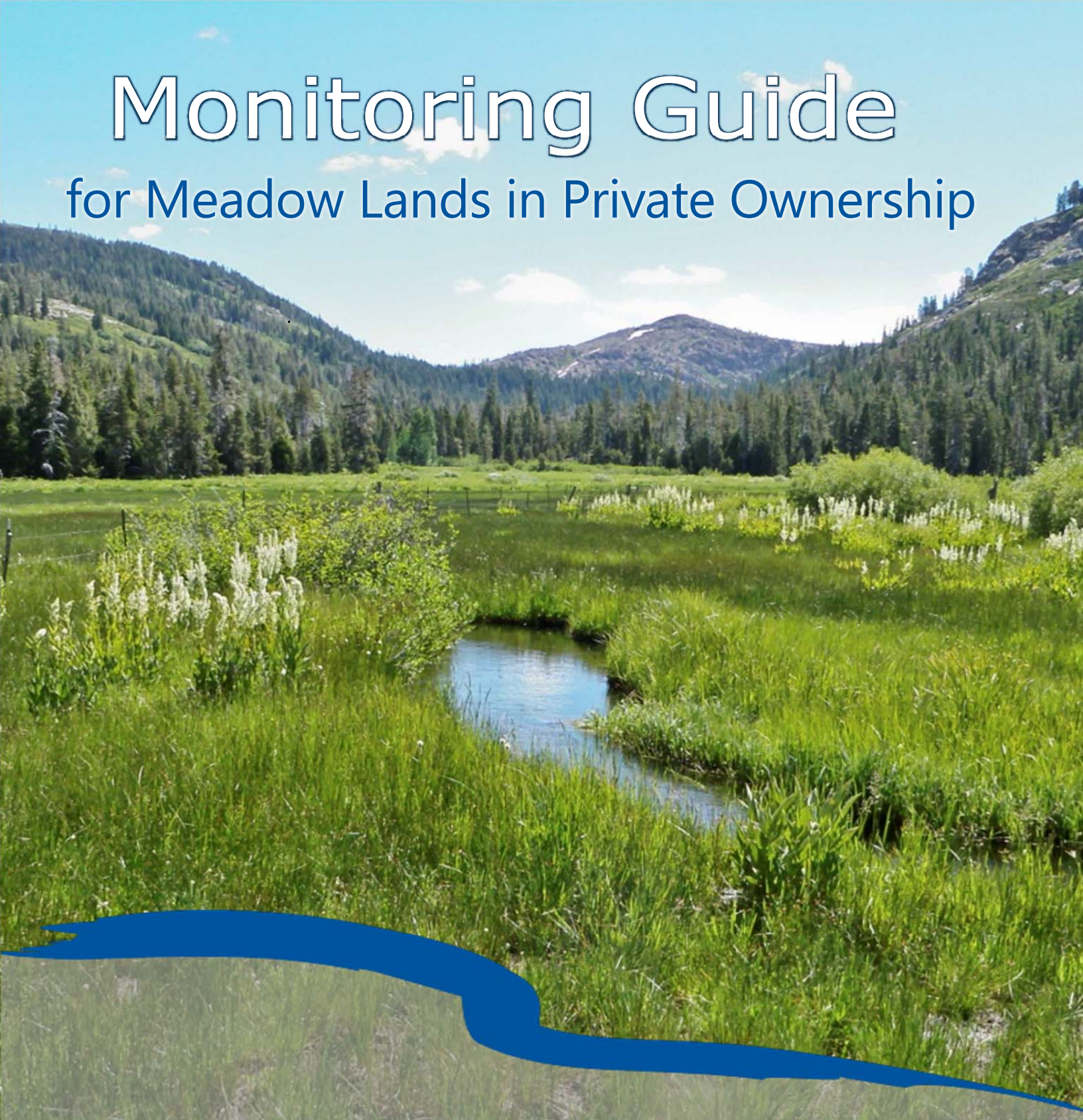
Monitoring Guide

for Meadow Lands in Private Ownership



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Introduction

Sierra Nevada meadows have held a special place in human history and culture for thousands of years. Following the California gold rush, human use increased dramatically. By 1930, impacts from uses such as logging, overgrazing, mining, and fire suppression were significant and conservation/restoration[1] efforts were being undertaken[2]. Currently there is strong support for meadow restoration in the Sierra[3–5], with both private and public funders investing in meadow restoration. These include landowners, the National Fish and Wildlife Foundation (NFWF), Sierra Nevada Conservancy, Bella Vista Foundation, U.S. Forest Service (USFS), Natural Resource Conservation Service (NRCS) and others. Accompanying this surge in activity is the call from landowners, neighbors, and funders to carefully monitor meadow restoration projects[6,7].

Monitoring is defined as repeated measurements that span an extended time period and which are designed to measure magnitudes and rates of changes[8]. A well-designed monitoring plan for meadow restoration will specify how a project will collect and report the information needed to make informed management decisions, identify problems and quantify progress toward restoration goals. As a companion to this monitoring guide, a restoration plan template[9] is a useful tool to ensure that project components, including monitoring, are well integrated.

The importance of integrating monitoring into the design and budget phases of a project cannot be overstated. Not only will it ensure that sufficient pre-project information is collected, but a project with a stated monitoring plan will often be designed to more closely match the project goals and evaluation criteria. Researchers have highlighted this problem, pointing out that monitoring data for restoration projects of all types often do not match project goals [10–12]. This results in wasted effort and inadequate data for management. The need for monitoring standards is also widespread among restoration projects. Our aim is to fill this gap for meadow restoration by integrating recently-developed monitoring standards into a framework that highlights the opportunities and challenges specific to private lands.

Purpose

The purpose of this monitoring guide is to provide a framework for designing a project-specific monitoring plan for restoration on privately owned meadow lands. Here, we synthesize the monitoring experience and suggestions of numerous landowners and practitioners experienced with restoring private meadows.

Long-term Landowner-Driven Data

On private meadow lands, a landowner or leaseholder usually observes the site periodically, often over many years or decades. This long-term consistency is an enormous asset, when monitoring

the effects of restoration on private lands. If monitoring of a restoration project can make use of data that a landowner is already collecting, the information will be the most immediately useful, and there will already be momentum to support and interpret monitoring data in a long-term context. In addition, the landowner often has intimate knowledge of livestock operations and other land uses, which may help identify the best locations for monitoring. For example, stream crossings by livestock are likely important points to monitor, as are new culverts and fence lines. To use the long-term consistency provided by a landowner to maximum advantage, it is important to take into consideration how the landowner will communicate his or her observations. A written record is essential. It is even better if accompanied by quantitative data and photographs.

Monitoring the effects of a restoration project will almost always require additional measurements, beyond those needed for typical operations. The project budget may fund monitoring for a few years following the project. However, the support for in-depth, long-term monitoring is difficult to secure outside an academic setting. Therefore, collaborating with a private landowner, or in some cases a local entity with a long-term interest in the project (successful examples include the monitoring work of the Feather River Coordinated Resource Management Group [Feather River CRM] and Alpine Watershed Group) may be the most practical way to ensure monitoring continues after the project funding is exhausted. To be feasible, little or no additional unfunded effort should be required by these long-term elements of the monitoring plan.

Two Examples

One certified Angus breeder in the Northern Sierra regularly analyzes forage on his rangelands. These data are important for his management, and with a small increase in coordination, they will also provide important monitoring data. This ranch is planning a pond-and-plug restoration project, and one goal is improved forage production. Clearly, this rancher will be able to use the results of his forage analyses to track whether his investment in restoration paid off. The change in forage following restoration will also fill an important gap in the science of meadow restoration, which currently lacks solid data on how pond-and-plug restoration projects affect forage production. If monitoring is planned early, as in this case, the unique long-term forage data that the rancher has already collected may also make the restoration project more appealing to funders that have combined goals of research and restoration.

Another example comes from the rangeland transects used by some ranchers to estimate the percentage of forage which has been grazed. For example, on leased and USFS-permitted allotments, it is common to use pace transects to record plant heights before and after grazing. In the Central Sierra, pace transects are conducted for sedges (*Carex* spp.). The length of the transect is a rough, but quantitative measure of the area covered by sedges, an indicator of wet-

meadow conditions. Tracking the area of sedge coverage before and after restoration is a potential way to tie restoration monitoring into existing long-term data and piggyback on future efforts.

These examples illustrate the potential to integrate performance monitoring for restoration into existing monitoring efforts. Existing monitoring is unlikely to fulfill all the requirements of a large restoration project, but the value of a long-term dataset and engaging the landowner should be fully and creatively explored.

Writing the Monitoring Plan

A monitoring plan has the following principal sections:

- **Background**: The project history, restoration goals, and location as well as the partners and stakeholders who will use the monitoring information.
- **Purpose:** The monitoring goals and how they support the project goals.
- **Monitoring Activities:** The measurements to be taken, how they will be taken, by whom, and on what specific timeline.
- **Reporting:** How the measurements will be analyzed, how findings will be summarized, and which metrics will be reported. How information will be shared and with whom.

The Background section will identify the geomorphic setting of the project, as well as why the site needs restoration, and the specific goals of the project. This section will also list project partners and their role in the project and may include key stakeholders and how they will use the monitoring data (for example a grazing leaseholder or water master). When stakeholders are identified in the monitoring plan and consulted during development, it is more likely that they will accept the resulting data and conclusions (see Independent Data below).

A clear statement of purpose is critical to a successful monitoring plan because planned monitoring activities may not address all the goals of a project. For example, a monitoring plan designed to detect needed repairs to the project may not include wildlife surveys, even if increased wildlife use may be an important and unmeasured project goal. A clear purpose that has been vetted by project partners and stakeholders will ensure that the monitoring effort is focused correctly and that key information is not overlooked.

The Monitoring Activities section will include the specifics of the monitoring methods (see Resources for Monitoring Methods below). Guidelines for data collection will be established, including who will collect data, how measurements will be taken, the timeline for data collection, and standards for acceptable data (for example, hold times for water quality measurements, or seasonal windows in which vegetation data may be collected). This section will provide sufficient detail so monitoring methods can be repeated independently in the future.

A plan for interpreting and reporting findings is one of the most frequently overlooked sections in a monitoring plan. However, unless data are summarized and interpreted, and conclusions reported, the monitoring effort is wasted. The goal on the front end should be to identify clear decision points (for example, exclosure fencing will be installed if transplanted vegetation is grazed over 70%) and summary statistics to report (for example, the lowest stream flow or the number of days the water table is below 2 feet). A clear plan for reporting is the key to efficient data collection and avoiding the effort to take measurements that will never be interpreted.

The reporting section should also describe how the monitoring results are to be shared. It will identify the publicly available information (if any) and state guidelines for how partners will respond to information requests.

Resources for Monitoring Methods

The details of each monitoring plan will be somewhat different because every meadow is different and the goals of projects vary. The managers and project partners involved will require more data in some places and less in others and monitoring will be planned to meet these needs within a given budget. There are existing protocols and methods for monitoring plans, which should be referenced whenever possible. Referencing existing methods avoids "reinventing the wheel" and ensures that comparable (or ideally standardized) methods are employed. Comparable data are key to improving methods and adapting proven methods to new situations.

Monitoring methods specific to meadow restoration have been developed by the Plumas Corporation[13]. In addition, NFWF recently supported the development of a number of meadow-specific monitoring standards: the Institute for Bird Populations published recommendations for bird monitoring[14], UC Davis and partners published recommendations for fish monitoring[15], and American Rivers and Stillwater Sciences published recommendations for monitoring vegetation, water quality, and hydrologic changes[16,17]. Some methods are intensive and require a substantial budget and specialized expertise. Others (for example photo points[18]), are accessible with a small budget and minimal training.

The NFWF-funded protocols have been developed to further the state of the art of meadow restoration and to document the ecological benefits of projects. Elements go beyond what a land manager would require. Yet if incorporated into the funding stage of a project, these monitoring costs may be covered by the entity whose goals require the additional monitoring. If so, the landowner may receive both detailed reports of the value of restoration, and financial support for his or her existing monitoring needs during the project period.

Independent Data Collection

Third-party data collection is sometimes recommended, required by regulatory agencies, or additional technical expertise may be necessary. In addition, independent monitoring may be useful if contentious issues (e.g., water rights) are anticipated. For example, groundwater and streamflow monitoring in Perazzo Meadows (Little Truckee River Watershed) was performed by a contractor and the data are therefore acceptable to all parties as they negotiate a possible water rights infringement. In contrast, streamflow measurements collected by the Feather River CRM are controversial because some neighboring landowners view the Feather River CRM as an interested party and do not accept their records.

In some cases, a memorandum of understanding between stakeholders has successfully been used to avoid the added costs of independent monitoring. The agreement, entered into at the beginning of the project, confirms that the methods used are unbiased and transparent, and the resulting data will be trusted by all parties. One successful example of this kind of monitoring agreement is between the USFS and permittees on public grazing allotments. The USFS has agreed to accept specific monitoring data collected by the permittee to document forage use.[19]

Summary

Monitoring should be planned early in every restoration project to minimize costs, lay the groundwork for successful management, and avoid duplicated or wasted efforts. A key step on private lands is to review and incorporate current monitoring efforts. This is not only cost saving; existing monitoring has the potential to provide a valuable long-term perspective. The following checklist is a useful starting point for developing an effective and well-integrated monitoring plan. Monitoring specifics can then be built out from standard methods referenced in the text (pages 4 and 5).

Information Needed to Develop a Monitoring Plan:

☐ **State project goals.**
(E.g., raise the water table, remove invasive or non-meadow species, reduce bank erosion)

☐ **State monitoring goals and/or requirements.**
(E.g., management and maintenance, demonstrate the project's value, document impacts on downstream water rights)

☐ **Identify existing and ongoing data collected.**
(E.g., annual pace transects, photographs)

Who will use the data?

☐ Landowner/ manager ☐ Funders ☐ Neighbors ☐ Regulatory agency ☐ Legal

Need for independent monitoring increases →

☐ **Who will complete the analysis and reports? How often and for how long? In what format?**

☐ **Who will keep the data and report archives? What information will be made publicly available?**

☐ **Identify monitoring methods (include citations) for short-term, intensive and long-term monitoring.**

Acknowledgements

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Notes and References

1. A note on terms: Our use of "restoration" follows Webster's Dictionary definition: "Restoration to an unimpaired or improved condition". The goal of restoration is to rehabilitate ecosystem functions that are believed to occur naturally. For example restoring the habitat provided by a meadow or restoring a naturally-shallow water table.
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3. Stillwater Sciences *Status and Trends of Sierra Meadows in the Headwatersof the CABY Region.* (Prepared for the Natural Heritage Institute, Nevada City, California.: 2008).at <http://www.stillwatersci.com/resources/2008sierrameadowscaby.pdf>
4. *The Forest Steward: The myriad benefits of mountain meadows*. (2011).at <http://www.ceres.ca.gov/foreststeward/pdf/news-fall2011.pdf>
5. *Business Plan: Sierra Nevada Meadow Restoration*. (National Fish and Wildlife Foundation: 2010).at <http://www.nfwf.org/Content/ContentFolders/NationalFishandWildlifeFoundation/GrantPrograms/Keystones/WildlifeandHabitat/Sierra_Meadow_Restoration_business_plan.pdf>
6. *Mountain meadow enhancements: Perspectives from Sierra Nevada stakeholders. 2011 Focus Group Findings*. (Environmental Defense Fund. Sacramento, CA: 2011).
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8. Danielsen, F. *et al.* A simple system for monitoring biodiversity in protected areas of a developing country. *Biodiversity and Conservation* **9**, 1671–1705 (2000).
9. Small, S.L. & Scrafford M. *Restoration plan template for Sierra Nevada meadows in private ownership. Version 1.0.* 34 (Environmental Defense Fund. Sacramento, CA.:).at <www.edf.org>
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12. Kondolf, G.M. Five elements for effective evaluation of stream restoration. *Restoration Ecology* **3**, 133–136 (1995).
13. Plumas Corporation *Quality Assurance Protection Plan*. (2001).at <http://www.feather-river-crm.org/images/pdfs/qa_plan.pdf>
14. Loffland, H.L., Siegel, R.B. & Wilkerson, R.L. *Avian Monitoring Protocol for Sierra Nevada Meadows: A tool for assessing the effects of meadow restoration on birds Ver. 1.0*. (The Institute for Bird Populations, Point Reyes Station, CA:).

15. Purdy, S. *Monitoring Approaches for Fisheries and Meadow Restorations in the Sierra Nevada of California*. 26 (UC Davis Center for Watershed Science: 2011).
16. American Rivers *Monitoring hydrologic and water quality responses to Meadow restoration in the Sierra Nevada.* (2011).at <http://americanrivers.org/meadowpubs>
17. Stillwater Sciences *Monitoring meadow vegetation response to restoration in the Sierra Nevada.* (Prepared for American Rivers, Nevada City, California.: 2011).at <http://americanrivers.org/meadowpubs>
18. Photo-point monitoring is a simple method which will likely be a component of every monitoring plan. To insure identical photographs, take these three steps: 1) take the photograph from the same place and at a constant height every time –for example, in front of a fence corner at your eye level. 2) center the photograph at the same landmark each time 3) use the same zoom, or alternatively, crop the photographs identically. As long as the 1) Location 2) Photograph Center and 3) Field of view are the same, the photographs will be easily comparable.
19. *Servicewide Memorandum of Understanding NO. 09-SU-11132421-171 between Pubic Lands Council and United States Department of Agriculture Forest Service*. (2009).at <http://www.publiclandscouncil.org/CMDocs/PublicLandsCouncil/MOUs/PLC-FS%20Signed%20MOU%20--%20final.pdf>