft Study of Livestock Impacts on the Objects of Biological Interest*

Peer reviewers provided numerous comments to improve the *Draft Study of Livestock Impacts on the Objects of Biological Interest* within the Cascade-Siskiyou National Monument. Several issues were highlighted based on the number and significance of comments received.

These include:
1) the size of livestock exclosures;
2) appropriate variables for measurement within livestock exclosures;
3) the number of livestock exclosures;
4) the design of the *Shrub- and Ground-nesting Bird Density* project;
5) and the selection of thresholds of change for inferring livestock effect.

In the past, 1/4-acre livestock exclosures have proved to be a powerful tool for assessing livestock effects to plant communities and soils. Several reviewers commented that livestock exclosures as defined within the draft study plan were too small. Some comments were in reference to particular variables such as bird nesting density, seed movement/plant recruitment, and interactions with wildlife—all variables that can only be measured at the landscape scale. The bird nesting project has been cancelled as a consequence of these comments. Monitoring within the exclosures and paired transects will be restricted to variables appropriate to the size of the constructed exclosures. Future livestock exclosure size will be dependent on the local site conditions including topography, and extent of plant community of interest. A total of thirteen exclosures have been completed with eleven for long-term monitoring and/or protection and two for testing native grass seed. Five exclosures are still scheduled to be constructed and would be used for long-term monitoring.

The tendency of livestock to trail along fencelines is well documented in the literature. This funneling effect of fences locally concentrates livestock impacts. Care will be taken to ensure that transect placement outside of livestock exclosures will not confound the measurement of livestock effects due to proximity to fencelines. Additional transects outside the exclosure and amended methods of analysis will allow the detection of fenceline effects where they occur. In addition to comparing paired plots to each other, plots will also be examined on an individual basis. Key plant species known to be increasers or decreasers in response to livestock utilization will be used to determine if plots external to exclosures are being influenced by the fenceline effect.

Some study projects proved to be impractical due to lack of Bureau of Land Management expertise or scientific rigor, including the monitoring of mollusks within springs and the assessment of butterfly assemblages. The need to protect rare mollusk habitat has led to fencing off of springs where these organisms occur. Neither fenceline contrast nor paired spring comparisons remain an option. Several reviewers were able to improve statistical methods employed to test hypotheses. Regression and randomization techniques have been included where relevant.

Several peer reviewers commented on the inappropriateness of using threshold values of monitored variables derived from research in other ecosystems. This study plan remains committed to the derivation of threshold values of livestock impact for use as indicators of proper management. Literature derived threshold values will be used as a guide only, to be refined using results from site specific research described in this document. Finally, many reviewers expressed concern that individual small scale studies may not be relevant at the larger landscape-scale of the monument. Actually, many of the surveys are designed to provide a landscape context for individual projects. Generalized maps of plant communities, soils, livestock utilization, weed invasion, individual plant habitat, etc., will be analyzed to provide a broader interpretation of results across the Cascade-Siskiyou National Monument.

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I. INTRODUCTION

The Presidential Proclamation calls for the protection of a range of objects of biological interest dependent on the continued ecological integrity of the Cascade-Siskiyou National Monument (CSNM) for their survival. The objects of biological interest include: Greene's mariposa lily, Gentner's fritillary, Bellinger's meadowfoam, populations of long-isolated fish species, special plant communities (rosaceous chaparral and Oregon white oak-juniper woodlands), mixed conifer and white fir forests, wet meadows, old-growth habitat crucial to the threatened Northern spotted owl, as well as the diversity of butterfly and freshwater snail species associated with the assemblage of plant communities dispersed across the landscape.

The Presidential Proclamation identifies the need to "…study the impacts of livestock on the objects of biological interest in the monument with specific attention to sustaining the natural ecosystem dynamics." To fulfill these requirements with limited resources, this study plan advocates the monitoring of selected objects of biological interest and indicators of ecosystem health in response to livestock management across the monument landscape. Landscape-level surveys will be used to extrapolate results gained from site-specific studies to the larger landscape. This implies a multi-disciplinary and multi-scale approach for assessing livestock impacts to the CSNM landscape. Monitoring projects not directly related to livestock issues are presented in the *Cascade-Siskiyou National Monument Draft Resource Management Plan/Environmental Impact Statement* (USDI 2001).

A Description of the Cascade-Siskiyou National Monument

The Cascade-Siskiyou National Monument consists of 52,947 acres of federal land administered by the BLM in southern Jackson County, Oregon (Map 1). The CSNM is located in the Klamath and Rogue River basins and four watersheds that have a combined total of approximately 780 miles of streams. The topography of the CSNM is variable, with the area around Agate Flat being nearly level to slopes in excess of seventy percent along the head walls of creeks in the Klamath River-Iron Gate watershed. Elevation ranges from 2,400 feet along Emigrant Creek to 6,134 feet at the top of Chinquapin Mountain. Average annual precipitation for this area ranges from 24 to 46 inches with most coming in the form of rain below 3,500 feet and snow above that level.

The CSNM is noted for its biological and ecological diversity because of its location at the confluence of the Klamath Mountains, Cascade Mountains and the Great Basin Geological Provinces. Each geologic province provides its own assemblage of organisms and ecological processes known as ecoregions which are based on geology, climate, soils, flora and fauna, elevation, and land use. There are four ecoregions identified in the CSNM having particular biological significance in terms of species richness, endemism, and unique evolutionary/ecological phenomenon.

Archaeological evidence indicates that people have lived in the region for at least 10,000 years. Human populations were very low in numbers and highly mobile until about 7,000 years ago. Various native peoples inhabited or used the CSNM area including the Shasta, Klamath, and

Modoc tribes. Euro-American settlement in the Rogue and Shasta valleys beginning around the 1850s spurred the development of a new way of life in the region. Farmers and ranchers began to transform the land. Cattle and sheep ranching became a significant use in the CSNM during the latter half of the nineteenth century. Livestock grazing of cattle on an allotment basis continues today across the monument with authorized active use of 2,714 animal unit months (AUMs).

Logging became more important in the CSNM after the development of transportation routes, such as the railroad in the 1880s. Large scale salvage logging, partial harvests, and selective logging began in the 1940s and continued through the 1980s with clear-cutting being the preferred harvest method. In the 1990s, timber harvest levels decreased in the area now designated as the CSNM, although approximately 83 percent of the coniferous forest has a timber harvest history.

There are approximately 463 miles of road on approximately 85,126 acres of land across all ownerships associated with the CSNM. Of this total, the BLM controls approximately 246 miles of road that accesses the 52,947-acre monument. These roads provide access for recreation, private property, and management activities such as wildfire suppression.

The majority of the CSNM is in a moderate to high fire hazard as a result of past vegetation management and fire suppression activities. Fire has played an important role in influencing historical ecological processes and continues to be recognized as playing an important role in the development and maintenance of vegetative diversity in fire-prone ecosystems found throughout the CSNM.

The Cascade-Siskiyou National Monument covers 52,947 acres of federal land in southwest Oregon (Map 1). These federal lands are managed by the Bureau of Land Management's Medford District Office. Although there are approximately 32,222 acres of non-federal lands interspersed among the federal land within the Presidential Proclamation boundary, the Cascade-Siskiyou National Monument is comprised of only federal land.

Monitoring Plan Strategy

This document contains monitoring projects relating directly to livestock. Livestock monitoring is a subset of all the monitoring projects presented in Appendix LL of the *Cascade-Siskiyou National Monument Draft Resource Management Plan/ Environmental Impact Statement* (see Map 46 for a summary of all current monitoring sites).

Individual monitoring projects will have clearly stated objectives and hypotheses with supportive predictors/standards. Methods of analysis used to examine predictors/standards supporting alternative hypotheses will be transparent and repeatable, relying as little as possible on anecdotal information, and subject to peer review.

The effects of livestock grazing and associated activities on individual species, populations, communities, and the richness of plant and wildlife habitat in the context of ecosystem functioning across the landscape is complex and may not be easily understood over a period of a few years. Thus, a subset of monitoring projects will be continued beyond the 3-5 year initial study period. This monitoring plan seeks guidance from existing documents as well as the Presidential Proclamation of the CSNM to ensure an adequate monitoring program.

Several documents have been used to direct surveys, monitoring, and research:

1) The Presidential Proclamation (Appendix A);
2) *Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl (Northwest Forest Plan) Aquatic Conservation Strategy* (ACS)(USDA and USDI 1994,);
3) *Medford Grazing Management Program/Environmental Impact Statement* (USDI 1983a);
4) *Standards for Rangeland Health and Guidelines for Livestock Grazing Management* (USDI 1995, Appendix C);
5) Biological issues identified within *Cascade Siskiyou Ecological Emphasis Area Draft Management Plan/Environmental Impact Statement* completed prior to the Presidential Proclamation of the Cascade-Siskiyou National Monument (USDI 2000).

The context for examining livestock impacts on objects of biological interest remains the allotment management plan(s) currently in place. Rangeland management specialists strive to manage the landscape as effectively as possible within the constraints of current grazing Environmental Impact Statement (EIS) (USDI 1983a) and allotment agreements.

This study plan fulfills several general goals:

- the data provided by the individual monitoring projects will fulfill the requirements for completing upcoming Rangeland Health Assessments;
- it examines whether current management strategies fit the landscape in terms of the maintenance of important natural resources (implementation monitoring);
- it determines if the current management plan is effective in meeting its objectives (effectiveness monitoring);
- and it monitors specific objects of biological and ecological context relative to livestock effects.

Oregon Standards for Rangeland Health and Guidelines for Grazing Management

The *Oregon Standards for Rangeland Health and Guidelines for Grazing Management* (Standards and Guidelines) identify five specific standards that are used to determine the degree to which “ecological function and process exists within each ecosystem.” Guidelines are practices, methods, techniques and considerations used to ensure that progress is made in a way and at a rate that achieves the standard(s). The Standards and Guidelines (Appendix C) also specify a set of potential indicators for use when conducting Rangeland Health Assessments on the allotments to determine whether or not standards are being met. The Livestock Study has been designed to provide information regarding many of these potential indicators. These are the initial indicators that will be examined first; however, it may be necessary to use other site-specific or species-specific indicators to determine “the impacts of livestock grazing on the objects of biological interest in the monument.” The results of the Livestock Study will be used in conjunction with other available data to determine whether or not the standards are being met by current grazing practices.

The five standards and associated guidelines are described below, along with a set of potential indicators that can be used to determine compliance with the standard. The ongoing Livestock Study will provide additional information on those indicators identified with an asterisk (*).

Standard 1 Watershed Function – Uplands: Upland soils exhibit infiltration and permeability rates, moisture storage and stability that are appropriate to soil, climate and landform.

Guidelines:

- Provide adequate cover to promote infiltration, conserve soil moisture and maintain soil stability in upland areas.
- Promote soil surface conditions that support infiltration.
- Avoid sub-surface soil compaction that retards the movement of water in the soil profile.

Potential Indicators

° amount and distribution of plant cover (including forest canopy cover)*;
° amount and distribution of plant litter*;
° accumulation/incorporation of organic matter;
° amount and distribution of bare ground*;
° amount and distribution of rock, stone, and gravel;
° plant composition and community structure*;
° thickness and continuity of A horizon;
° character of micro-relief;
° presence and integrity of biotic crusts;
° root occupancy of the soil profile;
° biological activity (plant, animal, and insect); and
° absence of accelerated erosion and overland flow*.

Soil and plant conditions promote moisture storage as evidenced by:

° amount and distribution of plant cover (including forest canopy cover)*;
° amount and distribution of plant litter*;
° plant composition and community structure*;
° accumulation/incorporation of organic matter; and
° accumulation/incorporation of organic matter; and

Standard 2 Watershed Function – Riparian/Wetland Areas: Riparian/wetland areas are in properly functioning physical conditions appropriate to soil, climate and landform.

Guideline:

- Provide adequate cover and plant community structure to promote streambank stability, debris and sediment capture, and floodwater energy dissipation in riparian areas.

Potential Indicators

° frequency of floodplain/wetland inundation;
° plant composition (stubble height, herbaceous/woody vegetation ratio, bare soil, hoof impacts),
° age class distribution, and community structure*;
° root mass;
° point bars revegetating;
° streambank/shoreline stability (bare soil, hoof impacts)*;
° riparian area width;
° sediment deposition;
° active/stable beaver dams;
° coarse/large woody debris;
° upland watershed conditions*;
° frequency/duration of soil saturation; and
° water table fluctuation.

Stream channel characteristics are appropriate for landscape position as evidenced by:

° channel width/depth ratio*;
° channel sinuosity*;
° gradient;
° rocks and coarse and/or large woody debris;
° overhanging banks;
° pool/riffle ratio*;
° pool size and frequency*; and
° stream embeddedness.

Standard 3 Ecological Processes: Healthy, productive and diverse plant and animal populations and communities appropriate to soil, climate and landform are supported by ecological processes of nutrient cycling, energy flow and the hydrologic cycle.

Guidelines:

- Help prevent the increase and spread of noxious weeds.
- Maintain or restore diverse plant populations and communities that fully occupy the potential rooting volume of the soil.
- Maintain or restore plant communities to promote photosynthesis throughout the potential growing season.
- Promote soil and site conditions that provide the opportunity for the establishment of desirable plants.

Potential Indicators

° plant composition (relative abundance of native to non-native plants, bare soil) and community
structure*;
° accumulation, distribution, incorporation of plant litter and organic matter into the soil*;
° animal community structure and composition;
° root occupancy in the soil profile*; and
° biological activity including plant growth*, herbivory*, and rodent, insect and microbial activity;
°soil compaction.

Standard 4 – Water Quality: Surface water and groundwater quality, influenced by agency actions, complies with state water quality standards.

Guideline:

- Protect or restore water quality.

Potential Indicators
° water temperature;
° dissolved oxygen;
° fecal coliform;
° turbidity;
° pH;
° embeddedness;
° populations of aquatic organisms; and
° effects on beneficial uses (i.e., effects of management activities on beneficial uses as defined under the Clean Water Act and State implementing regulations).

Standard 5 – Native, Threatened and Endangered, and Locally Important Species: Habitats support healthy, productive and diverse populations and communities of native plants and animals (including special status species and species of local importance) appropriate to soil, climate and landform.

Guideline:

- Provide for the life cycle requirements, and maintain or restore the habitat elements of native (including threatened and endangered, special status, and locally important species) and desired plants and animals.

Potential Indicators
° plant community composition, age class distribution, productivity*;
° animal community composition, productivity;
° habitat elements*;
° spatial distribution of habitat*;

° habitat connectivity*; and
° population stability/resilience*.

Framework for Making Future Decisions Regarding Livestock Grazing

The BLM is currently engaged in conducting studies, monitoring projects, and a literature review designed to determine "the impacts of livestock on the objects of biological interest in the monument with specific attention to sustaining the natural ecosystem dynamics." The Livestock Study and associated data collection will continue through 2006. Data analysis will take place concurrently and extend through 2006. Some monitoring projects and data collection would continue over the long-term.

Current monument grazing leases administered by the Medford District expire in 2006. Under existing laws and regulations, lease renewals are not automatic, but are preceded by a Rangeland Health Assessment of grazing allotments and an evaluation to determine whether or not they are meeting the Oregon Standards and Guidelines for Rangeland Health (Appendix D) and other applicable guidelines.

During the lease renewal process, the following steps would be taken to ensure that livestock grazing is consistent with current laws and regulations and meets the intent of the monument proclamation (Figure XX). Each grazing allotment would be assessed and monitored, and management specific to allotments would be developed, consistent with the BLM-wide grazing lease renewal process.

Step 1: Conduct Rangeland Health Assessments
Rangeland Health Assessments (RHAs) are required prior to considering reissuing grazing leases. These assessments are conducted by an interdisciplinary team of resource specialists who evaluate ecological processes, watershed functioning condition, water quality conditions, special status species, and wildlife habitat conditions on an allotment. All available data, including the results of the Livestock Study, would be used to make an overall assessment of rangeland health as described in the Oregon Standards for Rangeland Health, in light of the Fundamentals of Rangeland Health at 43 CFR § 4180.1. The authorized officer uses the RHAs to determine whether or not standards are being met.

Assessments are a form of evaluation that are appropriate at the watershed and subwatershed levels, at the allotment and pasture levels, and on individual ecological sites or groups of sites. Monitoring, which is the well-documented and orderly collection, analysis, and interpretation of resource data, serves as the basis for making determinations of rangeland conditions and trends and making management decisions. In cases where monitoring data do not exist, professional judgment, supported by interdisciplinary team recommendations, may be relied upon by the authorized officer in order to take necessary action.

Step 2: Evaluate Current Livestock Grazing Practices and Determine Rangeland Health and Compatibility with Objects

The monument manager will use the assessment described in Step 1 to determine whether or not current livestock grazing practices within the monument allotments are meeting the standards and following the guidelines described in the Oregon Standards for Rangeland Health and whether or not current livestock practices are compatible "with protecting the objects of biological interest".

To the extent the evaluation results determine that the standards are not being achieved or are not making progress toward being achieved, the monument manager shall determine whether or not existing livestock grazing management practices or levels of use are significant factors in failing to achieve the standards and conforming to the guidelines. The monument manager shall take appropriate action such that significant progress toward fulfillment of the standards and conformance with the guidelines is reached. This action shall be taken as soon as practicable, consistent with the regulations, and may include actions such as reducing livestock stocking rates; adjusting the season or duration of livestock use; modifying or relocating range improvements; and/or restricting or eliminating livestock use in portions of the allotments.

To the extent the evaluation results determine that existing livestock grazing practices are "incompatible with protecting the objects of biological interest" as defined in the presidential proclamation, the monument manager shall determine whether practices can be modified to achieve compatibility.

Step 3: Follow the NEPA Process for Lease Renewals or Cancellations
Following the evaluation and determination of rangeland health and compatibility "with protecting the objects of biological interest", lease renewals would be subject to the appropriate level of environmental analysis as prescribed under the National Environmental Policy Act (NEPA). The NEPA analysis would develop a full range of management alternatives for livestock grazing consistent with all applicable legal authorities, including the presidential proclamation. Alternatives would include current grazing management, a no-grazing alternative, and other alternatives developed to respond to the findings in Step 2.

Decisions regarding livestock grazing will utilize a landscape approach relying on all available data including information gained from the study mandated by the proclamation. This process would designate lands that are available for livestock grazing based on compatibility with monument resources and the objects of biological interest. Grazing leases would specify the types and levels of use authorized and would define quantifiable, time specific objectives for meeting standards.

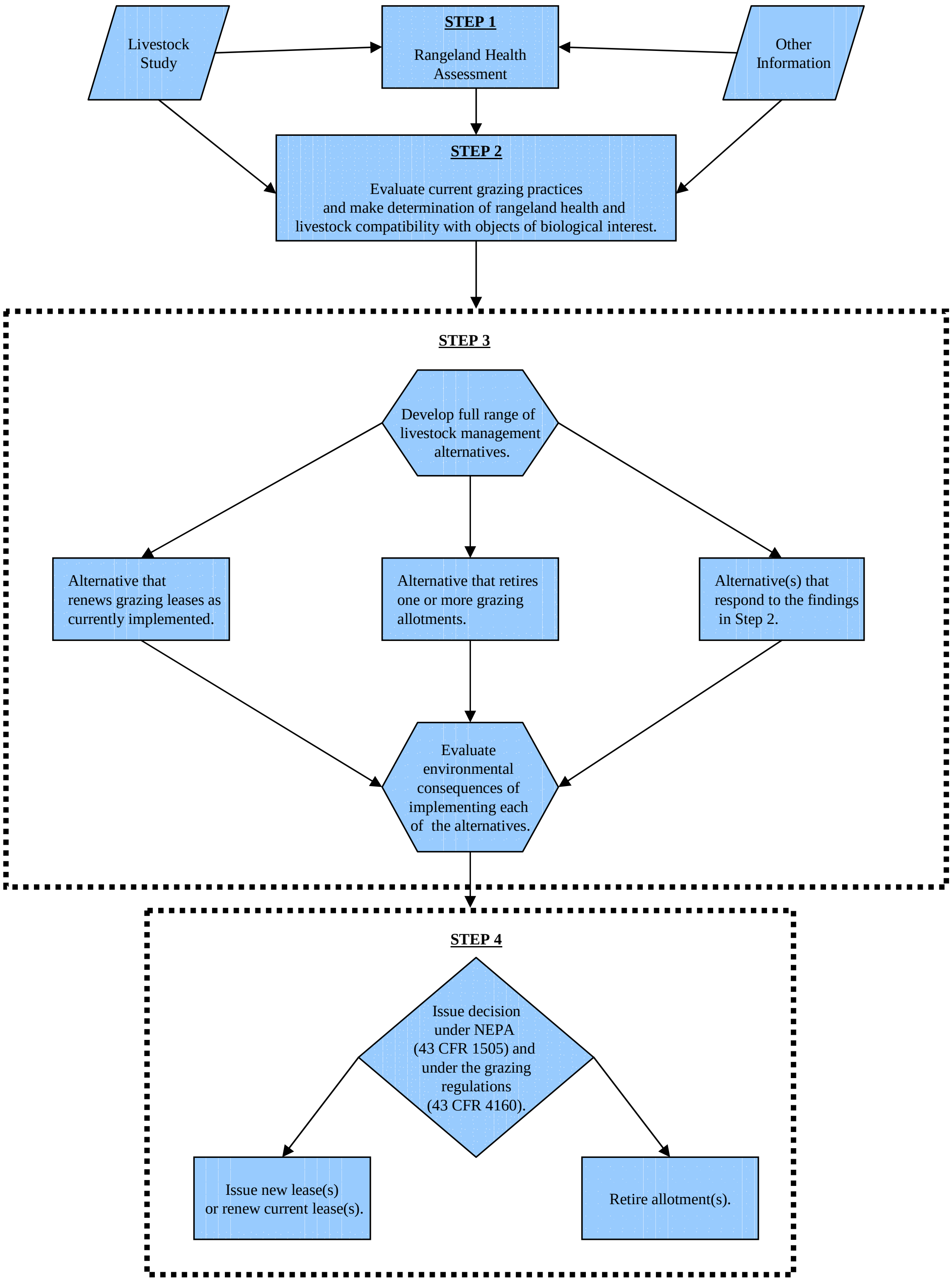
If modification of current grazing systems is required, leases would include an adaptive management strategy that allows for modifications to the leases in response to ongoing monitoring, future rangeland health evaluations, and the needs of the lessees where consistent with the monument plan and the mandates of the proclamation.

Step 4: Implement Grazing Lease Issuance/Renewal or Retire Allotments

Following the appropriate level of NEPA analysis, a decision would be issued under the provisions of 43 CFR 1505 and 43 CFR 4160 to implement the issuance/renewal of a grazing lease or retire the grazing allotments. Once the decision process is completed, a final grazing lease would be issued if current or proposed grazing practices are compatible "with protecting the objects of biological interest" and meet the Oregon Standards for Rangeland Health. This process would designate lands that are available for livestock grazing based on compatibility with monument resources and the objects of biological interest. Grazing leases would specify the types and levels of use authorized and would define quantifiable, time-specific objectives for meeting standards.

If livestock grazing on specific allotments should be found "incompatible with protecting the objects of biological interest," and grazing systems cannot be modified to achieve compatibility, those allotments would be retired as specified in the presidential proclamation and applicable laws, regulations, and procedures.

Figure XX. Process for assessing rangeland health and determining livestock compatibility with the objects of biological interest.



II. IMPLEMENTATION, EFFECTIVENESS, AND VALIDATION MONITORING

The *Cascade-Siskiyou National Monument Draft Resource Management Plan/ Environmental Impact Statement* (USDI 2001) directs monitoring on public lands: "Monitoring is an essential component of natural resource management because it provides information on changes in resource use, condition, processes, and trends. Monitoring also provides information on the effectiveness of management activities and strategies. The implementation of this plan will be monitored to ensure that management actions follow prescribed management direction (implementation monitoring), meet desired objectives (effectiveness monitoring), and are based on accurate assumptions (validation monitoring). Some effectiveness monitoring and most validation monitoring will be accomplished by formal research."

In the context of grazing within the monument, implementation monitoring examines whether criteria for grazing strategy (e.g. timing and intensity of grazing), location of livestock handling facilities, the adherence to ACS and other objectives are being implemented.

Research Objectives Fulfilling the Role of Implementation Monitoring

- Determine if the spring/summer and other grazing management strategies are being implemented according to lease requirements, and determine if these requirements are compatible with the ecological health of each of the allotments of the monument.
- Determine if any livestock handling features fall within Riparian Reserves.
- Determine if currently unmonitored and isolated springs, seeps, and wetlands meet the definition of riparian communities ordained by the ACS.
- Determine if surveys are required to assess whether conditions of isolated springs, seeps and wetlands meet ACS objectives.
- Determine if surveys for listed species (RMP) have been completed.
- Determine if the basic assumptions of conventional range management concerning pasture homogeneity, livestock distribution, and plant community successional changes are valid for the monument landscape.
- Determine if the use of "Potential Natural Vegetation" is an adequate benchmark for assessing rangeland condition.

Research Objectives Fulfilling the Role of Effectiveness Monitoring

Many of the objectives pertinent to effectiveness monitoring are defined by the *RMP* (USDI 2000), ACS, Best Management Practices (Appendix AA), Rangeland Standards and Guidelines (Appendix C), *Medford Grazing Management Program/EIS* (USDI 1983a), and the Federal Clean Water Act (as amended by the Water Quality Act of 1987). The following objectives are derived from the above documents:

- Determine if current management maintains water quality associated with riparian plant communities [Federal Clean Water Act (as amended by the Water Quality Act of 1987)].
- Determine if the physical integrity (bank integrity, bottom integrity) of riparian plant community habitats are maintained under the current management regime.
- Determine if plant composition of the range of wetland plant communities (riparian along streambanks, isolated springs, and wetlands) within the monument fall within a desired state.
- Determine if total plant cover, species composition, litter cover, bare ground, and erosion meet Standards for Rangeland Health (Appendix C).
- Determine if soil and site conditions provide the opportunity for the establishment of desired plants.
- Determine if the management strategy provides periodic breaks from grazing for rangeland vegetation during critical growth periods to promote plant vigor, reproduction, and productivity.
- Determine whether important wildlife habitats/issues identified within the *Medford Grazing Management Program/EIS* (elk and deer range & interaction with livestock, maintenance of wetlands as important foraging and nesting habitat for grouse; maintenance of important waterfowl habitat in the proximity of Hyatt and Howard Prairie lakes) are maintained by the current management regime and meet Rangeland Health Standards.
- Develop local livestock grazing impact guidelines for proper use (Best Management Practices, Appendix AA).

Research Goals Fulfilling the Role of Validation Monitoring

The Presidential Proclamation calls for examining the impact of livestock on the objects of biological interest within the monument. This implies the use of validation monitoring with suitably defined treatments (that is, livestock impacted areas) and controls (no grazing) to assess current livestock impact on the biological elements listed in Table 1.

The first research goal is therefore to identify if livestock directly affect any of the objects of biological interest listed in Table 1 so as to reduce their abundance, or ability to persist on the monument landscape. Research objectives relating directly to the objects listed in Table 1 are addressed within the discussion of the livestock exclosure project.

The second goal is to determine if the livestock exclosures are representative of the rest of the monument using landscape-level surveys. Where possible, these surveys will be designed to also provide information allowing the achievement of effectiveness monitoring. These surveys are discussed in more detail under the heading "Supporting Landscape and Effectiveness Monitoring/Surveys."

Existing Data

Determining livestock affects on objects of biological interest requires examining and critiquing existing data as well as designing new projects to fill in any data gaps. Existing projects include:

- rangeland trend data collected at 7 locations within the monument
- utilization data collected within 12 plots/transects within the monument;
- general maps of livestock utilization;
- transects examining browsing of trees/shrubs;
- riparian photos;
- riparian transects; and
- analysis of fecal composition to determine diets of livestock, deer, and elk

These data will be re-analyzed using a common set of statistical tools and interpreted in mutual context to each other and information from projects completed over the next three to five years. The individual project descriptions at the end of this document provide more detail on existing data sets.

Summary of Perceived Data Gaps

Several projects are underway to examine plant community changes that have occurred over the past few decades. This data will serve as an important temporal backdrop for current rangeland condition surveys. Together with historical information on management changes over the last 100 years, understanding patterns of plant community change will help prioritize management issues in the future.

Vegetation maps derived from imagery (acquired from satellite and low altitude plane platforms) and field surveys will provide an understanding of the patterning of plant communities across the landscape, while also identifying areas for restoration.

From existing information, it appears that there is little information about the distribution and condition of springs, seeps, and wetlands within the Monument. Lack of range trend sites within wetland plant communities identifies a serious knowledge gap. Also missing is an understanding of livestock impacts on higher elevation semi-wet meadow and conifer understory plant communities.

Noxious weed surveys and preliminary plant community surveys indicate that the most serious threat to local plant communities is weed invasion. Patterns of weed invasion across the landscape, factors facilitating weed invasion, and methods of weed eradication need to be studied to prevent further deterioration of native plant communities.

Plant community trend monitoring needs to be extended to all plant communities across the landscape, particularly those impacted by livestock and located in parts of the landscape not currently monitored (north of Highway 66).

Perhaps the most serious problem with current monitoring is the lack of control areas (monitoring in livestock impact-free areas), to serve as a comparison to livestock impacted areas. Control areas in the form of livestock exclosures are needed to represent each general plant community within the CSNM. Additional livestock exclosures are needed to examine particular issues (for example, weed invasion, or livestock impact to a rare plant and wildlife species).

Detailed site specific studies centered around livestock exclosures must be supported by landscape surveys to achieve a landscape perspective of direct impacts of livestock on important elements of the CSNM. The remainder of the document describes the intensive monitoring projects associated with livestock exclosures, and the supporting monitoring/landscape surveys.

III. LIVESTOCK EXCLOSURE STUDIES OF LIVESTOCK IMPACT ON OBJECTS OF BIOLOGICAL INTEREST

In prior versions of this document, the words livestock exclosure and enclosure are used interchangeably dependent on whether livestock or the objects of biological interest were the subject of discussion. When referring to livestock and their exclusion from a study site, the word livestock exclosure was used. The word enclosure was used in reference to biological elements enclosed by a fence. In this document, the word exclosure is used regardless of the current subject. The biological elements examined in association with the livestock exclosures are listed in Table 1.

Table 1. Important Biological Elements of the CSNM forming part of the Livestock Exclosure Project.

No.	Biological Object examined in/outside of exclosures	Management Action/Comment	Supporting Monitoring/Survey Projects
1a	Plant communities (grasslands, shrublands, woodlands, conifer understory, riparian, wetland)	Monitoring will focus on the balance between weeds & natives and key species utilized by livestock	All livestock exclosures, existing range monitoring; landscape condition surveys; reexamination of historic vegetation plots
1b	Weeds (classified as noxious, and others) The current emphasis on riparian areas means reduced focus on livestock impacts on upland weeds such as the annual grasses and yellow starthistle.	Weeds have the ability to directly impact most of the values described within the Presidential Proclamation.	Continuing surveys; pilot studies aimed at weed eradication; livestock exclosure study; permanent transects; trend data; landscape condition surveys; reexamination of historical data

Table 1. Important Biological Elements of the CSNM forming part of the Livestock Exclosure Project.

No.	Biological Object examined in/outside of exclosures	Management Action/Comment	Supporting Monitoring/Survey Projects
2	Greene's Mariposa lily	Mariposa lily preserve created to protect from grazing	Continued landscape surveys; population monitoring,
3	Willow and aspen recruitment	Livestock are known to impact persistence and recruitment of willows and aspen	Fencing off of the parsnip lakes will allow the study of willow and aspen establishment and growth following livestock removal
4	Canada thistle is perceived to be invasive in disturbed areas at higher elevations	Livestock may facilitate the reintroduction or persistence of Canada thistle in previously infested and treated areas	landscape-wide Canada thistle surveys, GIS analysis of interaction with livestock utilization, soils, etc

Rationale for Livestock Exclosures

Livestock impact on biological objects of the Monument can only be assessed relative to areas of zero livestock impact. Since the entire landscape has been grazed in the past, monitoring within newly created control areas (livestock exclosures) will be a measure of recovery, or response of plant communities/biological elements to the removal of current livestock impact. Control areas (livestock exclosures) without livestock are also necessary to determine if changes in the abundance of variables of interest are due to livestock impact, other extrinsic influences (climate change, fluctuation in amount and pattern of precipitation), or other unrecorded disturbance events. Ideally, livestock impacted areas and livestock exclosures should be located adjacent to each other on the same ecological site to ensure that transects are comparable.

Limitations of the Livestock Exclosure Project

The livestock exclosure study is limited by the number and size of the fenced areas. Probably the most severe limitation of the livestock exclosure study relates to replication. In general, this is common to landscape-level projects. Some of the biological elements being examined only occur on 2 or 3 locations within the monument - an inherent restriction in replication. In the previous incarnation of this monitoring plan, the wide range of biological elements potentially impacted by livestock mean that few replicates are associated with each element being examined. Most of the future livestock exclosures will be built in riparian areas because of their perceived sensitivity to livestock impact. This will increase the replication rate for livestock exclosures in lentic and lotic systems.

Additional monitoring plan design features to alleviate the problem of replication include:

- multiple external plots paired to individual plots within exclosures;

- Landscape surveys of conditions represented by livestock exclosure and paired area will be conducted to determine the extent of the situation represented by the livestock exclosure and paired transects;
- New monitoring endeavors will be integrated with historical data. The accumulation of historic sites together with the diversity of new monitoring projects will provide an improved understanding of the landscape that will likely transpire a statistical assessment of a single variable.

For most variables, statistical inference will be derived at the plot level as well as at the landscape level. Most data (vegetation, soil cover, disturbance) are collected as point cover, allowing their assessment as non-parametric or parametric data. At the plot level, chi-squared analysis will be used to examine change over time of individual transects or paired transects. This follows the standard Bureau of Land management protocol also recommended for the rangeland frequency trend plots. T-tests will be used to determine if differences in stubble height exist inside and outside of livestock exclosures. At the landscape level, analysis of variance or correlation techniques will be used to assess statistical significance. Alternative statistical corollaries using randomization techniques (Manly 1991) will be used where the initial conditions of the plot being assessed for change do not meet standards required for statistics based on central tendency. Regression analyses will be used to examine the relationship between measures of livestock utilzation (residual stubble height and phytomass, hoof impact) and determinate variables of interest.

Landscape Location

An examination of existing trend/plant composition plots indicates incomplete coverage of plant communities found across the landscape (Map 47). No current rangeland monitoring plots fall within springs, wetland, and rocky plant communities. Furthermore, only 1 utilization plot occurs north of State Highway 66. New monitoring sites will be placed to fill these data gaps. Livestock exclosures are being constructed at key locations to provide the necessary control to examine livestock impacts on a larger range of plant communities, as well as specific biological elements identified by the Presidential Proclamation for the CSNM.

Thirteen livestock exclosures have been completed, most to protect/study rare biological elements mentioned in the Presidential Proclamation (Map 47). Preliminary data indicate that riparian areas are most sensitive to livestock impact. New livestock exclosures will be preferentially placed in springs, seep, wetlands and riparian systems to improve our assessment of these areas.

Current Status of Livestock Exclosure Construction

Table 2 identifies livestock exclosures already constructed and also projects the number of livestock exclosures needed to adequately represent plant communities and rare elements within the Monument.

Table 2. Cascade-Siskiyou National Monument Livestock Exclosures.			
General Location	**Plant Communities**	**Comments**	**No. excl.**
Livestock exclosures already completed (13)			
Howard Prairie	riparian, conifer understory		1
Chinquapin Mtn	wet meadow/spring/semi-wet meadow		1
Chinquapin Mtn	wet meadow/spring		1
Chinquapin Mtn	spring	protect *Fluminicula* #17	1
Chinquapin Mtn	dry meadow		1
Oregon Gulch	wet meadow, riparian	enlarged to protect entire meadow	1
Hobart Peak	dry meadow/spring	high elevation meadow	1
Hobart Peak	Conifer understory		1
Hobart Peak	dry meadow, conifer understory	existing range trend site	1
Soda Mountain	rocky meadow		1
Soda Mountain	semi-wet meadow	restoration site	1
Boccard Point	semi-wet meadow	restoration site	1
Beane cabin	conifer understory		1
Livestock exclosures located & surveyed for rare plant and cultural resources (5)			
Parsnips lakes	wet meadow large exclosure of 25 acres	also site of rare sedge	1
Highway 99	oak woodland, Mariposa lily study site	rebuild existing livestock exclosure	1
Onion Creek	Agate flat riparian area	study livestock impact on intermittant creek riparian area	1
Beaver Creek	Coarse-leaved sedge dominated meadow	this site has considerable willow	1
Soda Mountain	hellebore meadow and blue-wildrye grassland	some of these sites have high gopher populations	1

Table 2. Cascade-Siskiyou National Monument Livestock Exclosures.			
General Location	**Plant Communities**	**Comments**	**No. excl.**
Total projected number of livestock exclosures (18)			

Time-line

The Presidential Proclamation requires that potential livestock impact on important biological elements of the CSNM be studied prior to altering the present allotment management plan(s). This monitoring plan calls for intense monitoring for an initial 3 to 5 years. The completed livestock exclosures and database will provide a framework for less intensive but sustained monitoring of biological elements and ecological issues in the longer-term existence of the CSNM.

IV. MONITORING WITHIN LIVESTOCK EXCLOSURES

This section of the monitoring plan is comprised of 4 individual studies examining variables associated with individual plant, plant community composition/structure, and physical environment within livestock exclosures and paired sites.

1a and 1b. Plant Community change following livestock removal: Grasslands, Shrublands, Woodlands, Conifer Understory, Riparian, Wetlands

Introduction

This project examines plant community change following livestock exclusion to determine if plant communities within livestock exclosures change towards a more desired condition relative to current vegetation composition and structure. Public comment and scientific opinion have differed regarding the effects of livestock on the range of structural, compositional, and environmental characteristics of plant communities within the CSNM. A literature survey of plant community changes associated with livestock exclosures in other ecosystems will identify the range of changes expected within the livestock exclosures constructed within the Monument.

Case Studies of Long-Term Vegetation Dynamics - upland communities

Anderson and Holte (1981) reported a doubling in the cover of shrubs and perennial grasses after 25 years of rest from livestock grazing at Idaho National Engineering Laboratory (INEL). The

20-fold increase in grasses is thought not to be at the expense of shrubs but related to increased seed reserves with the development of the perennial grass plants. The authors described a stage of slow recovery (the initial 10 years) followed by more rapid recovery related to seed reserves. No obvious seral stages could be defined. The study showed high variance between plots. Anderson and Inouye (1988) discussed the establishment of dense stands of non-native cheatgrass (*Bromus tectorum*) since monitoring the initial presence of non-native cheatgrass (*Bromus tectorum*) at the INEL sites in 1975. The authors noted that establishment occurred in the absence of fire and grazing and during a period of higher than average rainfall (1966-1975). A subsequent decrease during drier years implied a dependence on rainfall.

Burning of good condition plots, including perennial grasses, resulted in an increase in palatable grasses, in spite of an initial large increase in cheatgrass (Hosten 1995). The exclusion of cattle during the recovery period after burning is thought to be crucial (West and Hassan 1985, Hassan and West 1986).

Yorks et al. (1992) reported on the repetition of a 63-year-old transect covering several vegetation types, including sagebrush-dominated communities in Pine Valley, Utah. Many factors, including a moderation in livestock grazing, could be responsible for the substantial increases in canopy cover observed for several perennial grasses. This trend was less noticeable with sagebrush and attributed to a filling out of individual plants rather than increased numbers. The proportion of understory cover relative to total plant cover also showed an increase.

West et al. (1984) found that shrub-dominated communities (sagebrush semidesert) in 5 large paddocks in west central Utah did not show significant increases in perennial grasses following 13 years of rest under favorable precipitation conditions. The presence of annual grasses increased the possibility of community deflection towards cheatgrass domination.

Eckert and Spencer (1986) examined changes in shrub canopy cover, basal cover of herbaceous species, and frequency of occurrence of all species at 2 sites in northern Nevada. Both sites were managed under a 3-pasture rest rotation grazing system. One site showed no long-term change in frequency of species. The other site showed increased shrub cover and decreased palatable grass (*Stipa thurberiana* and *Agropyron spicatum*) cover over the 10 years examined. At one of the above sites, Eckert and Spencer (1987) found heavy periodic grazing to be the major cause for restriction of basal area growth and reproduction of palatable grass species over a 9-year study period.

Various Livestock exclosure Studies - upland communities

Peters et al. (1993) commented on vegetation changes in 2 livestock exclosures near Burley and Castleford (Idaho) over 50+ years following crop-land abandonment. Using frequency of occurrence data, the authors showed that 1 site showed change toward late-seral perennial grass species (*Agropyron riparium* and *Poa secunda*) while the other site remained dominated by annuals and biennials.

Rose and Miller (1993) reported on inside versus outside differences of 13 livestock exclosures 66 years after establishment using cover and density data. No statistically significant differences in cover between grazed pastures and livestock exclosures were found for shrubs, although *Artemisia tridentata* showed increased density outside the livestock exclosure. Total grass cover and density of all perennial bunchgrasses, except *Poa sandbergii*, were higher inside the livestock exclosure. Forbs appeared to have a slightly higher cover and density within the livestock exclosures, although these changes appeared to be species-specific.

Robertson (1971) examined an eroded and grazed 20-acre tract 30 years after the initiation of rest. The plant community showed increased cover by all its life-forms and reestablishment by *Agropyron spicatum*. The highest recovery was exhibited by thurber needlegrass (a 7-fold increase). The only decreases were shown by annual forbs and locoweed.

Tueller and Tower (1979) emphasized the negative aspects of livestock exclosures – the stagnation effect arising from non-use of plants. As an example, they presented data showing an average 70% decline in the production of bitterbrush 10 years after fencing.

Pearson (1965) showed that aboveground production for sagebrush and several major bunchgrasses increased after 11 years of rest, in comparison to a site that had been grazed continuously for 70 years. An exception was *Phlox caespitosa*. This trend did not extend to below-ground production. The area being rested showed only 68% of the belowground root mass of the grazed area.

Sanders and Voth (1983) found greater ground cover on grazed plots versus protected plots in the Boise National Forest after 46 years of periodic data collection. No clear trends could be found on a species basis.

Holecheck and Stevenson (1983) found that 22 years of rest from grazing in northwestern New Mexico had little influence on plant composition at either of 2 sagebrush semidesert sites studied. Forbs had been eliminated from the study site prior to construction of the livestock exclosures by heavy sheep grazing.

Potter and Krenetsky (1967) showed a decrease in ground cover by both grass and forbs in protected and grazed plots occupied by sagebrush semidesert in northwestern New Mexico.

Daddy et al. (1988) examined 3 sites with different grazing histories in northwestern New Mexico. Major phytomass contributors at the heavily grazed site were *Aristida sp.* and *Bromus tectorum*. *Brotclova gracilis* and *Hilaria jamesii* were more productive on grazed sites. The moderately grazed site had twice the herbaceous aboveground phytomass of the protected site.

Sneva et al. (1984) examined 10 livestock exclosures established in eastern Oregon during the drought years of the 1930s in big and low sagebrush-dominated vegetation. Frequency estimates were evaluated in 1937, 1960, and 1974. Frequency of all native grasses (*Agropyron spicatum*, *Festuca idahoensis, Sitanion hystrix, Stipa thurberiana, Poa sandbergii*) was shown to increase or remain stable both within and outside the livestock exclosures with one exception. *Poa sandbergii* decreased in 1 livestock exclosure located in low sagebrush-dominated vegetation. Several factors confounded the results: the switch from spring sheep to spring-through-fall cattle-grazing, higher precipitation following 1937, a decline in overall livestock grazing intensity, and the effects of the sagebrush defoliator moth during the early 1960s.

McLean and Tisdale (1972) noted dramatic changes in the range of plant communities within a set of livestock exclosures located in southern British Columbia.

Fescue Grassland Zone (McLean and Tisdale 1972): "Twenty nine years after fencing, there was five times the foliage cover of bluebunch wheatgrass, (*Agropyron spicatum*), Rough fescue, and Kentucky bluegrass (*Poa pratensis*) inside the livestock exclosure as compared with that outside. There was also a marked decrease in the amount of Sandberg bluegrass, low pussy toes, and dwarf fleabane." "The average herbage production during the period 1959 to 1966 showed a 98% greater yield inside the livestock exclosure compared with outside."

Fescue Grassland Zone (McLean and Tisdale 1972): "Twenty-nine years after fencing, there was a much greater cover of rough fescue, bluebunch wheatgrass, and junegrass inside the livestock exclosure, compared to an abundance of dwarf fleabane and Sandberg bluegrass outside. A review of earlier observations suggests that vegetation on the grazed area had not changed appreciably." "The 4-year average herbage yield shows 73% greater production inside the fence [no grazing] as compared with outside [grazed area] following 32 years of protection". Text in brackets [ ] added for clarity.

Fescue Grassland Zone (McLean and Tisdale 1972): "Observations made in 1940 and 1950 suggest that considerable improvement took place in the first 10 years after fencing. There was a marked increase in bluebunch wheatgrass and decrease in sandberg bluegrass. Between 1950 and 1959, there was a striking increase in the proportion of rough fescue present. The data support these observations, for 21 years after fencing the foliage cover of rough fescue was 10 times greater inside the livestock exclosure than in the grazed area."

Ponderosa Pine Zone (McLean and Tisdale 1972): "Ten years after fencing, there was a considerably more bluebunch wheatgrass and rough fescue inside the livestock exclosure as compared with the grazed area and much less low pussy toes and Sandberg bluegrass. By the end of the next 9 years, there was still greater increase in the amount of bluebunch wheatgrass and rough fescue inside the livestock exclosure and a marked decrease in Sandberg bluegrass, needleandthread, and low pussy toes." "Average herbage production indicated a 60% greater yield inside the livestock exclosure as compared with that outside 15 years after fencing".

Ponderosa Pine Zone (McLean and Tisdale 1972): "Data recorded in 1959, 23 years after fencing, show that bluebunch wheatgrass plants inside the exclosure had over four times the foliage cover of those plants outside. Sandberg bluegrass on the other hand had much greater coverage on the outside as compared with inside. The poorer range condition outside was also reflected in the greater frequency of low pussy toes. In the 9 years following 1959 there was a marked increase in bluebunch wheatgrass both inside and outside the exclosure, and increase in pasture sage inside and a decrease in low pussy toes." "The average herbage yield indicated a 160% increase in production inside the exclosure over that outside after 23 years of protection."

Ponderosa Pine Zone (McLean and Tisdale 1972): "General observations and limited quadrat data obtained in 1949 and 1959 suggest that the greatest improvement took place in the 13 years following 1936, and continued to a lesser extent over the next ten years. During the initial period there was a marked increase in bluebunch wheatgrass. There was also a decrease in needleandthread, low pussy toes, and rabbitbrush." "The average herbage yield indicates a 124% increase in production inside the exclosure as compared with outside."

Ponderosa Pine Zone (McLean and Tisdale 1972): "Records taken in 1960 (23 years after fencing) indicate more bluebunch wheatgrass and silky lupine inside the exclosure as compared with the grazed area. There was also less western needlegrass (Stipa occidentalis), low pussy toes, shaggy fleabane, sixweeks fescue, and cheatgrass inside the exclosure. Ten years later the bluebunch wheatgrass had decreased and cheatgrass increased inside the exclosure because of gopher activity. Ground disturbance by gophers was greater inside the exclosure presumably as a result of protective cover for the rodents provided by old plant growth."

In studies under Ponderosa pine forests of northern Arizona, Arnold (1950) noted grazing related shifts away from native bunchgrasses and towards weeds and undesirable annual grasses. The authors noted the following:

"Under protection from grazing the taller bunchgrass species dominated the herbaceous composition within the five exclosures. The species that escaped or withstood a high degree of repeated grazing [outside the exclosures] were less abundant [inside the exclosures]."

"...the bunchgrass were highly sensitive to grazing, particularly under the lighter [tree] canopy [closure] classes where grazing was intense."

"By repeated removal of the tall stems and leaves [by livestock] the bunchgrasses on the grazed areas were reduced to a small part of the total herbaceous cover. This result contrasts sharply with those obtained from the ungrazed exclosures, where bunchgrass species dominated the herbaceous composition."
Text in brackets [XX] added for clarity.

Chronosequence Approaches - upland communities

Tueller and Platou (1981) determined a successional gradient in northern Nevada by examining plant community changes moving away from a watering point. The observed pattern was determined to be different from theoretical pathways. *Agropyron spicatum* was found to vary greatly between plots but was greatly reduced in the 2 plots closest to the watering points.

Bromus tectorum cover was found to be highest closest to the watering points, while *Lupinus caudatus* and *Phlox longifolia* showed the opposite trend. *Poa secunda* generally showed a lack of trend. Cover values seem to correspond well with density data. *Sitanion hystrix* showed relatively high densities in low and high seral stage plots. Sagebrush density appears to vary considerably, being highest in the third and last plots, thus not yielding a clear pattern. In general, vegetation cover increased with decreasing condition, while litter cover and microphytic cover was highest in the plots furthest away from the water.

An examination of ten piospheres on the Snake River plains of Idaho yielded different results (Hosten 1995). While species level trends were apparent within individual piospheres, species trends were not replicated at the landscape level. This may be due to the diversity of environmental factors at larger spatial scales. Across the landscape, the least impacted transects (furthest from the watering points) were most similar to nearby relict (ungrazed) areas. The data stress the importance of basing management on site-specific plant community monitoring.

Studies of bitterbrush habitat types in north central Washington also suggest that moderately livestock impacted communities were more similar to reference communities than heavily impacted sites (Youtie et al 1988). As with sagebrush steppe communities, areas of intense livestock impact showed higher shrub cover and lower bunchgrass cover (Youtie 1988, Hosten 1995). General landscape-level patterns of community change may be obscured by the interaction of other ecological processes such as fire.

Many of the above upland studies were conducted in the Great Basin, however, a generalized model of plant community dynamics within an oak woodland environment supports some of the common plant community changes identified in the above literature, especially regards annual and perennial grass dynamics. George et al. (1992) associates annualization of grasslands in an oak woodland environment with poor livestock management and identifies the difficulty of restoring "Mediterranean" grasslands back to native perennial domination [see the weed management plan and literature review in Appendix GG of the CSNM DRMP (USDI 2001)].

Riparian Communities

The importance of riparian zone habitat to the maintenance of biological diversity at the landscape and local scales cannot be over emphasized. Riparian zones are one of the most limited, (Elmore 1987) and most sensitive (Kaufman and Krueger 1984) habitats in the western landscape. Riparian zones are the most productive and diverse habitats in much of the west (Thomas et al. 1979) and frequently produce 10 times the forage of adjacent upland forested sites (Elmore1987).

The link between riparian vegetation diversity, especially in the shrub and overstory layers, and riparian wildlife diversity is well documented (Kauffman and Krueger 1984, Taylor 1986, Szaro et al. 1985). Wildlife populations adjacent to riparian zones are affected by habitat conditions and resultant wildlife populations in the riparian zones (Kauffman and Krueger 1984). Healthy riparian habitat also usually supports species not found in the uplands and thus contributes to species diversity at larger landscape scales.

Plant compositional and structural changes in riparian communities are better understood. Poor livestock management can result in the loss of woody and herbaceous species critical for stabilizing streambanks.

In a study comparing riparian vegetation between grazed areas and ungrazed livestock exclosures northwest of Fort Collins (Colorado), Schultz and Leininger (1990) found significant differences in vegetation structure and composition. Total vascular vegetation and the abundance of shrubs and grasses were greater in livestock excluded areas, while forbs showed similar abundance to grazed areas. Livestock excluded areas showed higher litter and lower bare ground.

The recovery of woody riparian appears to occur rapidly following livestock exclusion. In south central Washington, Rickard and Cushing (1980) show the re-establishment of willow (Salix amygdaloides) in streamside riparian areas within 10 years of livestock exclusion.

Issues: Management Objectives

Results from the literature suggest that observable short-term (less than 3-4 years) differences between livestock exclosures and paired grazed sites may be restricted to fluctuations of annual plants, vegetation structure, and soil disturbance. The following ecological issues and associated management objectives will thus be the focus of the determination whether livestock impact objects of biological interest and the plant communities forming their context:

- plant community composition: increase relative cover by native species;
- key species age/maturity/condition class distribution: maintain a distribution of age/maturity/condition classes for key species;
- weed invasion/abundance: minimize new points of weed invasion; reduce existing noxious weed populations;
- establish and promote growth of riparian shrubs:
- vegetation structure: maintain/improve vegetation structure (sward height and the balance of life-forms (herbaceous, shrub, and tree strata) as a basis for improving wildlife habitat;
- soil cover: minimize bare soil consequent to displacement of perennial vegetation by livestock;
- post-holing: minimize post-holing in riparian areas
- minimize thatch/litter buildup by medusahead.

While monitoring variables associated with the above ecological issues/objectives is straightforward, deciding the point at which measurements indicate degradation is more difficult. The literature will be used as an initial guide to define threshold values indicating resource degradation. Surveys will be conducted prior to livestock turnout to determine pre-treatment values for all of the above variables. Differences between livestock exclosure and paired livestock impacted sites will be assessed following the grazing season.

Objectives

Objective 1: Determine if the current range management regime results in differences in plant community composition between livestock exclosures and paired sites. (HA = alternative hypotheses).

HA1.1: There are no significant differences in plant composition between paired livestock exclosures and impacted sites (Predictions: Ordinations show interspersion of livestock impacted and paired livestock exclosure sites; Plant community classification procedures maintain livestock impacted and paired non-impacted sites within the same classes).

HA1.2: There are significant differences in plant composition between paired livestock exclosures and impacted sites (Predictions: Ordinations show lack of interspersion of livestock impacted and paired livestock exclosure sites; Plant community classification procedures maintain livestock impacted and paired non-impacted sites within different classes).

Objective 2: Determine if the current range management regime results in differences in key species (native bunchgrasses) abundance between livestock exclosures and paired sites.

HA2.1: There are no significant differences in the abundance of key species between paired sites (Prediction: Chi-squared analysis, t-tests, and repeated measures Analysis of Variance (ANOVA) show no significant difference in canopy cover, 5% at p=0.10).

HA2.2: Livestock impact results in a significantly higher abundance of key species immediately prior to livestock release in the years following livestock exclosure construction (Prediction: Chi-squared analysis, t-tests, and repeated measures ANOVA show significant difference, at least 5% canopy cover at p=0.10).

HA2.3: Livestock impact results in a significantly lower abundance of key species immediately prior to livestock release in the years following livestock exclosure construction (Prediction: Chi-squared analysis, t-tests, and repeated measures ANOVA show significant difference, at least 5% canopy cover at p=0.10).

Objective 3: Determine if the current range management regime impacts weed species abundance relative to livestock exclosure areas.

HA3.1: There are no significant differences in the abundance of weed species between livestock exclosures and paired sites in the years following livestock exclosure construction (Prediction: Chi-squared analysis and repeated measures ANOVA show no significant difference in weed canopy cover).

HA3.2: Livestock impact results in a significantly lower abundance of weed species in livestock impacted sites compared to livestock exclosures immediately prior to livestock release in the years following livestock exclosure construction (Prediction: Chi-squared analysis and repeated measures ANOVA show significant difference, at least 5% canopy cover at $p=0.10$).

HA3.3: Livestock impact results in a significantly higher abundance of weed species in livestock impacted sites compared to livestock exclosures immediately prior to livestock release in the years following livestock exclosure construction (Prediction: Chi-squared analysis and repeated measures ANOVA show significant difference, at least 5% canopy cover at $p=0.10$).

Objective 4: Determine if the current range management regime within springs, seeps, and wetlands increases or decreases soil surface and deeper soil disturbances relative to ungrazed controls.

HA4.1: There are no significant differences in soil surface disturbance and deeper soil disturbance between livestock exclosures and paired sites (Prediction: Chi-squared analysis and repeated measures ANOVA show no significant difference).

HA4.2: There is significantly less soil surface and deeper soil disturbance in livestock exclosures than paired sites (Prediction: Chi-squared analysis and repeated measures ANOVA show significant difference).

Methods and Materials

Plant community, soil surface disturbance, and vegetation structural data will be collected in all livestock exclosures and paired sites. Individual plant species cover, soil surface cover, and soil surface disturbance will be assessed using a recognized BLM vegetation monitoring methodology (Interagency Technical Reference 1996). A gimballed point technique (Winkworth and Goodall 1962) will be used to measure plant species point cover for the range of vegetation strata (tree, shrub, and herbaceous) within the livestock exclosures and paired plots. The technique is very similar to that employed by the Nature Conservancy (Sawyer and Keeler-Wolf 1995), and data sheets will meet the requirements of both handbooks. The utility of a sighting device (gimballed point sighting tube) instead of a suspended rod improves accuracy of recordings (Interagency Technical Reference 1996).

Livestock exclosure relative to patterns of vegetation

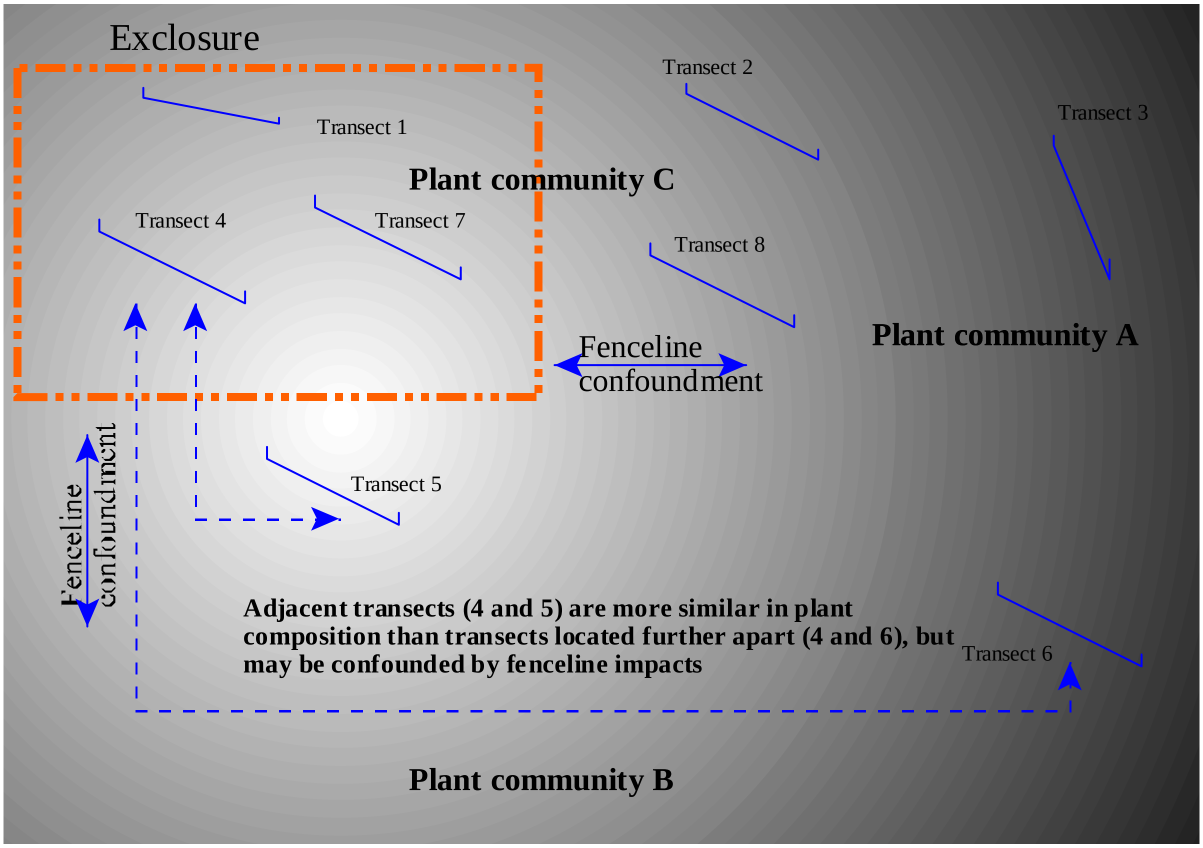
The easiest plant communities to monitor using livestock exclosures are relatively homogenous and occupy large portions of the monument (plant community A: transects 1, 2, and 3). In such situations it is usually feasible to locate paired transects beyond the fenceline effect surrounding exclosures (transects 1 and 3 versus transects 1 and 2).

Figure X. Diagram depicting location of vegetation transects relative to pattern of vegetation change.

Plant communities within the monument are highly variable and usually occur as gradients in plant composition (plant community B: transects 4, 5, and 6). At the time of building the exclosure, transects 4 and 5 would be more similar to each other than transects 4 and 6. In an effort to maintain high similarity between paired transects, transect 5 may inadvertantly be placed within the zone of fenceline effect. This situation can be identified through visual assessment (trailing, and gradient of stubble heights over short distances) and an examination of the data collected along the transects.

Some plant communities occupy very restricted ranges (Plant community C: transects 7, and 8) but still require study because of their rarity. Transects external to the livestock exclosure, but within the area of fenceline effect may be unavoidable.

Transect placement



Since there is a tradeoff between transect similarity and confoundment due to the fenceline effect, at least two transects must be placed external to exclosures. Where the closest of the paired transects are shown to be compromised by a fenceline effect, the data may still be used to examine plant community successional changes and identify increaser and decreaser species relative to livestock disturbance and livestock exclusion. Such fenceline compromised paired-plots will not be used to gauge the magnitude of plant community change due to removal of livestock disturbance from the area within the livestock exclosure. Instead, the less similar and further displaced paired transects will be used to gauge plant community change between livestock excluded and grazed transects. Transects located too close to exclosure fences are not representative of livestock impacts across the landscape.

Data analysis strategy

Individual species abundance and plant community change on individual transects

The change in abundance of individual species and changes in composition of the vegetation along transects can be compared to the initial data collection. Lack of change in abundance and composition would be indicated by fluctuation around the baseline data. Change would be indicated by continued divergence between readings subsequent to the baseline data.

Examination for divergence over time is useful for identifying change in unpaired transects and transects compromised by the zone of increased livestock influence adjacent the fenceline.

Individual species abundance and plant community change of paired transects

In addition to examining change over time relative to baseline data, change can also be examined as the difference between paired transects over time. Change would be identified as continued divergence between paired transects over time, while lack of change would be indicated by non-divergent differences. The advantage of using paired transects would be the removal of the confoundment of climatic influence on vegetation change (individual species abundance and composition) by use of a control.

All forms of vegetation and soil cover data need to be collected twice during a sampling season. During the first year of sampling, data needs to be collected prior to livestock turnout. This is necessary to measure the initial similarity of livestock exclosure and paired sites prior to livestock turnout. Measurement of the same variables at the end of the grazing season will quantify livestock impact on plant structural attributes and the physical environment defined by the percent bare soil and surface disturbance. Differences in individual species abundance and plant community composition can only be assessed during subsequent years, following at least one year of rest within livestock exclosures, and continued grazing within the paired site. These differences need to be based on data collected prior to livestock turnout, so as not to be biased by the current years grazing.

An important adjunct to the above-defined cover readings are the photos to be taken at the same time. Permanently installed fenceposts will identify the site of origin of the photos, as well as define the direction and angle of sighting. Photos will be taken at the same time of day to minimize confoundment by different patterns of shadow attributed to changes in the angle of insolation.

In addition to the transects described in this section, Project K is aimed at identifying the range in plant compositions and livestock impacts of riparian communities across the landscape, thus creating a landscape context for the exclosures.

Analyses

Sample adequacy

For cover data collected using a point cover intercept technique, the Interagency Technical Reference (1996) recommends plotting running average and standard deviation for a range of sample sizes bracketing the likely desired sampling rate.

Individual variable (species, growth form, or soil cover attribute)

Pretreatment data will be collected to determine similarity of plots before the advent of the grazing season. Paired plots will be deemed suitable if analysis of pre-treatment data shows no significant difference between livestock exclosure and paired transect.

Following guidance by the Interagency Technical Reference (1996), analysis will consist of a Chi Square contingency table analysis to test for significant change in numbers of "hits" on key species, other plant species, or cover classes between years within individual transects, or between paired transects. Data will also be expressed and presented graphically as percentage cover. Repeated measures Analysis of Variance (ANOVA) will be used to examine statistical difference between grazed and ungrazed pseudo-replicates at the individual livestock exclosure, and paired plots stratified by plant community.

Plant community analysis

Standard multi-variate statistical procedures will be used to identify plant communities and plant community dynamics from the original field data collected by field technicians. These statistical procedures are commonly referred to as "dimension reduction" techniques (Kent and Coker 1992). Several procedures will be employed to assure an unbiased examination of data. All multi-variate techniques used are based on an examination of a plot by plot similarity matrix constructed using a similarity index. Indices bias the relative importance of rare or common species within the similarity matrix depending on the formulation of the index. For this reason, indices favoring either perspective (rare or common species) will be used to assure unbiased interpretation of results.

Classification is a multi-variate technique that seeks natural groupings of objects (in this case, stands or sampling locations) within multi-variate hyperspace. Stands (transects) within classes are more similar to each other than stands representative of different classes. Hierarchical classification will be used to gain an understanding of the structure of the plant composition data. This will allow the choice of plant community classes at a suitable level of similarity as defined by similarity index chosen for the classification exercise. Groupings derived from the classification procedures should reflect patterns observed within ordination scatter diagrams. For pre-treatment data, paired transects should fall within the same classes prior to livestock impact. Paired transects separated into different classes in years following livestock exclosure construction and the completion of at least one year of livestock impact are indicative of divergent plant community development under rest and continued grazing.

Ordination summarizes data from n-dimensions (each plant species being a dimension) to just two or three dimensions. The proximity of objects (in this case, individual transects representing livestock exclosure and paired transect) within ordination space is a representation of similarity between transects. Patterns between sets of objects in ordination space represent patterns in the original field data. Such summarization of data may also result in loss of information, hence these techniques are termed exploratory. Adequacy of fit of objects within a scattergram in ordination space is measured by a "stress" indicator. Additional multi-variate techniques will be employed to validate observations where "stress" is above the acceptable level. Increased distance between paired sites after successive years of grazing would indicate that livestock are impacting plant communities for the sites examined.

Network analysis focuses on object-to-object relationships, a very different perspective than the "data-wide" patterns detected using ordination techniques. The algorithm produces minimum spanning trees, relating objects monotonically and using association values from the association matrix for the data set being examined. These diagrams can be used to check the relative positions of objects within ordination diagrams.

The collection of paired monitoring sites falling within each of the plant communities (grasslands, shrublands, and woodlands) may offer the opportunity of using Multi-variate Analysis of Variance (MANOVA) suitable for time series analysis based on difference in canopy cover for all species within the paired plots.

2. Green's Mariposa Lily *(Calochortus greenei*) Monitoring

Introduction

This rare lily is a local endemic plant, and is listed by the US Fish and Wildlife Service as a federal species of concern (C2), and is proposed for listing as a threatened species in Oregon. Most of the known populations for this species occur within the monument in Jackson county, and south into Siskiyou County, California. Several past formal and informal monitoring studies have been completed, including Knight (1992) and by Brock (1988). A 'Mariposa preserve' was established within the monument in the Colestine valley west of the Interstate 5. In 1996, a conservation strategy for the Medford BLM drafted by Richard Brock identified the need for formal monitoring of this species to a) monitor trends and b) more fully understand its biology and autecology, especially in response to herbivory and livestock grazing.

This species occurs in open sites in grasslands, chaparral and oak woodland/savannah communities, usually on gentle slopes (< 30%), most often on south and west aspects in heavy clay soils. Many areas supporting *Calochortus greenei* have been influenced by livestock grazing. Open areas with C. greenei habitat that were once dominated by native bunch grasses are now dominated by annual grasses such as bulbous blue grass and medusa head. Herbivory from deer, rabbits, insects, and livestock, habitat conversion from noxious weeds, and tree and shrub encroachment (succession) have all been identified as threats to this species. This species, like other lilies, is relatively longed lived (50+ years). Individuals can go dormant and in any given year not appear above ground. Long-term studies of this species are necessary to understand population dynamics, and any effects from livestock grazing.

Objectives

Objective 1: Develop a better understanding of the life and reproduction cycle, and gain an insight into life history, physiology, and population biology.

Objective 2: Monitor populations to measure demographics, trends, and analyze any affects from herbivory, grazing, and successional changes.

Objective 3: Identify significant changes in the numbers of *Calochortus greenei* plants within livestock impacted areas versus paired livestock inclosures.

HA 3.1: There are no significant differences in counts of *Calochortus greenei* plants inside versus outside the livestock inclosures [Prediction: analysis show counts of *Calochortus greenei* within livestock impacted sites not to be more than 05% below livestock inclosure numbers (p=0.05)].

HA 3.2: Counts of *Calochortus greenei* are significantly lower within livestock impacted sites relative to paired livestock inclosures [Prediction: analysis show counts of *Calochortus greenei* within livestock impacted sites to be more than 05% below livestock inclosure numbers (p=0.050)].

Methods and Materials

Formal Monitoring

Three areas within the monument are selected to establish long term monitoring and grazing study plots for *Calochortus greenei* and the associated plant communities; Agate flat, Oregon Gulch / Keane ridge, and the Colestine area. These study areas encompass the range of *C. greenei* in Oregon, contains some of the largest occurrences, and also spans the range of cattle grazing utilization. The Agate flat populations have the highest grazing utilization, Oregon gulch/Keane ridge have moderate to low grazing, and Colestine is essentially un-grazed.

The monitoring at each site follows a modified protocol outlined in the 1996 Medford Draft Conservation Strategy for *Calochortus greenei*. Fifteen pairs of 2 x 2 meter plots are established, five pairs in each of the three areas (30 plots total). Plots are placed to contain as many plants as possible and to maximize the similarity in microsite and plant community. Within the plot pairs, one is randomly selected to be fenced in a 3 x 3 meter hog wire inclosure, and the other is unfenced. All plots are monumented with rebar, mapped, documented the UTM coordinates, and photographed.

Within each plot, individual C. greenei plants are mapped, using a 1 m x 1m frame with 10 cm string and wire dividers, and the height and width of the leaves measured. With reproductive plants, plant height and flower number are measured. Any evidence of herbivory is recorded on leaves or flowering plants. Herbivory is classed as mammal (usually a bite from the top), or insect (usually small lateral holes).

Plant community information is also recorded, collecting data on the percent cover and frequency of associated species. Percent frequency was collected on life forms (perennial grass, annual grass, forbs, shrubs, bare soil, rock, and cow flops.

The plots are visited three times a year, before cattle release, later during the flowering season, and after seed set These plots will be examined annually for 5 years during the Grazing study, and then for 5 more years for the demographic study. At the conclusion of the monitoring, a determination will be made to continue monitoring or not.

Informal Monitoring

For each of the populations formally monitored, a 100% census will also be done every year using the standard BLM Rare Plant sighting form. At these sites, smaller satellite populations have been documented in close proximity, outside the formal monitoring areas. At a minimum, 10% of these sites will be revisited each year such that in ten years, all documented sites will have been revisited at least once. The sighting report information will be stored in the Medford Rare Plant database. Empirical comparisons with previous observations can be made to show general status and trends for *Calochortus greenei* throughout the Monument.

Analyses

Differences in on plant size, flowering, herbivory collected from the paired plot areas will be analyzed by using paired t-tests or repeated measures ANOVA and post hoc Bonferroni tests. Differences in plant community data (frequency) are done by non-parametric Kruskal-Wallis tests with pair wise Mann-Whitney tests, as well as one way ANOVA. Percent frequency of cover data will use chi-square from the non-parametric Kruskal-Wallis tests. Differences in plant community composition among the study areas are ordinated with non-parametric Multidimensional scaling in PC-ORD. In the future, demographic data will be used to develop life cycle matrices and population estimates for different age classes. These estimates are necessary to understand Green's Mariposa viability and persistence on the landscape.

3. Willow and aspen establishment and growth following livestock exclosure

Introduction

Willow and aspen are commonly used by livestock in the late summer and fall when upland vegetation is dormant and animals are seeking a protein source. The literature records recruitment problems and reductions in plant volume as a consequence of livestock utilization. The general goal of this project is therefore to determine if livestock are having a similar impact to riparian vegetation within the different allotments of the Cascade-Siskiyou National Monument.

Objectives

Objective 1: Determine if livestock reduce aspen and willow regeneration

HA 1.1: There are no significant differences in counts of aspen and willow plants inside versus outside the livestock exclosures [Prediction: chi-squared analysis show counts of aspen and willow within livestock impacted sites not to be more than 10% below livestock exclosure numbers (p=0.10)].

HA 1.2: Counts of aspen and willow are significantly lower within livestock impacted sites relative to paired livestock exclosures [Prediction: chi-squared analysis show counts of aspen and willow within livestock impacted sites to be more than 10% below livestock exclosure numbers (p=0.10)].

Objective 2: Determine if livestock impact willow cover as measured by changes in visual obstruction

Methods and Materials

A combination of belt transects and repeat photos will be used to examine changes in hardwood sapling counts and plant cover between permanently marked points in the ground.

One hundred meter long and one meter wide belt transects will be placed through aspen and willow stands within and outside of livestock exclosures. The start and end of the transects will be marked using metal rebar to ensure accurate repetition of data collection during subsequent years. The number and height of willow and aspen sprouts will be measured for each 1 meter interval along the 100 meter long transect.

Changes in visual obstruction before and after the period of livestock grazing will be examined inside and outside of livestock exclosures where suitable plant communities exist. Repeat photography will be used to assess the change in obstruction of a photo-board or robel pole by plant foliage. The photoboard/pole setup location and point from which photos are taken will be permanently marked using metal rebar. Changes in percent visual obstruction will be measured following procedures being developed by the Agricultural Research Station in eastern Oregon and Oregon State University (http://oregonstate.edu/dept/eoarc/researchhome/currentresearch/ecology/willowdia.html). Visual obstruction of the photo-board/pole is calculated by scanning and calculating the percent of board exposed at different time intervals at set locations inside and outside of livestock exclosures.

Analyses

Changes in the counts of willow and aspen saplings can be analyzed using chi-squared analysis. T-tests can be used to examine for statistical differences for changes in visual obstruction within and outside of the livestock exclosures.

4. Plant Community and Canada thistle recovery in herbicide treated pastures in the presence and absence of livestock impact

Introduction

Canada thistle invasion in meadows of the Cascade-Siskiyou National Monument is recognized as a serious problem. The pernicious nature and extent of Canada thistle monocultures in states such as Idaho and Montana has forced the BLM to resort to spot herbicide treatment of infested areas within the monument. This project will help determine if continued livestock impact in meadows will promote the re-invasion of Canada thistle. Concurrent monitoring of adjacent transects will provide information on plant community recovery following herbicide treatment and removal of livestock impact. The exclosure containing Canada thistle is also subject to considerable gopher activity.

Life History of Canada thistle

Canada thistle reproduces both vegetatively and sexually. Persistent perennial underground roots make hand-pulling and mechanical weed eradication impossible. Any disturbance resulting in root breakage produces new plants as pieces of the original rhizome sprout. Dispersal over longer distances occurs by seed. Establishment by seed likely requires disturbed soil and consequent reduced competition from the local plant community. Once established, the deep rooted nature of Canada thistle allows water and nutrient extraction in areas of the soil profile not utilized by more shallow rooted plants. This allows Canada thistle to prosper when other plants are entering summer dormancy.

How Grazing May Affect Canada thistle recovery

Livestock impact may facilitate the return of Canada thistle by providing areas of bare soil for the reestablishment of plants by seed. Removal of competing vegetation during the non dormant season (spring to early summer) may enhance the growth and thus reestablishment of Canada thistle. Alternatively, livestock trampling and browsing may slow down the reinfestation by Canada thistle. Examination of paired herbicide treated transects inside and outside of livestock exclosures may resolve this question.

Objectives

Objective 1: Determine if livestock impact favors the reestablishment of Canada thistle.

HA 1.1: Canada thistle frequency of occurrence in livestock impacted areas are no different than within paired livestock exclosures [Prediction: chi-squared analysis show Canada thistle frequency of occurrence within livestock impacted sites not to be more than 10% above or below livestock exclosure numbers (p=0.10)].

HA 1.2: Canada thistle frequency of occurrence in livestock impacted areas are different than within paired livestock exclosures [Prediction: chi-squared analysis show Canada thistle frequency of occurrence within livestock impacted sites to be more than 10% above or below livestock exclosure numbers (p=0.10)].

Objective 2: Determine if livestock impact facilitates cover recruitment by Canada thistle.

HA 2.1: Canada thistle cover abundance in livestock impacted areas are no different than within paired livestock exclosures [Prediction: chi-squared analysis show Canada thistle cover abundance within livestock impacted sites not to be more than 10% above or below livestock exclosure numbers (p=0.10)].

HA 2.2: Canada thistle cover abundance in livestock impacted areas are different than within paired livestock exclosures [Prediction: chi-squared analysis show Canada thistle cover abundance within livestock impacted sites not to be more than 10% above or below livestock exclosure numbers (p=0.10)].

Methods and Materials

The methods and materials will be the same as those described in section 1a.

Analyses

Analysis will be similar to that described in section 1a.

V. PROJECTS PROVIDING CONTEXT FOR THE LIVESTOCK EXCLOSURE STUDY

The following surveys were designed to provide the landscape context for the livestock exclosure projects while also answering the needs for effectiveness monitoring for range management across the landscape.

The projects identified by Table 3 will provide information about plant communities and individual species (both plant and wildlife) considered important within the Monument and subject to livestock impact. Several surveys and monitoring projects focus on riparian condition relative to livestock impact, underscoring the importance of these habitats. Emphasis is also placed on maintaining current rangeland monitoring while facilitating additional monitoring to fill in previously identified data gaps. The surveys will also answer the need for effectiveness monitoring to determine if current management is meeting Monument Aquatic Conservation Strategy (Appendix BB) and Grazing EIS (USDI 1983a) objectives (see introduction).

The remainder of the document defines projects identified in Table 3 which are to be initiated and completed within the 3-year period of monitoring set aside to examine livestock impacts on important resources of the CSNM.

Table 3. Stand-alone Monitoring/Survey/Research Projects designed to provide a Landscape Context for the Livestock Exclosure Based Projects.

No.	Project Objective	Management Action/Comment	Variable(s)
A	General landscape condition survey for Klamath river ridges area	Will provide fuels data as well as rough estimates of weed impact and special plant community identification	Estimates of percent cover by species (herbaceous, shrubs and trees)
B	Reexamination of historical vegetation plots	Old SVIM and SCS plots have already been reexamined	Estimates of percent cover by species (herbaceous, shrubs and trees)
C	Rare individual plant and plant community analyses	Several surveys have already been completed to locate rare plants and communities	Survey to locate and define habitat, annual walk-through site visits, formal plot-level monitoring. Analyze relationship between location and livestock utilization/distance from watering points in GIS space
D	Hyperspectral Imagery/LIDAR from airborne platform	Will provide important contextual data for site specific projects	Individual species, plant communities
E	Weed monitoring/surveys	Several sources of information will provide us with an understanding of weed dynamics across the Monument landscape	Fixed transects, reexamination of vegetation plots, other existing surveys
F	Dietary overlap between livestock and native ungulates	Examination of diet for the range of large herbivores within the Monument landscape will provide information about potential interactions between native and non-native ungulates	Re-analysis of fecal composition data collected for deer, elk, and cattle in the late 1970's and early 1980's

Table 3. Stand-alone Monitoring/Survey/Research Projects designed to provide a Landscape Context for the Livestock Exclosure Based Projects.			
No.	**Project Objective**	**Management Action/Comment**	**Variable(s)**
G	Shrub utilization studies	Maintaining winter deer browse may be dependent on maintaining a range of shrub age and condition classes across the landscape	Re-examination of shrub utilization data collected in the late1970's will provide some objective data concerning shrub condition at a range of sites within the Monument landscape
H	Fish habitat and riparian condition monitoring within grazed and ungrazed streams	Project dovetails with other riparian projects & water quality monitoring	Channel width/depth ratio, residual pool depth, pool frequency, plant community structure, shading
I	Proper Functioning Condition Riparian Surveys	Monitoring protocol provides information on physical functioning of riparian-wetland areas	Stream classification, streambed material, bank condition, stream canopy cover, vegetation species, biotic indicators, valley form
J	Stubble height monitoring	Monitoring protocol provides information on bank stability, vegetation structure, and species composition	Plant cover, stubble height, greenline transect protocol
K	Range utilization	Ongoing project	Percent utilization
L	Range trend	Ongoing project	Frequency
M	Rangeland condition	Ongoing project	Conventional rangeland condition assessment based on plant community composition only
N	Photo-monitoring	Database of photo-monitoring points	Changes in life-form abundance
O	Actual Use by livestock	Ongoing project	Livestock number, kind and class of livestock, period of use, AUMs (animal unit months)

A. General Landscape/Plant Community Condition Survey for the Klamath River Ridges Area

Introduction

Analyses of the plant community within individual plots at specific locations may provide little information concerning the condition of plant communities of the larger landscape. Plot-based field sampling intensive enough to achieve an understanding of plant community condition at the landscape-level is not economically feasible. Coarse walk-through surveys examining gross plant community composition can be used to attain a notion of the distribution of plant communities and associated range of conditions at the landscape scale. Plant community condition can be assessed relative to the dominant pathways of plant community change including weed invasion, the effects of fire suppression on shrub cover, and changes due to livestock impact using conventional range condition methodology (see project M).

This project is aimed at classifying plant community data collected within the CSNM to identify the range of plant communities and associated conditions.

Objectives

Objective 1: Create a map of plant communities for the Klamath River Ridges portion of the Monument.

Objective 2: Create a map denoting condition defined by the balance between native and non-native vegetation.

Objective 3: Create a map denoting condition defined by the cover abundance of shrubs reflecting past interaction with fire.

Objective 4: Create maps of plant community condition following conventional range management procedure (see project M).

Methods and Materials

Estimates of plant composition within large polygons of homogenous vegetation have already been conducted across the Klamath River Ridges Eco-region of the Monument. Polygons were defined at a level of resolution as similar to existing NRCS (Natural Resources Conservation Service) survey polygons. Canopy cover by trees and shrubs together with estimates of foliar cover estimates by individual herbaceous species will provide the information for defining plant communities. A total of four surveys by different investigators will be combined to create a seamless cover for the Klamath River Ridges Eco-region overlapping with the CSNM. Additional surveys may be conducted in other areas of the Monument described as components of the diversity management emphasis area.

The landscape surveys will be used to examine the richness of plant communities across the landscape. For all identified plant communities, the balance between native bunchgrasses and non-native annual grasses will be used as a measure of plant community condition from the weed invasion perspective. The data will also be used to assess landscape patterns of weed invasion (annual grasses and noxious weeds (see project E), and contribute to an understanding of conventional rangeland condition (see project M). Data will also be used to validate the NRCS (1993) framework of plant communities for the Klamath River Ridges portion of the Monument. The data will provide a basis for planning management by supplying a basic inventory of plant communities, fuels as defined by woody vegetation cover and plant community condition based on species composition.

Analyses

All of the standard multi-variate classification procedures described within the plant community portion of the livestock exclosure project will be used in this study. The resultant classifications will form the basis for creating maps within Arcview/Arcmap. Standard GIS procedures will be used to depict plant communities and their range of conditions as defined by the balance of weeds and desired herbaceous vegetation. Overlap analysis with livestock utilization, soil characteristics, and other environmental characteristics will identify factors correlating with the range of plant community conditions (as identified by the balance between native and non-native vegetation) stratified by plant community.

B. Re-examination of Historical Vegetation Plots

Introduction

Plant community composition data collected by the NRCS (Natural Resources Conservation Service) and BLM between 20 and 30 years ago will provide the basis for understanding some of the recent historical changes in plant communities across the CSNM landscape. A comparison of species composition between 20 to 30 year old vegetation study sites and current composition may provide an indication of whether plant communities are moving towards a desired condition under the current management regime. Desired conditions can be defined in different ways.

Desired conditions may be defined by a relative domination of native species, an equitable distribution of plant life-form groups composed of native plants, or new populations of weed species establishing and increasing in abundance. Condition will also be assessed using rangeland management convention described under project M. Physical and management related factors involved in the inferred changes in composition will be examined using overlap analysis within the GIS environment, particularly regarding weeds (see project E).

Methods and Materials

Ninety-seven vegetation plots and polygons from historical vegetation surveys have already been re-examined. The SCS plots and SVIM vegetation polygons date back 20 to 30 years. Species level composition data will provide an understanding of plant community changes across the range of plant communities of the Monument over the past three decades.

Objectives

Objective 1: Identify Monument-wide and allotment-wide patterns of vegetation change stratified by major plant community.

Objective 2: Identify all site specific changes in vegetation considered significant (based on literature defined rates of sampling and observer error for the sampling methods employed).

Objective 3: Examine sites with significant compositional changes as case studies.

Objective 4: Interpret the plant composition data using the range of perspectives on condition (weed invasion, shrub abundance as a consequence of fire-suppression, conventional range condition).

Objective 5: Contribute data to other projects (Project E, L, and M)

Analyses

The field data will classified into plant community and conventional range condition. Site specific indicators will provide inference about the range trend direction. More objective examination of the data will identify "significant" plant compositional changes based on observer and sampling error rates reported in the literature (West and Hatton 1990). Repeat estimates of species abundance with overlapping confidence limits derived from the literature-derived rates of observer and sampling error will be considered not significantly different from each other.

Sites showing significant changes in species abundance will be considered for local case studies. More detailed examination of site history (including past management), soil conditions, and local plant community composition may provide insight concerning local plant community dynamics. Within plant communities, Canonical Correspondence Analysis (Kent and Coker 1992) may be used to elucidate plant community dynamics relative to the above factors.

Examining the same data within the GIS environment may identify spatial patterns particular to allotment boundaries, soil patterns, and other features within the GIS. Precipitation data will be examined to ascertain that observed differences are not due to marked difference in precipitation pattern and abundance for those years during which data was collected.

C. Rare Individual Plant and Community Analyses

Introduction

Little is known about the range, distribution and condition of individual plants or communities of special interest. As these objects are inventories they will be recorded in the GIS system for the monument. This will allow an analysis to determine proximity to areas of high livestock utilization, roads, areas of weed invasion, and other possible threats to their persistence on the monument landscape.

A number of other rare plant species are documented from the Monument, and recent surveys have focused mainly in areas where recent BLM activities have occurred. Some habitat focused surveys in the southern and southwestern portions of the Monument are proposed for Gentner's fritillary. These surveys are likely to document other populations of rare plants associated with similar habitat in this area of the monument. Many of the occurrences documented in the Monument have not been revisited or informally monitored since they we initially located, some as early as 1979. To clearly assess the status of these rare elements, re-visits and documentation of some populations must occur. Formal monitoring of certain species is proposed.

Species are prioritized based on rarity, and perceived threats. Specific information is given in parenthesis.

1. *Fritillaria gentneri*
2. *Calochortus greenei*
3. *Astragalus californicus* (1 population in the Monument in the Scotch creek RNA)
4. *Lathyrus lanszwertii var. tracyi* (1 population documented, also in the Scotch creek RNA; monitor with *Astragalus californicus*)
5. *Limnanthes floccosa* ssp. *Bellingeriana* (Populations near Lincoln and 1 small occurrence in the Oregon gulch RNA)
6. *Cypripedium fasciculatum* (1 Existing monitoring plot)
7. *Plagiobothrys figuratus* ssp. *corallicarpus* (vernal pool species)

Objectives

Objective 1: Establish permanent monitoring plots for high priority species to gather needed demographic data, assess trends, and threats within the next three years.

Objective 2: All high priority populations will be informally monitored at least once in the next three years to assess the effects of grazing using qualitative methods (counts, photopoints, site condition assessment) as part of the grazing study, and to gather the needed information so as to develop a long term monitoring design and plan.

Objective 3: For all other Bureau special status species documented in the Monument, an informal monitoring schedule (revisits) will be developed such that at least 70% of all known occurrences of Bureau Special Status Plants will be revisited at least once in a ten year period.

Objective 4: Complete GIS analyses to determine relationship of rare plant communities and individual species populations of interest relative to GIS based information of environmental data including soils, livestock utilization, distance from watering points, etc.

Methods and Materials

Landscape Surveys

Landscape scale surveys will be used to validate presence and absence of Genter's fritillary within the southern and southwestern portion of the Monument. Most of the un-surveyed habitat for this rare lily lies south of Tyler Creek, and west of the power line that intersects Tyler Creek and runs southeast to Agate Flat. Small un-surveyed areas also occur in the eastern portion of the DEA, however much of this area has had botanical surveys. The northern portion of the Monument also has small areas of un-surveyed habitat.

Using aerial photographs, existing vegetation information, and professional knowledge, landscape level surveys will be conducted during the blooming period for Gentner's fritillary. It is estimated that of the approximately 32,000 acres within this portion of the Monument, less than 6,000 acres will be identified as suitable habitat and surveyed. Populations of other rare plants found in the communities surveyed will also be documented to further the understanding of the diversity in the Cascade-Siskiyou National Monument.

Plot-based monitoring

Permanent plant monitoring will occur in the 1 documented population and at least 2 new plots will be established if new occurrences are found in the landscape level surveys.

The monitoring consists of 3 parts.

1) Annual revisits will census the entire population and count flowering *F. gentneri* and *F. recurva* individuals (a congener) and do count estimates of vegetative *Fritillaria* spp. leaves. The standard BLM Rare Plant sighting form will be used to document this information. New occurrences found in landscape surveys will also be annually revisited. Every population of this listed plant in the Monument will be visited annually during the blooming period. This monitoring will provide census trend data for the existing population in the Monument.

2) Ten (10) 1 x 1 meter permanent plots will randomly be selected within the existing population to annually monitor individual plants, herbivory, and physiology. Each plot needs to contain at least 1 flowering *Fritillaria gentneri* plant at establishment, which will be tagged with 1/16'' diameter steel pins with aluminum tags, placed approximately 3 cm from the base of the plant on the north side. Vegetative plants within the plots will also be tagged to see what percentage of these plants are *F. gentneri* or *F. recurva*. Based on vegetative characteristics, these two species are indistinguishable. Each plot will be monumented (distance and bearing) from the one of the fence posts placed for the vegetation transect (below). The inside of each corner of the 1 x 1 m plot will be permanently staked with steel pins so that a 1 x 1 meter frame can be accurately placed on it. Information on presence/absence,

herbivory, number of buds, flowers fruits, basal leaf width and length of vegetative leaves will be taken for each plant within the plot. Every plot will be photographed. Estimates of cover by species will be done for every micro plot including population counts for invading species, like yellow star-thistle. The plots will be read between May 1st – May 20th every year for three years. At that time, a decision will be made whether to continue the monitoring.

3) A 100 meter Point and Cover transect, monumented at the beginning and end with steel fence posts will be conducted every year to document changes in the plant community.

Formal Monitoring

The formal monitoring methods cannot be well defined, as specific information needed to design monitoring is not currently known. Plots will generally follow methods defined for Calochortus *greenei* or *Fritillaria gentneri* (above). Site specific monitoring objectives and methods will be developed and implemented within three years. The monitoring frequency will vary by species but will generally occur annually unless identified differently in specific monitoring plans.

At least three 5 meter x ½ meter permanent linear plots are placed within a population. Information is collected within 1 x ½ meter micro-plots. Qualitative, census, frequency, or density measures will be taken, depending on the species and the specific objectives developed. For cases where the populations are very small (e.g. *Lathryus lanszwertii var. tracyi*), the entire population may be measured. For other larger populations, permanent plots will sample these occurrences.

Informal Monitoring

For all other rare plant species in the Monument, at a minimum, 70% of all existing occurrences will be revisited at least once over the next ten years, starting in 2001. Within the next three years of the grazing study, an effort will be made to revisit at least 1population for each of the 24 Bureau Special Status Plants documented for the Monument that occur in areas that are utilized. Information will be recorded using the Standard BLM Rare Plant sighting form, any threats will be assessed and populations will be accurately mapped (GPS). Data will be stored on the Medford Rare Plant Database and GIS and at the Oregon Natural Heritage Program. Comparisons of past visits will be used to assess general population trends. Depending on the status, condition, and threats, populations may be revisited more than once in the ten-year period, and if necessary, permanent plots could be established. Activities or conditions potentially affecting populations would likely trigger the establishment of formal monitoring plots to assess effects and trends.

Analyses

Specific analytical processes will be developed in the monitoring plans developed for these plant species that are formally monitored. Normally, paired t-tests and repeated measure ANOVA will be used to analyze significant changes in permanent plots. Informal monitoring data (counts) from different time periods can be analyzed using chi-square analysis to assess trends.

New sites documented will be included in the monitoring portion of this document. Repeated site visits will monitor the trend in these populations.

The total census information (counts) will be analyzed with non-parametric statistics for annual information to detect significant changes in total population numbers, assuming the surveys find more population. Information collected within the 10 plots will be analyzed using paired t-tests (2 year comparisons) or for data 3 years and older using a repeated measure ANOVA will be used. Vegetative point and cover information will be analyzed following methods outlined in the community section of this document.

Standard GIS based analyses will be used to examine the relationship between objects of biological interest (rare plant communities, individual plants of interest) and environmental data (soils, slope, aspect, livestock utilization, distance from watering point, etc) within GIS. Analytical methods include overlap analyses, weighted averages, logit modeling, and log linear modeling.

D. Hyperspectral Imagery/LIDAR from airborne platform

Introduction

The BLM contracted to complete an airborne Hyperspectral Imaging (HSI) and light detecting and ranging (LIDAR) survey of the monument. The project has provided color infrared image, RGB image, and digital elevation data for all lands south of Hwy 66. Further data analysis is pending funding.

E. Examining Patterns of Weed Abundance

Introduction

The establishment of new populations of weeds or increases in the abundance of noxious and other weeds are indicators of the degradation of native plant communities. Existing maps of weed locations can be used to determine which plant communities are at greatest risk to weed invasion. Many factors contribute to the rate and extent of weed invasion. This GIS based project uses overlap analysis to examine relationships between weed abundance and a range of environmental factors thought to play a role in the process of weed invasion. Factors considered include: soils (type, texture, and mineralogy), plant community, topography (slope and aspect), livestock utilization (including hotspots of utilization), range management strategy, and road proximity.

Many authors have implicated livestock in the introduction and spread of weeds on western rangelands (Belsky and Gelbard 2000). DeClerck-Floate (1997) concluded that livestock have the potential to be very effective spreaders of certain weed seeds by transporting burrs in their fur. Allen and Bartolome (1989) noted higher numbers of weeds in grazed versus ungrazed clear-cuts in northern California.

Based on the above information, permanent transects will be located across the CSNM landscape to more accurately measure the rate of weed invasion within susceptible plant communities.

Objectives

Objective 1: Identify Monument-wide and allotment-wide patterns of weed presence/absence or increase (where temporal data exists) stratified by soils (type, texture, mineralogy), NARCS (1993) defined plant communities, topography, rangeland management strategy, livestock utilization, proximity to roads, etc.

Objective 2: Establish transects to more accurately monitor future rates of weed invasion within susceptible plant communities of the CSNM.

Methods and Materials

Several sources of point locations for noxious weeds exist within the CSNM. Past and ongoing BLM sponsored weed surveys form the basis of the noxious weed location maps. Other field observations and senior student projects from Southern Oregon University have also contributed to the weed location map. Plant community surveys and analyses derived from other projects (projects A, B, H, I and K) will be used to analyze the patterns of weed abundance concomitant with environmental factors (soil characteristics, slope, topography, existing plant community, range management strategy, and livestock utilization) across the landscape.

Analyses

The maps of weed abundance resulting from weed surveys, general landscape condition surveys, and the re-examination of historic vegetation plots will be intersected by GIS coverages of the range of factors thought to play a role in the process of weed invasion. Each factor, for example, soils, is divided into a number of classes (for example, the range of soil types, or mineralogy classes). Overlap analysis of soil types with weed presence/abundance will identify soil types most commonly associated with a particular weed species. The strength of the relationship between soils (and a particular class of soils) will be indicated by the percentage overlap between weed presence/absence and the range of classes for the factor of interest. A ranking of the maximum percentage overlap with any class associated with the range of factors is a measure of the relative importance of that factor.

Canonical Correspondence Analysis will be used to verify relationships between plant community/weed abundance and attributes relating to the physical environment. Results from this and other projects will contribute to a Monument wide understanding of weed invasion.

F. Dietary Overlap Between Deer, Elk, and Livestock within CSNM Winter Deer Habitat

Introduction

The grazing EIS states: "The amount of forage removed by cattle during the summer months on elk winter range could play a significant role in winter elk survival due to dietary overlap." Similar interactions may occur between deer and livestock.

Research literature indicates that livestock grazing has the potential to impact forage quality, forage amount, and foraging site selection by deer and elk. The competitive relationships are not clear, and it appears that the effect of livestock grazing on the forage resource available to deer and elk are highly variable and are highly situation dependant. Variables that appear to be important in determining effects of grazing include: timing, duration, and intensity of livestock use, forage species being utilized, variation in seasonal and annual weather patterns, and type of livestock on the range [steers v.s. cow/calf] (Bernardo et. al. 1994, Loomis et. al. 1991, Ragotzkie and Bailey 1991).

Some studies from the western United States indicate that livestock grazing under some conditions is generally neutral or even beneficial with regard to forage resources available to wild ungulates (Austin and Urness 1986, Stevens 1966, Thilenius and Hungerford 1967, Roberts and Tiller, 1985, Dragt and Havstad 1987).

Other studies cite reduced forage quality and or quantity and deer/ elk avoidance of areas recently grazed by livestock (Austin and Urness 1986). Some studies indicate that deer and elk actively avoid livestock on shared range (Stevens 1966, Prasad and Guthery 1986, Ragotzkie and Bailey 1991).

Some studies indicate that factors other than livestock presence, and current and historic livestock grazing are very important in forage site selection by deer and elk. These factors include: availability of hiding cover, % slope, aspect, distance to open roads, and availability of thermal cover (Wambolt and McNeal 1987, Lyon 1979, Black et. al. 1976, Edge et. al. 1988). Existing fecal content data collected during the late 1970s and early 1980s will be analyzed to identify plants commonly used by native and non-native ungulates to assess the potential for competition for individual species. Total percentage dietary overlap will be a further indication of potential competition for forage. Where dietary overlap does occur and the potential for competition for resources exists, further study may be warranted to determine if forage/browse is limited, threatened through overuse, and if no alternative source of forage/browse exists.

Together with patterns of livestock utilization (Project K) and results from past browse studies (Cole-Browse Utilization Transects - Project G), the fecal analysis data will be used to examine the possibility of interaction between livestock and native ungulates (deer and elk) on the basis of diet.

Objectives

Objective 1: From samples collected in the early 1980s, determine if diets for cattle, deer, and elk within the Monument overlap based on fecal plant species composition.

HA1.1: There is no overlap between the diets of cattle, deer, and elk within the Monument (Prediction: There is no interspersion of points representing cattle, deer, and elk fecal plant species composition within ordination space; data representing cattle, deer, and elk fecal species composition do not fall within the same classes defined through standard classification procedures).

HA1.2: There is overlap between the diets of cattle, deer, and elk within the Monument. (Prediction: There is interspersion of points representing cattle, deer, and elk fecal species composition within ordination space; data representing cattle, deer, and elk fecal species composition do fall within the same classes defined through standard classification procedures).

Objective 2: From samples collected in the early 1980s, determine if seasonal shifts in fecal plant species composition occur for livestock, deer, and elk.

Objective 3: Where dietary overlap occurs, determine if use is concurrent by using graphic overlay of species-time utilization histograms for livestock, deer, and elk.

Objective 4: Determine if plant species utilized by livestock and native ungulates are in short supply or threatened through lack of reproduction and/or over-use.

Methods and Materials

Fresh fecal samples from livestock and native ungulates (deer and elk) were collected intermittently through the whole year from 1979 through 1981. The Composition Analysis Laboratory at Colorado State University identified relative utilization of individual plant species expressed as a percentage of recognizable plant fragments.

In addition to the fecal analysis data, this project makes use of other existing information (shrub browse data, livestock utilization maps, and plant community maps) and information derived from other projects. All data layers and related projects will contribute to the final interpretation of livestock interaction with native ungulates.

Analyses

Fecal analysis yields plant species compositional data expressed as a percent. Standard ordination and classification tools can be used to examine for dietary overlap between livestock and native ungulates. Direct ordination [gradient analysis - Kent and Coker 1992)] will be used to examine seasonal trends in fecal composition. Together with browse utilization data, seasonal trends may determine if use of any forage/browse base occurs simultaneously by different animals, or if use is separated by time.

Fecal analysis data was collected within three regions of the CSNM including Agate Flat, Keene Creek Ridge, and Skookum Creek. If dietary overlap between livestock and native ungulates is observed in any of these areas, livestock utilization, vegetation maps, and data from Cole Browse transects will be examined to determine if the plant species in question are in short supply within the pastures of concern.

Standard GIS procedures will be used to examine relationships between diet overlap, livestock distribution (current and historic), forage/browse utilization patterns (see projects G, and K), plant community (see project A, B, I, J), and maturity and age classes as discerned by the Cole Browse transects (see project G).

G. Shrub Utilization Studies

Introduction

Site specific surveys of shrub form and maturity class provide information about the past history of shrub browse use by livestock and native ungulates. Shrub form class indicates the availability and degree of hedging by browsing on a particular shrub species. High rates of browsing are indicated by form classes restricted to browse height (the entire shrub can be reached by the browsing animal) and a high degree of hedging. Maturity classes indicate whether shrubs at the site examined are reproducing and likely to persist on the landscape. A literature review will be used to characterize the range of shrubs utilized by livestock and native ungulates. An understanding of life-history, longevity, and response to browsing as well as other common ecological processes on the Monument will provide a suitable background for the interpretation of the shrub form and maturity data. A re-examination of the transects may provide information about changes in shrub form and maturity class over the last 20 years.

Objectives

Objective 1: Determine the nature of browsing pressure on shrubs considered to be a critical winter browse source for deer.

HA1.1: Browsing pressure is negligible (Prediction: Form class distribution is weighted heavily towards classes extending beyond the reach of livestock and native ungulates and showing negligible hedging).

HA1.2: Browsing pressure is substantial (Prediction: Form class distribution is weighted heavily towards classes entirely within the reach of livestock and native ungulates and showing high degrees of hedging).

Objective 2: Examine the health of the shrub population as defined by the distribution of shrub maturity classes.

HA2.1: Shrub populations are decadent (Predictions: few seedlings and young shrubs; distribution of shrub maturity classes is weighted heavily towards mature and decadent maturity classes).

HA2.2: Shrub populations are healthy and likely to persist in the longer term (Predictions: all maturity classes are represented, with no domination by a particular maturity class).

Objective 3: Determine if shrub form and maturity class distribution has changed in the last 20 years (compare class distribution patterns using histograms).

Methods and Materials

Histograms showing the distribution of form and maturity classes will be assessed to examine shrubland condition at the sites examined. The sites examine will be mapped to determine if the data can be generalized for the entire landscape. Additional study sites will be examined if the distribution of transects is inadequate or if other commonly utilized shrub species (as identified by project F) are not considered. Final results will be stratified by plant community. Transects will be repeated during the ensuing two years if conditions are considered to have changed considerably.

Analyses

In this study, data from historical transects located across the Monument landscape in the early1980s will be re-analyzed to determine the distribution of age and form classes. Data will be interpreted relative to the biology of the shrub species in question. For example, the dynamics of resprouting versus obligate seed reproducers are likely to differ in accordance with their life-histories. The fecal analysis data will indicate whether additional surveys need to be implemented within other shrub dominated communities.

H. Fish Habitat and Riparian Condition Monitoring in Grazed and Ungrazed Streams

Introduction

The Northwest Forest Plan includes monitoring as an integral component of the Aquatic Conservation Strategy (USDA FS and USDI BLM 1994). Among other things, the BLM is directed to determine if the standards and guidelines of the Northwest Forest Plan are being followed (implementation monitoring), and verify if the Standards and Guidelines are achieving the desired results (effectiveness monitoring)[1]. In addition, the March 18, 1997 Biological Opinion from the then National Marine Fisheries Service (NMFS, now NOAA-Fisheries), required that the BLM monitor the impacts of cattle grazing on listed anadromous fishes[2]. As a result, BLM developed a monitoring program to evaluate the impacts of livestock grazing on fish habitat throughout the Ashland Resource Area. Currently, there are 13 long-term sites within the Cascade-Siskiyou National Monument (CSNM) (Map1). Two sites were established in 1999, three in 2000, four in 2001, and four more in 2002.

The "range-riparian" monitoring program, as it's called, is designed to evaluate long-term change of riparian and stream habitat condition. Therefore, data will be compared within sites over time, since "control" sites are difficult to locate. Long-term data will be combined with other available information (e.g. the livestock exclosure study, long-term photo point monitoring throughout the CSNM, and hydrologic monitoring) to provide a more thorough understanding of the impacts of grazing on fish and stream systems in the CSNM. The range-riparian data also provide within-year comparisons of each site. Each site is visited at the beginning and the end of the grazing season. This allows BLM the flexibility to evaluate immediate effects at particular sites and recommend livestock handling changes, if necessary.

The "range-riparian" monitoring program was not designed to evaluate livestock impacts on riparian systems within the timeframe of the CSNM Presidental Proclamation. However some of the information collected for this study will be used to provide some contextual landscape-level information for evaluating the impacts of livestock grazing in the CSNM.

Objectives

Objective 1: To assess long-term impacts of cattle grazing on certain aspects of fish habitat.

Objective 2: To evaluate within-year changes in riparian condition at particular sites.

Methods and Materials

In order to determine whether cattle grazing impacts aquatic habitat, BLM chose to monitor those variables the literature suggested could be impacted by livestock specifically: bank vegetation species composition and condition, emergent vegetation species composition and condition, extent of overhanging banks, shade, bank angle, and feces deposition (Platts and

[1] In all alternatives of the Cascade-Siskiyou National Monument plant, the Aquatic Conservation Strategy will apply to BLM-managed lands in the Cascade Siskiyou National Monument.
[2] At the time of this writing, the only listed fish is the Southern Oregon/Northern California Coastal stock (ESU) of coho salmon (*Onchorhynchus kisutch*), listed as "Threatened" since 1997.

Nelson 1985, Leonard et al. 1997, Moore et al. 1998). Woody species (e.g. willow) protect stream banks from erosion, create cover for fish–critical in meadow areas, provide habitat for aquatic macroinvertebrates, and are an important allocthonous food source. Grasses and forbs are important for bank stabilization and trapping fine sediments during floods. Overhanging vegetation provides critical cover for fish, resting areas for the adult forms of aquatic insects, and important food sources for streams (with leaf fall). Shade is critical to keep stream temperatures low and aquatic systems healthy.

In addition, stream channel width:depth ratio and overall riparian condition are analyzed in the context of other riparian and watershed activities. An inappropriately large width:depth ratio can increase stream temperature, increase fouling by algae, and decrease quality of good aquatic habitat. Bankfull stage shear stress decreases, which changes velocity and consequently induces sediment deposition (Rosgen 1996). Channel widening can be caused by degrading streambanks. In some stream channel types, downcutting and narrowing of the stream channel has the opposite and equally deleterious effect.

The following methods are used:

- modified "Greenline" riparian survey;
- monumented cross-section channel survey; and
- permanent photo points with pictures taken at the beginning and end of the grazing season.

We are currently evaluating the efficacy of adding stubble height transects.

The modified Greenline survey simply records the species of plants found along the Greenline transect. This removes the classification portion of the Greenline survey. The current classification tables available are appropriate to the Great Basin or the intermountain West, and certainly not for the Klamath-Siskiyou Bioregion. Should someone create classification tables in the future, the species information we have collected can be classified at that time. Preserving the species information also ensures repeatibility over many years and different surveyors.

I. Proper Functioning Condition Riparian Surveys

Introduction

Riparian zones are one of the most limited, (Elmore 1987) and most sensitive (Kaufman and Krueger 1984) habitats in the western landscape. Riparian zones are the most productive and diverse habitats in much of the west (Thomas et al. 1979) and frequently produce 10 times the forage of adjacent upland forested sites (Elmore1987).

The link between riparian vegetation diversity, especially in the shrub and overstory layers, and riparian wildlife diversity is well documented (Kauffman and Krueger 1984, Taylor 1986, Szaro et al. 1985). Wildlife populations adjacent to riparian zones are affected by habitat conditions and resultant wildlife populations in the riparian zones (Kauffman and Krueger 1984). Healthy riparian habitat usually supports species not found in the uplands and thus contributes to species diversity at larger landscape scales.

Riparian areas also play a critical role in channel process and aquatic habitat. Riparian trees and shrubs slow flood water and trap flood debris (Platts 1991). Trees fall into the stream during flood events, creating pools and trapping gravels for spawning habitat. Trees and shrubs also provide shade and in some cases, cover for fish. Grasses and forbs in floodplains trap fine sediments during floods (Platts 1991). In meadows, grasses and shrubs stabilize stream banks with their roots. The stream scours against these banks at curves, creating pools and deep overhanging banks. Riparian vegetation also provides an important food source for instream insects (Allen 1995).

Several years ago, the BLM directed the Field Offices to complete Proper Functioning Condition (PFC) surveys on all its streams. Over the last few years, the Medford District BLM has been working towards this goal as funding has allowed. Some of the streams within the CSNM have already been surveyed for PFC, but coverage is not complete. Having all the streams, wetlands, and other hydrologic features surveyed would provide more contextual information about the condition of streams and riparian areas throughout the CSNM, and as such is a vital component of the overall monitoring program as well as the livestock monitoring program.

Objectives

Objective 1: To comprehensively assess all streams, wetlands, and other hydrologic features on BLM-managed land with the same methodology, compatible and interchangeable with already-existing methodologies, in order to have the information needed to direct restoration or other land management activities.

Methods and Materials

The PFC method was developed by the BLM, the Fish and Wildlife Service, and the Natural Resources Conservation Service. The PFC method for assessing the condition of flowing water (lotic) systems is found in Technical Report (TR) 1737-15 (USDI et al. 1998) and the PFC method for assessing standing water (lotic) systems is found in Technical Report 1737-16 (USDI et al. 1999). The Medford District lotic PFC assessments follow the method described in TR 1737-15 with a Riparian-Wetland Functional Checklist that has been modified for western Oregon.

PFC is a minimum tool for assessing the physical functioning of a riparian-wetland area. PFC does not take the place of more intensive inventory and monitoring protocols; it is a minimum tool that can and should be used in conjunction with more detailed methodologies (USDA FS and USDI BLM 1997).

Medford BLM has expanded upon the PFC methodology in order to collect additional information necessary for a variety of land management activities. Variables collected for surveys (by reach, or section of stream generally between major tributaries) on all perennial and intermittent reaches include:

- location information;
- feature type;
- classification as perennial or intermittent as defined by the Northwest Forest Plan's Aquatic Conservation Strategy(ACS) (USDA FS and USDI BLM 1994);
- streamflow classification that classifies flow in relation to the expression of flow at the ground surface (continuous or interrupted) and in terms of seasonal duration (perennial, intermittent, or ephemeral);
- presence of biotic indicators of perennial flow (e.g. presence of Pacific giant salamanders, *Dicamptodon tenebrosus*, or *Lara* spp.);
- % streambed material;
- bank condition (% eroding, stable, etc.);
- valley form;
- slump presence and potential;
- amount of large woody material and debris jam in specified length and diameter categories;
- % stream canopy cover;
- amount of past timber harvest, each bank; and
- vegetation species within ACS-defined Riparian Reserve widths;

In addition, each reach is tagged (locations of tags recorded), photos taken, and three cross-sections estimate the bankfull channel dimensions, floodprone area width, stream gradient, and width:depth ratio. Surveyors also record notes and observations.

On features that are not a perennial or intermittent stream channel (dry draw, wetland, spring, seep, pond, lake, reservoir, ditch, etc.), the following variables are recorded:

- location information;
- feature type;
- valley form;
- slump presence and potential;
- reach tag location information;
- photo point location;
- notes, including the size of a wetland area, the depth of water or amount of flow present, and the associated riparian vegetation, when applicable.

Analysis

All data are organized, collated, and entered into a computer database. In the near future, the database will be integrated into GIS. Once this is achieved, a variety of spatial analyses will be possible. The types of analysis will include the following:

- The PFC Surveys will be used to see if problem areas identified in 1979/1980 surveys are in “Proper Functioning Condition.”
- Determine if there is an association of reaches in the “at risk” or “non-functioning” conditions with the major disturbance types of the CSNM (roads, timber harvest, livestock impacts)
- Compare conditions in paired watersheds with different management histories (grazing and timber harvest)

The PFC Surveys will also provide contextual data for site specific studies (e.g. exclosures) in riparian areas. The provision of context will allow a landscape perspective of site specific observations.

J. Stubble Height Studies

Introduction

This project is designed to support Project I (PFC Riparian Surveys) to quantify plant community composition and utilization by livestock in riparian and wetland plant communities of the CSNM. Comments from the 1983 Grazing EIS (USDI 1983a) supporting the need for riparian surveys include:

- “Due to its relative scarcity (less than 5% of the total land base), water associated and riparian vegetation are very important to wildlife as habitat for feeding and reproducing.”
- “Habitat for semi-wet meadow is far below potential for most semi-wet meadow primarily because of past heavy livestock use, and the subsequent invasion of annual weed species such as medusahead.”
- “Important summer deer areas also include the numerous riparian areas and wet meadow habitats.”
- “The riparian and upland wet meadows provide a large supply of insects and succulent forbs for young birds making them crucial habitat for both quail and brood rearing.”
- “Hyatt and Howard Prairie lakes are the two main areas of significant waterfowl production on public lands within the EIS area.” (USDI 1983a)

Little is known about the variability of plant composition, structure, and livestock impact to these communities within the CSNM. More detailed study of springs, seeps, isolated wetlands and riparian areas is critical since these communities occupy a small part of the landscape, but are disproportionately important to wildlife (Thomas et al. 1979, Elmore 1987). Springs, seeps, and isolated wetlands are likely to be the most highly livestock-impacted plant communities within rangelands (Lytjen et al. 2000, USDI 1983a).

Cattle are adapted to live in cool, moist environments where water is readily available. In the arid and semi-arid portions of western United States, the riparian zones provide the habitat most preferred by cattle. The availability of water, high quality forage in relative abundance, shade, and relatively flat ground make riparian zones highly attractive to cattle (Kauffman and Krueger 1984, Bryant 1982). Generally, the hotter and drier the uplands, the more attractive riparian areas become. Thus cattle tend to concentrate their use and associated impacts in riparian zones (Roath and Krueger 1982, Bryant 1982, Kauffman and Krueger 1984).

In a 1982 study of cattle use patterns in an allotment in northeastern Oregon, Roath and Krueger found that riparian areas (as described and defined in 1982) constituted 1.9 percent of the allotment, provided 21 percent of the available forage on the allotment, and produced 81 percent of the forage actually consumed by the cattle on the allotment. Large portions of the allotment's uplands were not used at all. An improved understanding of riparian/wetland utilization by livestock is needed to ensure adequate management of these rare landscape elements.

Stubble Height as a Guideline for Range Management

Stubble height has become a commonly used variable for measuring herbage left ungrazed within riparian areas and uplands. Stubble height is easier to measure than the traditional "percent utilization" and provides a better gauge of grazing impacts to wildlife habitat within riparian areas (Clary and Leininger 2000). Knowing what is left following a period of grazing is a better indicator of cover for ground-nesting birds, ability to trap sediments, and protect streambanks during times of high flow. While no residual stubble guides have been developed for the Monument, the literature suggests a minimum of 7 cm for high elevation systems with naturally low-statured vegetation to 15-20 cm of stubble on vulnerable streambanks, or where willows exist (Clary and Leininger 2000). These stubble heights are for sediment capture, and do not reflect the needs of wildlife for cover. Permanent transects located at sites identified by Project J will provide information on riparian use by livestock in Class I and II streams.

Smith et al (1993) suggest that ephemeral channels may be greater contributors to non-point source sediment loads. Though ephemeral streams are far less studied, it is known that riparian plants in these situations offer important structural diversity. Transects will be permanently marked along the ephemeral streams of Agate Flat to better understand this phenomenon.

Stubble height is also a useful tool in upland areas - this will be explored within the Oregon Gulch Research Natural Area, part of the landscape set aside to study natural ecosystem processes.

Plant Community Composition

Plant community data will be collected concomitant with the above stubble height study.
The grazing EIS (USDI 1983a) also identifies several potential impacts of livestock (grazing and trampling) on plant community composition and structure. Impacts may vary with grazing strategy (Bock et al. 1992, Taylor 1986, USDI 1983, McMahon and Ramsy 1965). Suitably designed research objectives will answer the need for implementation monitoring (see introduction to this manuscript) as well as determine landscape pattern and levels of utilization

by livestock. Abbreviated descriptions of potential livestock impacts by grazing strategy include:

> Spring/Summer Grazing System: "Grazing occurs every year during the critical part of the growing season under this system. A decrease in composition of key native, upland herbaceous and woody species is expected on those areas of the allotment that receive heavy utilization - primarily areas adjacent to water developments, riparian areas, and flat valley bottoms".
>
> Summer Grazing: "The majority of summer grazing takes place in the forested zone on logged areas. Forage is temporary in nature and is generally shaded out due to increased canopy of conifers within 20-25 years." "... as herbaceous upland species become dry in the late summer livestock begin grazing green herbaceous and shrubby species in riparian areas, and heavy utilization may occur."
>
> Deferred rotation grazing system: "Under this system grazing would take place during the growing season until seed ripe of grass key species. Pastures would be allowed to rest every other year. At moderate grazing levels, shrub species composition is not expected to change. Concentration of livestock in riparian zones is expected to decrease because of the timing and brevity of the grazing season."
>
> Rest Rotation Grazing System: "Rest rotation grazing alternates one or more years of complete rest with other grazing treatments. The length of the rotation cycle and number of grazing treatments depend on the number of pastures in the grazing system." Where employed in the monument, "the rest rotation system alternates 1-1/2 to 2 months of spring or summer use grazing with one complete year of rest. This system would increase the composition of all upland and riparian key species because early spring grazing allows plants to complete regrowth and replenish carbohydrate reserves. The year of rest further ensures reproductive success and seedling survival of key species."
>
> Exclusion: "An initial improvement in the vigor of key species would occur because the absence of grazing during the growing season would allow plants to complete vegetative growth and reproduction. Where the potential exists, a rapid increase in riparian woody species is expected".

Plant species compositional data will contribute to an existing classification framework (USDI 1983b). Where possible, transects placed to address the objectives of this project will be located at sites examined in the past (USDI 1983b) so as to integrate current information with past studies and to provide a historical context.

Physical Parameters

Land managers are concerned about the impact of livestock on streambanks, erosional processes, and consequences to stream cross-section. The greenline sampling protocol will be used to assess selected locations across the CSNM landscape, including livestock exclosures spanning riparian areas.

Objectives

Objective 1: Determine the range of plant composition within springs, seeps, wetlands, and riparian areas.

Objective 2: Determine current rates of utilization (referenced to livestock exclosures and temporary exclusion cages) by livestock and residual stubble height stratified by plant life-form.

Objective 3: Monitor stability, current condition and long term trend of the physical aspects of riparian areas, woody and herbaceous riparian plant communities as a indication of the effectiveness of management towards meeting ecological objectives.

The following objectives are derived from the need to complete implementation monitoring of rangeland management within the CSNM:

Objective 4: Determine if the spring/summer and other grazing management strategies fit the generalized landscape of the diverse allotments and pastures of the Monument.

Objective 5: Determine if any livestock handling features fall within riparian systems

Methods and Materials

Transects for measuring plant community composition using the same protocol as described in the livestock exclosure project will be applied to a minimum of 30% of spring, seeps, wetlands and riparian areas identified on USGS topographical maps. These transects will be conducted immediately prior to the advent of grazing to identify the range of plant community compositions within riparian communities.

The same transect lines will be repeated at the closure of the grazing season. Following the grazing season, stubble height measurements will be collected using guidelines from the Interagency Technical Reference (1996). The permanent and temporary livestock exclosures will be used to calculate livestock utilization on a sward height basis. Utilization cages are located at the majority of the sites to use as a reference for percent utilization.

Analyses

Sample adequacy

Several methods are used to assess sample adequacy. For cover data collected using a point cover intercept technique, the Interagency Technical Reference (1996) recommends plotting running average and standard deviation for a range of sample sizes bracketing the likely desired sampling rate.

Individual variable (species, growth form, or soil cover attribute)

For stubble height measurements, the Interagency Technical Reference (1996) suggests the use of confidence intervals calculated around the median value. This analysis will be stratified by plant community and life-form.

Change in composition or soil cover attributes will be measured using Chi Square contingency table analysis to test for significant change in numbers of "hits" on key species, and life-forms. This is described in greater detail within the livestock exclosure projects section. Data will also be expressed and presented graphically as percentage cover.

Community Level

In addition to multi-variate statistical methods described previously, TWINSPAN will be used to classify plant communities, while DECORANA (Kent and Coker 1992) will be used to identify gradients of plant community composition. Canonical Correspondence Analysis (Kent and Coker 1992) will be used to elucidate relations between plant community composition and variables of interest such as percent utilization by livestock, stubble height, percent bare soil, and percent soil subjected to deep disturbance. Overlap analysis within GIS will be used to examine and quantify spatial patterns of change in plant community associated with management strategy, soils, slope, and aspect. In addition to the objectives outlined above, the data will contribute to the completion of livestock utilization mapping.

K. Rangeland Utilization

Introduction

The proportion or degree of the current year's forage production that is consumed or destroyed by animals (including insects) is called rangeland utilization. The term may refer either to a single plant, a group of species, or to the vegetation community as a whole. Utilization is synonymous with use.

Monitoring utilization ensures in part that the management guidelines are achieved, or identify management problems subject to possible alleviation by altering the number of animal unit months, season of grazing, or moving of salt and watering points.

Current and past utilization maps will be used to describe historical and current utilization patterns within the Monument. These maps will provide spatial utilization data used in other projects described in this manuscript while also allowing an assessment of whether range management standards are achieved.

Objectives

Objective 1: Determine if current utilization within utilization plots placed to represent the larger landscape meets utilization standards (less than 60% utilization of herbaceous vegetation in upland plant communities; less than 40% utilization of woody species on upland plant communities; less than 40% utilization of herbaceous vegetation in riparian plant communities; less than 25% utilization of woody species in riparian plant communities).

Objective 2: Create maps of forage utilization to determine if utilization meets allotment wide standards and to identify possible 'hotspots' of use.

Objective 3: Field validate above defined maps of utilization.

Methods and Materials

Utilization transects are completed annually on key areas using the Key Species Method (pp.81-85 Rangeland Monitoring Oregon and Washington). Key species are generally an important component of the plant community. Key species serve as indicators of change and may or may not be forage species. Key areas are indicator areas that are able to reflect utilization across the larger landscape. A key area should be a representative sample of a large stratum, such as a pasture, allotment, wildlife habitat area, herd management area, watershed area, etc. Additionally, an ocular estimation method is employed annually throughout the allotments and this information used to develop maps of utilization patterns.

Analyses

Standard analysis identified by the Interagency Technical Reference (1996) will allow statistical validation of utilization data to determine if current grazing standards are being achieved. Hand-digitizing will be used to transcribe hand-drawn utilization maps into the GIS environment. These maps will be used to determine if general allotment-wide utilization standards are achieved.

L. Rangeland Trend: Long-term Studies

Introduction

Together with the assessment of rangeland condition (Project M) and utilization (Project K), determining rangeland trend is considered critical to ensure adequate management of rangeland allotments. Trend generally refers to changes in plant community composition based on cover, frequency, or phytomass data. True trend can only be interpreted from a time series of data collected at fixed points. Apparent trend is a professional estimate of trend direction derived by examining community compositional changes along a chronosequence or seral ensemble. Such data are considered to be much less reliable than temporal data collected from fixed points. Where clear management objectives are identified (for example a 'potential natural community composition' - see project M), trend (change across time) can be assessed to be moving towards or away from the desired condition.

Intense plot-based methods for assessing rangeland trend are considered to be relevant to the site of data collection only. Since trend monitoring sites are selected to be representative of rangelands across the larger landscape, results are often extrapolated to similar plant communities on similar soils experiencing similar environmental/management conditions (i.e., within allotments). Together with plant community maps, actual use (number of animal unit months reported by lessees), range condition and utilization surveys help validate such extrapolations.

Several assumptions underlying the rangeland condition framework need to be described to ensure an adequate interpretation of trend:

- Trends can only be assumed to be similar in the same plant community proximal (within the allotment or pasture) to the trend site - it cannot be assumed that trend in one plant community is the same as trend in different plant community close-by.
- Livestock are uniformly distributed across the plant communities represented by trend sites.
- The successional framework on which condition is based accurately represents plant community dynamics is relevant to the plant communities of interest

While these assumptions may not be strictly met in the strict sense of the word, they need to be carefully considered before statistically validated trends are extrapolated from data collection sites to the larger landscape. This requires the professional judgement of the rangeland management specialist and reliable additional information regarding the location of study plots relative to salt and watering sites, maps of rangeland utilization and condition, as well as the dispersion and patterning of the full range of plant communities across the landscape.

Objectives

Objective 1: Determine if there are significant changes (trends) in individual key plant frequency.

HA1.1 There are no significant changes in key species abundance [Prediction: Chi-squared analysis indicates no significant changes (p=0.05)]

HA1.2 There are significant changes in key species abundance [Prediction: Chi-squared analysis indicates significant changes (p=0.05)]

Objective 2: Describe significant changes in key species relative to range condition.

HA2.1 Rangeland trend is towards a desired condition (Prediction: there is an increase in the abundance of desired key species, and a decrease in undesired key species including weeds)

HA1.2 Rangeland trend is towards an undesired condition (Prediction: there is a decrease in the abundance of desired key species, or an increase in undesired key species including weeds)

Methods

Nested frequency is a Bureau-approved method for monitoring rangeland trend. Frequency is usually measured in plots, and can be defined as the percentage of possible plots within a sampled area occupied by the target or key species. It describes the abundance and distribution of species and is useful to detect changes in plant community over time. The change over time is expressed as trend.

Frequency is appropriate for any growth form. It is especially sensitive to changes in spatial arrangement. It may be appropriate for monitoring some annuals, whose density may vary dramatically from year to year, but whose spatial arrangement of germination remains fairly stable. Rhizomatous species, especially grass species growing within similar vegetation, are often measured by frequency because there is no need to define a counting unit as would be the case with measurements of density. Frequency is also a good measure for monitoring invasions of undesirable species.

If the primary reason for collecting frequency data is to demonstrate that a change in vegetation has occurred, then on most sites the frequency method is capable of accomplishing the task with statistical evidence more rapidly and at less cost than any other method that is currently available (Hironaka 1985).

Another advantage of frequency over methods of measuring cover is the longer time window for sampling. Once germination has occurred frequency measurements are fairly stable throughout the growing season. Comparatively, cover measurements may change dramatically from week to week as plants grow. Cover measurements are thus taken once communities are stabilized consequent to advanced phenology over the course of the summer.

The disadvantage is that frequency is a measure affected by both spatial distribution and the density of the population. Numbers obtained are dependent upon quadrat size. Therefore care must be taken to select quadrat sizes which will include an accurate representation of the plant community sampled. A further disadvantage is that frequency provides no information about structural characteristics defining habitat for plants and wildlife. Since frequency only measures presence or absence within plots, increases or decreases in size and number of individual plant species are not recorded. This shortcoming of frequency may be alleviated by measuring point cover at the tip of the nested frequency quadrat frames.

Fourteen plots are established for the seven allotments overlapping with the boundary of the CSNM. Seven of these plots fall within the actual boundary of the CSNM.

Temporal data derived from other projects (Projects B, I, J) will be examined in a similar manner to deduce trend and whether change is towards a desired condition.

Analysis

Follow the Bureau-approved protocol set forth in Rangeland Monitoring Oregon and Washington pp. 37-43 (1985). To determine if the change for key species between sampling periods is significant a Chi-Square contingency table analysis will be used.

M. Range Condition

Introduction

Several government agencies have developed frameworks for assessing rangeland condition, where condition is assumed to indicate ecological integrity. Most condition frameworks within the Bureau of Land Management and Natural Resources Conservation Service are based on an approximation of how similar current plant community composition is to the 'climax' or 'potential natural community' plant composition. Current condition may be expressed as the percent similarity to the climax composition, or categorized using terms such as early-seral, mid-seral, late-seral, and climax. Older terminology uses terms such as poor, fair, good, and excellent condition. Under older range management terminology, plant community compositions closely representing the climax composition are deemed to be in excellent condition. Condition is considered to decrease as the percent similarity to the assumed benchmark decreases. These terminologies fail to capture the difference in plant community development due to the varied forces of fire, grazing, succession, and weed invasion. Fire and grazing also vary in effect with intensity and timing of occurrence. Another reason for not using stand-level condition ratings (such as poor, fair, good, and excellent condition) is the desirability to retain a range of 'conditions' or 'seral states' representing a range of plant and wildlife habitat at the landscape-level. The monitoring plan as a whole considers different stand-level and landscape level metrics for a balanced perspective.

The Jackson County Soil Survey (USDA 1993) identifies Potential Natural Community composition by soil type. For this project, this soil and vegetation data will be used as guidance for the determination of current stand-level plant community condition/state. Current plant community data for assessing state relative to the climax condition will be derived from other projects described within this monitoring plan (Projects A, B, I, J). The major objective of this study will be the production of rangeland condition/state maps to be used in other projects and provide input to the final interpretation of livestock impact on the biological resources of the CSNM.

Objectives

Within non-transitory rangeland, create maps of rangeland condition/state based on current plant community composition (stratified by plant community) relative to the composition of the climax/potential natural community and soil condition utilizing the interagency protocol for "Interpreting Indicators of Rangeland Health (USDI 2000c)." Within transitory range, consider the percentage composition by native species compared to noxious weeds and "non-desirable" introduced species as an alternative metric. The term "non-desirable" introduced species is used to distinguish between introduced species that were used to reseed disturbed areas with the intention of stabilizing soils and providing forage for wildlife and livestock from those that are not considered noxious, but are undesirable from all other perspectives (limited use to wildlife & ability to stabilize soil, etc). An assessment of percent composition of native versus non-native species within transitory range communities will also be completed.

Methods and Materials

Condition on rangeland is determined by comparing existing vegetation on the site to the Potential Natural Community (PNC) and measurements of soil conditions. PNC is dependent on soil, climate, aspect, slope, and other environmental factors. Monitored sites are periodically compared to the assumed PNC and rated on a percentage accordingly for that vegetation type.

Early seral (poor condition) is 0 to 24 percent of climax/PNC, mid-seral (fair condition) is 25 to 49 percent of climax/PNC, and late seral (good condition) is 50 to 74 percent of climax/PNC. A site is considered at climax (excellent condition) for that site the current plant composition is above 74 percent similarity to the climax/PNC. In the past, range evaluations rated conifer forests along with standard rangelands. Since even standard rangelands in excellent condition would not approach PNC for a forested community type they would be rated lower than their actual seral state. According to the 1997 Little Butte Creek Watershed Analysis future range evaluations will be based only on monitoring non-transitory range sites. Oak woodlands, shrublands, and grasslands are all considered non-transitory range sites. In the 1993 Soil Survey of Jackson County, Oregon each range type has a description of full Climax (100 percent PNC).

Several projects will contribute data for the assessment of rangeland condition. Plant species cover data was sampled at 97 sites in the 2000 field season to examine changes against field data collected in the past 20 years. Further compilation and analysis of these data sets is described elsewhere in this document (see Project B). Coarse plant community composition data derived from Project A (Section IV) will be analyzed using the same standards. Though older and of questionable quality, Soil and Vegetation Inventory Methods (SVIM) data collected in the early 1980s may also provide information about rangeland condition. This project examines condition relative to climax or potential natural vegetation. The final interpretation of results form all projects will consider range condition but not be limited to:

- Amount and distribution of canopy cover;
- Amount and distribution of plant litter;
- Accumulation/incorporation of organic matter;
- Amount and distribution of bare ground;
- Plant composition and community structure;
- Absence of accelerated erosion and overland flow.

Currently the 2-phase method of determining rangeland condition (Appendix B) is used within the monument landscape. This system of condition survey will be replaced with the more recent and comprehensive interagency protocol entitled "Interpreting Indicators of Rangeland Health (USDI 2000c)."

Analyses

Several projects and data sets will supply plant compositional data to classify study sites into the range of condition classes as described in the 'Methods and Materials'. A spreadsheet or statistical program will be used to create a similarity matrix based on the Bray Curtis Index. The resultant similarity matrix will contain comparisons of field data to the hypothetical 'climax' or 'potential natural vegetation' expressed as a percentage similarity. These percentages will be used to classify the represented sites into the condition classes identified above.

N. Photo-Monitoring

Introduction

Numerous photos documenting surveys, fence building projects, restoration efforts, wildfire, prescribed fire, historic photos along roadways back to the early 1900s and other management endeavors from the mid 1950s through to the 1990s are archived at the BLM. The photos are part of the routine monitoring performed by hydrologists, rangeland management specialists, fisheries biologists, wildlife biologists, and ecologists, and do not exist in a centralized collection. This project aims at duplicating images in hard-copy and digital image formats. The establishment of exact photo-location using a Global Position System (GPS) will allow easier repetition of photo-monitoring as well as the construction of local management history within GIS. The construction of a GIS based chronology of disturbance events (fire, flood, road construction, timber harvest) and livestock management in terms of grazing system (spring, summer, etc), grazing intensity, timing of grazing, proximity to watering/salting points, and grazing exclusion (as in the case of the former Box-O Ranch) will provide the necessary information for the accurate interpretation of monitoring photos.

Objectives

Objective 1: Identify photos suitable for longer-term photo-monitoring

Objective 2: Create GIS based photo-location database

Objective 3: Repeat photos suitable for long-term monitoring

Objective 4: Identify coarse plant community change in terms of increase or decrease of plant life forms (annual grass/forb, perennial grass/forb, shrub, and tree) between photo-monitoring events

Objective 5: Interpret results relative to disturbance events, by plant community, and by livestock management practices.

Methods and Materials

Existing photos will be relocated in the field using features from the photos. Time of year, time of day, weather, and photo azimuth will be replicated as close as possible to facilitate comparison of photos. Positions will be accurately located using GPS technology. Once positions are imported within the GIS database for the CSNM, photos will be stratified by plant community, geographic, and management criteria as part of the photo-interpretation process. Relative abundance of the top 10 species will be recorded at each photo site. Since the photo database exceeds 300 photos, this will allow the association of species composition with management activities. Plant community change will be assessed as increase, decrease, or no change in life-form abundance between photo-monitoring events. Where possible, these observations will be extended to individual species on a photo-by-photo basis.

Analyses

Association analyses, LOGIT modeling, or Log Linear Modeling of photo observations, vegetation data collected at each photo site and landscape data (utilization, soils, etc.) will provide information about vegetation change over time and consequent to environmental variables. In general, photos will be interpreted on a case-by-case basis, or be used to substantiate results from other projects in close proximity to photo-points. More general conclusions stratified by plant community will be made where sufficient numbers of photos exist across management or geographic boundaries. In such cases, the strength of the observations will be expressed by the percentage of photos showing similar plant community dynamics.

O. Actual Use

Introduction

This is an annual report of the actual livestock grazing use certified to be accurate by the permittee or lessee. Actual use may be reported in terms of Animal Unit Months (A.U.M.'s) or Animal Units (A.U.). An Animal Unit Month (A.U.M.) is the amount of forage required to support one cow-calf pair for a period of one month, ie..5 cows for 4 months would be the equivalent of 20 A.U.M.'s. An Animal Unit (A.U.) is an exact measure of the stocking rate, ie. 5 cows equates to 5 Animal Units (A.U.) Animal Units can be multiplied by the number of days grazed and divided by 30 to calculate A.U.M.'s.

Objective

Track actual use of each allotment over time and compare with preference and allowable use determined in the Land-Use Plan. This can then be used to compare actual use and preference against trend and other rangeland monitoring data in order to ascertain if stocking rates and rangeland trends and other monitoring data are correlated.

VI. POTENTIAL THRESHOLDS OF CHANGE

Much of the monitoring identified in this document is aimed at defining the impact of livestock on important biological objects of the monument. An interdisciplinary team representing range management, ecology (terrestrial, fish, aquatic), wildlife, and soils identified important variables for defining livestock impacts to the ecosystem. Local research and literature will identify thresholds denoting the need for a change in management. Management action may be localized or pasture-wide depending on the scope of the threshold variable.

Table 4. Summary of Potential Biological and Environmental Thresholds of Change prompting Management Action. (Numbers refer to livestock exclosure projects while letters refer to supportive studies.)

PROJECT [and parameter]	THRESHOLD	RATIONALE
1a, 1b [Plant community composition; percentage similarity]	Trend of dissimilarity between livestock exclosures and grazed areas while trend within livestock exclosures includes increases in desirable plant species and/ or reduction in undesirable plant species	Vegetation is a primary indicator of wildlife habitat quality. Undesirable shifts in plant community effect wildlife and overall biological diversity of native species.
1a, 1b [Key plant species: cover abundance by Idaho Fescue, willow species, alder, ash, poplar, sedges, rushes, cottonwood]	Abundance (cover) of key species inside livestock exclosure	Idaho fescue = important forage species. Willow, alder, ash, poplar, cottonwood = important riparian habitat structure and food for beavers. Rush, rush, tall native perennial grasses = riparian zone hiding/nesting cover and forage species.
1a, 1b [Perennial herbaceous plant abundance: cover]	Abundance (cover) of the perennial herbaceous life-form inside livestock exclosure	Perennial herbaceous plants provide long-lived roots for added bank stability, and foliage for trapping sediments
1a, 1b [Key species abundance; cover by yellow star thistle, non-native *Galium spp.*, weedy annual grasses	Abundance (cover) of key weed species outside livestock exclosures is higher than paired livestock exclosure	All compete with/ displace more palatable native species. Galium spp. and weedy annual grasses can cause mechanical damage to wildlife.
1a, 1b, H, I [severe surface disturbance within riparian communities]	Percent surface disturbance (cover) outside exceeds inside cover by a threshold to be determined	Severe surface disturbance may lead to bank/bottom instability, loss of plant/wildlife habitat/species richness

Table 4. Summary of Potential Biological and Environmental Thresholds of Change prompting Management Action. **(Numbers refer to livestock exclosure projects while letters refer to supportive studies.)**		
PROJECT [and parameter]	**THRESHOLD**	**RATIONALE**
2, C [*Calochortus greenei*: numbers of individuals]	Significant differences within the 15 paired plots for vegetative and reproductive individuals demonstrating that livestock grazing is influencing populations (p = .05)	any decline in species for which the monument was established to protect requires management action
H, I Width to depth ratio[1]	Narrow floodplain (A & E channel types) = <12 Wide floodplain (B & C channel types) = >12	An inappropriately large width:depth ratio can increase stream temperature, increase fouling by algae, and decrease quality of good aquatic habitat. Bankfull stage shear stress decreases, which changes velocity and consequently induces sediment deposition. Channel widening can be caused by degrading streambanks. *Note*: In some stream channel types, downcutting and narrowing of the stream channel has the opposite and equally deleterious effect.
H, I, J, K, N Plant community structure[3]	Loss of woody species, riparian-dependent plant species, increase in bare ground, decrease in willow height attributed to livestock	Woody species (e.g. willow) protect stream banks from erosion, create cover for fish–critical in meadow areas, provide habitat for aquatic macroinvertebrates, and are an important allocthonous food source. Grasses and forbs are important for bank stabilization and trapping fine sediments during floods.
H, I, J, K, N Overhanging vegetation (within ~0.5m of water surface)[4]	Overhanging vegetation on 50% or more of the streambank, especially on outside bends.	Overhanging vegetation provides critical cover for fish, resting areas for the adult forms of aquatic insects, and important food sources for streams (with leaf fall).
I, J, K, L Shade (forested streams only)[2]	No decline in shade attributable to livestock	Shade is critical to keep stream temperatures low and aquatic systems healthy.

Table 4. Summary of Potential Biological and Environmental Thresholds of Change prompting Management Action. (Numbers refer to livestock exclosure projects while letters refer to supportive studies.)

PROJECT [and parameter]	THRESHOLD	RATIONALE
J [Stubble height: average stubble height in riparian areas]	The average stubble height (stratified by plant life-form and plant community) does not fall below a stubble height defined by 25% phytomass utilization for a particular riparian community, provided no other impacts to objects of biological interest occur	Stubble heights are easier to measure than percent utilization, and provide more information about ecosystem functioning i.t.o. sediment retention and habitat for ground-nesting birds
J, M [Range vegetation utilization (herbaceous component)]	Utilization of key forage plants is moderate or light (less than 60%) for the uplands and light (less than 40% utilization) for riparian areas.	Utilization is a good indicator of livestock use patterns. Utilization provides a measure of the effects of herbivory on plant species as it relates to plant physiological condition.
J, M [Range vegetation utilization (woody component)]	Utilization of key shrubs/woody perennials measured at the end of the livestock grazing season is light (less than 40% utilization) for the uplands and less than 25% utilization for riparian areas.	
L [Rangeland trend as indicated by desired key species frequency]	Reduction in desired key species abundance	Change in frequency of key species is the conventional method for detecting trend in rangeland management
L [Rangeland trend as indicated by undesired key species frequency]	Increase in undesired key species abundance	

[1] Rosgen, D. 1996.
[2] Moore, K., K. Jones, and J. Dambacher. 1998.
[3] Platts, W.S. and R. L. Nelson. 1985.
[4] Leonard, S., G. Kinch, V. Elsbernd, M. Borman, and S. Swanson. 1997.

VII. FINAL PROJECT INTERPRETATION

Individual projects generally provide information on a subset of subjects including weeds, general plant community dynamics, abundance of individual species, wildlife - livestock interaction, range utilization, diverse measures of range condition, and other topics. Since the scope, intensity, and method of data collection varies between projects, it is critical to analyze data within the context of the individual project. However, a “Final Project Interpretation” will also be performed to present results by subject/issue. This will be accompanied by a more thorough literature review than that presented within the current manuscript.

Several projects will aide the development of threshold values of variables considered to be a measure of livestock impact on objects of biological interest. Once threshold values are established, change beyond these benchmarks would identify the need for change in livestock management in terms of grazing intensity, timing or, the exclusion of grazing from part of, or the complete CSNM.

Results from landscape-level surveys may also prompt a change in livestock management. All of the studies listed in this monitoring plan will also provide information for future allotment assessments and resource management plan amendment. Some of the subjects that provide important contextual information for the interpretation of the livestock exclosure projects include:

- Plant Communities (identification, mapping, change over time);
- Weed Invasion (mapping, rate of invasion, relation to physical environment, relation to livestock utilization & management);
- Rangeland Condition [examining different perspectives of range condition (conventional BLM/SCS range condition versus alternative approaches using different benchmarks emphasizing wildlife habitat, the weed invasion process, interaction with fire, etc);
- Livestock-wildlife interaction (deer, elk, ground-nesting birds, etc.)
- Livestock impacts to springs, seeps, wetlands and other riparian plant communities
- Discussion of implementation monitoring objectives
- Discussion of effectiveness monitoring objectives

The final discussion will focus on using this knowledge to determine how livestock affect the important biological elements defined within the Presidential Proclamation of the Monument, as well as the ecosystem functioning and integrity of the larger landscape forming the context for the livestock exclosures and paired sites. Knowledge from the monitoring projects will aid the development of threshold values to assess livestock impacts to objects of biological interest.

VIII. GLOSSARY OF TERMS

Allotment: An area of land designated and managed for grazing of livestock.

Analysis of Variance: A statistical algorithm intended to test whether differences between sample means of a single variable (for example, cover) are large enough to imply significant differences between population means. This is achieved by comparing within-sample-variation to between-sample-variation. The algorithm makes assumptions about random sampling, sample independence, homogeneity of variance, normality, and additivity, all of which are required to be verified to ensure test results are valid.

Animal Unit: One mature (1000 lb. (455 kg.)) cow either dry or with a calf up to six months of age.

Animal Unit Month: The amount of feed or forage (600 lb. (273 kg.)) required by one animal unit for one month.

Browse: Woody plant species consumed by animals.

Carrying Capacity: The maximum stocking rate possible year after year without causing damage to vegetation or related resources

Class 1 Stream: A system of stream classification established in the Oregon Forest practices Act. Class 1 streams are those which are significant for: a) domestic use; b) angling; c) water dependent recreation; and d) spawning, rearing, or migration of anadromous or game fish.

Class 2 Stream: All other streams that don't meet the definition of a Class 1 stream.

Crucial Habitat: Habitat that is basic to maintaining viable populations of fish or wildlife during certain seasons of the year or specific reproduction periods.

Deferred Rotation: Deferment involves delay of grazing in a pasture until the seed maturity of the key forage species. This permits the better forage species to gain vigor and reproduce. Under a deferred rotation system one pasture may be used early one year and late the next.

Livestock exclosure: An area of approximately ¼ to 3 acres that is completely enclosed by a fence to prevent animal disturbance such as grazing. This term is synonymous with livestock exclosure.

Forb: Herbaceous (non-woody) plants other than grasses and grass-like plants.

Grazing Capacity: The maximum stocking rate possible year after year without causing damage to vegetation or related resources

Greenup: The period of time during which plants break dormancy and put on vegetative growth.

Habitat Diversity: The relative degree or abundance of plant species, communities, habitats, or habitat features (e.g. topography, canopy layers) per unit area.

Herbaceous Plants: Non-woody plants.

Intermittent Stream: Seasonal stream. A stream that flows only at certain times of the year when it receives water from springs or from some surface source, such as melting snow in mountainous areas.

Key Species: A forage species whose use serves as an indicator to the degree of use of associated species, and because of it's importance, must be considered in any management program.

Litter: Non-decomposed dead organic matter.

Multivariate Analysis of Variance: The same as 'Analysis of Variance', but intended for more than one variable.

Pasture: An area designated to be grazed for a specified time period.

Perennial Stream: A stream that flows continuously. Perennial streams are usually associated with a water table in the localities through which they flow.

Range Condition: Departures from some conceived potential for a particular site, usually based on soil parameters and differences in vegetative species composition.

Range Improvement: An authorized physical modification or treatment which is designed to improve production of forage; change vegetation composition; control patterns of use; provide water; stabilize soil and water conditions; restore, protect, and improve the condition of rangeland ecosystems to benefit livestock, wild horses and burros, and fish and wildlife. The term includes but is not limited to structures, treatment projects, and use of mechanical devices or modifications achieved through mechanical means.

Range Trend: The direction of change over time, either towards or away from desired management objectives.

Rest: Indicates the range receives non-use for a full year rather than just during the growth period.

Rest Rotation: A grazing system where animals are moved from one pasture to another on a scheduled basis with one pasture receiving a full years rest each year.

Riparian: Riparian habitat is defined as an area of land directly influenced by permanent (surface or sub-surface) water. They have visible vegetation or physical characteristics reflective of permanent water influence. Lake shores and streams are typical riparian areas. Excluded are such sites as ephemeral streams, washes and dry gulches that do not exhibit the presence of vegetation dependent on free water in the soil.

Seral Stages: The series of relatively transitory plant communities that develop during ecological succession from bare ground to climax

Spring/Summer Grazing: Grazing that occurs during the Spring/Summer season of the year

Upland: Any area that is not considered a riparian area.

Utilization: The percentage of the current year's herbage production consumed or destroyed by herbivores.

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X. APPENDICES

XI. MAPS