electroshocking data). Despite the lack of comparable pre- and post- project sampling techniques, it appears that the fishery continues to improve in the project area.

Map 3. Red Clover McReynolds Volunteer Fishing Locations

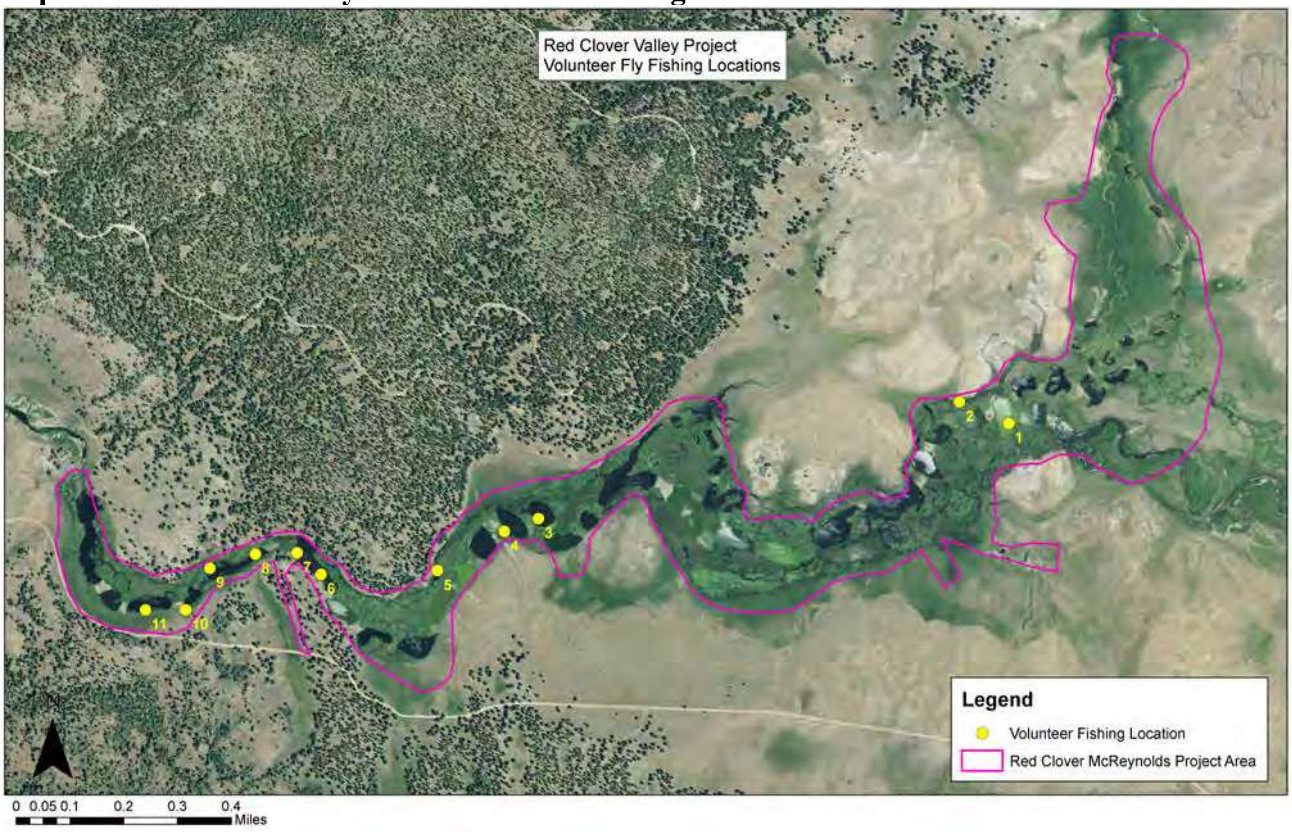


Table 3. Red Clover Creek post-project volunteer fishing days.

June 2008				June 2010			
Location**	Species (Trout)	Size (In)	Visual Only	Location**	Species (Trout)	Size (In)	Visual Only
1	Rainbow	13	✓	3	Rainbow	12	✓
1	Rainbow	15		4	Rainbow	15	
1	Rainbow	16					
2	Rainbow	12	✓	4	Rainbow	12	
6	Rainbow	13	✓	5	Rainbow	16	
6	Brown	16		7	Rainbow	5	✓
6	Rainbow	13		8	Rainbow	8	
				8	Rainbow	11	
				8	Rainbow	12	
				9	Rainbow	12	
				10	Rainbow	16	
				10	Rainbow	13	
				10	Rainbow	13	
				11	Rainbow	12	
				11	Rainbow	14	✓
				11	Rainbow	12	
				11	Rainbow	18	

**Fishing locations are number 1-11 starting at the top of the project

Photo 1. Volunteer Fishing Day. Craig Martynn and Trout- photo by G. Martynn, 2008

What is the project's effects on wildlife?

In 2010, avian point count monitoring was initiated by PRBO Conservation Science, Plumas National Forest, and Plumas Audubon. Results were analyzed by comparing all points in unrestored sections of Red Clover Valley (pre-project Red Clover Poco and unrestored Red Clover Confluence and Red Clover Dotta project areas) to post-project Red Clover McReynolds and 1985 Red Clover Demonstration project areas. Figure 3 compares indices of species richness, total bird abundance, and the richness and abundance of riparian focal species. The riparian focal species included in this analysis are Red-breasted Sapsucker, Willow Flycatcher, Warbling Vireo, Swainson's Thrush, Black-headed Grosbeak, Yellow Warbler, MacGillivray's Warbler, Wilson's Warbler, Song Sparrow, and Lincoln's Sparrow. Species richness is the total number of species detected at the point that are adequately sampled using the point count method Total bird abundance is the sum of total individuals detected per visit.

Figure 3 shows that the Red Clover/McReynolds project area is significantly higher than the unrestored sites for all of the metrics. The 1985 Red Clover Demonstration project shows increase in all the metric from the unrestored sites, but due to the small sample size these differences are not statistically significant. This point count analysis was restricted to a subset of the species encountered. Species that do not breed in the study area, as well as those species that are not adequately sampled using the point count method (e.g. waterfowl, raptors, and wading birds), were not included in the analysis.

In 2007-2009 CA Dept. of Water Resources conducted avian monitoring in the Red Clover McReynolds project area using line transect surveys. Data from these efforts are available in the 2007-2009 monitoring reports. Both methods of survey show increased riparian focal species, however point counts do not take into account waterbirds.

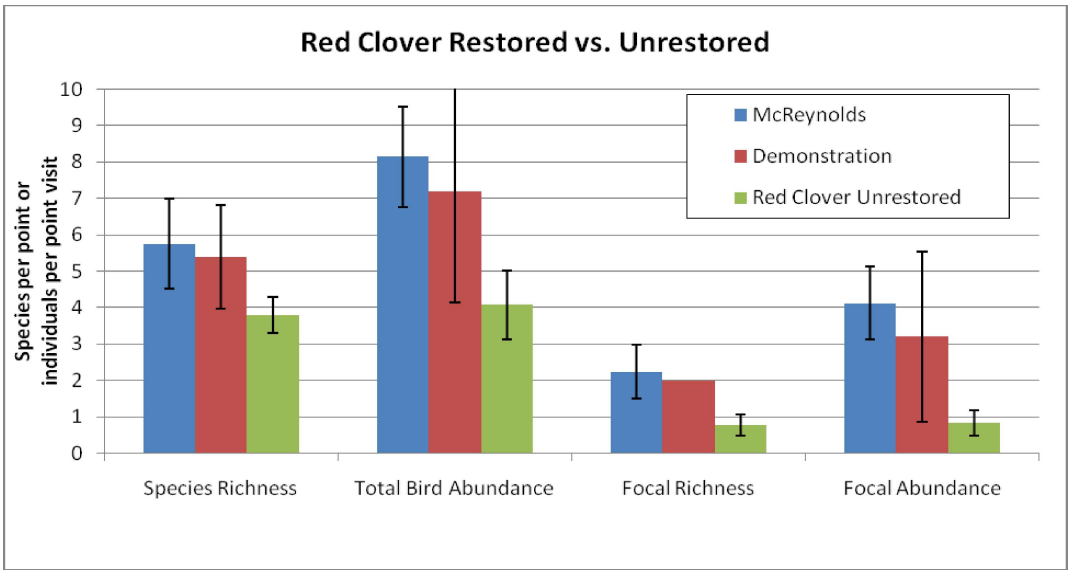


Figure 3. Red Clover McReynolds Point Count Summary: Point Richness and Abundance

Photo 2 and 3. Photo point monitoring of Red Clover Creek at cross-section 19 pre-project June 2006 and post-project June 2008.

Erosion/Sedimentation

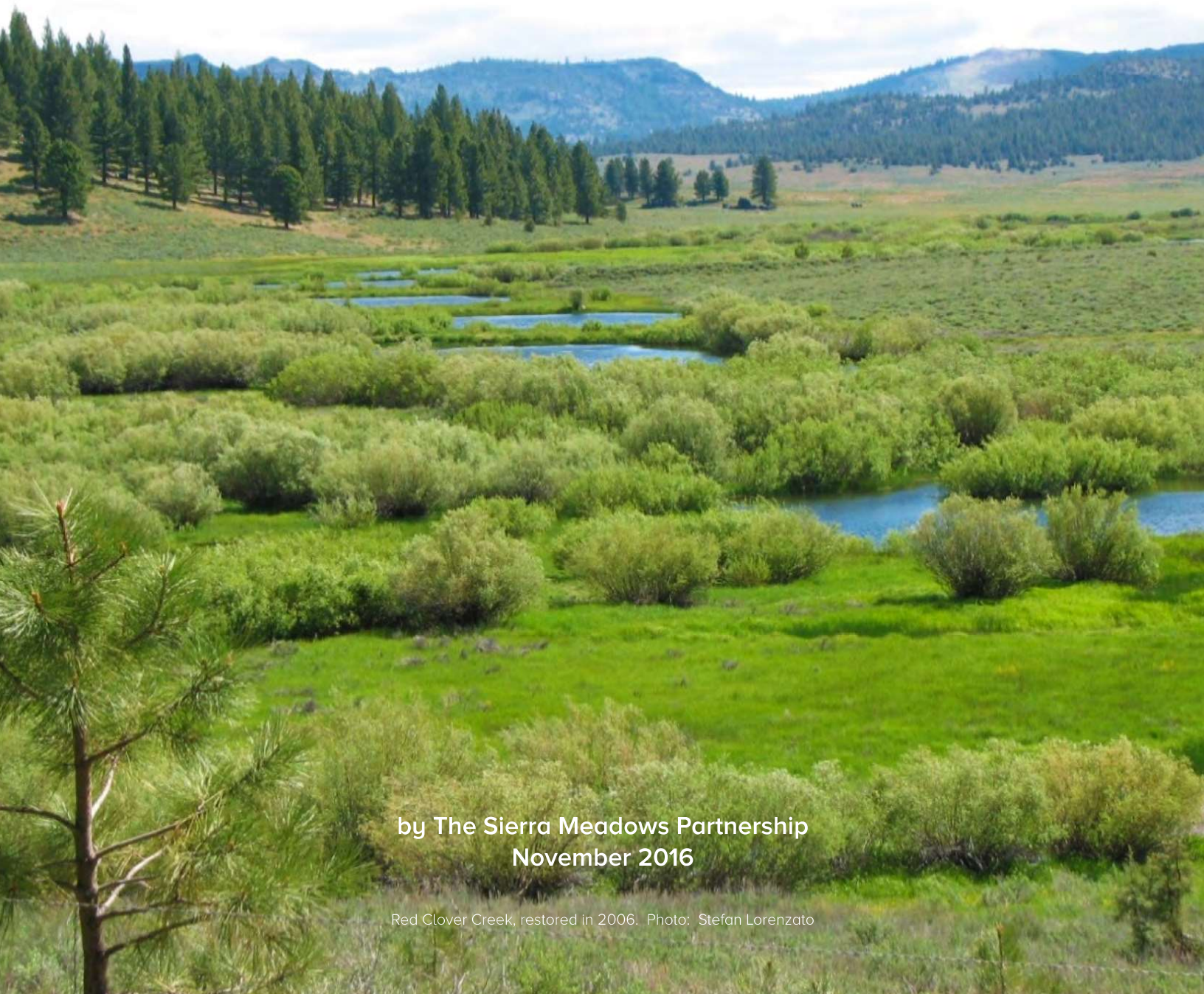
The Red Clover/McReynolds Creek Restoration project has re-established the depositional function in the project area with net erosion expected to be near zero. Restoring this function affects erosion rates in two ways: 1) the source of sediment from gully walls is eliminated; 2) spreading high flows over the vegetated floodplain filters sediment delivered from upstream sources. This was demonstrated through turbidity samples taken during high water events in 2007 through 2010. Turbidity is an indicator of sediment transport levels; it does not take into account settleable solids or bedload. Turbidity is measured using an HF Scientific, Inc. DRT-15CE Turbidimeter.

Turbidity samples were taken at the top of the project area above the confluence with McReynolds Creek and just below the bottom of the project area. Samples are taken during most accessible storm events. Throughout 2007 to 2010, turbidity levels were higher entering the project than exiting the project during high flow events. The outflow turbidity is 50% less than the inflow turbidity for 15 sampling periods during the runoff seasons from 2007-2010 for the Red Clover McReynolds project area. Turbidity samples were collected during one accessible storm event in 2010 and show an 8% decrease in turbidity through the project area.

FULL REPORT

Sierra Meadows Strategy

An “all-hands, all-lands” approach to
increasing the pace, scale and efficacy of meadow restoration
and protection throughout the Greater Sierra Nevada.



by The Sierra Meadows Partnership
November 2016

Red Clover Creek, restored in 2006. Photo: Stefan Lorenzato

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Sierra Meadows Partnership Paper 1: PP 40

The Sierra
Meadows
Partnership

Collaborative meadow
restoration and protection.

Contents

Section I

Executive Summary

The Sierra Nevada Region is of great significance to the State of California because it occupies about 25% of California's total land area and is the source area for more than 60% of its developed water supply[1]. In addition, the region contains a rich diversity of ecosystems, supporting 50% of California's plant species and 60% of California's animal species[2,3].

Within the region, the Sierra Nevada's meadows are hotspots in terms of the importance of biodiversity[4,5,6]. Their ecosystems play a vital role in supporting wildlife and plant diversity, providing habitat for all life history stages of many fish and amphibian species, attenuating floods, storing, filtering, and releasing water, sequestering carbon, providing forage for livestock, and providing unique aesthetic and recreational value[7-14]. Healthy meadows add resiliency to the hydrologic and ecological processes that sustain California's headwaters.

The Importance of Meadows

Current estimates indicate that meadows cover approximately 191,000 acres within the Sierra Nevada. Although this area makes up a relatively small fraction of the greater Sierra Nevada region, meadows' unique hydrologic and ecological functions are recognized as being vital to watershed health and are valued for the ecosystem goods and services they provide[15].

However, approximately 50%, or roughly 90,000 acres of these meadows are known or expected to be degraded, resulting in the loss of important goods and services[16]. Stresses such as climate change and development continue to threaten ecologically important meadows. Given the iconic nature of Sierra meadows and the critical importance of the Sierra Nevada to California water supply, many state and federal agencies have agreed on the urgent need to increase the pace, scale and efficacy of meadow restoration and protection. The Sierra Meadows Partnership was formed, in part, to address this critical need.

The Sierra Meadows Partnership

The Sierra Meadows Partnership (Partnership) was formed to foster expansion of and more effective collaboration among partners currently engaged in meadow conservation to increase the pace, scale and efficacy of meadow restoration and protection in the Sierra for the benefit of people and ecosystems.

The shared vision of the Sierra Meadows Partnership is a greater Sierra Nevada region with healthy and resilient meadows that provide sustained goods and services to benefit flora, fauna and people.

The composition of the Partnership thus far has included stakeholders from non-profit and for-profit natural resource organizations, public natural resource agencies, academia, and funding institutions. The Partnership remains open to new parties, including implementing groups, private land owners, industry, funding interests, and individuals interested in improving the ecological health of mountain meadows.

At Calistoga Meadows Workshop II, members of the Partnership collaborate to develop structure and content of the Strategy. Photo: M. Drew

A solid foundation of partnerships among private, state and federal land managers, advocacy groups, restoration practitioners, land trusts, and research institutions exists, and these partnerships have been critical to realizing the restoration of approximately 10,000 acres of montane meadow to date[17].

The Sierra Meadows Strategy

This Sierra Meadows Strategy (Strategy) aligns with the:

- State Water Action Plan which calls for 10,000 acres of meadows to be restored[18];
- Sierra Nevada Conservancy's Watershed Improvement Program Regional Strategy that supports meadow restoration since meadow health is critical to stream condition and downstream water quality[19];
- National Fish and Wildlife Foundation Sierra Meadows Restoration Business Plan that calls for 20,000 acres of meadows restored[20]; and
- USDA Forest Service Region 5 Ecological Restoration Leadership Intent that calls for restoration of 50% of accessible degraded meadows in the next 15 -20 years[21].

"All-lands, all-hands"

In this document, the Partnership sets forth an "all-lands and all-hands" approach with an overarching goal of restoring and/or protecting 30,000 acres on all lands in the Sierra Nevada. It proposes to refine this acreage through adaptive management. This ambitious goal was based on increasing the pace, scale, and efficacy of meadow restoration over current effort levels.

The Partnership chose an acreage higher than stated in the State Water Action Plan and the National Fish and Wildlife Foundation Sierra Meadows Restoration Business Plan in acknowledgement of the urgent need for increased meadow function. Attainment of this goal—which was felt to be challenging but feasible—would result in the restoration or conservation of one third of the currently degraded 90,000 acres of meadows in the Sierra Nevada, the Modoc Plateau, the Southern Cascades and Warner Mountains, which together comprise the "Strategy Area".

The Partnership also chose a longer, fifteen year timeframe for this work because it believes that the target of restoring 10,000 acres in five years—as set forth in the State Water Action Plan—would only partly meet the overall need for restoration. The Partnership is confident that the restoration or conservation of 30,000 acres can be achieved within 15 years (circa 2030) and, moreover, that this critical work to improve the resilience of the Sierra Nevada and southern Cascades in the face of a changing climate **must** be accomplished within the fifteen year timeframe.

Guidance for Practitioners

The intent of this Strategy is to help direct the Partnership and others involved in meadow protection, restoration and conservation to increase the pace, scale, efficacy, and benefits of meadow restoration and protection.

In order to achieve this ambitious plan of action, we have developed three guiding approaches that highlight desired conditions for restored meadows, and eight specific goals associated with those conditions. These form the basic tenets for practitioners to follow and which will also guide monitoring of the work.

Approach 1

Restore and/or protect meadows to achieve desired conditions.

GOALS

1. Desired conditions supporting the hydrologic and ecologic functionality of 30,000 acres of meadows are restored and protected.
2. Meadow soil resources that are most vulnerable to rapid and unrecoverable loss (e.g. peat soils found in fens and wet meadows) are protected.
3. Habitat conditions and ecosystem function for 30,000 acres are restored and/or protected to support populations of meadow dependent species representing multiple phylogenetic classes and that are currently rare, threatened or endangered.
4. Stressors affecting the health and integrity of meadows are mitigated.

Approach 2

Enhance regulatory and institutional funding capacity and coordination.

GOALS

5. Effective, efficient and coordinated regulatory requirements are established for restoring and protecting meadows.
6. Sufficient and broad-based funding sources are secured necessary for meadow restoration, protection and on-going monitoring and adaptive management.

Approach 3

Increase and diversify institutional and partnership capacity for meadow restoration and/or protection in the greater Sierra.

GOALS

7. Active participation of all-lands in meadow projects and increased capacity of landowners to fully participate in the designs, and implementation is increased.
8. State and regional water planning efforts reflect the key role meadow restoration can play in improving State water security.

Calistoga Meadows Workshop I participants, February, 2014. Photo: R. Kattelmann

Osa Meadow in the Sequoia National Forest—recently restored—is a long term study meadow. This picture shows the gullying that has degraded the meadow. Photo: M. Drew

This Strategy offers an opportunity to articulate and pursue common goals systematically and at scales ranging from meadow-specific to Sierra-wide. It is a living document developed by individuals involved in the Partnership and is intended to guide Sierra meadow protection, management, and restoration by describing desired conditions and by providing a roadmap towards these conditions. This roadmap includes a set of Approaches and associated actions, metrics, and outcomes, as well as a decision support framework. The geographic scope for the Strategy includes all of the Sierra Nevada, the Modoc Plateau, and the Southern Cascades of California. The Strategy has a greater footprint for downstream water users. The value of water flowing from federal, state and private lands has become increasingly important, especially where severe drought continues. More than half the state water supply flows from the Sierra Nevada and Southern Cascades.

This Strategy provides the guidance necessary to achieve an ambitious and effective course of action to increase rates of meadow conservation.

The content presented in the Strategy aims to identify a purpose, set of goals and a series of actions aimed at increasing the pace, scale and efficacy of meadow restoration. The three approaches, as described, are intended to address not only how to make positive change with respect to “on-the-ground” restoration, but also institutional change in terms of permitting, planning, funding and stakeholder involvement and partnership capacity. To achieve the target of restoring and protecting 30,000 acres in a 15 year period will require an all-hands, all-lands approach involving people, institutional change, improved coordination as well as perseverance. The Strategy is intentionally ambitious. However, a pathway does exist to increase the pace, scale and efficacy of meadow restoration throughout the broader Sierra Nevada.

By reaching consensus on a path forward, a diverse group of agencies, scientists, and stakeholders can more effectively leverage necessary resources and the strategic changes required to increase the pace, scale and efficacy of meadow restoration and protection in the greater Sierra Nevada Region.

We invite all stakeholders to read the Strategy and join the Sierra Meadows Partnership in restoring and conserving meadows and their watersheds to provide and to restore a healthier and more resilient landscape within the next 15 years.

Section II

Overview

Purpose

The Sierra Meadows Strategy (Strategy) is a living document intended to guide Sierra meadow restoration, protection, and conservation (henceforth conservation), by describing desired meadow conditions and how the development and application of measurable objectives to achieve those conditions can facilitate rapid, integrated, and cost effective recovery of meadows and the services they provide. The shared vision of the Sierra Meadows Partnership is a greater Sierra Nevada region with healthy and resilient meadows that provide sustained goods and services to benefit flora, fauna and people. This document is intended as a decision support framework which supports and complements strategies developed by Federal and state agencies and other institutions involved in the broader meadow conservation effort (i.e. the State Water Action Plan; United States Forest Service Region 5 Restoration Strategy; and National Fish and Wildlife Foundation Sierra Nevada Business Plan).

Sierra Meadows Strategy Structure

This Meadows Strategy offers an opportunity to articulate and pursue common goals using a systematic, scientific approach that can integrate across the Strategy Area, landscape, watershed and meadow scales. The Strategy provides guidance relevant to identification of healthy meadows, pre-restoration, restoration and post-restoration considerations as well as approaches to addressing institutional, permitting, funding, capacity and partnership needs and includes specific guidance on:

- Development of spatial prioritization for the Strategy Area to achieve landscape-scale desired conditions and desired outcomes;
- Development of watershed (e.g., HUC 12) and meadow-scale desired conditions;
- Development of objectives that support desired conditions and outcomes;
- Development of restoration and protection actions and adaptive management;
- Improved institutional, permitting and funding conditions and capacity necessary to increase the pace, scale and efficacy of meadow restoration;
- Next steps necessary to fully implement the Sierra Meadows Strategy.

Sierra Meadows Defined

This Strategy offers a relatively inclusive definition of meadows developed from multiple sources[22-25]. In the simplest terms, meadows are defined by six hydrology, vegetation and soil characteristics. Meadows in the Sierra Nevada and Southern Cascades in California have these characteristics in common:

1. A meadow is an ecosystem type composed of one or more plant communities dominated by herbaceous species;
2. Meadows support plants that use surface water and/or shallow groundwater (generally at depths less than 1 yd.) during at least 2-4 weeks of the growing season;
3. Hydrologic sources include snowmelt, surface water from streams, and/or groundwater discharge near the land surface (generally at depths of less than 1 yd.);
4. Woody vegetation, like trees or shrubs, may occur and be dense but are not dominant;
5. Soils range from mineral soils to highly organic soils (peats);
6. Low stream gradients, if a stream channel is present, typically less than 2%.

The Partnership

The Sierra Meadows Partnership first began very informally with the implementation of the National Fish & Wildlife Foundation's Sierra Nevada Meadow Restoration Business Plan[20] and has subsequently grown, particularly with respect to engaging an array of partners involved in meadow restoration in a more coordinated manner.

In February, 2014, a Sierra meadows workshop was convened in Calistoga, California with the intent of further enhancing coordination and developing a vision for Sierra meadow restoration moving forward. An outcome of "Calistoga 1" was the recognized need and development of an initial framework for a proposed "meadow strategy." Since the initial Calistoga gathering, there has been a focused effort on the part of many stakeholders to complete a Sierra Meadows Strategy, including three workshops convened at U.C. Davis and a second Calistoga workshop convened in February 2016 where more than 20 different entities actively participated in discussions that largely centered on developing the Strategy. It was during the "Calistoga 2" workshop that involved stakeholders decided to recognize the stakeholders involved as the Sierra Meadows Partnership.

Today, the Partnership comprises entities engaged in meadow protection, management, restoration and applied research to establish a common vision and approach necessary to increase the pace scale and efficacy of meadow restoration and protection in the greater Sierra Nevada region for the benefit of people and ecosystems. Consensus from the partnership on a path forward is reflected in this Strategy. Leveraging necessary resources and the strategic changes required to increase the pace and scale of meadow restoration and protection in the greater Sierra Nevada region is a shared goal of all.

Figure 1. The Sierra Meadows Partnership meeting in Calistoga in February 2016 brought the need and direction for a comprehensive Meadow Strategy into focus.

The shared vision of the Sierra Meadows Partnership is a greater Sierra Nevada region with healthy and resilient meadows that provide sustained goods and services to benefit flora, fauna and people.

The Sierra Meadows Partnership is a collaboration among interested stakeholders and has had participation by representatives from non-profit and for-profit natural resource organizations (Plumas Corporation, California Trout, Trout Unlimited, Stillwater Sciences, Sierra Foothill Conservancy, Truckee River Watershed Council, American Rivers, The Nature Conservancy, Point Blue, Institute for Bird Populations, Occidental Arts and Ecology Center), public natural resource agencies (United States Forest Service [USFS], Pacific Southwest Research Station, National Park Service [NPS], United States Geological Survey [USGS]), Universities (University of California [UC] at Merced, Davis and Berkeley, University of Nevada Reno, California State University at Sacramento), and funding institutions (National Fish and Wildlife Foundation [NFWF], California Department of Fish and Wildlife [CDFW], and the State Water Resources Control Board [SWRCB]). At the time of writing, the Partnership is being broadened to include Resource Conservation Districts [RCDs], private and/or public funding entities, permitting agencies, and is open to new parties, including implementing groups and individuals interested in improving the ecological health of mountain meadows. The Partnership is open to all interested in supporting meadow restoration and management.

Geographic Scope

The geographic scope for the Sierra Meadows Strategy, referred to as the Strategy Area, includes all of the California portion of the Sierra Nevada, the Modoc Plateau, and the Southern Cascades along with the Sierra and Cascade foothills and the Warner Mountains (see Figure 2).

While recognizing that there are meadows in other regions of California, this region is prioritized because of:

1. its shared legacy of impacts from grazing, railroads, logging, fire suppression, invasive plant and wildlife species, roads and recreation,

2. its shared central role in California water infrastructure,

3. its broad geography and relevance to USFS revisions to current USFS Sierra Nevada Forest Management Plans, and

4. the convenience of being geographically aligned with USFS (Sierra Nevada Forest Plan Amendment, generally referred to as the “Sierra Nevada Framework”), the Sierra Nevada Conservancy’s Watershed Improvement Program and the National Fish and Wildlife Foundation Meadows Business Plan planning areas.

Figure 2.
The geographic scope, or Strategy Area, for the Sierra Meadows Strategy includes all of the Sierra Nevada, the Modoc Plateau, and the Southern Cascades, along with the Sierra and Cascade foothills and the Warner Mountains

Section III

Background

Importance of Meadows: Derived Goods and Services

The Sierra Nevada–Southern Cascade Region is of great significance to the State of California. Comprising 25% of California's total land area, the region is California's principal water source, playing a critical role in California's water supply and hydrological system (Sierra Nevada Conservancy 2014). More than 60 percent of California's developed water supply originates in the Sierra Nevada, serving end users throughout the State[2]. In addition, the region contains a rich diversity of ecosystems, supporting 50 percent of California's plant species and 60 percent of California's animal species[2,26,27]. The region also provides world class recreational opportunities enjoyed by millions around the world. Healthy meadows are important for local natural resource based economies supporting recreational, tourism, agricultural activities, among others[28,29].

Meadows cover less than 2% of the overall Sierra/Cascade landscape, but their unique hydrologic and ecological functions make meadows extraordinarily important. Fully functioning meadows add resiliency to the hydrologic and ecological processes that sustain California's headwaters, particularly during drought years which experts predict will be more common as climate warms[30,31,32]. Decreases in snowpack storage are expected to occur in the central Sierra Nevada particularly at mid-level elevations (2000 to 3000 ft. above MSL,33). Many meadows depend upon hydrologic inputs derived directly or indirectly from snowmelt[34] and bedrock stored groundwater[35] and could therefore, be vulnerable to effects of climate change[14]. However, the ability of meadows to store water from a variety of surface or subsurface sources makes them potential high elevation water storage alternatives to snowpack in the mountain landscape. In addition to water, healthy meadows can store roughly 1.5 to 2 times more soil carbon than degraded ones; however, higher carbon storage per unit area occurs in some meadows, such as fens, relative to others[36,37].

Healthy meadows can filter out sediment and pollutants, improving downstream water quality. Native meadow sedges have long and dense root and rhizome networks that are inherently resistant to erosion and that help maintain wet soils through much of the summer[38,39,40]. Healthy mountain meadows support these graminoid communities, while hydrologically altered meadows do not[41]. Channel banks occupied by sedge species erode much more slowly than channel banks supporting other vegetation[38]; thus these species help maintain the integrity and shape of the meadow channel and reduce bank erosion rates. With the smaller channel geometry common to functional meadows, high flows more frequently overtop the banks, allowing for percolation to subsurface storage, sediment and microbial filtering prior to the water re-entering the open channel[42,43]. By filtering out suspended sediment, healthy riparian vegetation builds stream banks and increase the seasonal quality of water released for downstream ecosystems and human uses[44,45,43].

Mountain meadows are key habitats for many Sierran animal species because they provide water and shade availability during the three to six month dry season, promote lower summer stream temperatures, higher plant productivity, increased insect prey availability, and special vegetation structures such as willow thickets[46]. Moreover, these ecologically rich oases often occur along riparian corridors, linking meadow to meadow and creating movement pathways across the broader landscape. The health and connectivity of these ecological corridors are critical for maintaining genetic diversity within species since these corridors facilitate interbreeding among populations and because they enable animals and plants to find new areas to inhabit. In the face of climate change and growing development pressures, these corridors can be lifelines for these species. The Sierra Nevada mountain range includes about two-thirds of the bird and mammal species and about half the reptiles and amphibians in the State of California[46,47]. During summer months, montane meadows are considered the single most important habitat in the Sierra Nevada for birds[46,47,48]. Meadows with streams that flow through them are also important habitat for native trout and other aquatic species[49], but are threatened by widespread warming[50].

The formation and maintenance of some mountain meadows may be due in part to actions of beaver (Castor canadensis)[51]. Beaver dams increase the vertical and lateral connectivity of rivers and streams, and associated floodplains that include mountain meadows. By raising the water table around dams, beaver increase the productivity of riparian and aquatic vegetation and help restore habitat for native species dependent upon functional meadows and associated channels. Research from the Rocky Mountains illustrates the role beaver have played over thousands of years in alluvial sediment storage and formation of meadow landscapes and the long-term carbon storage provided by beaver ponds[52,53,54]. More studies are needed to understand the role of beaver in providing habitat, storing carbon, and providing an alternative approach to meadow restoration.

Meadows occur along a hydrologic continuum ranging from
a) dry meadows, which remain moist or wet in the rooting zone only for several weeks following snowmelt, to
b) wet meadows, which stay saturated at or near the surface for 1-2 months but can drop to moderate soil moisture levels later in season, to
c) fens, which typically remain saturated at or near the surface throughout the entire growing season and support organic soil.

Fens are peat-accumulating wetlands with a steady hydrologic regime, consisting of groundwater flow combined with surface flows such as snowmelt and/or streamflow, that allows them to remain saturated for most if not all of the growing season. The groundwater input to fens gives rise to unusual chemistry, which results in a highly diverse and distinct flora dominated by mosses, grasses, and sedges, but which also includes shrubs and trees[55,24]. In contrast, bogs receive water primarily from precipitation. There are no bogs in California due to its semi-arid climate. These properties define existing meadows.

An altered meadow is one that once supported meadow vegetation as stated above but has been altered usually hydrologically or by other types of disturbance, so that the ecosystem no longer shares the six meadow characteristics listed above. While some of these alterations can be part of natural cycles (e.g. climate); most were induced by legacy land use. In this document, meadow degradation is defined as a loss of some or all in meadow forming and stabilizing processes that leads to reduced hydrologic and ecologic functionality of a meadow and hinders recovery.

Extent and Current Status

The most recent estimate is that approximately 191,000 acres of meadow are distributed across nearly 17,000 meadows in the Sierra Nevada (Figure 2;[14,16]). Approximately 40-60% (77,000 – 115,000 acres) has been degraded and are in need of restoration[56-59]. Meadows are found on private and public land, including land owned by individuals, corporations, conservation organizations, and state and federal agencies. Approximately 28% of meadow acreage within the Strategy Area is under private ownership (see Table 1;[14,16]). With 46% of the meadow acreage on Forest Service lands, the USFS is by far the largest land manager of Sierra meadows, including the majority of small meadows and fens. The National Park Service is the third largest meadow land manager, with 22% of the meadow acreage in the Strategy Area (Table 1). Most of the remaining 4% is owned by local public entities and other Federal lands (Table 1). Thus, the responsibility for managing meadows is spread across various agencies and owners.

Osa Meadow with incised channel, one of the most common characteristics of a degraded meadow. Photo: L. Keszey

Jepson Regions	Total area (acres)	Number of meadows	Cumulative percent of total	Percent of area
High Sierra	147,028	15,227	77%	77%
High Cascade	21,181	1,024	88%	11%
Modoc Plateau	11,437	445	94%	6%
Eastern Sierra	8,571	216	99%	4%
Sierra Foothills	2,755	76	100%	1%
Cascade Foothills	44	9	100%	0%
Ownership				
USFS	87,695	8,358	46%	46%
Private	53,935	2,123	74%	28%
National Parks and Monuments	41,738	6,380	96%	22%
Local Public Ownership	4,436	38	98%	2%
Other Federal Lands	2,516	32	100%	1%
State Ownership	696	66	100%	0%
Grand Total	**191,017**	**16,997**		**100%**

Legacy Impacts and Current On-going Threats to Meadows

In addition to conversion of meadows to other land uses during the last century (e.g., inundation by reservoirs, drainage for agriculture or development, roads etc.) 60 widespread disturbances to meadows have occurred throughout the Strategy Area. Disturbances, whether from human activities or natural causes such as fire, debris slide, or an extreme flood, can cause a cascade of events that can affect meadow function and the benefits meadows provide[61].

One of the most common characteristics of a degraded meadow is channel incision and/or gully creation. Incision can be caused by a number of different land use practices working alone or in combination. The most common sources of incision are channelization, construction of roads or railroads, ditching, overgrazing, and logging. Heavy livestock grazing contributed to the degradation of meadows during the late 19th century[62,63,55,15]. Changes to meadows attributed to legacy overgrazing include gullying, desiccation, conifer encroachment, and changes in plant species composition, structure, and diversity[64,55,8,63,65,15]. Today conditions and grazing-use patterns are improving; however, in some cases impacts from grazing are still occurring[66]. Grazing management permits cattle removal or reduction in seasonal use or numbers. However, once damage has occurred in a meadow it can be exacerbated by natural climatic variation, affecting meadow hydrology[67,68,69,34].

When stream channels in meadows become incised, or when a gully is created in a meadow with no pre-existing channel, the immediate effect is that water once stored in the rooting zone soil (primarily upper 1 yd.) drains down to the incised channel, lowering the water table and releasing subsurface groundwater from storage through the eroded channel or gully. This lowered water table has ramifications throughout the meadow, such as more rapid runoff and decreased meadow water storage capacity[70,71]. During the growing season, a lower water table effectively changes the hydrologic regime experienced by the vegetation; when these conditions persist and no longer support the existing plant communities, other species tolerant of drier conditions will thrive and eventually could dominate the affected areas. In highly organic “peat” soils, a lowered water results in microbial oxidation of the organic matter, which could eventually lead to land-surface subsidence[72].

Deeply incised channels and associated drawdown of groundwater can result in a destabilizing cascade of events: erosion channelizes flow and concentrates the erosive energy of floodwaters; down-cutting accelerates and, eventually the meadow surface, once a floodplain and recharge area during high flows, becomes a terrace; the terrace is cut off from the rewetting effect of seasonal floods; wet meadow vegetation is replaced by other drier vegetation types, with roots that are incapable of stabilizing streambanks; bank erosion is exacerbated, and the channel widens. Likewise tributary channels and swales incise to match the new, lower elevation of the main channel, and the result is a network of erosion gullies that drain the meadow. Such positive feedback among hydrologic, fluvial geomorphic and vegetative responses can exacerbate what may begin as a small perturbation, thereby hindering or preventing recovery without active restoration[61]. Thus, in many areas, meadows have been protected from grazing and other impacts for thirty years, but have still not recovered.

Long-lasting effects of soil compaction can also result in degraded meadow conditions, even where groundwater table elevations remain high[73-78]. Such effects include increased soil bulk density, reduced infiltration and water holding capacity and reduced root density. Soil compaction combined with selective grazing, can affect plant species composition by increasing the cover of grazing resilient species[73,63,79].

A changing climate and altered fire regime are also affecting meadow conditions in the Sierra Nevada. Fire suppression and an altered fire regime have resulted in both conifer encroachment[80,63] and hydrologic and sediment impacts associated with stand replacing fires in meadow contributing areas (e.g., scouring peak flows and large sediment deposits in the downstream meadow;[81,61]). Climate change is affecting the spatial and temporal distribution of snow vs. water in the Strategy Area[30]. Some parts of the Strategy Area are expected to have more reduced snowpack than others, and many areas are expected to see increased frequency of extreme events, including drought, rain on snow, and large peak flows[33,82]. Forest fires in contributing areas can combine with these shifts in weather and hydrologic patterns to generate very high peak flows and/or sediment deposits into the meadow channel and/or floodplain[14]. Healthy wet meadows, including fens, under saturated soil conditions, usually due to stable groundwater flows. These conditions are highly conducive to carbon accumulation over long time periods and the presence of unusual flora and fauna. The benefits from these meadows are particularly vulnerable to climate change. Fluctuations in snow and rain influence water availability and thus the saturated conditions essential for existence of these meadows and the benefits they provide[83].

Restoration, Protection, and Conservation Defined

The term 'restoration' refers to implementation of one or more actions to improve meadow conditions or the discontinuation of activities that stress meadow conditions. These changes are directed at the processes and/or structures in the watershed or within the meadow itself that support meadow function[62]. Such actions or types of change may include:

1. actions at the watershed scale to improve and manage watershed and soil conditions (fuels and fire regime; roads and trails; connectivity of habitat; or grazing, development; or other land use practices to the extent they affect riparian vegetation or sediment and water flows to and within meadows) and
2. actions at the meadow scale to address, improve, and manage hydrologic and geomorphic process and associated structure (channel condition, channel floodplain interactions, bank condition, etc.), vegetation structure and condition, wildlife habitat and species population condition and or the suite of services (range forage, recreation, etc.) meadow systems support.

In this document, the term 'restoration' is used to refer not only to actions intended to 'return' the meadow to the un-disturbed pre-EuroAmerican influence conditions (in itself a challenging target to identify), but also to actions that enhance existing processes and structures in the meadow to move the meadow closer to what has been identified as the 'desired conditions'. Desired conditions may or may not reflect best estimates of a particular meadow's condition under pre-EuroAmerican conditions; but could rather reflect what is considered to be the best possible functional state given the current and projected future trajectory or key parameters.

Sierra meadow protection and management are wrapped up together. The health of the watershed influences the health of the meadow or meadow complexes in the watershed. While watersheds in good condition may be functioning well, they need to be evaluated for future changes as warming or extended drought occur. Prioritization based on biodiversity of Species of Conservation Concern may also be used to drive protection and preservation. The protection of a meadow or a fen may entail taking steps to prevent erosion within the meadow, taking steps to protect and manage the watershed (upper watershed) for resilience to fire and future hydrologic changes. It may involve active management or allowing natural processes to occur. Sierra meadow protection, management, and restoration is referred to as "conservation" in this document. Restoring and maintaining healthy meadows that provide multiple benefits requires long term engagement and a perspective that sees meadow functions at site to landscape scales. Meadow conservation over the long-term requires incorporating the anticipated trajectory of a meadow and its supporting landscape, where the trajectory includes future pressures from climate change, human use, invasive species, and land use change. Conservation requires long-term engagement through monitoring before and after initial actions, and adaptive management in response to monitoring observations and changing conditions. Ideally, long-term funding to support monitoring and adaptive management is built into all restoration project funding packages, as is adequate funding to monitor and adaptively manage effects of restoration at watershed and landscape scales.

For more information on restoration in meadows, examples of different types of restoration actions that have been used at the time this strategy was developed, and lists of information sources on restoration actions, see Stillwater 2012 and Norman 2015, and the U.C. Davis Meadow Clearinghouse (http://meadows.ucdavis.edu/projects).

Upper Sardine Meadow. Photo: H. Drew

Guiding Principles

The Sierra Meadows Partnership participants recognize a number of important principles that will help guide successful implementation of this Strategy. These are broadly described in this section.

Successfully increasing the pace, scale, and efficacy of meadow conservation will require a holistic approach that addresses:

1. Natural, biophysical and social sciences,
2. Policy/permitting,
3. Funding/investment,
4. Reaching across land boundaries,
5. Capacity building, and
6. Political support.

While we have emphasized the biophysical and natural roles played by meadows, we recognize the importance of these iconic places to human socioeconomic as well as human-ecological interactions. The broad and diverse Sierra Meadows Partnership can assist in developing capacity, working with regulators and funders, and build upon the convergence of support across the State.

In developing plans to implement meadow conservation at broad scales, it is best to use a scientifically based and structured approach to move from identifying desired conditions to achieving outcomes. Where meadows and their watersheds are functioning well, they can be identified as areas for protection. This protection may mean active management of activities within the watershed or reliance on natural processes to maintain the meadows. Specifically, desired conditions can be clearly articulated through specific, measurable, achievable, relevant, and time bound (SMART) objectives and associated metrics. Actions can be designed to achieve objectives (e.g. provide flow access to 50 - 100 percent of old floodplain), and outcomes (e.g. improved meadow condition, recovered plant community.) These metrics can be evaluated against desired conditions and adaptively managed based on the extent to which they achieve outcomes. In all instances, participants should strive to use and contribute to the best available scientific information (BASI). At each step in project development and implementation, multiple scales should be considered such that strategies, objectives, actions and measurements of outcomes can be understood at the scale of the individual meadow, the watershed (~HUC12), province/mini-region, and the Strategy Area. Moreover, ecosystem service production is an effective means of indicating meadow function where the linkage between function and service is well understood (e.g., increased groundwater storage or increased downstream water quality). This is based upon the recognition that ecosystem services are provided by functioning ecosystems.

Conservation is undertaken through a series of phases:

1. Pre-restoration site assessment,
2. Assessment of sources of stress, limiting factors and constraints on natural vs. assisted recovery,
3. Development of measurable objectives,
4. Planning, design and permitting,
5. On-the-ground restoration,
6. Post-restoration monitoring, and
7. Adaptive management over the short and long term.

These conservation actions should be designed to allow natural processes to develop and maintain dynamic meadow ecosystems, rather than focus on building or maintaining a static system (e.g., use remnant channels where possible rather than constructing or armoring channels that do not move; allow for beaver activities to effect channel migration and local ponding). Diverse restoration and/or enhancement methods can be applied, as tailored to site-specific conditions, and new ideas and methods should be encouraged and systematically monitored to compare and optimize for the most effective methods for the range of conditions, site histories, geographic locations, and institutional capacities. We suggest that restoration be implemented using multiple tools and using adaptive management of activities in watersheds across the Strategy Area to include both private and public lands.

Once a meadow has been restored, it will need to be adaptively managed along with other functioning meadows to ensure that the benefits to wildlife, plants, recreation, grazing and downstream water users are provided over the long term. In addition, practitioners should recognize and adapt to changing conditions and their effects on meadow processes (e.g. climate change effects on hydrologic regime). In this way, meadow conservation should provide for resilience and adaptability to climate change.

Section IV

Desired Conditions and Associated Goals

The desired conditions and associated goals described in this section apply to the Strategy Area as a whole and are intended to (1) guide and track the overall success of the Strategy and (2) guide development of finer-scale desired conditions, objectives, actions, and outcomes. The desired conditions describe conditions we would like to have achieved within fifteen years, both ecologically and for human use and management; while the goals provide a set of quantitative targets we need to meet in order to build this future together.

Desired Conditions

The desired conditions are broadly defined outcomes for the Strategy Area. These can be further refined and specified for watershed and project scale planning. We used desired conditions drafted by Region 5 of the Forest Service as a starting point (basis for desired condition found in USDA Forest Service 2014, and draft plans at http://tinyurl.com/r5earlyadopters). The Meadows Partnership members refined and elaborated upon the draft Forest Service text and ultimately agreed upon the Desired Conditions described below:

Meadows are diverse and complex.

- Meadows often include a mosaic of habitats and successional plant communities that support native plant and animal populations. Meadow species composition is predominantly native, where graminoid species are well represented and vigorous, and regeneration occurs naturally. Ground cover is resilient, protecting against erosion. Species composition is diverse, recognizing that species composition and diversity are dependent on both hydrologic conditions and disturbance factors. Natural processes, including disturbances, and management activities are sufficient to maintain desired vegetation structure, species diversity, and nutrient cycling. Healthy stands of willow, alder, and aspen are present within and adjacent to meadows where they would naturally occur. Meadows with perennial streams contain a diversity of age classes of hardwood shrubs along the stream bank, where the potential exists.

- A diversity of healthy meadow types exists, including types that are dependent on water inputs to create wet rooting conditions from surface, subsurface, or groundwater, throughout the growing season, through mid-summer, or only in the early spring[25]. These types occur on different geomorphic surfaces, such as alluvial fans, terraces and floodplains, local depressions, and lake edges, and include meadows that act as ground water recharge areas and as surface water source areas. The range of meadow types are well distributed according to their potential in the Strategy Area and support diverse soils and plant community types.

- Meadows support diverse native plant, terrestrial and aquatic animal species, including aquatic species dependent upon cool and high quality water flows in downstream reaches.

Healthy watershed and meadow hydrology and geomorphology are intimately linked and well understood.

- Meadows are depositional features in the landscape with fine textured mineral or organic soils, where sediment and water from the contributing area are temporarily stored (for short periods to 1 to 10s to 100s and 1,000s of years) as these elements migrate downslope. Meadows typically exhibit a high degree of hydrologic connectivity, both laterally across the floodplain and vertically between surface and subsurface flows. Depending on their particular hydrology, meadows can provide important ecosystem services such as high quality water purification and groundwater recharge. Meadows are resilient and recover from natural and human disturbances. Meadows buffer the downstream effects of large fluctuations in sediment and water input from upslope areas, thereby ameliorating effects of increased climatic variability on downstream resources.

- The hydrologic, edaphic, and other needs of wet and headwater meadows, such as fens, are well understood and maintained to ensure that these unique meadow types and their dependent plant and wildlife species are supported, fully functional, and resilient to variations associated with climate change. Soil in these meadows can accumulate organic matter and are spongy and moist, generally as a result of a shallow water table which slows litter decomposition in relation to plant growth and litter production. Such soils have high water holding capacity and function to filter, store and release water over an extended period of time. Wet meadows with highly organic soils may continue to accumulate organic material in their soil for hundreds and thousands of years[83] and therefore be net long-term carbon sinks. The balance between organic matter accumulation in the soil and emission of wetland associated greenhouse gases (e.g., methane and nitrous oxide) into the atmosphere has been determined over multiple years and for a range of wet meadow types. Unusual water and soil chemistry in meadows supporting highly organic soils that receive important amounts of water from groundwater sources (e.g., fens) host unusual plant species and are protected to support landscape beta diversity[83,84].

- The role of beaver in creating dynamic meadow habitat for flora and fauna is well understood and non-lethal solutions to beaver management are in widespread use.

- The watersheds are resilient to climate changes including prolonged drought, changing patterns of precipitation, and warmer conditions. Insect outbreaks, increased risk of severe fire, severe erosion, and tree mortality are minimized through active management of watersheds.

Meadow Protection and Enjoyment

- Meadows are protected from development where important ecological resources are threatened.

- Meadows and streams support recreational uses of such as fishing, hunting, bird and butterfly watching and wildflower viewing.

- Natural resource management institutions and practitioners manage human actions and natural resources that affect meadows in a coordinated, pro-active way that supports and maintains fully functional watershed and meadow processes and physical conditions. Interactions among institutions, including implementation of regulations intended to protect natural resources, are coordinated, transparent, effective and efficient to protect and also support timely restoration and/or enhancement actions.

- Land owners and land managers across the Strategy Area are engaged in meadow management and restoration and have easy access to the most recent information and resources—including sources of financial support—and expertise in meadow management, restoration, and restoration effectiveness monitoring.

Sierra Meadows Strategy Goals

The goals are broadly defined for the Strategy Area. These can be further refined and specified for watershed and project scale planning. These eight goals are intended to guide development of finer scale SMART objectives that are described in Section V. An assumption underlying these goals is that the Strategy will lead to an increase in the pace, scale and efficacy of meadow restoration, management and protection.

In addition, these goals:

- Are intentionally broad and use correspondingly broad metrics which can be assessed at the landscape level and refined for a project. These goals will lend themselves to region wide assessments of the role and advancement of meadow restoration;

- Will be updated approximately every two years;

- Are not listed in order of importance;

- Are inter-related, so that achieving one will require achieving others;

- Address not just restoration, but also continued management and protection of meadows;

- Will require implementation of three Approaches (detailed in Section V):
    - On-the-ground restoration and conservation management to achieve and maintain desired conditions; and increase the pace of meadow restoration;
    - Enhancement of regulatory and institutional coordination; and
    - Increased capacity and partnership opportunities.

A solid foundation of partnerships among land managers, advocacy groups, restoration practitioners, land trusts, and research institutions exists, and these partnerships have been critical to realizing the restoration of approximately 10,000 acres of montane meadow to date[85]. This Strategy aligns with

- the State Water Action Plan[18],
- the Sierra Nevada Watershed Improvement Program Regional Strategy[19],
- the National Fish and Wildlife Foundation Sierra Meadows Restoration Business Plan[20]; and
- the USDA Forest Service Region 5 Ecological Restoration Leadership intent[85].

California's State Water Action Plan calls for 10,000 acres of meadows to be restored[18]. US Forest Service Region 5 Ecological Restoration Leadership Intent[86] calls for restoration of 50 percent of accessible degraded meadows in the next 15 to 20 years. The Watershed Improvement Program supports restoring and protecting the health of Sierra Forests and acknowledges that significant effort will be required to restore meadows, since their health is critical to stream condition as well as downstream water quality[19]. The NFWF Sierra Meadow Business Plan called for 20,000 acres of meadows restored prior to 2014[20].

To increase the pace and scale of meadow restoration in the Strategy Area, we chose an acreage target that is higher than that of the State Water Action Plan and the NFWF Sierra Meadow Restoration Business Plan, and less than that of the estimated 90,000 degraded meadow acres in the Strategy Area[14]. Thus, the Strategy sets forth an "all-lands and all-hands" approach with an overarching goal of restoring and/or protecting 30,000 acres on all lands in the Sierra Nevada and proposes to refine this acreage through further analysis over time. The overarching goal was based on increasing the pace, scale, and efficacy of meadow restoration. The Sierra Meadows Partnership chose an acreage higher than the State Water Action Plan and the NFWF Sierra Meadow Restoration Business Plan to support significant increases in pace, scale and efficacy over current effort levels, recognizing both that this target is challenging but feasible, and the urgent need to achieve increased meadow function. Achievement of this goal will result in the restoration or conservation of one third of the currently degraded 90,000 acres of meadows in the Sierra Nevada, the Modoc Plateau, the Southern Cascades and Warner Mountains, which comprise the "Strategy Area"[14]. The Partnership chose a fifteen year time window based on several factors. The target of restoration of 10,000 acres in five years set forth in the State Water Action would only partly meet the overall need for restoration. The Partnership believes that the goal of restoring approximately one third of the degraded meadows can be achieved within 15 years (circa 2030) and that this critical piece of improving the resilience of the Sierra Nevada and southern cascades to our changing climate must be accomplished within the 15-year timeframe.

This will be accomplished through a combination of protecting currently functioning but threatened meadows, and by enhancing and/or restoring degraded meadows. Those that currently or potentially provide critical hydrologic, edaphic, and/or biodiversity benefits should be prioritized.

The following goals are more specific to ecosystem function, vulnerability, species, climate and other stressors, regulatory and funding requirements, participation of all lands, and contribution to the overall water supply in California.

GOAL 1

Desired conditions supporting the hydrologic and ecologic functionality of 30,000 acres of meadows will be protected and restored (according to the conditions as described).

Emphasis to be landscape-scale, supporting downstream resources for humans and native species (e.g., supporting biological diversity through recovery and protection of native meadow and river-dependent aquatic, avian, plant and other wildlife species).

GOAL 2

Protect from threats those meadow soil resourcesthat are most vulnerable to rapid and unrecoverable loss (e.g., such as peat soils found in fens and wet meadows).

Threats include those ssociated with climate change, land use change, and/or human manipulation of upstream and downstream water resources. Protection means that soils and native vegetation are intact within the next fifteen years.

GOAL 3

Habitat conditions and ecosystem function for 30,000 acres are restored and/or protected to support populations of meadow dependent species representing multiple phylogenetic classes and that are currently rare, threatened or endangered.

This is designed to support the broader goal of those populations being substantially recovered within the next fifteen years, with the recognition that recovery for those populations may hinge on conditions beyond what can be achieved through meadow restoration. Meadow type, location and connectivity in the landscape is protected and restored to support recovery of native meadow dependent species and downstream rare aquatic species. Protecting and expanding upon existing habitat and targeting areas which serve as critical landscape links among existing populations will support large and genetically robust populations of meadow and stream dependent species throughout their potential range.

GOAL 4

Stressors affecting the health and integrity of meadows are mitigated.

The existing and future potential distribution of meadow resources (including hydrology, biodiversity and soil resources) and their overlap with current and future stressors (including climate, fire, land use change, water use infrastructure, grazing, and invasive species) is well articulated.

GOAL 5

Effective, efficient and coordinated regulatory requirements are established for restoring and protecting meadows within the next fifteen years.

Land management agencies (NPS, USFS, BLM, USFWS, CEDFW and State Parks) and Partnership parties provide training, resources and collaboration to support regulatory compliance under NEPA and CEQA to facilitate actions under the “all-hands-all-lands” approach. The necessary resources for regulatory compliance include sufficient budget for in-house labor, permit costs, and expertise required to perform surveys and assess findings. Within the next fifteen years, agreements are put in place among land management and regulatory agencies that ensure that the regulatory requirements for protecting and restoring meadows are met in an effective, efficient and coordinated manner.

GOAL 6

Sufficient and broad-based funding sources are secured necessary for meadow restoration, protection and on-going monitoring and adaptive management.

GOAL 7

Active participation of all lands in meadow projects and increased capacity of landowners to fully participate in the designs, and implementation is increased.

GOAL 8

State and regional water planning efforts reflect the key role meadow restoration can play in improving State water security.

Existing and future versions of the State Water Action Plan and Integrated Regional Water Management Plans) acknowledge the Sierra Nevada and it associated ecosystems as an important element of California’s water infrastructure and by extension the key role meadows could play in improving California water security.

Section V

Guiding Approaches

The Sierra Meadows Partnership developed three overarching approaches to achieve desired conditions and associated goals (Section IV). The three approaches focus on (1) restoration of meadows to desired conditions; (2) enhancing regulatory and institutional funding capacity and coordination; and (3) increasing and diversifying institutional and partnership capacity. These pproaches are intended to be implemented simultaneously and will need to be in order to achieve the stated goals of the Sierra Meadows Strategy. These approaches are also meant to complement already existing efforts to advance meadow restoration and management within the Sierra Meadows Strategy Area. It is acknowledged that in some areas, actions identified in one or more of the approaches are already being implemented.

Approach 1

Restore and/or protect meadows to achieve desired conditions.

Focus on implementing the 8 steps of a successful meadow restoration project (See Figure 3 on the next page): pre-restoration monitoring; development of restoration needs to bring meadows to desired conditions; development of measurable objectives; design based on objectives and needs; compliance and permitting; on-the-ground restoration implementation; post-restoration monitoring; and adaptive management. Meadows in good functioning condition identified in pre-restoration monitoring would be monitored and adaptively managed in a manner consistent with restored meadows. A key component of this approach is to use clear measureable objectives tied to effectiveness monitoring that can then trigger (require) adaptive management.

Approach 2

Enhance regulatory and institutional funding capacity and coordination.

Identify and alleviate regulatory bottlenecks and establish efficient and respectful communication pathways. Field visits and knowledge gleaned from earlier restorations can be used to assist in building a good working relationship among regulators, restoration specialists and land managers. Ensure funding meadow restoration and monitoring is a priority at the state and federal levels.

Approach 3

Increase and diversify institutional and partnership capacity for meadow restoration and/or protection in the greater Sierra.

Institutional and public outreach, including schools, colleges, Integrated Regional Water Management groups, state and county agencies can broaden the base of support and understanding of the value of restored Sierra meadows. Assist in establishing priorities for restoration based on Species of Concern or other priorities.

Approach 1

Overview

This approach focuses on actions taken on the ground to improve meadow health, function and resilience. This approach is designed to function at the Strategy Area scale and at smaller scales to allow watershed, Forest or site-specific meadow characteristics and processes to come into focus. Thus, scales can range from a single meadow to a series of meadows in a watershed.

This approach also addresses protecting meadows from conversion to urban development or other incompatible land uses (gravel mining, golf course, roads, other). Meadows are targeted for protection based on their value for biodiversity, threatened and endangered species, or rare species, ecosystem services, or restoration potential at a landscape scale. Threats, known as well as based of future assessments, to meadows in terms of land development pressure are considered in prioritizing locations for meadow protection to accomplish the desired outcomes below.

Steps for achieving restoration to desired conditions are outlined in Figure 3. These steps are meant as guidance rather than a required set of actions. Their primary intent is to ensure that meadows are targeted for restoration and/or protection based upon a landscape scale assessment of needs and opportunities to most efficiently and directly achieve the Desired Outcomes described in Section IV above.

As shown in Figure 3 (next page), identifying desired conditions and assessing current conditions relative to desired conditions serves as the basis for determining restoration needs. Once needs have been identified, identification of SMART objectives (Specific, Measurable, Achievable, Realistic and Timely) serves as the foundation for developing a given restoration project/action and in doing so will help to identify which permits may be required and any associated compliance obligations.

Obtaining necessary permits then provides the trigger for implementing actions and subsequently monitoring the effects of such actions to determine if objectives are being met and ultimately if desired outcomes are realized, or, whether further adaptive management actions are necessary. As an example, restoring hydrologically degraded meadows could yield the desired outcomes of expanding and protecting habitat connectivity for a listed meadow-dependent species such as the willow flycatcher. Meadows within the area would be assessed based on existing desired conditions for that hydro-geomorphic meadow type/ area/ watershed.

Landscape and site-specific information (such as contributing area hydrology, species presence and potential, geology, climate and soils) and current and future threats and opportunities (e.g., climate change, fire, and invasive species) would be integrated to create as set of SMART objectives for meadows in the target area. A conservation design for meadows in that area should help meet those SMART objectives. Restoration actions would then be implemented through the next phases of implementation and post implementation monitoring/adaptive management.

Desired Outcomes, Actions and Milestones

A set of desired outcomes, necessary actions and milestones for Approach 1 are provided in Tables 1-3 below. These are presented as short-term (to occur within next five years), intermediate-term (to occur within next ten years), and long-term (to occur within the next fifteen years) actions. The fourth column indicates whether the actions are expected to occur at the local (W for watershed) or regional (R) scale. In this case, watershed refers to approximately HUC12 size watersheds or HUC10 and regional stands for the Strategy Area (Figure 2).

Short term desired outcomes include refining our understanding of existing conditions; identifying and addressing critical information gaps; articulating desired conditions; identifying priority meadows for action; and prioritizing meadows for conservation and adaptive management. Intermediate desired outcomes include achieving continued meadow restoration and protection over the next 10 years; and monitoring and evaluation to support improvement of meadow functionality. Long term desired outcomes include monitoring restored meadows to adaptively manage them; evaluating whether restored meadow functionality closely approaches desired conditions; evaluating whether restored meadow functionality is resilient across the range of water year types (reduced vulnerability); and evaluating whether benefits to biodiversity, hydrology, soils, and carbon storage are being achieved.

Using SMART Objectives to Achieve Desired Outcomes

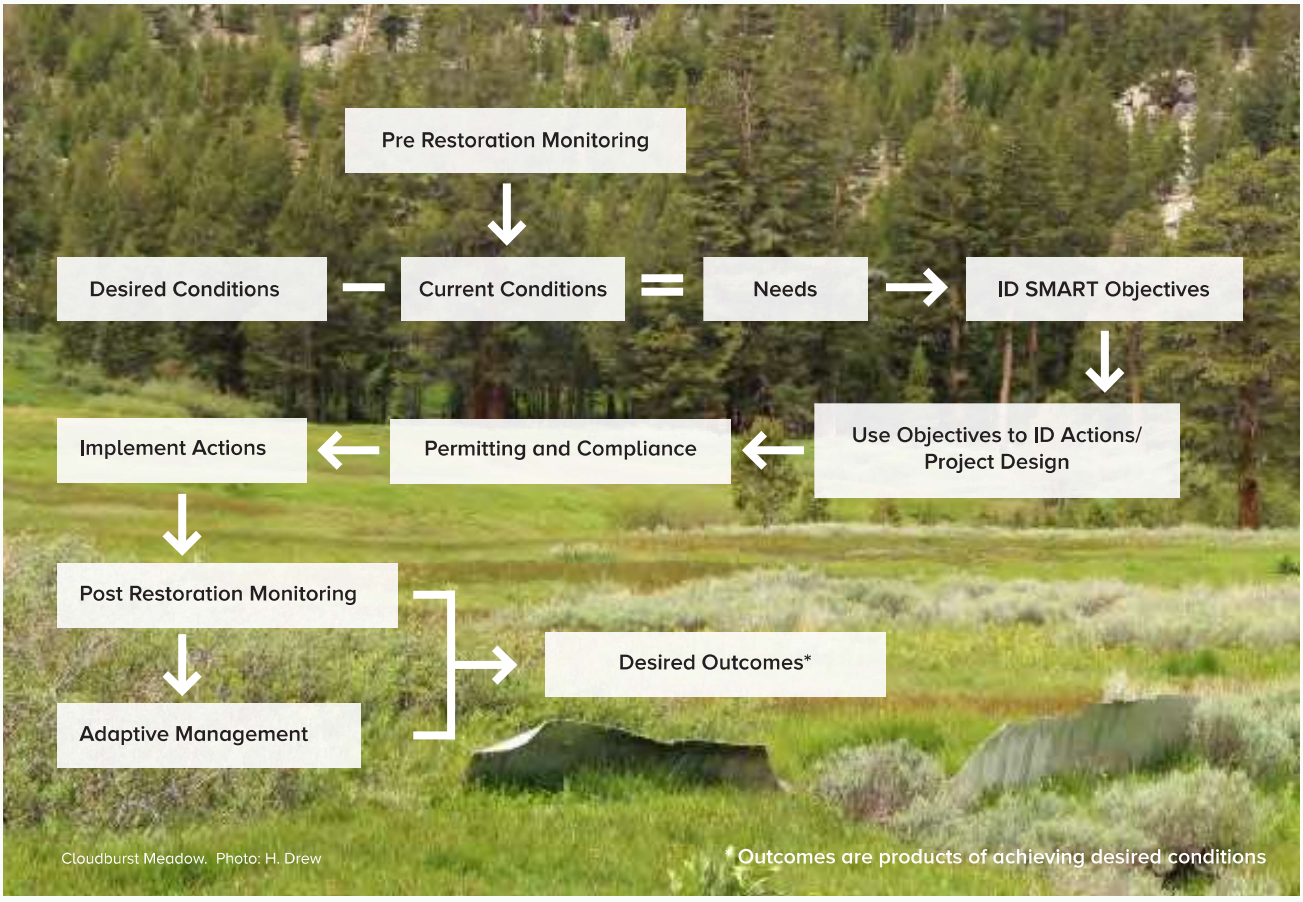

Figure 3. Flowchart of the steps for achieving restoration to desired conditions and outcomes.

Approach 1: Short-term Plan

Desired outcomes, actions and milestones to restore and protect meadows to achieve desired conditions.

Desired Outcomes	Actions	Milestones	W/R
Critical information gaps identified and addressed	Develop methodologies for measurement/monitoring of greenhouse gases and carbon sequestration in meadows.	Demonstrated effective methodologies for measurement/ monitoring of greenhouse gases and carbon sequestration in meadows available for use (white paper).	R
	Research carbon cycling in variety of meadows to determine net carbon balance and whether they have a positive, negative, or neutral global warming potential.	Research projects successfully executed; peer-reviewed publications on findings; critical information gaps identified and filled.	R
	Determine needs for ground validation of landscape level and remote sensing data used to map wetlands.	Methodology developed for incorporating individual wetland delineations (soils, hydrology, & vegetation/plants) into meadow database.	R
	Determine best methods for assessing aquatic, plant, and wildlife use and habitat condition.	Have one validated methodology to allow for comparisons among sites.	R
	Develop guidelines for definition and management of riparian areas around meadows based on BASI.	Riparian Management updated to include use of fire or other techniques that are consistent with managing for all species.	R
	Develop an approach to restoring Yosemite toad habitat in meadows with USFWS and interested stakeholders.	A plan to allow meadow restoration in occupied habitat for Yosemite Toad will include a Programmatic Biological Opinion for restoration within each designated critical habitat and/or occupied areas for Yosemite Toad.	R
	Based upon other reports and project products (e.g., listed as other actions above), summarize key information gaps for soils, hydrology and biodiversity including landscape and site scale structure and processes.	Report summarizing key information gaps limiting understanding needed for restoration of meadow hydrology, soils and biodiversity.	R/W
	Secure funding to fill critical information gaps.	Reports that cross-tabulate with set of information gaps identified in action above and associated funding in-hand vs. funding needs.	R/W
	Perform studies to fill gaps to describe existing conditions in each focus meadow for soil, hydrology and biodiversity.	Report summarizing condition of each focus meadow using consistent methodology and set of metrics (landscape and site scale).	W
	Perform studies to fill gaps on meadows for soil, hydrology and biodiversity at landscape and regional scales.	Report summarizing conditions for meadow soil, hydrology and biodiversity at landscape and regional scales.	R
Desired conditions articulated	Develop desired conditions and associated SMART objectives for hydrology and soils by Weixelman type as at least one framework.	Report summarizing desired conditions by Weixelman type for soils and hydrology.	W/R
	Develop desired conditions and associated SMART objectives for biodiversity (including aquatic and terrestrial wildlife and plants).	Report summarizing desired conditions for biodiversity by Weixelman Meadow type and location.	W/R
	Select indicator species and associated SMART objective based on meadow types, location, connectivity issues, species range and potential responses of the species to meadow conservation.	Report summarizing desired conditions for selected indicator species.	W/R
	Develop desired conditions in terms of number of meadows or acres of meadows that need protection to provide adequate habitat and ecosystem service provision.	Report summarizing state of meadows relative to desired conditions.	W
	Update and refine desired conditions according to new information as it comes in or at least every 3 to 5 yrs.	Updated reports, every 3-5 years.	W/R
Priority meadows for action identified	For region, identify priority watersheds (HUC 12) for meadow restoration using Weixelman types, focal species, and vulnerability assessments (e.g., climate and land use change, limiting factors analyses) and beaver dam building habitat model.	Prioritization of HUC 12 watersheds with explanation and rational for methods for focal species, soils (carbon), and water storage and delivery, and with description of critical information gaps.	R
	Secure funding to perform spatial analysis of meadows to determine extent of known information, information gaps, and assist prioritization of future meadow restoration, protection etc.	Funding secured.	W
	Articulate feasibility issues for each meadow.	Feasibility assessment for each meadow.	W

Table 1. Fourth column indicates local watershed (W) or regional scale (R)

Approach 1: Short-term Plan, Cont.

Desired outcomes, actions and milestones to restore and protect meadows to achieve desired conditions.

Desired Outcomes	Actions	Milestones	W/R
Priority meadows for action identified	Assess potential benefits or effects of restoration on each set of resources for each meadow at site and landscape scales. Evaluate whether these benefits will achieve desired conditions.	Landscape and site scale assessment of possibility of achieving desired conditions for each meadow.	W
	Identify meadows important for biodiversity, threatened and endangered species, rare species, climate refugia, connectivity, and ecosystem services. Overlay important meadows with development pressure to determine priorities.	Meadow spatial analysis completed with priority ranking based on biodiversity and ecosystem services.	R/W
	Prioritize meadows for restoration.	Annotated list of priority meadows for restoration (watershed or landscape).	R/W
Priority meadows restored and adaptively managed	Secure funding for pre- restoration monitoring and initial project designs.	Sufficient funding to perform pre-restoration monitoring and initial project designs available to practitioners.	W
	Develop restoration, monitoring and adaptive management plans for high priority meadows.	Complete restoration, monitoring and adaptive management plans.	W
	Perform pre-restoration monitoring to establish baseline for soils, hydrology, and biodiversity at site and landscape scales.	Pre- restoration monitoring reports.	W
	Report on landscape scale conditions or processes that currently protect, impact, improve or depend upon meadow function for target meadow (both above and below).	Landscape scale condition report or section of existing conditions report.	W
	Refine and revise, as needed, restoration design based on findings of pre-restoration monitoring.	Refined restoration design as needed.	W
	Secure funding for permits, implementation, monitoring, and adaptive management.	Funding sufficient to perform permitting and full implementation, monitoring, and adaptive management.	W
	Secure necessary permits and address compliance obligations.	Necessary local, state and federal permits; Compliance obligations addressed.	W/R
	Implement restoration actions.	Number of projects successfully implemented.	W
	Post-project effectiveness monitoring to assess restoration actions relative to established objectives and desired conditions.	Evaluation of the project to meet desired conditions and outcomes.	W
	Based on post-project monitoring findings, design adaptive management actions as needed. Priority meadows.	As needed, adaptive management actions are identified to achieve desired conditions.	W
	Subject to permitting, compliance and funding, implement adaptive management actions.	Adaptive management actions implemented.	W

Table 1, Cont. Fourth column indicates local watershed (W) or regional scale (R)

Approach 1: Intermediate-term Plan (5-10 yrs., or by 2020-2025)

Desired outcomes, actions and milestones to restore and protect meadows to achieve desired conditions.

Desired Outcomes	Actions	Milestones	W/R
Continued meadow restoration and protection achieved	Restore remaining unrestored priority meadows and adaptively manage all meadows in need of protection.	List showing percentage of priority meadows that have undergone restoration and on-going adaptive management. Evaluation of the achievement of objectives with previous restorations, if needed propose additional adaptive management actions in watershed.	W
	Integrate knowledge gained through recent studies and restoration projects into additional meadow restoration actions.	Report with an evaluation on the effectiveness of restoration actions in achieving goals and objectives. Evaluation of recent studies of restoration actions and/or monitoring reports and with any necessary suggested changes to designs for future restorations and adaptive management actions.	W
Monitoring and evaluation to support improvement of meadow functionality	On-going measurement of net soil carbon storage in restored meadows and representative subset of protected meadows with soil carbon storage as a component of the greater functioning ecosystem observed in reference meadows.	Report on 2 to 5 year post-restoration measurements of GHG flux and net change in soil carbon reservoirs in restored meadows compared to pre-restoration measurements to determine if desired conditions are being met; development and implementation of adaptive management plans if not being met.	W
	On-going monitoring of floodplain and ground water connectivity at site scale where restoration has targeted increased connectivity in ground and surface water.	Report on 2 to 5 year post-restoration measurements of meadow groundwater levels and surface water flows to indicate whether or not desired conditions are being met according to water year types; development and implementation of adaptive management plans if not being met.	W
	On-going monitoring of habitat conditions known to support focal plant and animal species compared to pre-restoration conditions.	Report on 2 to 5 year post-restoration measurements of meadow habitat conditions for key focal species to test whether or not conditions are significantly improved compared to pre-restoration conditions; development and implementation of adaptive management plans if not being met.	W
	Monitor population or occupancy of key focal fish, amphibian, bird, wildlife and plant and animal species compared to pre-restoration conditions.	Report on 2 to 5 year post-restoration occupancy or population trends for key focal species to test whether or not conditions are significantly improved compared to pre-restoration conditions.	W
	Develop an annual report for partners to share work currently underway as well as accomplishments.	Report on monitoring, assessment, evaluation of SMART objectives, restoration and other work underway across the Strategy Area. Summarize more technical reports for a more general audience. Post/distribute findings.	R
	On-going monitoring of flows and stream temperatures downstream of restored meadows to determine restoration effects on their dynamics.	Report on 2 to 5 year post-restoration measurements of stream flows and temperatures to determine whether or not desired conditions are being met according to water year types and season; development and implementation of adaptive management plans if not being met.	W/R

Table 2. Fourth column indicates local watershed (W) or regional scale (R)

Approach 1: Long-term Plan (in 15 yrs.)

Desired outcomes, actions and milestones to restore and protect meadows to achieve desired conditions.

Desired Outcomes	Actions	Milestones	W/R
Restored meadows are monitored and adaptively managed	Hydrologic monitoring of surface and groundwater at meadow scale.	Reports and data available on ground and surface water flows.	W/R
	Hydrologic monitoring of channel flows upstream and downstream of meadow	Reports and data available on surface water flows and/or weather data.	W
	On-going monitoring, reporting and adaptive management at site and landscape scale.	Reports and monitoring data demonstrating positive effect of on-going adaptive management at site, watershed, and landscape scales (based on metrics for Desired Conditions).	W/R
Restored meadow functionality moves toward desired conditions	Vegetation monitoring (mapping and community composition reporting).	Monitoring reports show that vegetation composition and distribution approaches conditions observed in reference meadows.	W
	Weed monitoring and reporting.	Monitoring reports show that invasive plant species cover remains low in restored meadows (under 5% cover).	W
	Aquatic habitat condition monitoring and reporting.	Monitoring reports show that aquatic habitat conditions approach those observed in reference meadows.	W
	Riparian and terrestrial habitat condition monitoring and reporting.	Monitoring reports show that riparian and terrestrial habitat conditions approach those observed in reference meadows.	W
	Focal species occupancy or population trends are evaluated relative to desired conditions.	Reports show that focal species occupancy or population trends match or approach those observed in reference meadows.	W
Restored meadow functionality resilient across the range of water year types (reduced vulnerability)	Vegetation monitoring (mapping and community composition reporting).	No state shifts in vegetation other than restoration changes; shifts may occur but overall suite of vegetation communities remain same through range of water years.	W
	Weed monitoring and reporting.	Non-native invasive plant species do not take hold at site (or are actively managed).	W
	Aquatic habitat condition monitoring and reporting.	Channel aquatic habitat conditions remain steady through range of water years and potential channel migration.	W
	Riparian and terrestrial habitat condition monitoring and reporting.	Meadow riparian and terrestrial habitat conditions remain high through range of water year types.	W
	Focal species occupancy or population trends are evaluated across many water year types.	Reports show that focal species occupancy or population trends are increasing or stable across variable climatic conditions.	W/R
Benefits to diversity are achieved	Monitoring and modeling.	Results show significant change over time at landscape scale (population recoveries?).	W/ R
Benefits to hydrology are achieved	Monitoring and modeling.	Results show significant change over time at landscape scale (increased storage, cooler temperatures and late season flows?).	W/ R
Benefits to soils and carbon storage are achieved	Monitoring and modeling.	Results and reports show significant change over time at landscape scale if such change is expected based upon outcomes of current studies.	W/ R

Table 3. Fourth column indicates local watershed (W) or regional scale (R)

Approach 2

Overview

The emphasis of this approach is to improve policy, legislation, and permitting to benefit meadow health, function and resilience. The focus will be on 'golden keys' that can unlock the capacity and potential of existing institutions and resources to protect and restore meadows. This could include site visits to familiarize regulators with the sites and proposed work early in the compliance process, and/or expediting the permitting process while completing all requirements for permitting agencies. This approach also includes increasing availability of private and public sector funding to support the full meadow restoration and adaptive management process.

Desired Outcomes, Actions and Milestones

A set of desired outcomes, necessary actions and milestones for Approach 1 are provided in Tables 1-3 below. These are presented as short-term (to occur within next five years), intermediate-term (to occur within next ten years), and long-term (to occur within the next fifteen years) actions. The fourth column indicates whether the actions are expected to occur at the local (W for watershed) or regional (R) scale. In this case, watershed refers to approximately HUC12 size watersheds or HUC10 and regional stands for the Strategy Area (Figure 2).

Approach 2: Short-, Intermediate- and Long-term Plan

Desired outcomes, actions and milestones to enhance regulatory and institutional funding capacity and coordination.

Desired Outcomes	Actions	Milestones	W/R
Streamlined permitting processes	Explore options for multiple meadow permitting such as "batch" or "programmatic" permits.	Multi-meadow permitting implemented staff time, costs, and regulatory response is tracked.	R
	Change in Nationwide 27 permit – Section 404 permit to allow streamlined process on federal land (to align with current private lands expeditious process).	Stream-lined Nationwide permitting allowed for meadows on federal lands.	R
	Clarify SWPPP and 404 permit interaction and acreage triggers, and ability of USFS personnel to complete SWPPPs.	Clear understanding amongst regulators that SWPPP applies to area above high water mark only. Clear direction for USFS staff on ability to prepare SWPPP's.	R
	Work with SHPO to identify how permitting can be expedited.	SHPO permitting occurs at reasonable pace and is no longer a bottleneck for restoration projects.	R
	WRDA wetland restoration agreement (ACE process) – Get agreement with each region of the CORPS to have a dedicated ACE person to address permits.	Identified ACE permitting person for each ACE region in state; permits are processed at reasonable pace and not a bottleneck for restoration projects.	W/ R
USFS support in priority Districts obtained	Place meadow restoration benefits at District to watershed scale.	Watershed or District level document on benefits completed.	R
	Align consistent NGO to provide support and communication.	NGO engaged in communication with District or Supervisors Office Specialists.	W
USFS support in priority Districts obtained	Develop strategic plan that places meadow restoration benefits in context of region and forests.	Strategic plan accepted by Region 5 Forest Service that is integrated into planning, management and monitoring process.	R
	Work with USFS Standards and Guides to ensure they contribute to healthy meadow soils.	USFS Standards and Guides for soils has been peer reviewed and by meadow soil scientists.	R
Support/ engagement with National Park Service obtained	Work with NPS staff to develop meadow restoration and management strategy for NPS lands.	Strategic plan accepted by NPS that is integrated into planning, management, and monitoring process.	R
Consistent conservation across ownership boundaries is enabled	Support development of Federal and private lands policy that supports species and biodiversity conservation.	Federal lands policy accepted by California regions of USFS, NPS and BLM, private lands accepted by Morgan Foundation, SPI etc.	R
	Local NGO(s) work with Federal land-owning agency (NPS, USFS, BLM) to help coordinate with local private landowners to restore meadows in target watersheds.	Coordinated actions and clear communication among public lands agency, private landowners, and NGO that facilitates meadow restoration, management and monitoring.	
Support from key regulatory agencies obtained	Create and refine species specific and habitat protocols that are consistent with Conservation Strategies or approved by regulatory agencies (USFWS or NOAA or State) or are from peer reviewed papers.	Protocol acceptance by agencies and published if new methodologies are developed.	R

Table 4. Fourth column indicates local watershed (W) or regional scale (R)

Approach 2: Short-, Intermediate- and Long-term Plan Cont.

Desired outcomes, actions and milestones to enhance regulatory and institutional funding capacity and coordination.

Desired Outcomes	Actions	Milestones	W/R
Beaver policy reform	Identify policy barriers to appropriate use of beavers for maintaining and restoring meadows and streams.	Policy barriers identified and summarized in a report shared with appropriate agencies (DFW, USFS, NPS, and NRCS) and land managers (NSP, private).	R
	Develop strategies for desired policy reform regarding beavers.	Strategies developed and shared with the meadows partnership as a report.	R
Support programs that provide funding for carbon, water and wildlife benefits from meadow restoration obtained	Research and develop payment for ecosystem services program(s) relevant to hydrology, carbon and biodiversity.	Payment for ecosystem services program established and implemented relevant to federal, state and private lands.	R
	Support development Federal lands policy that rewards Carbon sequestration and other ecosystem benefit credits.	Federal lands policy accepted by California regions of USFS, NPS and BLM; funding through Carbon and other ecosystem benefit credits.	R
	Identify and advocate for funding programs that support meadow restoration and monitoring at federal level.	Continued or increased availability of federal funding from current or new sources.	R
	Identify and advocate for funding programs that support meadow restoration and monitoring at state level.	Continued or increased availability of state funding from current or new sources.	R
	Advocate for public funding to support planning, pre-project monitoring and permitting (since this is hardest funding to get).	Continued or increased availability of state and federal funding to do requisite planning, pre-project monitoring, and permitting.	R
Support federal and state funding programs for meadow restoration obtained	Determine degree of fit and/or alignment with private funding sources.	Identification of private funders that are aligned with meadow restoration.	R/ W
	Develop and implement funding from well-aligned private funding sources.	Number of meadow restoration projects supported through private funding (dollars).	R/ W
Identification and access to private funding for meadow restoration addressed	Track lessons learned in how to 'market' restoration to private sources. For example, 'save' shovel ready project costs for private funding.	Memo that is updated annually on lessons learned in accessing private funding.	R

Table 4. Fourth column indicates local watershed (W) or regional scale (R)

Approach 3

Overview

The emphasis in this approach is on actions that can be taken to address institutional capacity shortfalls, build regional partnerships, and maintain a high level of communication and shared knowledge. This approach focuses on improving communication and partnering, encouraging different modelsin cooperation, education and outreach, increasing institutional capacity, and supporting diverse representation.

Desired Outcomes, Actions and Milestones

A set of desired outcome, necessary actions and milestones to guide this approach are provided in Table 5 below. It is expected that all of these actions will begin in the short-term (to occur within five years) and extend into the intermediate-term (to occur within ten years). On-going support of smaller local partners will be required for the long-term (within next fifteen years). The fourth column indicates whether the actions are expected to occur at the local (W for watershed) or regional (R) scale.

Approach 3: Short-, Intermediate- and Long-term Plan

Desired outcomes, actions and milestones to increase and diversify institutional and partnership capacity for meadow restoration and/or protection in the greater Sierra.

Desired Outcomes	Actions	Milestones	W/R
Maintain and grow open communication among institutions and individuals	Build upon and maintain cross-institutional communication and support network for meadows. (SMRRP and beyond)	Number of institutions engaged in meadow conference calls and in annual meadow meetings.	R
	Build upon and maintain UC Davis Meadows Clearinghouse.	Clearing House continues to grow and provide most up to date data and reports in highly accessible way(s).	R
Increase participation of private landowner in meadow projects	Identify areas with priority meadows, where private lands dominate and where current participation is low.	Map with priority privately owned meadows identified that are in areas with low participation.	R
	Outreach with local institutions (RCDs, local Land Trusts and other Natural Resource Groups).	Number and geographic distribution of private land owners engaged in meadow restoration projects (landowners by county).	W
	Partner with local groups to train and provide initial support to get programs running.	Number of local groups engaged in meadow restoration projects (number of groups; number of meadows).	W
	Support nascent US Fish and Wildlife Service focus on private meadows.	Number of grants and partnerships.	R
Increase the number and capacity of existing practitioners through training/ partnership	Develop and implement training programs and partnerships for all steps in meadow restoration: applying for funds, monitoring, permitting, restoration design, restoration implementation, adaptive management.	New institutional members become self-sufficient for meadow projects. Grants are successful due to partnerships.	R
	Determine entities involved in meadow protection.	List of contact created and added to this partnership list. Suggestions include Native Plant Society, Cattleman's Association etc.	R/W
	Determine where public and private meadows that have been restored in the past or are functioning well and could need protection in the future.	Outreach to public and private meadow owners at sites of past restoration conducted to determine interest in protection options.	W/R
Increase/develop resources to aid practitioners/guide through process	Build on existing resources to provide accessible (on Meadows Clearinghouse website) guides.	Guides easily found and accessed on Meadows Clearinghouse website; frequently used and updated.	R
Convene meetings	Meadow Conference(s) to identify information gaps and to work on strategy update and creation.	Number of working partners who attend; the identification of new gaps; and updated strategies for increasing the pace and scale of restorations based on implementation of current strategy.	R
Communicate benefits	Identify benefits of restoration and determine confidence of achieving these benefits.	Consensus document on meadow benefits available.	R
Integrate with Regional and State Plans	Continue to advocate for the inclusion of meadow restoration within various plans: CA Water Plan, SNC Watershed Improvement Program, Forest Plans, ACWA Headwaters Framework, etc.	Meadow restoration highlighted in local and regional plans.	R

Table 5. Fourth column indicates local watershed (W) or regional scale (R)

Section VI

Next Steps: Applying the Meadows Strategy

Next Steps and Moving Forward

Meadow Protection and Enjoyment

- Develop prioritization for restoration and protection white paper (brief) supported by limiting factors analyses and existing databases on distribution of rare meadow dependent species relative to the landscape or watersheds within and among land owners. Much of these databases exist and an excellent prioritization framework based on these databases was presented to the larger group at the Second Meadow Meeting in March 2016. We anticipate that this would be made available by March 2017.

- Work on a white paper (brief) to link whole watershed management including roads, trails, dispersed camping, thinning needs and other components in a watershed that can and do influence hydrology, climate stressors and risk of high intensity wildfire as they affect or are effected by meadows.

- Develop Forest Service Strategy to complement this Strategy. Much of Approaches 1- 3 cover many of the needs of the National Forests within the Strategy Area. The purpose and goals align with the Region 5 Ecological Restoration Leadership Intent (USDA Forest Service 2015).

- Pursue an NCEAS working group to build upon existing evidence of ecological, economic, and social benefits of meadow restoration. This will have the added benefit of identifying true gaps in our knowledge.

- As new topics arise, evaluate their relevance to the Strategy and apply resources to investigate and write white papers (briefs) on the issues.

- Several studies are testing new restoration methodologies. Write briefs on progress on these studies to the larger Sierra Meadows Partnership group.

- Several test cases and case studies are underway; write briefs and summarize the intent and methods to be employed.

- Characterize meadow condition / vulnerability across the Strategy Area (based on landscape data and local / project level data):
  - Articulate specific Desired Conditions for area.
  - Develop objectives to focus on function (three areas / multiple scales).
  - Identify priority meadows.
  - Apply coordinated pre and post project monitoring to measure effects.
  - Apply case study to determine if the multiple meadow project will go through compliance and permitting in an expedited way.
  - Implement.
  - Monitor, manage, report.
  - Report on Framework process and lessons learned.
  - Report on Progress made on Assessment, Permitting and Compliance and lessons learned.

Conclusion

The Sierra Meadows Partnership has identified a purpose, a set of goals and a series of actions aimed at increasing the pace, scale and efficacy of meadow restoration.

The three approaches to meadow restoration described in this paper address not only how to make positive change with respect to “on-the-ground” restoration, but also institutional change in terms of permitting, planning, funding and stakeholder involvement and partnership capacity. To achieve the target of restoring and protecting 30,000 acres in a 15 year period will require an all-hands, all-lands approach involving people, institutional change, improved coordination as well as perseverance.

The Strategy is intentionally ambitious. However, the Sierra Meadows Partnership, with this body of work, are poised for such an ambitious challenge. We, with the support of all, look forward to its implementation.

Section VII

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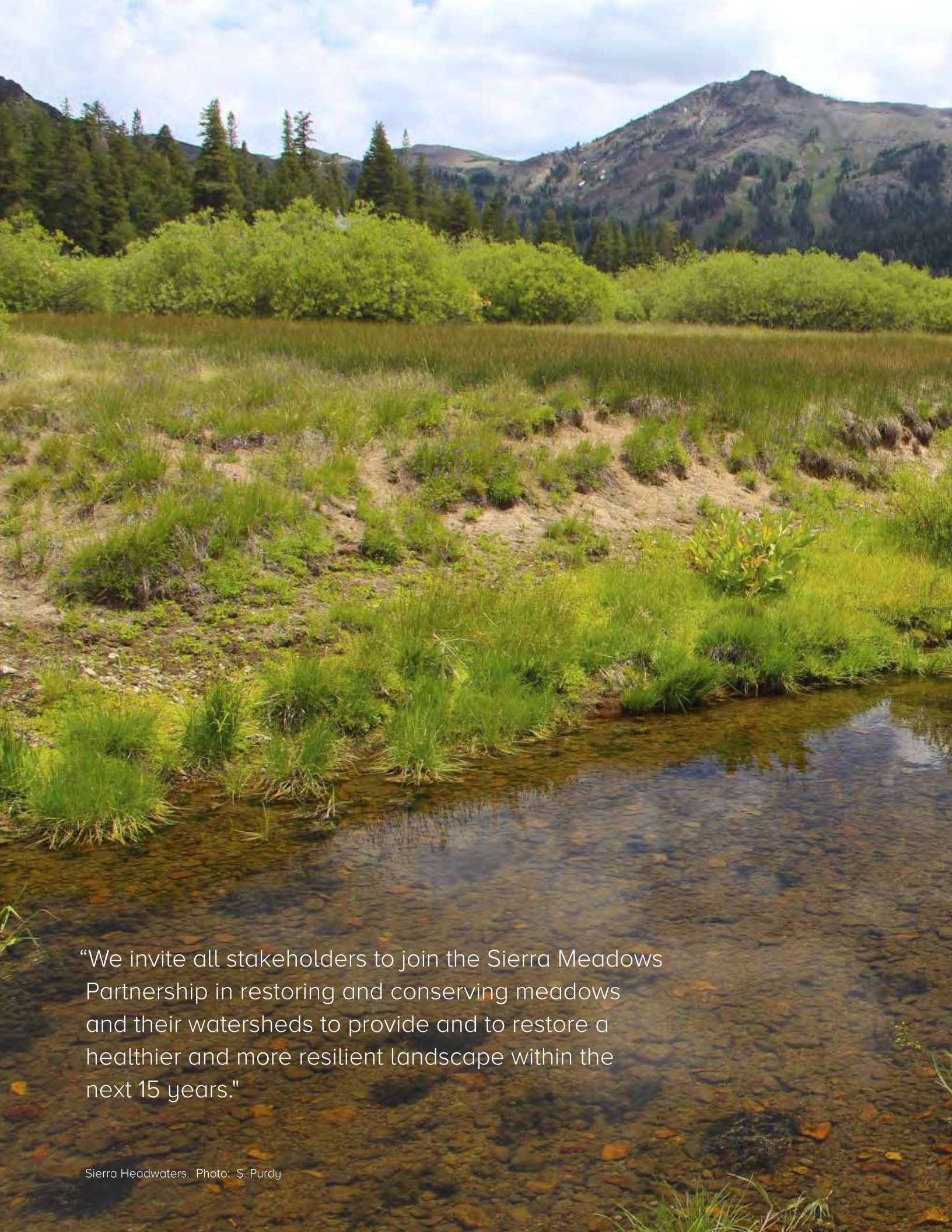

“We invite all stakeholders to join the Sierra Meadows Partnership in restoring and conserving meadows and their watersheds to provide and to restore a healthier and more resilient landscape within the next 15 years."

Sierra Headwaters. Photo: S. Purdy

The Sierra Meadows Partnership

Collaborative meadow restoration and protection.