

Report:

Inventorying and monitoring of grazed and ungrazed meadows, streams, and associated plant communities, and recommended best management practices, Sequoia National Forest, California

Prepared by Nina House¹ and Laura Cunningham²

August 2026.

¹ California Botanic Garden

² California Director, Western Watersheds Project

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Purpose and Goals

Western Watersheds Project and the California Botanic Garden are seeking to inventory meadow plant diversity, and monitor differing livestock grazing pressures on meadows in the Sequoia National Forest, ranging from ungrazed or lightly grazed, to moderately grazed, to heavily grazed. Best science and current monitoring methods are explored in order to understand how to best conserve native meadow and riparian plant communities, maintain functioning stream morphology, and improve water quality. Such improvements can increase associated fish and wildlife species—such as trout and breeding birds.

This inventorying and monitoring project originated with a floristics project initiated by the California Botanic Garden under permit with botanist Nina House to collect plant specimens in a study area comprised of two watersheds: the Salmon Creek and Manter Creek watersheds.

Because the meadows in these areas include ungrazed areas in the Domeland Wilderness, as well as meadows currently grazed by cattle, a comparison of grazing pressures on different meadows should shed light on impacts of cattle grazing on meadow and riparian communities, and stream morphology.

Our intent was not to carry out extensive quantitative measures of vegetative canopy cover, productivity, or detailed streambank assessments on every reach, but to gain a preliminary understanding of how monitoring of grazing impacts in a rapid assessment method can be combined with a detailed floristics study. An initial understanding of grazing impacts on particular vegetation communities and plant species was sought. More detailed quantitative monitoring methods can be used in the future if warranted.

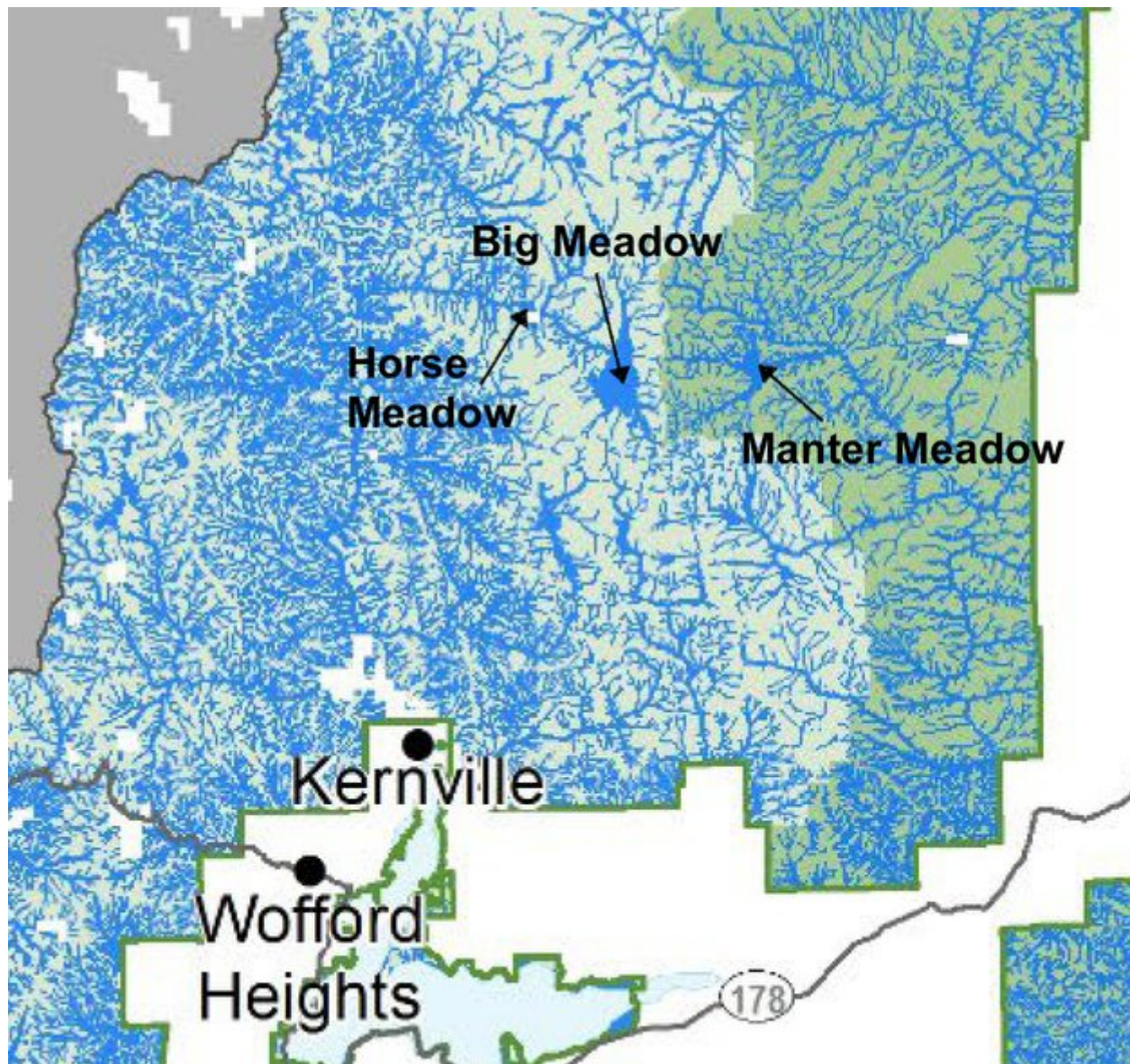
Therefore we chose to highlight several areas where conditions may be trending downward or could use management attention, in order to further discussions with the Forest Service. We provide observations for healthy baseline conditions, recommendations for potential management measures, and we ask questions in the spirit of cooperation with Forest staff and permittees towards understanding these complex systems better.

We incorporate the revised Land Management Plan and Record of Decision for the Sequoia National Forest (USDA Forest Service, Sequoia National Forest 2023a and b) when referring to management.

Location

Surveys were undertaken in the Manter and Salmon Creek watersheds in the southern Sierra Nevada, Tulare County, California. Specific locations include prominent meadows such as Big Meadow, Horse Meadow, and Manter Meadow, and their immediate borders. The flora of small, nameless meadows, as well as other meadow-like habitats in the watersheds (i.e. seeps, riparian corridors, lodgepole pine forest, etc.) are also included.

This comment letter specifically addresses conditions at Big Meadow and Horse Meadow in the Salmon Creek watershed, which drains westward into the North Fork of the Kern River. These cattle-grazed meadows are compared with Manter Meadow in the Manter Creek watershed, which drains eastward to the South Fork of the Kern River within the Domeland Wilderness.



Map showing the meadows under study, based on Figure 11, Maps of Specific Character, Appendix A at 145, Land Management Plan for the Sequoia National Forest. The blue color represents Riparian Conservation Areas. Green is designated Wilderness. (USDA Forest Service, Sequoia National Forest. 2023a)



Examples of meadows in the Manter and Salmon Creek watersheds. From left to right, top to bottom: Big Meadow, Horse Meadow, Manter Meadow, Little Manter Meadow, Deadwood Meadow, and a small stringer meadow.

Big Meadow and Salmon Creek are in the Cannell allotment (A6051), authorized for cattle grazing (formerly the Buck Rock allotment?). Manter Meadow in the Domeland Wilderness Area is within the A. Brown allotment (A6050) which is a vacant allotment.

Methods

The floristics of these watersheds have not been investigated in detail in recent times, and so a flora of the region was undertaken by Nina House, while at the same time monitoring of grazing impacts to meadow vegetation was undertaken by Laura Cunningham.

Floristic Inventory

As part of the vascular plant inventory of the Manter and Salmon Creek watersheds (House 2026), a preliminary checklist was developed from specimen records queried on the Consortium of California Herbaria (CCH1 and CCH2 2020), SEINet (2020), and the California Natural Diversity Database (CNDDDB 2020). This information was used to guide collection efforts, with work focused on areas that had been poorly documented previously (e.g., Domeland Wilderness), different habitat types (e.g., montane meadows, coniferous forest), and different rock types. Grazing impacts were documented in a monitoring effort during two field trips, using qualitative measures of vegetation in order to rapidly assess several sites and compare grazed and ungrazed meadows and other vegetation types.

Over the course of 86 field days during the months of April through September, in the years 2019 through 2021, 1411 herbarium specimens were collected in the Manter and Salmon Creek watersheds. With each collection, detailed information was recorded in the field, including: geographic coordinates and elevation (taken with the Gaia GPS application on an Apple iPhone 8+), aspect, substrate, habitat, abundance, plant attributes (height, flower color, life form, etc.), and associated taxa. Threats, especially those caused by cattle grazing, drought, invasive species, and fires, were documented when present. Finally, notes on vegetation types were taken, and later determined using the Holland and Keil (1995) classification, a system recognized as foundational to organizing the great diversity California vegetation types.

The Jepson Flora Project (2024), a primary taxonomic database of California plants, was primarily used while identifying specimens, with the Flora of North America (1993+) consulted, as well. The herbarium at California Botanic Garden (RSA) was used frequently to assist with plant identification. Assistance was acquired from experts in the plant families Boraginaceae (Michael Simpson), Cyperaceae (Mare Nazaire), Phrymaceae (Naomi Fraga), and Polygonaceae (Travis Columbus). Voucher specimens (permanently preserved plant specimens) were deposited in the herbarium at California Botanic Garden (RSA), with two duplicate sets sent to California Academy of Sciences (CAS) and New York Botanical Garden (NY). The associated data has been made available digitally through the Consortium of California Herbaria (CCH1 and CCH2 2020).

Approximately 1147 historical collections of plant specimens had been collected in the two watersheds prior to this project. Of those, approximately 250 were reviewed and annotated from the following herbaria: CAS, CDA, DAV, GH, POM, RSA, SBBG, SFV, UC/JEPS, UCR, and UCSB. These specimens were prioritized for examination because they represented taxa that were not encountered during field work or were easily accessible at the home herbarium of the researcher (RSA). Examining historically collected rare taxa was also prioritized. Herbarium specimens are important in order to be able to compare plant collections across time periods,

among many researchers, to preserve whole plants for the study of detailed characters, and to be able to take genetic samples if needed.

A checklist of the vascular flora (land plants with a vascular system of xylem and phloem, including all plants other than mosses, liverworts, and hornworts) of the Manter and Salmon Creek watersheds was produced and can be found in House (2026). Using that, a subset checklist of the meadows of the Manter and Salmon Creek watersheds in the southern Sierra Nevada, Tulare County, California was made for the purposes of this recommendation letter. These include prominent meadows such as Big Meadow, Deadwood Meadow, Horse Meadow, Little Manter Meadow, and Manter Meadow, and their immediate borders. The vascular plants of small, nameless meadows, as well as other meadow-like habitats in the watersheds (i.e. seeps, riparian corridors, lodgepole pine forest, etc.) are also included.

These floras and plant checklists are important in order to measure the ecological health, habitat integrity, and uniqueness of plant communities. Stable, undisturbed habitats can be compared using indicator species with disturbed habitats. Sensitive native plant species may vanish with elevated human disturbance levels. Monitoring these floras over time can show restoration trends.

Grazing Documentation

Grazing impacts were documented in a monitoring effort during two summer field trips, using qualitative measures of vegetation in order to rapidly assess several sites and compare grazed and ungrazed meadows and other vegetation types.

We used qualitative visual observation methods and ocular estimates to assess grazing impacts based on the range monitoring methodologies Interpreting Indicators of Rangeland Health (Pellant *et al.* 2020) and Describing Indicators of Rangeland Health (Lepak *et al.* 2024), standard monitoring methods used by federal agencies to determine whether vegetation communities are in a healthy state. Indicators of excessive grazing pressure observed include presence and descriptions of rills, gullies, erosional water flow patterns, bare ground, pedestals on grasses, wind scour and depositional areas, leaf litter, soil compaction, plant vigor, dead or dying plants, and any invasive plants.

Riparian vegetation, spring and stream morphology, streambank alteration, meadow type and function, and qualitative observations of water quality, such as turbidity and shade, were noted. We referred to several different lentic and lotic monitoring methodologies to gain an understanding of how to assess grazing impacts to riparian areas, streams, wetlands, meadows, and other aquatic habitats, including Dickard *et al.* (2015), Bureau of Land Management (2024), Boyer (2009), and Winward (2000). These monitoring methods are important for tracking habitat for trout and rare frogs and toads in the Sierra Nevada.

Detailed notes and photographs were taken of vegetation and plant responses to grazing impacts, including trampling, cropping, selection by cattle, breakage, and removal.

Photo points using the Theodolite application on an iPhone were used to take GPS points of various height and ground cover comparisons of meadow and riparian vegetation and stream morphology. Riparian health is an important ecological indicator because riparian areas are both sensitive to disturbance and disproportionately important to the biodiversity of meadow plant and wildlife communities. These can be used in the future for repeat monitoring efforts.

A stadia rod with decameter markings was used to show measures in these photos to help describe vegetation cover, height, and streambank morphology during the rapid assessment. A stadia rod is collapsible and thus can measure plants taller than a three-foot yardstick.

Ungrazed vegetation communities were similarly documented to compare with similar grazed vegetation types and plant species, with a goal of finding possible reference sites that can be used as a baseline for management towards better rangeland health.

Grazing management Standards and Guidelines in the Sequoia National Forest Land Management Plan (USDA, Sequoia National Forest 2023a) and Record of Decision (2023b) were referred to in order to assess best management measures towards meeting Plan goals.

Results

Vegetation and Habitats

Eight commonly occurring and easily recognized plant communities were noted to have occurred in the Manter and Salmon Creek watersheds (House 2026). These were described using Holland and Keil (1995) reference descriptions. The eight communities occurring in the two watersheds are: mixed chaparral, montane chaparral, Jeffrey pine forest, mixed conifer forest, lodgepole pine forest, subalpine forest, montane riparian, and montane meadows. All are described below, modified from House (2026), except for mixed chaparral and subalpine forest, which are the only two that do not come in close proximity to the montane meadows under examination in this letter. Fens are newly described here and were not classified under their own vegetation type in House (2026). Non-native taxa are denoted with an asterisk (*).

Montane Meadows – Montane meadows are common in the Manter and Salmon Creek watersheds, mainly found in flat openings of montane coniferous forest (2560--2068 m/8400--6784 ft). They can vary from just small openings in the tree canopy to large valleys. Depending on where water collects in the meadow, the species composition can be quite variable. Drier patches of meadows will often be dominated by Baltic rush (*Juncus balticus* subsp. *ater*) and clustered tidy lupine (*Lupinus lepidus* var. *confertus*). The wettest patches are often dominated by Nebraska sedge (*Carex nebrascensis*) (Fig. 10). The most prominent montane meadows in the study area are Big Meadow, Deadwood Meadow, Horse Meadow, Manter Meadow, and Little Manter Meadow (not all of these meadows were visited for monitoring of grazed and ungrazed impacts: Big meadow and Horse Meadow were visited for monitoring grazing impacts, while Manter Meadow was visited for observations of an ungrazed meadow). Many stringer meadows are scattered throughout the Salmon Creek watershed. Vegetation composition within montane meadows can also vary and is highly dependent on moisture. While typically dominated by sedges, rushes, and grasses, other herbaceous taxa are frequent. In the driest areas, *Artemisia*

rothrockii (Rothrock sagebrush) can be quite common. Additionally, young lodgepole pines (*Pinus contorta* subsp. *murrayana*) are often found encroaching at the edges of the meadow, and solitary willows (*Salix* spp.) can be found in the wettest parts of the meadow. Several meadows, Deadwood Meadow most predominately, have large stands of *Veratrum californicum* (corn lily). Montane meadows are often the most consistently disturbed vegetation type, as regular cattle grazing occurs in several of them. Several springs were also documented within or nearby Horse and Manter Meadows. These had similar vegetation to the montane meadows and thus are included in this vegetation classification. We documented grazing impacts to an unnamed small spring adjacent to Horse Meadow. We compared this to ungrazed springs on the edge of Manter Meadow. DOMINANT: sedge (*Carex* spp.), rushes (*Juncus* spp.), grasses (Poaceae spp.) SHRUBS AND TREES: Rothrock sagebrush (*Artemisia rothrockii*), willows (*Salix* spp.) HERBACEOUS: white yarrow (*Achillea millefolium*), Spanish clover (*Acmispon americanus* var. *americanus*), rough bentgrass (*Agrostis scabra*), California brome (*Bromus sitchensis* var. *carinatus*), Nebraska sedge (*Carex nebrascensis*), rusty sedge (*C. subfusca*), tufted hairgrass (*Deschampsia cespitosa* subsp. *cespitosa*), slender hairgrass (*D. elongata*), Hall's willowherb (*Epilobium hallianum*), shortray fleabane (*Erigeron lonchophyllus*), primrose monkeyflower (*Erythranthe primuloides*) (Fig. 12), cushion cryptantha (*Greeneocharis circumscissa* var. *circumscissa*), Scouler's St. John's wort (*Hypericum scouleri*), big-petaled ivesia (*Ivesia lycopodioides* var. *megalopetala*), Baltic rush (*Juncus balticus* subsp. *ater*), clustered tidy lupine (*Lupinus lepidus* var. *confertus*), Sierra beardtongue (*Penstemon heterodoxus* var. *cephalophorus*), Sierra yampah (*Perideridia parishii* subsp. *latifolia*), alpine shooting star (*Primula tetrandra*), marsh checker mallow (*Sidalcea ranunculacea*), dandelion (*Taraxacum officinale*), mountain carpet clover (*Trifolium monanthum* subsp. *Monanthum*), and corn lily (*Veratrum californicum* var. *californicum*).

Fens – We documented the presence of one fen on the edge of Big Meadow. Fens have a waterlogged, organic layer of peat with a depth 20-80 cm. Soils are highly organic, with very little decomposition due to saturated conditions and a lack of oxygen, and are nutrient poor. Dense layer of moss may be present. Peat forms in low-oxygen bogs. Fens are a mineral rich wetland from groundwater seepage, and are rare and widely scattered. DOMINANT: sedge (*Carex* spp.), spikerush (*Eleocharis* spp.), rush (*Juncus* spp.) SHRUBS AND TREES: lodgepole pine (*Pinus contorta* subsp. *murrayana*). HERBACEOUS: short-beaked sedge (*Carex simulate*), Sierra yampah (*Perideridia parishii* subsp. *latifolia*), primrose monkeyflower (*Erythranthe primuloides*), Hall's willowherb (*Epilobium hallianum*), Anderson's alpine aster (*Oreostemma alpigenum* var. *andersonii*), lotus (*Hosackia* sp.). We documented feather mosses (Order Hypnales) and *Ptychostomum* moss submerged in shallow water in the fen. *Sphagnum* moss may also be present in this and other fens in the area.

Montane Riparian – This vegetation type is frequent in the thin margin around perennial streams, especially Manter and Salmon creeks, though it can be found throughout the two watersheds (1050--2991 m/3445--9977 ft; Fig. 29). Small streams that join with these more major tributaries, as well as the channels around intermittent streams, are also dominated by this vegetation type. Manter Creek flows through Manter Meadow and Salmon Creek through both Big and Horse Meadows, with montane riparian vegetation occurring most predominantly along the streambanks just outside the meadows. Cattle often travel between Big and Horse Meadows, following the Salmon Creek and impacting it with trampling and grazing of bank vegetation.

Characterized by dense cover, it is common for willow (*Salix*) thickets that characterize montane riparian vegetation to be so thick that it is almost impossible to reach the water. In other places, Utah serviceberry (*Amelanchier utahensis*), red osier dogwood (*Cornus sericea*), and willows (*Salix* spp.) create a uniquely impenetrable wall of vegetation. These species often grow in the middle of the stream, if shallow enough. Larger trees, such as aspen (*Populus tremuloides*) and black cottonwood (*Populus trichocarpa*), can be found at higher elevations, though often infrequent in number. In places not dominated by larger perennials, herbaceous taxa such as narrow-leaved lotus (*Hosackia oblongifolia* var. *oblongifolia*) and meadow lupine (*Lupinus polyphyllus* var. *burkei*) become dense along the stream bank. Seeps, uncommon on the hillsides above montane meadows, will often have plant communities similar to montane riparian vegetation. DOMINANT: narrow-leaved lotus (*Hosackia oblongifolia* var. *oblongifolia*) and arroyo willow (*Salix lasiolepis*). SHRUBS AND TREES: Utah serviceberry (*Amelanchier utahensis*), red osier dogwood (*Cornus sericea* subsp. *sericea*), aspen (*Populus tremuloides*), black cottonwood (*P. trichocarpa*), and interior rose (*Rosa woodsii* subsp. *ultramontana*). HERBACEOUS: rough bentgrass (*Agrostis scabra*), red columbine (*Aquilegia Formosa*), California mugwort (*Artemisia douglasii*), Western bistort (*Bistorta bistortoides*) (Fig. 14), Jones' sedge (*Carex jonesii*), variable-nerved sedge (*C. heteroneura*), fireweed (*Chamerion angustifolium* subsp. *circumvagum*), Chinese houses (*Collinsia tinctoria*), Hall's willowherb (*Epilobium hallianum*), field horsetail (*Equisetum arvense*), coralline monkeyflower (*Erythranthe corallina*), California cranesbill (*Geranium californicum*) (Fig. 13), tall mannagrass (*Glyceria elata*), Bigelow's sneezeweed (*Helenium bigelovii*), Kelley's lily (*Lilium kelleyanum*), meadow lupine (*Lupinus polyphyllus* var. *burkei*), streamside bluebells (*Mertensia ciliata* var. *stomatechoides*), Sierra bog orchid (*Platanthera dilatata* var. *leucostachys*) (Fig. 7), white water buttercup (*Ranunculus aquatilis* var. *diffusus*), small-fruited bulrush (*Scirpus microcarpus*), white hedge-nettle (*Stachys albens*), and western mountain aster (*Symphotrichum spathulatum* var. *spathulatum*).

Mixed conifer forest – Mixed conifer forest is one of the most prevalent vegetation types in the Manter and Salmon Creek watersheds. It dominates the Salmon Creek watershed and is common in the unburned western edges of the Manter Creek watershed as well. Starting at the edge of the Kern Plateau, mixed conifer forest dominates until almost the highest reaches of the two watersheds (Siretta Peak), where it begins to mix with subalpine forest (1981–2743 m/6500–9000 ft). It is mostly dominated by the local narrow endemic Critchfield red fir (*Abies magnifica* var. *critchfieldii*) and Jeffrey pine (*Pinus jeffreyi*), though changes in the landscape (e.g., aspect, water accessibility, etc.) can lead to slightly different assemblages. North-facing slopes tend to have higher numbers of sugar pine (*Pinus lambertiana*), while more mesic areas have greater numbers of lodgepole pine (*Pinus contorta* subsp. *murrayana*). Particularly wet areas support other vegetation types, such as lodgepole pine forest and montane meadows. DOMINANT: Critchfield red fir (*Abies magnifica* var. *critchfieldii*) and Jeffrey pine (*Pinus jeffreyi*). SHRUBS AND TREES: white fir (*Abies concolor*), Utah serviceberry (*Amelanchier utahensis*), greenleaf manzanita (*Arctostaphylos patula*), incense cedar (*Calocedrus decurrens*), mountain whitethorn (*Ceanothus cordulatus*), Kern ceanothus (*C. pinetorum*), chinquapin (*Chrysolepis sempervirens*), green rabbitbrush (*Chrysothamnus viscidiflorus* subsp. *viscidiflorus*), Great Basin rubber rabbitbrush (*Ericameria nauseosa* var. *oreophila*), sulphur-flower buckwheat (*Eriogonum umbellatum*), small-leaf creambush (*Holodiscus discolor* var.

microphyllus), Sierra juniper (*Juniperus grandis*), granite prickly phlox (*Linanthus pungens*), pale mountain monardella (*Monardella odoratissima* subsp. *pallida*), San Bernardino penstemon (*Penstemon caesius*), mountain pride (*P. newberryi* var. *newberryi*), beaked penstemon (*P. rostriflorus*), sugar pine (*Pinus lambertiana*), Western white pine (*P. monticola*), bitter cherry (*Prunus emarginata*), California black oak (*Quercus kelloggii*), wax currant (*Ribes cereum* var. *cereum*), willows (*Salix* spp.), and mountain snowberry (*Symphoricarpos rotundifolius* var. *parishii*). HERBACEOUS: Sierra onion (*Allium campanulatum*), broad-seeded rockcress (*Boechera platysperma*), wavy-leaf paintbrush (*Castilleja applegatei* subsp. *pinetorum*), Wright's collinsia (*Collinsia torreyi* var. *wrightii*), harlequin monkeyflower (*Diplacus bicolor*), California squirreltail (*Elymus elymoides* var. *californicus*), naked buckwheat (*Eriogonum nudum*), spreading groundsmoke (*Gayophytum diffusum* subsp. *parviflorum*), prickly hawkweed (*Hieracium horridum*), pygmy mountainparsley (*Oreonana clementis*), California mountain pincushion (*Orochaenactis thysanocarpha*), Southern Sierra phacelia (*Phacelia austromontana*), one-sided bluegrass (*Poa secunda*), snow plant (*Sarcodes sanguinea*), and narrow-leaved wire-lettuce (*Stephanomeria tenuifolia*).

Lodgepole Pine Forest – This vegetation type is rather rare in the study area, prevalent only in the small margin around high-elevation montane meadows and in moist clearings of the otherwise mixed conifer forest (2377--2682 m/7800--8800 ft; Fig. 27). Best representations are around Big Meadow, especially at the southernmost extent, as well as where the Deadwood Meadow and Cannell Meadow trails meet. Both are characteristically flat and moist areas, with understories composed of taxa typical of montane meadows. There are instances of some lodgepole pine encroachment in almost all of the montane meadows present in the two watersheds. DOMINANT: lodgepole pine (*Pinus contorta* subsp. *murrayana*). SHRUBS AND TREES: mountain whitethorn (*Ceanothus cordulatus*), chinquapin (*Chrysolepis sempervirens*), Jeffrey pine (*Pinus jeffreyi*), and Sierra currant (*Ribes nevadense*). HERBACEOUS: rosy pussytoes (*Antennaria rosea* subsp. *confinis*), Idaho bentgrass (*Agrostis idahoensis*), thingrass (*A. pallens*), smooth-beaked sedge (*Carex integra*), Ross' sedge (*C. rossii*), primrose monkeyflower (*Erythranthe primuloides*), small-flowered horkelia (*Horkelia fusca* var. *parviflora*), pygmy bitterroot (*Lewisia pygmaea*), mat muhly (*Muhlenbergia richardsonis*), naked catchfly (*Silene aperta*), and mountain carpet clover (*Trifolium monanthum* subsp. *monanthum*).

Montane Chaparral – This vegetation type dominates in the burn scars of the Manter Fire and McNally Fire (1530--2835 m/5020--9300 ft). Because of the nature of the burn scars, this vegetation type is disjunct, occurring just north of Horse Meadow and in large swaths throughout the Manter Creek watershed, including surrounding much of Manter Meadow. It is often characterized by dense, shrubby vegetation and the occasional standing Jeffrey pine (*Pinus jeffreyi*), Sierra juniper (*Juniperus grandis*), or single-leaf pinyon (*Pinus monophylla*). As elevation drops moving eastward in the Manter Creek watershed, and the climate becomes steadily drier, the distance between shrubs opens. Taxa such as mountain mahogany (*Cercocarpus ledifolius* var. *intermontanus*), Sierra juniper (*J. grandis*), single-leaf pinyon (*P. monophylla*), and bitterbrush (*Purshia tridentata* var. *tridentata*) become more common. This is likely a remnant of what the landscape looked like prior to the 2000 Manter Fire. In addition, shrubs become sparse around large granitic outcrops, where it seems some trees were able to gain protection from the fires. DOMINANT: greenleaf manzanita (*Arctostaphylos patula*),

mountain whitethorn (*Ceanothus cordulatus*) and bitterbrush (*Purshia tridentata* var. *tridentata*). SHRUBS AND TREES: mountain mahogany (*Cercocarpus ledifolius* var. *intermontanus*), Wright's buckwheat (*Eriogonum wrightii* var. *subscaposum*), golden yarrow (*Eriophyllum confertiflorum* var. *confertiflorum*), Jeffrey pine (*Pinus jeffreyi*), single-leaf pinyon (*P. monophylla*), bitterbrush (*Purshia tridentata* var. *tridentata*), canyon live oak (*Quercus chrysolepis*), and mountain snowberry (*Symphoricarpos rotundifolius* var. *parishii*). HERBACEOUS: limestone dudleya (*Dudleya abramsii* subsp. *calcicole*), golden eardrops (*Ehrendorferia chrysantha*), California fuchsia (*Epilobium canum* subsp. *latifolium*), giant eriastrum (*Eriastrum densifolium* subsp. *elongatum*), Coville's fleabane (*Erigeron breweri* var. *covillei*), Parish's buckwheat (*Eriogonum parishii*), spurry buckwheat (*E. spergulinum* var. *reddingianum*), broad-leaved lotus (*Hosackia crassifolia* var. *crassifolia*), and one-sided bluegrass (*Poa secunda* subsp. *secunda*).

Jeffrey Pine Forest – Though much of the mixed conifer forest is dominated by Jeffrey pine (*Pinus jeffreyi*), the almost equal presence of Critchfield's red fir (*Abies magnifica* var. *critchfieldii*) makes it quite different from the purer stands of Jeffrey pines that can be found in limited quantities in the Manter Creek watershed. Likely more common prior to the Manter Fire, these stands of Jeffrey pine forest are now diminished to unburned portions of the watershed, such as around Little Manter Meadow and Manter Creek. Jeffrey pine forest, which resembles ponderosa pine forest, is confined to the Manter Creek watershed, especially below 2,591 m (8500 ft), where the dryer conditions allow this vegetation type to prosper. DOMINANT: Jeffrey pine (*Pinus jeffreyi*). SHRUBS AND TREES: Greenleaf manzanita (*Arctostaphylos patula*), mountain big sagebrush (*Artemisia tridentata* subsp. *vaseyana*), mountain whitethorn (*Ceanothus cordulatus*), intermountain curl-leaf mountain mahogany (*Cercocarpus ledifolius* var. *intermontanus*), chinquapin (*Chrysolepis sempervirens*), Great Basin rubber rabbitbrush (*Ericameria nauseosa* var. *oreophila*), Wright's buckwheat (*Eriogonum wrightii* var. *subscaposum*), Sierra juniper (*Juniperus grandis*), granite prickly phlox (*Linanthus pungens*), bitterbrush (*Purshia tridentata* var. *tridentata*), canyon live oak (*Quercus chrysolepis*), California black oak (*Q. kelloggii*), and blue elderberry (*Sambucus mexicana*). HERBACEOUS: California squirreltail (*Elymus elymoides* var. *californicus*), Coville's fleabane (*Erigeron breweri* var. *covillei*), bearded monkeyflower (*Erythranthe barbata*), Kern fraseria (*Frasera tubulosa*), and Southern mule's ears (*Wyethia ovata*).



Examples of vascular plants found in meadows and riparian areas of the Manter and Salmon Creek watersheds. From left to right, top to bottom: Sierra bog orchid (*Platanthera dilatata* var.

leucostachys), alpine shooting star (*Primula tetrandra*), Salmon Creek paintbrush (*Castilleja praeterita*), Nebraska sedge (*Carex nebrascensis*), alkali bluegrass (*Poa secunda* ssp. *juncifolia*), primrose monkeyflower (*Erythranthe primuloides*), California cranesbill (*Geranium californicum*), and California bistort (*Bistorta bistortoides*).

Grazing Impacts

What follows are our detailed descriptions from field notes and photographs, of our observations of cattle grazing pressures on meadows, springs, riparian areas, and adjacent uplands of varying stocking rates and land management zones—from nearly zero to heavy stocking rates. Grazing allotments (public-land leases that are rented for ten-year terms by federal agencies for livestock grazing to private cattle and sheep ranches) are compared to ungrazed Wilderness Areas.

We focused our observations of grazing impacts to montane meadow, stream, spring, and fen habitats, as those were most severely impacted by livestock concentrations.

Grazing impacts to the other vegetation types (montane chaparral, Jeffrey pine forest, mixed conifer forest, and lodgepole pine forest) were much less as cattle did not appear to concentrate in these habitats.

Big Meadow

We visited Big Meadow on July 27, 2020, and September 12, 2025. There are three meadows in the southern Sierra Nevada that have the word “big” in their names: Big Meadow (the focus of this study, located in southern Tulare County), Big Whitney Meadow (located near Mount Whitney), and Big Meadows (located in northern Tulare County). Big Meadow is currently grazed by cattle.

While not directly relevant to this study, it is noted that the Big Meadows located in northern Tulare County has had a long history of degradation and restoration activities. Olin (2005) described Big Meadow as a wet montane meadow having some reaches dewatered, due to streambank incision. Streambank incision occurs when disturbing activities like heavy livestock grazing and trampling removes stabilizing vegetation on streambanks, resulting in increased erosion; eventually banks slough away, the stream channel deepens, and the stream can become disconnected from its floodplain. Some 65% of the channels were found to be moderately entrenched. Olin (2005) gives reasons for meadow degradation as probably due to intensified early- to mid-20th century grazing, road-building, logging, mining and other uses. Earlier in the mid 1900s the U.S. Forest Service (USFS) installed checkdams in an attempt to restore surface water flows, but some reaches and channels continued to be dry. Olin (2005) designed a restoration plan to bring the stream and meadow back into Proper Functioning Condition, which included reducing channel entrenchment, establishing a single-thread channel of water, increasing in-stream cover and shading in order to lower unnaturally high water temperatures, enhancing aquatic and terrestrial habitat for the federally endangered southern mountain yellow-legged frogs (*Rana muscosa*), and raising the local groundwater level. A pond and soil-plug

restoration plan was approved in a 2007 Decision Memo by the District Ranger (USDA 2007) to fill gullies. A report (Fly Fishers for Conservation 2009) showing lush moist meadows two years post-project appears to indicate the restoration effort was successful.

While this work pertains to a different meadow in the southern Sierra Nevada than the ones that were studied during this project, it is important to note that, with improper management, the long-term consequences can be expensive, time intensive and, ultimately, avoidable. Many of the observations seen in Big Meadows were also observed in Big Meadow during this study - see pictures below.



North Big Meadow showing stream and grazing exclosure. July 27, 2020.



North Big Meadow showing moderately grazed sedge (*Carex* sp.) and aquatic plants. Some trampling of streambanks is apparent but water turbidity (muddiness) is low with good clarity. July 27, 2020.



Shallow channel with more heavily grazed sedges. Utilization of grasses and sedges by livestock appears to be heavier here. North Big Meadow. July 27, 2020.



This reach of stream shows heavier livestock grazing of sedges on the banks, and with brownish color. This brown murky color indicates potential suspended sediments eroded from streambanks and slopes, as well as dissolved organic matter that could result from livestock manure or disturbed vegetation particles. July 27, 2020.



Stream reach showing a sandier substrate with cow hoof trampling and shallow, and a widening channel. As cattle trample the streambanks, streams are transformed from narrow and deep to wide and shallow, altering aquatic habitats in ways that harm fishes and amphibians. North Big Meadow. July 27, 2020.



A less-grazed or ungrazed fenced pasture near a campground, showing taller sedge (*Carex* spp.), streambanks well-vegetated, and banks with shade, overhanging. This provides good aquatic insect and fish cover. July 27, 2020.



Mountain big sagebrush (*Artemisia tridentata* subsp. *vaseyana*,) on the edge of North Big Meadow. This provides wildlife cover and should not be mowed. July 27, 2020.



Ungrazed muhly (*Muhlenbergia richardsonis*) in fenced pasture, North Big Meadow. This pasture was ungrazed this season and had 15% bare ground but part of this may have been due to

pocket gopher digging activity. This portion of the meadow is fenced off from the rest of the meadow and may be grazed less. July 27, 2020.



Grazed may muhly (*Muhlenbergia richardsonis*) on a drier part of North Big Meadow. Bare ground is not a natural condition but instead is due to cattle trampling and grazing. July 27, 2020.



Stand of annual hairgrass (*Deschampsia danthonioides*) with some sedges and tufted grasses in a drier part of Big Meadow, showing cropping and trampling by cattle. Bare ground is evident. Annual hairgrass grows quickly in moist ephemeral pool, shallow depressions, and wet meadow swale habitat that hold water in the spring, often with sandy, loamy, or clayey substrate that dries out later in the summer. Cattle can readily disturb this delicate meadow micro-habitat type, although the annual hairgrasses can withstand a certain amount of disturbance. Waterfowl and other birds eat the abundant seeds of the grass. These vernal pools and shallow wetlands can be important habitat for aquatic invertebrates and amphibians (Darris and Bartow 2005). September 12, 2025.



Annual hairgrass (*Deschampsia danthonioides*), Big Meadow, September 12, 2025.



Annual hairgrass (*Deschampsia danthonioides*), Big Meadow, September 12, 2025. Bare ground and cow manure are present.



Tall dense Nebraska sedge (*Carex nebrascensis*) in a low wet area above Salmon Creek. Cattle graze in the distance, and may wade through this marsh on occasion. This wet sedge marsh appears healthy, and may be in part created by the road crossing at Salmon Creek on the meadow edge backing up water flow through a large undercrossing pipe. This may serve as a kind of check dam holding water in this part of Big Meadow. This should be monitored for any blockage of debris. July 27, 2020.



Wet sedge marsh and undercrossing pipe at Salmon Creek. Cattle appear to be grazing and trampling this area more than upstream in Big Meadow. Wildlife would normally not cause this much impact. July 27, 2020.



Cropped Nebraska sedge (*Carex nebrascensis*). This area should be monitored for water quality, erosion, and any excessive utilization causing die-back of this sedge stand. Big Meadow, September 12, 2025.



Nebraska sedge (*Carex nebrascensis*) and Salmon Creek, Big Meadow, September 12, 2025. The meadow here looks good at the end of the grazing season. Vegetation cover, height, and species correlate with water quality and stream health.



Some portions of North Big Meadow having sandier soils appear partly dewatered and with more xeric (arid) vegetation with cattle trampling. July 27, 2020.



Overall North Big Meadow looks fairly good, with stream sinuosity and vegetated banks. Drier areas should be monitored. July 27, 2020. Under natural conditions, streams are characterized by more curves and loops, which slows the current and provides better habitat. When streams become unnaturally straightened (or "channelized") they lose some of their habitat value.

One grass species we would like to highlight as an early indicator of meadow health or degradation potential is tufted hairgrass (*Deschampsia cespitosa* ssp. *cespitosa*). This perennial cool-season bunchgrass is a facultative wetland species, a species thriving in wetlands but not always limited to them. It is found in seasonally flooded areas, montane (mid-elevation) and alpine wet meadows, and coastal bluffs and terraces with deeper soils in open habitats near the coast. Soils are often moist, muddy, or with surface water--seeds are dispersed by water. Some forms are salt-tolerant.

Ungrazed or very lightly grazed tufted hairgrass show 100% ground cover, dense thatch, lush green summer growth, tall culms (stems) to hip or waist height, and usually wet spongy soils. Tufted hairgrass is relished by all classes of livestock, especially cattle and horses. Sawyer et al. (2009) say that continued grazing and other disturbance can impact tufted hairgrass stands by introducing non-native plants, and by increasing stream down-cutting that impact riparian areas. Cattle grazing can lower the water table in these meadows, which eliminates pools, bogs, and wet meadow complexes. Continued grazing will extend the process of drying meadows. Stands can eventually convert to dry meadows with topsoil loss.

Meadow manipulation of irrigation ditch-digging, and diverting channel flows to increase livestock pasture also contribute to the demise of tufted hairgrass wetland habitats.

With respect to Proper Functioning Condition, riparian areas and meadows can be impacted by livestock use, with channel destabilization from hoof shear or trampling, erosion, bank chiseling and trampling from hoof shear, increasing turbidity (muddiness) in stream flows, algae growing in meadow streams as a result of excessive nutrient inputs from manure, and trampling that causes headcuts or gullyng. These indicators point to a downward trend in meadow and range health, and the need to rest these meadows from livestock grazing for at least 5-10 years.

For National Forest lands in the Sierra Nevada, CA, the Riparian Conservation Objective (RCO) specified in Forest Plans states that “the 2004 SNFPA Record of Decision (ROD) includes the following strategy for Riparian Conservation: RCO #2 is to maintain or restore: (1) the geomorphic and biological characteristics of special aquatic features, including lakes, meadows, bogs, fens, wetlands, vernal pools, springs; (2) streams, including in stream flows; and (3) hydrologic connectivity both within and between watersheds to provide for the habitat needs of aquatic-dependent species.” Maintaining and restoring meadows and their connection within floodplains to streams is a core objective—this is crucial for having high quality golden trout habitat.

Standard and Guideline 120 from the 2004 SNFPA ROD states:

For meadows in late seral status: limit livestock utilization of grass and grass-like plants to a maximum of 40 percent (or minimum 4-inch stubble height). Determine ecological status on all key areas monitored for grazing utilization prior to establishing utilization levels. Use Regional ecological scorecards and range plant list in regional range handbooks to determine ecological status. Analyze meadow ecological status every 3 to 5 years. If meadow ecological status is determined to be moving in a downward trend, modify or suspend grazing.

Include ecological status data in a spatially explicit Geographical Information System database.

If successfully implemented on the ground this should help prevent erosion, poor water quality, and degradation of plant communities. More monitoring is needed to determine whether a 4-inch stubble height, however, could be too impactful for taxa like sedges (*Carex*).



On the edge of Big Meadow adjacent to the wet sedge marsh we found cattle trailing and grazing amid a stressed tufted hairgrass (*Deschampsia cespitosa* ssp. *cespitosa*) stand that had small bunches, drying ground, and a few small panicles. July 27, 2020. Grazing utilization is too high here, over 40%, and tufted hairgrass will disappear here under these conditions.



Tufted hairgrass bunches are very small and not reproducing well with seedheads. This area should be monitored for a reduction in grazing pressure. July 27, 2020.



Grazed stand of tufted hairgrass on the western edge of Big Meadow. Some culms and seedheads are visible. September 13, 2025.



For comparison, this is a healthy tufted hairgrass moist meadow that is ungrazed by cattle. Table Mountain Wilderness Area, Monitor Range, Humboldt-Toiyabe National Forest, Nevada.

Big Meadow appears to meet the below Desired Conditions well, but with some early warning signs that indicate conditions need to be monitored so that functioning does not become at risk. Grazing pressure is too high in some areas, but moderate in others. The 2023 Sequoia National Forest Land Use Plan states:

Meadows

Desired Conditions (WTR-RCA-MEAD-DC)

01 Meadows are hydrologically functional. Sites of accelerated erosion, such as gullies and head cuts are stabilized, recovering, or within the natural range of variation. Vegetation roots occur throughout the available soil profile. Meadows with perennial and intermittent streams have the following characteristics: (1) stream energy from high flows is dissipated, reducing erosion and improving water quality; (2) streams transport sediment and capture bedload, aiding floodplain development; (3) meadow conditions enhance floodwater retention and groundwater recharge; and (4) root masses stabilize streambanks against cutting action.

02 Wetlands and groundwater-dependent ecosystems (including springs, seeps, fens, wet meadows, and associated wetlands or riparian systems) support stable herbaceous and woody vegetation communities that are resilient to drought, climate change, and other stressors. Root masses stabilize stream channels, shorelines, and soil surfaces. The natural hydrologic, hydraulic, and geomorphic processes in these ecosystems sustain their unique functions and biological diversity.

03 Meadows are resilient and recover rapidly from natural and human disturbances. They exhibit a high degree of hydrologic connectivity laterally across the floodplain and vertically between surface and subsurface flows. They provide important ecosystem services such as high-quality water, recharge of streams and aquifers, and moderation of climate variability and change.

04 Soils in wet and headwater meadows are influenced by a shallow water table and function to filter water. These soils also store and release water over an extended period of time, which helps to maintain streamflow during dry summer months.

05 Meadows have substantive ground cover and a rich and diverse species composition, especially of grasses and forbs. Meadows have high plant functional diversity with multiple successional functional types represented. Perennial streams in meadows contain a diversity of age classes of shrubs along the streambank, where the potential exists for these plants.

06 A complexity of meadow habitat types and successional patterns support native plant and animal communities. Meadow species composition is predominantly native, where graminoid (grass-like) species are well represented and vigorous, and regeneration occurs naturally. Healthy stands of willow, alder, and aspen are present within and adjacent to meadows with suitable physical conditions for these species. Natural disturbances and management activities are sufficient to maintain desired vegetation structure, species diversity, and nutrient cycling. (USDA Forest Service, Sequoia National Forest 2023a at 20-21)

Range

Guidelines (RANG-FW-GDL)

07 When grazing in riparian conservation areas under season-long use:

- For meadows and riparian areas that are properly functioning or functioning at-risk with an upward trend and/or are in mid-seral or better condition with a stable to upward trend, limit livestock utilization of deep-rooted herbaceous plants to 40 to 45 percent. Forstream channels and drainways, maintain a minimum 4-inch residual stubble height on the greenline. (USDA Forest Service, Sequoia National Forest 2023a at 93)

So far, Big Meadow is maintaining hydrologic connectivity, root masses are generally holding streambanks together, and meadow species composition is predominantly native and diverse species composition, although less so than the ungrazed Manter Meadow (see below).

We did not find any invasive cheatgrass (*Bromus tectorum*), likely because this meadow is too high in elevation and moist for typical cheatgrass range.

Salmon Creek below Big Meadow

We investigated Salmon Creek where it passes through and then leaves Big Meadow, and a section through Horse Meadow. This stream is currently grazed by cattle.



Salmon Creek just below Big Meadow, showing grazed sedges (*Carex* spp.) grazed by livestock and brown water color. Some bank erosion is apparent from cattle traffic. July 27, 2020.



Salmon Creek just below Big Meadow. Streambank vegetation is largely intact and overhangs the banks, providing shade and cover. Woody cover of dogwood (*Cornus sericea*) is good. Habitat for fish and aquatic invertebrates. Early warning sign: grazed grass by cattle on the right bank should be monitored, and the Forest should consider fencing off this reach from cattle. July 27, 2020.



The semiaquatic manna grass (*Glyceria elata*) is also present here, a grass which is sensitive to grazing. Manna grass is palatable to livestock but not an important forage since it is rather uncommon. We include it here because it is a good indicator of wet meadow and wetland conditions that could be degraded if heavily grazed.



Sedges (*Carex* sp.) trampled on Salmon Creek streambank just below Big Meadow. July 27, 2020.

Based on the observed conditions, we determined that this stretch of Salmon Creek currently reaches Desired Conditions, with clear, cold water, vegetation overhanging banks, and no immediate signs of erosion. Early warning signs, however, are manure near the water, and closely-cropped grasses and sedges in the riparian zone. Contrast this with Manter Stream in the ungrazed Manter Meadow, below.

Rivers and Streams

Desired Conditions (WTR-RCA-RIV-DC)

03 Instream flows are sufficient to sustain desired conditions of riparian, aquatic, wetland, and meadow habitats and retain patterns of sediment, nutrients, and wood routing as close as possible to those with which aquatic and riparian biota evolved. The physical structure and condition of streambanks and shorelines minimize erosion and sustain desired habitat diversity. (USDA Forest Service, Sequoia National Forest 2023a at 21)

Fen at the edge of Big Meadow

In September 2025, during fieldwork we encountered an apparent fen on the southwest side of Big Meadow next to Camp Andrew Brown. Sedges (*Carex*) were dominant and lightly grazed, and some trampling by cattle was present. We observed submerged feather mosses (Order Hypnales) and *Ptychostomum* moss in shallow water in the fen. *Sphagnum* moss may also be present in this and other fens in the area. Other plants that we found here include rough bent grass (*Agrostis scabra*), Gairdner's yampah (*Perideridia gairdneri*), and slender starry lady's-tresses (*Spiranthes perexilis*). This appears to be a sloping fen type. This fen is currently grazed by cattle.

Fens are wetlands that are fed groundwater discharge creating boggy conditions. Shallow standing water ponds up or flows slowly in marshy conditions. Oxygen can be low in these waters, creating slow decomposition of vegetation which eventually builds up a layer of peat. Walking in such fens can be an experience of “bounding” on top of a submerged peat layer. Mosses are often abundant and diverse in these rare wetland types.

The Forest Service states for Sierran fens: “Livestock management can affect fens by trampling, compacting peat, creating bare areas in the fen or in adjacent uplands, altering hydrologic conditions and initiating erosion and gully formation.”³ Fens need conservation, and this fen should be considered a field assessment and for exclusion fencing so that cattle do not punch through the peat later with their trampling.



Feather mosses (Order Hypnales). September 13, 2025.

³ https://www.fs.usda.gov/wildflowers/beauty/California_Fens/conservation/pfc.shtml



Fen with Nebraska sedge (*Carex nebrascensis*) and submerged mosses with lodgepole pine (*Pinus contorta* subsp. *murrayana*) at the edge of Big Meadow. September 13, 2025.



Ptychostomum moss.



Yampah (*Perideridia gairdneri*), and grazed sedge (*Carex*). September 13, 2025.



Location of the fen in Big Meadow (green pin).



Spring above the fen in a lodgepole pine forest near Camp Andrew Brown that is trampled by cattle. Many corn lily stalks (*Veratrum californicum*) are knocked down by trampling. September 13, 2025.

Our recommendations for this fragile habitat should follow Forest Plan management measures:

**All Riparian Conservation Areas
Standards (WTR-RCA-STD)**

09 Mitigate or prohibit ground-disturbing activities that adversely affect hydrologic processes that maintain water flow, water quality, or water temperature critical to sustaining fen ecosystems and the plant species that depend on these ecosystems.

10 Assess the hydrologic function of riparian areas, meadows, fens, and other special aquatic features during rangeland management analysis. Ensure that characteristics of special features are, at a minimum, at proper functioning condition or functioning at-risk and trending toward proper functioning condition, as defined in appropriate technical reports. If systems are functioning at-risk, ensure that grazing practices are not retarding rates of natural recovery and assess appropriate actions to move toward proper functioning condition. (USDA Forest Service, Sequoia National Forest 2023a at 18)

Potential Management Approaches

- Where feasible, complete initial inventories of fens within active grazing allotments prior to completing the allotment environmental analysis. If there are more than 10 fens in an allotment, complete initial inventories of at least 25 percent of all the fens in the allotment, and establish a 5-year schedule to complete inventory of the remaining fens in the allotment. (USDA Forest Service, Sequoia National Forest 2023a at 20)

Meadows

Desired Conditions (WTR-RCA-MEAD-DC)

Wetlands and groundwater-dependent ecosystems (including springs, seeps, fens, wet meadows, and associated wetlands or riparian systems) support stable herbaceous and woody vegetation communities that are resilient to drought, climate change, and other stressors. Root masses stabilize stream channels, shorelines, and soil surfaces. The natural hydrologic, hydraulic, and geomorphic processes in these ecosystems sustain their unique functions and biological diversity.

08 Fen condition is within the natural range of variation. Fens are resilient with continual peat accumulation and carbon sequestration. The hydrologic regime, and vegetation, soil, and water characteristics sustain the fen's ability to support unique physical and biological attributes. (USDA Forest Service, Sequoia National Forest 2023a at 20-21)

Range

Goals

02 Work with stakeholders to ensure livestock grazing management strategies minimize negative effects to the structure and function of vegetation and aquatic and riparian ecosystems, especially for small-scale special aquatic features such as fens and springs, as well as habitat and refugia for at-risk species. (USDA Forest Service, Sequoia National Forest 2023a at 92)

The fen should be assessed for water sources and hydrologic regime, as the spring above fen is heavily trampled by cattle, with vegetation knocked over and removed. Cattle may only be less present on this fen because it is next to a summer camp with periodic crowds of people. Grazing by cattle should be minimized further here. Investigation of whether a virtual fencing system could exclude cattle from the fen could be considered.

Horse Meadow

We first visited Horse Meadow on July 29, 2020, and September 14, 2025, which appeared to be more heavily grazed by cattle than Big Meadow. A rhizomatous sedge (*Carex* sp.) was shorter-cropped than in Big Meadow. Mat muhly (*Muhlenbergia richardsonis*) was grazed closely to the ground. Bare ground was estimated at 30%. Needlegrasses (*Stipa*) here were heavily grazed and trampled, showing 80% bare ground in patches indicating excessive utilization and grazing by cattle. Horse Meadow is currently grazed by cattle.

Several Desired Conditions from the Forest Plan, listed below, appear to be functioning at risk. This means the ecosystem is only in fair condition, and vulnerable to degradation of soils, hydrologic function, and lowered plant diversity and vitality. Intervention and restoration may be indicated. Root masses are not stabilizing streambanks. Streambank collapse may lead to disconnection of the stream from the floodplain, which would dry out the meadow. Erosion is apparent from bare ground and streambank trampling and chiseling. Bare ground was apparent in larger amounts than in Big Meadow and Manter Meadow. Unhealthy stands of willows were present, heavily browsed by cattle.

All 6 Desired Conditions listed below for Meadows appear to us to be functioning at risk, with many warning signs of potential downward trends:

Meadows

Desired Conditions (WTR-RCA-MEAD-DC)

01 Meadows are hydrologically functional. Sites of accelerated erosion, such as gullies and head cuts are stabilized, recovering, or within the natural range of variation. Vegetation roots occur throughout the available soil profile. Meadows with perennial and intermittent streams have the following characteristics: (1) stream energy from high flows is dissipated, reducing erosion and improving water quality; (2) streams transport sediment and capture bedload, aiding floodplain development; (3) meadow conditions enhance floodwater retention and groundwater recharge; and (4) root masses stabilize streambanks against cutting action.

02 Wetlands and groundwater-dependent ecosystems (including springs, seeps, fens, wet meadows, and associated wetlands or riparian systems) support stable herbaceous and woody vegetation communities that are resilient to drought, climate change, and other stressors. Root masses stabilize stream channels, shorelines, and soil surfaces. The natural hydrologic, hydraulic, and geomorphic processes in these ecosystems sustain their unique functions and biological diversity.

03 Meadows are resilient and recover rapidly from natural and human disturbances. They exhibit a high degree of hydrologic connectivity laterally across the floodplain and vertically between surface and subsurface flows. They provide important ecosystem services such as high-quality water, recharge of streams and aquifers, and moderation of climate variability and change.

04 Soils in wet and headwater meadows are influenced by a shallow water table and function to filter water. These soils also store and release water over an extended period of time, which helps to maintain streamflow during dry summer months.

05 Meadows have substantive ground cover and a rich and diverse species composition, especially of grasses and forbs. Meadows have high plant functional diversity with multiple successional functional

types represented. Perennial streams in meadows contain a diversity of age classes of shrubs along the streambank, where the potential exists for these plants.

06 A complexity of meadow habitat types and successional patterns support native plant and animal communities. Meadow species composition is predominantly native, where graminoid (grass-like) species are well represented and vigorous, and regeneration occurs naturally. Healthy stands of willow, alder, and aspen are present within and adjacent to meadows with suitable physical conditions for these species. Natural disturbances and management activities are sufficient to maintain desired vegetation structure, species diversity, and nutrient cycling. (USDA Forest Service, Sequoia National Forest 2023a at 20-21)

Management of rangelands may need to be adjusted somewhat to meet Desired Conditions, such as reducing the length of the grazing season, reducing the number of cattle, and/or fencing off Salmon Creek to cattle to prevent this active erosion, as discussed in the Forest Plan:

Range

Desired Conditions (RANG-FW-DC)

02 Livestock grazing is managed to meet or move toward the desired vegetation condition represented by diverse plant functional groups, species richness and diversity, and structure and condition of plant communities.

03 Rangelands are managed to maintain or restore hydrologic function and soil productivity of watersheds. Livestock grazing is managed to accommodate the maintenance or restoration of aquatic and riparian processes and functions.

04 Rangelands are in satisfactory condition and allotments have management strategies that achieve or maintain rangeland conditions in satisfactory condition. (USDA Forest Service, Sequoia National Forest 2023a at 91)

Standards (RANG-FW-STD)

01 Manage livestock grazing to attain desired conditions in blue oak-interior live oak woodlands, annual grasslands, aspen, special habitats, great gray owl protected activity areas, occupied willow flycatcher habitat, and riparian conservation areas. Where livestock grazing is found to prevent or retard attainment of desired conditions, modify grazing practices (such as number of livestock, timing, scheduled rest, and range structures). If adjusting practices is not effective, remove livestock from the area using appropriate administrative authorities and procedures.

02 Assess the hydrologic function of meadow habitats and other special aquatic features during range management analysis. Ensure that characteristics of special features are at a minimum proper functioning condition or functioning at-risk with an upward trend, as defined in the appropriate technical reports.

03 If meadow ecological status is determined to be moving in a downward trend due to grazing, modify or suspend grazing. Modify management of meadows that are in low ecological status or not in proper functioning condition and have active erosion to achieve or show substantial progress toward meeting mid- or late-seral status and proper functioning condition within 5 years.

Potential Management Approaches

- Measures such as salting, herding, water development, fencing and riding will be addressed in annual operating instructions, allotment management plans, permits and permit modifications to improve livestock distribution and minimize impacts to riparian and other sensitive areas. If condition and trend monitoring data, collected every 3 to 5 years, indicates that desired conditions and other plan components are not being

achieved, modify or suspend grazing in the affected area. (USDA Forest Service, Sequoia National Forest 2023a at 94)



Heavily grazed sedge meadow (*Carex*), with Kentucky bluegrass (*Poa pratensis* ssp. *pratensis*), mat muhly, *Potentilla*, white yarrow (*Achillea millefolium*), and other species. July 29, 2020.



Sedge (*Carex*) closely grazed to ground. July 29, 2020.



Sedge (*Carex*) closely grazed to ground. July 29, 2020.



Patches of bare ground were more common in Horse Meadow, generally 30%, with larger patches in drier sagebrush edges and under lodgepole pines. July 29, 2020.



A patch of native annual hairgrass (*Deschampsia danthoniodes*) growing in a low area in the meadow, now dry. It is heavily cropped by cattle. This species generally indicates potential vernal pools, ephemeral wet areas, and swales. July 29, 2020.



Mat muhly (*Muhlenbergia richardsonis*) grazed down to a few inches, with bare ground around it. July 29, 2020.



Another mat muhly in grazed Horse Meadow. September 14, 2025.



Grazed sedge (*Carex*), white yarrow (*Achillea millefolium*), and Kentucky blue grass (*Poa pratensis* ssp. *pratensis*). Kentucky bluegrass is usually considered non-native, but certain lineages could be native in this Holarctic grass meadow. July 29, 2020.



Wet meadow near Salmon Creek with sedges, grazed and trampled. July 29, 2020.



The rhizomatous sedge here is heavily grazed and trampled, with bare ground appearing. July 29, 2020. This appears to us to be over 40% utilization of these sedge plants, which could negatively impact their vigor. Bare ground indicates erosional processes could be impacting the adjacent stream.



We found a single panicle (branching seedhead) of tufted hairgrass (*Deschampsia cespitosa* ssp. *cespitosa*) here in this grazed sedge meadow. This perennial bunchgrass would probably be more common here with less grazing pressure: the reproductive process is being interrupted by cattle removing seedheads. July 29, 2020.



Browsed willows (*Salix*) with a browseline, potentially exceeding 20-30% of the current year's leader growth. This is potential willow flycatcher habitat, and we did observe a small gray flycatcher (*Empidonax* sp.) on July 29, 2020, in these willows. Browselines severely degrade willow flycatcher habitat—these birds require shady, complex riparian understories where canopies are connected to wetlands. Cattle are removing too much riparian vegetation here.

The Forest Plan states that willows should be protected from livestock when utilization indicators are reached or exceeded, which may be the case in Horse Meadow:

Range

Guidelines (RANG-FW-GDL)

06 Limit use of willows and other woody riparian species to an average of no more than 20 to 30 percent of current year's leader growth along streambanks and, as needed, other critical portions of the riparian conservation area. Remove livestock from the area when these utilization indicators are reached or exceeded. (USDA Forest Service, Sequoia National Forest 2023a at 93)



Salmon Creek through Horse Meadow showed grazing damage and streambank alteration. Vegetation in the riparian zone was grazed down and provided little shade for the water. The stream channel is beginning to widen, and likely experiencing higher temperatures. We saw a single trout here. July 29, 2020.

Herbaceous riparian vegetation included sedges (*Carex* sp.), a few patches of tufted hairgrass (*Deschampsia cespitosa* ssp. *cespitosa*), a few remnant bentgrasses (*Agrostis* spp.), a few perennial brome grasses (*Bromus* sp.), Kentucky bluegrass (*Poa pratensis* ssp. *pratensis*), and patch of creeping wildrye (*Elymus triticoides*).

The streambanks here appear to be poorly functioning with sloughing, chiseling, and trampling exceeding 20% of the reach through the meadow. Grazing is slowing riparian growth and impeding stream function and riparian recovery.

The photos below show that Salmon Creek through the cattle-grazed portion of Horse Meadow is not meeting Desired Conditions in the 2023 Forest Plan:

**All Riparian Conservation Areas
Desired Conditions (WTR-RCA-DC)**

01 The connections of floodplains, channels, and water tables distribute flood flows and sustain diverse habitats.

04 Native fish, amphibians, and other native aquatic species are present within their historic distribution, where supported by associated habitat. Habitat conditions support self-sustaining populations. Streams and rivers provide a variety of habitats for aquatic species, including deep pools and overhanging banks,

structure provided by large wood, off-channel areas, and cover within their natural range of variation. Woody and herbaceous overstory and understory regulate stream temperatures. Aquatic and upland components are linked, providing access to food, water, cover, nesting areas, and protected pathways for aquatic, riparian, and upland species.

07 Key riparian processes and conditions (including slope stability and associated vegetation root strength, wood delivery to streams and floodplains, input of leaf and organic matter to aquatic and terrestrial systems, solar shading, microclimate, and water quality) operate consistently with local disturbance regimes.

13 Native riparian vegetation is diverse, structurally complex, and provides food and cover to sustain fish and wildlife populations.

14 Streambank stability is within 90 percent of reach potential. (USDA Forest Service, Sequoia National Forest 2023a at 16-17, selected bullet points.)

Meadows and riparian vegetation appear to be in mid-seral stage with a downward trend, indicated by active erosion of banks into the streamwater. Guidelines listed in the Forest Plan should be followed as management here is reassessed:

Range

Guidelines (RANG-FW-GDL)

07 When grazing in riparian conservation areas under season-long use:

- For meadows and riparian areas that are in low to mid-seral condition with a downward trend, limit livestock utilization of deep-rooted plants to 30 to 35 percent. For streamchannels and drainways, maintain a minimum 6-inch residual stubble height on the greenline.

09 Within riparian conservation areas that are properly functioning or functioning at-risk with an upward trend:

- Limit annual disturbance to streambanks and shorelines of natural lakes and ponds, caused by trampling and trailing, from exceeding 20 percent of stream reach, or natural lake and pond shorelines. Disturbance includes bank sloughing, chiseling, trampling, and other means of exposing bare soil or cutting plant roots.
- Ensure that grazing practices are not retarding the rate of natural recovery in riparian conservation areas. (USDA Forest Service, Sequoia National Forest 2023a at 93)



Salmon Creek showing denuded and trampled riparian vegetation, hoof-chiseled banks, chunks of streambank collapsing into the stream, and erosion. July 29, 2020.



Trampled bare ground where cattle cross the stream, widening and flattening the channel. July 29, 2020.



Streambank collapse from heavy grazing and cattle traffic. July 29, 2020.



Streambed gravels here are silted in from sediment flow into the water, clogging potential salmonid spawning gravels, which lowers oxygen levels and reduces egg survival. July 29, 2020.



Chiseling of the streambank by cattle hoof traffic. July 29, 2020. This is how streambanks break down and deep narrow channels become wide and shallow.



Chiseling by hooves and streambank collapse, leading to erosion, sedimentation of gravels, and lack of streamside vegetative cover and shade. July 29, 2020.



Tea-colored water indicated lack of water clarity, organic debris input, and increased turbidity. Hornworts (*Ceratophyllum* sp.) are an aquatic plant on the substrate. July 29, 2020. High levels of turbidity or fine sediment cloudiness of the water, can strain the gills of trout and reduce their feeding efficiency. Trout eggs can suffocate with lowered dissolved oxygen levels.

The Forest Plan guides managers to restore these impaired water bodies:

**All Riparian Conservation Areas
Guidelines (WTR-RCA-GDL)**

02 Water quality or habitat for aquatic and riparian-dependent species should be maintained or restored. Roads, trails, off-highway vehicle trails, staging areas, developed recreation sites, dispersed campgrounds, special use permits, grazing permits, and day use sites that have been identified as contributing to degradation of water quality or habitat for aquatic and riparian-dependent species should have corrective actions implemented where possible. (USDA Forest Service, Sequoia National Forest 2023a at 19)



Streambank collapse. July 29, 2020.

These photos indicate sediment regimes are out of balance and unnatural, indicating a loss of stream health, with a downward trend (or an increasing magnitude of the problems). The Forest Plan indicates Desired Conditions:

Rivers and Streams

Desired Conditions (WTR-RCA-RIV-DC)

04 Streams and rivers maintain seasonal water flow over time, including periodic flooding, which promotes natural movement of water, sediment, nutrients, and woody debris. Flooding creates a mix of stream substrates for fish habitat, including clean gravels for fish spawning, large wood structures, and sites for riparian vegetation to germinate and establish.

05 Stream channel conditions exhibit a sediment regime under which aquatic and riparian ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport. The sediment regime should be similar to the natural distribution of reference conditions. (USDA Forest Service, Sequoia National Forest 2023a at 21-22)

Gravels here in Salmon Creek where cattle could access the reach through Horse Meadow were not clean and were clogged with sediment caused by cattle access to the stream, trampling and chiseling of the streambank, and erosion. This condition smothers the eggs of trout; the eggs rely on water flow through the gravel to deliver the oxygen that eggs need to survive. Sediment input is excessive and not natural when compared to Manter Creek through Manter Meadow.



Chiseling of streambank by cattle hooves, and the beginning of a larger section of streambank collapsing into the water. July 29, 2020.



Detail of streambank chiseling above. July 29, 2020.



Sloughgrass (*Leersia oryzoides*) growing in Salmon Creek in a slower run, well-rooted into the channel substrate. This is a native perennial cool-season rhizomatous grass that forms sprawling colonies in slow-moving water, including beaver ponds. Perhaps this is an indicator of a long-gone beaver pond and dam which may have helped raise the groundwater level of the meadow. This wetland grass species is useful for waterfowl food, sediment stabilization, and is palatable to livestock. *Leersia oryzoides* forms dense floating mats along with other aquatic plants, as seen in the photo, which form good cover for trout and other fish. July 29, 2020.



Sloughgrass (*Leersia oryzoides*) panicle. Salmon Creek in Horse Meadow, September 14, 2025.



Sloughgrass (*Leersia oryzoides*) panicle. Salmon Creek in Horse Meadow, September 14, 2025. Notice the siltation clogging the stream gravels in this photo.

The Forest Plan lists beaver restoration as a potential management measure to restore habitat. Beavers are not here presently, but Lanman et al. (2012) found much evidence that historically beavers were present in Sierra Nevada streams. Much work has focused on restoration of salmon streams and the intersection of beaver-constructed water features. Beaver dams can alter stream morphology and hydrology for the better, helping to reconnect incised channels to disconnected floodplains that were degraded by severe erosion and livestock grazing.

This reach of Salmon Creek should be considered for potential beaver reestablishment:

All Riparian Conservation Areas
Potential Management Approaches

- Consider restoration practices that are compatible with reestablishment of beavers where suitable habitat exists and when effectively integrated with other natural resource and multiple-use objectives, recognizing important ecological processes that beavers support. (USDA Forest Service, Sequoia National Forest 2023a at 20)



A less-accessed (by cattle) fenced mule pasture (at right) showing lighter grazing of sedges, and little browsing of willows. The cattle-grazed side on the left shows trailing. July 29, 2020.



Goldenrod and lupine (*Lupinus polyphyllus*) were abundant inside the fence from the streambank to 50 feet out into the meadow, unlike in the cattle-grazed areas. July 29, 2020. This demonstrates an increase in plant diversity in areas spared from heavy livestock grazing.



We found only a few relict goldenrods (*Solidago* sp.) and lupine (*Lupinus* sp.) in the grazed meadow, on a sloughing streambank about to erode into the water. July 29, 2020.

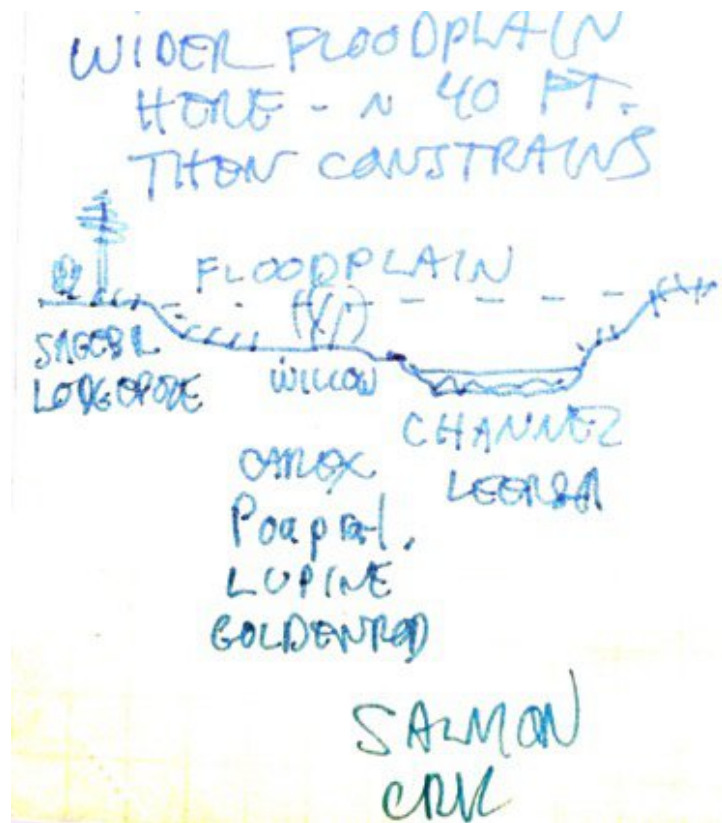
Much of Salmon Creek in Horse Meadow where cattle have access to the stream shows chiseling, sloughing, trampling, and bare soil. The Forest Plan indicates that this type of streambank disturbance should be prevented in order to head off downward trends in proper functioning conditions:

**All Riparian Conservation Areas
Standards (WTR-RCA-STD)**

07 Prevent disturbance to streambanks and shorelines of lakes and ponds caused by resource activities (such as livestock, off-highway vehicles, and dispersed recreation) from exceeding 20 percent of the stream reach, or 20 percent of natural lake and pond shorelines. Disturbance includes bank sloughing, chiseling, trampling, and other means of exposing bare soil or cutting plant roots. This standard may not be met within destination recreation areas, and sites authorized under special use permits, but activities will be designed and managed to reduce the percent of impact to the extent feasible.

And

10 Assess the hydrologic function of riparian areas, meadows, fens, and other special aquatic features during rangeland management analysis. Ensure that characteristics of special features are, at a minimum, at proper functioning condition or functioning at-risk and trending toward proper functioning condition, as defined in appropriate technical reports. If systems are functioning at-risk, ensure that grazing practices are not retarding rates of natural recovery and assess appropriate actions to move toward proper functioning condition. (USDA Forest Service, Sequoia National Forest 2023a at 18, selected bullet points.)



Field notes observing Salmon Creek floodplain, July 29, 2020. More than 20% of the stream reach is being impacted by cattle in this reach of Salmon Creek. Streambank sloughing, chiseling, trampling, and other means of exposing bare soil or cutting plant roots is resulting in erosion and compaction and a wider, shallower stream. This system is function-at-risk.

Spring and small meadow adjacent to Horse Meadow

We documented a small hillside spring located in a lodgepole pine forest at the edge of Horse Meadow. The water flowed into the meadow. The spring was heavily trampled, grazed, and widened by cattle. It had remnant small tufted hairgrass (*Deschampsia cespitosa* ssp. *cespitosa*), tufts of rush (*Juncus* sp.), some rhizomatous sedge (*Carex* sp.), Kentucky bluegrass (*Poa pratensis* ssp. *pratensis*), spike bentgrass (*Agrostis exarata*), wild rose (*Rosa* sp.), currant (*Ribes* sp.), and several forbs: white yarrow (*Achillea millefolium*), sneezeweed (*Helenium bigelovii*), shooting star (*Primula jeffreyi*), and cinquefoil (*Potentilla* sp.).

The small tributary springbrook has relict heavily grazed tufted hairgrass, and we could find only one standing culm and seedhead. Several culms were knocked over by cattle. 90% of standing plant material appeared to be grazed off and bare ground was about 70%.



Field sketch of the shape of the spring outflow and water development. Cattle have trampled the outflow substrate and removed vegetation, causing erosion and springbrook widening.



Small tributary draining into Horse Meadow, almost dry, heavily grazed and trampled with bare ground. Rushes (*Juncus* sp.), sedges (*Carex* sp.), and a single panicle of tufted hairgrass was evident. July 29, 2020. This watercourse has been destroyed by livestock. A substantial reduction in cattle grazing is needed here.



Rushes (*Juncus* sp.), sedges (*Carex* sp.), and a single small panicle of tufted hairgrass (*Deschampsia cespitosa* ssp. *cespitosa*). Other culms were knocked down. Over-utilization could extirpate tufted hairgrass at this site if management changes are not made. July 29, 2020.



Sedges (*Carex* sp.) grazed down on the small tributary flow. July 29, 2020.



Bare ground was common along this closely-grazed tributary. July 29, 2020. Bare ground in meadows like this can lead to rainwater runoff and flood scouring that can remove soils, deposit sediment in streams, and eventually lead to rills and gullies.



Small spring brook. July 29, 2020. Meadow grasses and sedges are grazed by cattle below 40% utilization—too short to be able to photosynthesize abundantly in order to store reserves in roots for the dormant winter season. These sedges often grow by spreading rhizomes, but grazing can reduce the ability of these plants to have enough energy reserves to increase in size. Seedheads are removed so reproduction is lessened further. Plant species diversity is reduced. Bare ground, trailing, and hoof chiseling lead to erosion and poor water quality. This spring and its brook are functioning-at-risk.



Lone panicle of tufted hairgrass (*Deschampsia cespitosa* ssp. *cespitosa*). July 29, 2020. Grass seed production and plant reproduction are almost gone for the year. Retention of these native grass species is at risk, while continued disturbance can allow invasive species a foothold.



Non-native dandelion (*Taraxacum officinale*) is an indicator of heavy grazing and disturbance. July 29, 2020.



Closely-grazed meadow next to a small tributary. July 29, 2020. This meadow is experiencing community simplification and biodiversity loss.



A small hillside spring is heavily grazed and trampled, widened and with muddy water. Relict tufted hairgrass (*Deschampsia cespitosa* ssp. *cespitosa*), tufted rush (*Juncus* sp.), rhizomatous sedge (*Carex* sp.), Kentucky bluegrass (*Poa pratensis* ssp. *pratensis*), and bentgrass (*Agrostis exarata*) were found, along with forbs: white yarrow (*Achillea millefolium*), cinquefoil (*Potentilla* sp.), shooting star (*Primula jeffreyi*), columbine (*Aquilegia formosa*), and sneezeweed (*Helenium bigelovii*). Some mosses (Bryophyta) were also evident. July 29, 2020.



Spring opening. July 29, 2020. Bare ground, soil compaction, and hoof disturbance lead to erosion, sediments plugging the stream opening, and a loss of plant species biodiversity. Sedges and grasses are over-utilized and stressed. Rare and sensitive plants such as orchids may have been present but have been eliminated. Spring flow may be reduced. This spring should be fenced off from livestock access, or cattle could be trained to accept solar-powered virtual fencing collar systems to exclude this spring.



Spring flow channel has been trampled and widened by grazing. July 29, 2020. Cattle hoof trampling across the spring is causing pedestalling, where soil is compacted between plants or groups of plants, and plant roots may be cut. Moss may be sheared off and fragmented. This can create paths for erosion, soil loss, and further widens the springbrook. Water quality and habitat for mountain yellow-legged frogs and golden trout can be impacted.



Rush (*Juncus* sp.) in flower. July 29, 2020. Cattle will graze these off if grazing pressure is too intense, impacting the ability of these rushes to reproduce.



The small hillside spring, tributary to Salmon Creek near Horse Meadow. July 29, 2020. As detailed in the above photos, this spring is severely impacted by cattle trampling and compacting soils, eroding and chiseling the spring opening, and removing vegetation causing bare ground and probable biodiversity loss.



Spring flow with cow tracks and mud. July 29, 2020. Here, hoof action is physically altering the springbrook and wetland substrate, leading to soil compaction and disturbance, releasing sediment into the water. A sharp drop in vegetative biomass occurs. Accelerated erosion is likely.

Based on the conditions observed, we determined that current spring standards do not reach Desired Conditions. These Forest Plan points should be followed:

**All Riparian Conservation Areas
Desired Conditions (WTR-RCA-DC)**

06 Soil structure and function are sustained to infiltrate and disperse water properly, withstand erosive forces, sustain favorable conditions of stream flow, and cycle nutrients. Associated water tables support riparian vegetation and restrict nonriparian vegetation. (USDA Forest Service, Sequoia National Forest 2023a at 16)

Springs and Seeps

Desired Conditions (WTR-RCA-SPR-DC)

01 Springs provide sufficient water to maintain healthy habitats for native riparian and aquatic species.

02 Springs are resilient to natural disturbances, groundwater diversions, and changing climate conditions. Springs function across the landscape within their type and water availability.

03 Springs and associated streams and wetlands have the necessary soil, water, and vegetation attributes to be healthy and functioning at or near potential. Water flow is similar to historic levels and persists over time, within constraints of climate change. (USDA Forest Service, Sequoia National Forest 2023a at 22)

Range

Goals

02 Work with stakeholders to ensure livestock grazing management strategies minimize negative effects to the structure and function of vegetation and aquatic and riparian ecosystems, especially for small-scale special aquatic features such as fens and springs, as well as habitat and refugia for at-risk species. (USDA Forest Service, Sequoia National Forest 2023a at 92)



Moss at the hillside springhead. July 29, 2020. Cow hoof tracks shear away sections of moss, crush moss plants, and can lead to the disappearance of these mosses from this small spring wetland. This site could have held a fen, but heavy season-long grazing and trampling may have eliminated it, with only a few mosses remaining to hint at lost biodiversity.



Turbidity and discoloration of water at spring head from cattle feces. July 29, 2020. Pathogens and zoonotic diseases are an ongoing problem from grazing in watersheds with runoff potential from rainstorms. Water-borne pathogens are a concern for drinking water and recreation, as well as for human health. Hazardous levels of fecal coliform bacteria and *E. coli* have resulted from cattle defecating directly into streams and ponds, but also from transport of fecal material via overland flow to the water body. This can impact recreation in the Forest.



Spring outflow into Horse Meadow is trampled and shows pedestalling of the turf from cattle hooves. July 29, 2020. Soil compaction and root shear caused by hoof action can lead to accelerated erosion as water runs off bare unprotected soils. Water infiltration rates drop as less rainwater is absorbed into wetlands. This can lower spring flows eventually.

Manter Meadow, Domeland Wilderness

On June 28, 2020 and September 13, 2025, we visited Manter Meadow and Upper Manter Meadow in the Domeland Wilderness Area. Except for possible light pack stock (such as saddle horses, pack mules, llamas) use at a camp and evidence of historical grazing activity (old fencing), we did not observe active grazing here during our surveys. Therefore, these meadows provided an excellent opportunity to qualitatively compare floristics, vegetation structure, and stream and spring surface hydrology. Manter Meadow is currently not authorized for grazing by cattle or sheep.

In general the meadows and springs here are in excellent shape. Cheatgrass (*Bromus tectorum*), an invasive weed that fuels frequent fire and degrades habitat conditions, is limited to less than 10% cover in this more arid watershed, and we only found it at the dry outer margins of the meadows. Springs and streams showed no chiseling or trampling, no bare ground, and tall tufted hairgrass, sedge, and other graminoids were dense and tall on banks.

Manter Creek had a deep, narrow channel with cold clear water. Banks were 90-100% vegetated, with many overhanging banks. We measured one plunge pool at 40 centimeters (cm) deep. Runs and riffles provided a variety of fish habitat; one run was 20 cm deep. We observed trout commonly in these stream habitats.

On July 28, 2020, we also observed a potential frog jumping from the bank of Manter Creek into the water, making a “plop” sound. We were not able to see the species but there is a possibility this was a mountain yellow-legged frog (*Rana muscosa*). Mountain yellow-legged frogs prefer high alpine lakes, but will also breed in pools in streams that do not dry out in summer and are deep enough not to freeze over winter. Eggs masses are attached to rocks, vegetation, or under overhanging banks. Tadpoles take two to four years to metamorphose into adult frogs. Adults feed on terrestrial insects and adult stages of aquatic insects. Mountain yellow-legged frogs have declined across their range, dropping 70-90% in population since historic times.⁴ Pesticide drift from the San Joaquin Valley and predation by trout may be leading causes of declines, but livestock grazing has also played a role.

Drier parts of the meadow contained healthy stands of alkali blue grass (*Poa secunda* ssp. *juncifolia*), Columbia needlegrass (*Stipa nelsonii* var. *dorei*), and slender wheatgrass (*Elymus trachycaulus* ssp. *trachycaulus*). We also found annual hairgrass (*Deschampsia danthonioides*) stands in dried shallow pools or spring-moist low spots in the meadow. We did not find alkali blue grass (*Poa pratensis* ssp. *pratensis*) or slender wheatgrass in Big Meadow or Horse Meadow, and these species may be highly sensitive to grazing pressure.

Moister and wet meadows contained abundant sedge (*Carex* spp.), spike-rush (*Eleocharis* spp.), rush (*Juncus balticus*), and tufted hairgrass (*Deschampsia cespitosa* ssp. *cespitosa*). Some areas had moss (Bryophyta) as part of the ground cover in the meadow.

Manter Meadow can be used as a reference area, an ecological baseline against which to measure disturbance from livestock, to guide management of grazed meadows not meeting Desired Conditions.

⁴ <https://wildlife.ca.gov/Regions/6/Amphibians/Mountain-Yellow-legged-Frog>



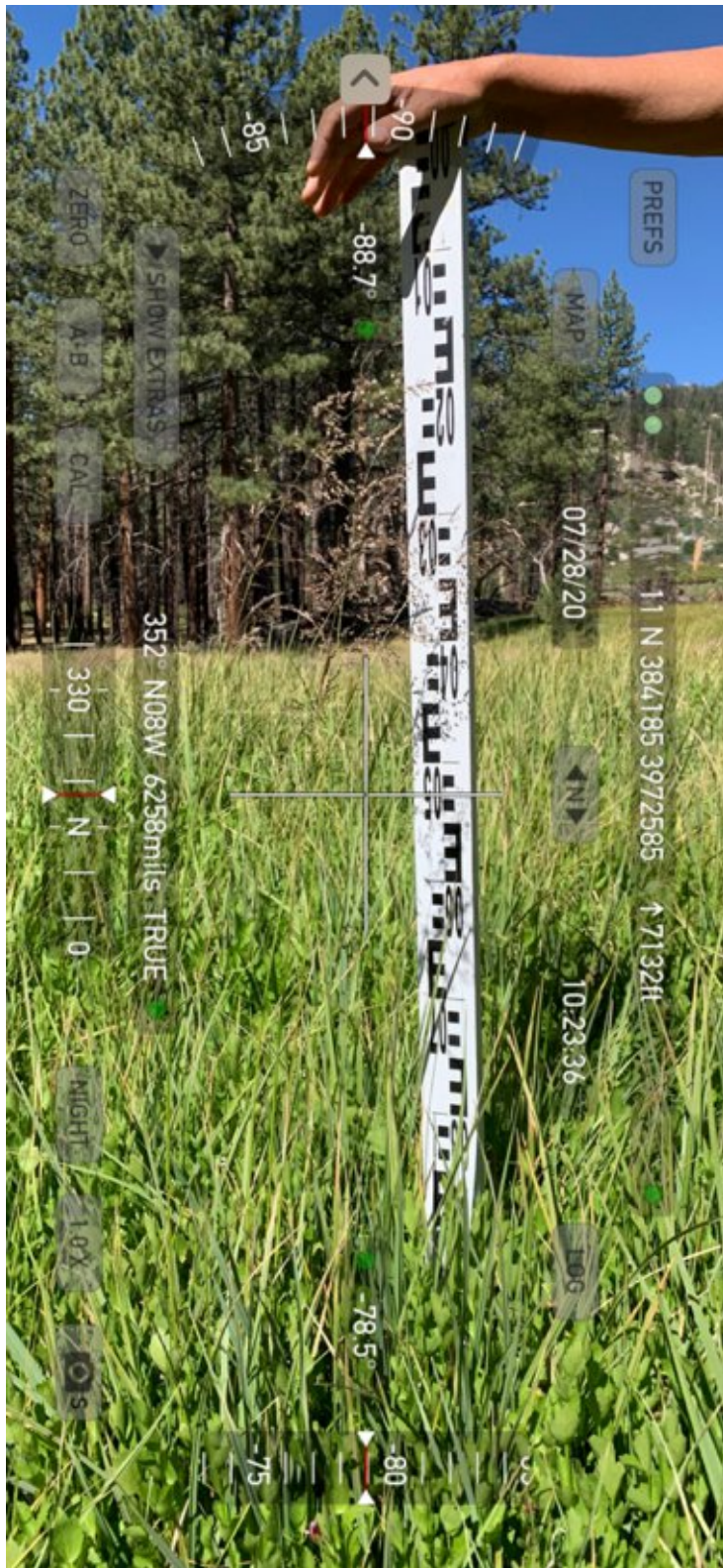
Manter Meadow ungazed by cattle, with lush sedges and grasses, no bare ground, and a high diversity of native graminoids (grasses, sedges, and rushes). We found sedges (*Carex* sp.), tufted hairgrass (*Deschampsia cespitosa* ssp. *cespitosa*), Kentucky bluegrass (*Poa pratensis* ssp. *pratensis*), rough bent grass (*Agrostis scabra*), rush (*Juncus* sp.), creeping wildrye (*Elymus triticoides*), mat muhly (*Muhlenbergia richardsonis*), and western needle grass (*Stipa occidentalis* var. *californica*). July 28, 2020.



Ungrazed tufted hairgrass (*Deschampsia cespitosa* ssp. *cespitosa*) seedheads in Manter Meadow, without cattle. Seeding will allow these grasses to reproduce and replace themselves into the future to maintain healthy meadow populations. July 28, 2020.



Ungrazed tufted hairgrass (*Deschampsia cespitosa* ssp. *cespitosa*) panicles were tall around a spring. The vegetation is so tall and dense that you cannot see the spring water. July 28, 2020. This is what is needed for reproduction of this species.



Lush, tall tufted hairgrass (*Deschampsia cespitosa* ssp. *cespitosa*) in ungrazed Manter Meadow. July 28, 2020.



Ungrazed spring with healthy tufted hairgrass (*Deschampsia cespitosa* ssp. *cespitosa*) and sedges (*Carex* sp.). Spring brooks are well-vegetated with no chiseling and no bare ground. Manter Meadow with no cattle. July 28, 2020.



Ungrazed spring opening in Manter Meadow. Note the clear, clean water, gravels not coated with fine sediment, and banks covered with dense vegetation—no bare soil is showing.



Watercress (*Nasturtium officinale*), an apparently non-native aquatic plant on the water surface of the springhead (although CalFlora describes this species as native to California⁵). July 28, 2020.



White water buttercup (*Ranunculus aquatilis* var. *diffusus*) is a native perennial aquatic herb, on the water surface near the springhead. The fruits provide food for waterfowl, and the plant itself gives shelter to aquatic invertebrates.

⁵ <https://www.calflora.org/app/taxon?crn=9597>



Springhead with tall tufted hairgrass (*Deschampsia cespitosa* ssp. *cespitosa*) and rush (*Juncus* sp.), recovering well from historic legacy livestock grazing. July 28, 2020.



Ungrazed springhead. Sedge (*Carex* sp.), rush (*Juncus* sp.), and tufted hairgrass (*Deschampsia cespitosa* ssp. *cespitosa*) are tall and overhang the banks of the spring and outflow. Here, spring banks are well covered with dense and tall vegetation, and erosion is at a minimum. Soils are not compacted by cattle hooves, so rainwater infiltration to porous soils is higher than in wetlands and slopes with trampled, compacted soils. Spring flow can be positively correlated with more rainwater infiltration and less runoff in a watershed. July 28, 2020.



Ungrazed springhead in Manter Meadow. Note tall, ungrazed vegetation and seedheads. July 28, 2020.



Healthy meadow with rush (*Juncus* sp.), sedge (*Carex* sp.), Kentucky bluegrass (*Poa pratensis* ssp. *pratensis*), tufted hairgrass (*Deschampsia cespitosa* ssp. *cespitosa*), bentgrass (*Agrostis* sp.), and other plants. Ungrazed Manter Meadow, July 28, 2020.



Spike of Columbian needlegrass (*Stipa dorei* spp. *nelsoni*) showing seeds in ungrazed Manter Meadow. These seedheads are often grazed and broken off by cattle trampling in grazed meadows. September 13, 2025.



Upper Manter Meadow showing Columbian needlegrass (*Stipa dorei* spp. *nelsoni*) next to pocket gopher (*Thomomys*) diggings, with sedge (*Carex* sp.) and rush (*Juncus* sp.). While this looks brown and dead, these grasses dry out as summer progresses, and will be back next year in a healthy and abundant state. September 13, 2025.



Upper Manter Meadow showing Columbian needlegrass (*Stipa dorei* spp. *nelsoni*) next to pocket gopher diggings, with sedge (*Carex* sp.) and rush (*Juncus* sp.). This is a healthy meadow showing no bare ground other than gopher burrow sign, and 100% cover of native plants and leaf litter. Soils are porous and not compacted. September 13, 2025.



Columbian needlegrass (*Stipa dorei* spp. *nelsoni*) bunch in ungrazed Manter Meadow on a drier edge site. This native perennial bunchgrass is healthy and ungrazed with seedheads and plenty of leafy growth. This is how tall these meadow grasses get if left ungrazed by livestock, and instead are grazed only by the native herbivores. September 13, 2025.



Slender wheatgrass (*Elymus trachycaulus* ssp. *trachycaulus*), ungrazed Manter Meadow, September 13, 2025. This species disappears with overgrazing.



Ungrazed slender wheatgrass (*Elymus trachycaulus* ssp. *trachycaulus*), Manter Meadow, September 13, 2025.



Alkali bluegrass (*Poa secunda* ssp. *juncifolia*), Manter Meadow, September 13, 2025.



Ungrazed small bunches of alkali bluegrass (*Poa secunda* ssp. *juncifolia*), along with sedges and rushes, upper Manter Meadow, September 13, 2025. Heavy cattle grazing can eliminate alkali bluegrass.



Upper meadow edge with stand of alkali bluegrass (*Poa secunda* ssp. *juncifolia*) bunches near an upland stony field with lupine. Manter Meadow, September 13, 2025. We did not see this habitat at Big Meadow or Horse Meadow, perhaps because of the sensitivity of the palatable alkali bluegrass to heavy grazing.



Baltic rush (*Juncus balticus* ssp. *ater*) dominated part of Manter Meadow. September 13, 2025. Baltic rush is one of the dominant species in these wet meadows. The rhizomes are thick and bind wetland soils. The stems can provide forage for livestock and native grazers when young and tender. Mature rushes become coarse and fibrous, and less palatable, although the seeds provide food for insects, birds, and small mammals.



Baltic rush (*Juncus balticus* ssp. *ater*) dominated part of Manter Meadow. September 13, 2025.



Spike-rush (*Eleocharis* sp.) in ungrazed Manter Meadow. Spike-rush forms dense spreading patches in moist meadows and seasonally wet meadow edges or areas with a high water table, with rhizomatous roots that have dense fibrous rootlets. It thus helps hold meadow soils together. Palatability to cattle is rather low because of the high silica content of the fibrous stems and leaves, but deer are known to graze on green growth and waterfowl eat the seeds. September 13, 2025.



Mat Muhly (*Muhlenbergia richardsonis*) in ungrazed Manter Meadow. September 13, 2025.



Mat Muhly (*Muhlenbergia richardsonis*) patches in ungrazed Manter Meadow, along with sedges and rushes. September 13, 2025. No disturbed bare ground is visible in this photo compared to the photo of Big Meadow, and growth is relatively lush at the end of summer.



Low dry swale that was wet and green earlier in the season, with annual hairgrass (*Deschampsia danthonioides*), in ungrazed Manter Meadow. September 13, 2025.



Low dry swale that was wet and green earlier in the season, with annual hairgrass (*Deschampsia danthonioides*), in ungrazed Manter Meadow. September 13, 2025.



Moss (Bryophyta) in sedge (*Carex* sp.) meadow, ungrazed Manter Meadow. September 13, 2025. We did not encounter mosses in the cattle-grazed meadows except at the fen in Big Meadow. These mosses may indicate fen formation in Manter Meadow and should be monitored.



Drier upland transition meadows had rough bent grass (*Agrostis scabra*), prairie junegrass (*Koeleria macrantha*), and needlegrasses (*Stipa* spp.), mixing in with sedges (*Carex* sp.) and rushes (*Juncus* sp.). Ungrazed Manter Meadow, July 28, 2020.



Manter Creek flows through the meadow in a narrow, deep channel with overhanging sedges (*Carex* spp.). We observed trout to be abundant in this stream. July 28, 2020. The lack of cattle grazing here allows the stream to have a narrow, deep shape, overhung with vegetation. No bare ground is visible from grazing and trampling by heavy livestock. Native wildlife such as mule deer are light on the land and vegetation.



Narrow stream channel with *sedges* (*Carex* sp.). The floodplain here appears wide while the active channel is narrow and deep. July 28, 2020.



Willows (*Salix* sp.) show ungrazed growth form with no browselines. July 28, 2020. Willow canopies connect here to the sedge wetlands, creating complex and cool habitats for willow flycatchers. Ungrazed Manter Meadow.



Sedge (*Carex* sp.) with deep thatch, which serves to help absorb water and snowmelt and keep the meadow moist and productive. Ungrazed Manter Meadow, July 28, 2020.



Ungrazed Manter Creek exhibits classic healthy montane stream characters of narrow, deep channel with overhanging banks and vegetation that help cool the water temperature. The water is clear with no discoloration or turbidity. This is good habitat for fishes, amphibians, and aquatic insects. July 28, 2020.



Gravels are clean of any sedimentation on Manter Creek with no cattle. Trout spawning here would have an abundant flow of oxygen to their eggs buried in the gravels. Banks are overhanging, providing excellent cover for trout. July 28, 2020.



Manter Creek within the ungrazed meadow, showing no streambank collapse and a deep narrow channel. Streambank stability is essential for healthy aquatic ecosystems. July 28, 2020.



Deep plunge pool in Manter Creek. July 28, 2020. This stream and meadow ungrazed by cattle shows a diversity of stream channel types, including runs, riffles, and deeper pools. In grazed stream reaches such as in Big Meadow and Horse Meadow, cattle hoof chiseling and streambank collapse, as well as grazing on bank vegetation, tends to flatten out microtopography and surface hydrology, resulting in shallower, warmer streams that are much less favorable to trout.

Based on our observations, we determined that this meadow is being maintained at Desired Conditions.

All Riparian Conservation Areas
Desired Conditions (WTR-RCA-DC)

01 The connections of floodplains, channels, and water tables distribute flood flows and sustain diverse habitats. (USDA Forest Service, Sequoia National Forest 2023a at 16)



Overhanging banks with trout cover in ungrazed Manter Meadow. We saw trout here on July 28, 2020.



Overhanging streambanks and 100% vegetative cover on the banks provide trout cover. Ungrazed Manter Meadow. We saw trout here on July 28, 2020.



Left, Northern naughehyde liverwort (*Ptilidium coliare*), found along Manter Creek overhanging banks (habitat photo right), ungrazed Manter Meadow, September 2025. This nonvascular plant species is limited to habitat conditions found only in the ungrazed or lightly grazed meadows. It is an example of a species that contributes to the plant diversity that is compatible with large native herbivores but disappears with heavy livestock grazing.



Ungrazed Manter Meadow with a spring opening with pools, showing crystal-clear water and duckweed (*Lemna* sp.) floating on the water surface. Tufted hairgrass (*Deschampsia cespitosa*) is abundant and lush, seeding well. July 28, 2020. This is a healthy spring and meadow complex and could provide habitat for mountain yellow-legged frogs, and perhaps w a water source for wildlife such as deer and bighorn sheep.



Clear water at the springhead with sedges and *Lemna minor*. July 28, 2020. *Lemna minor* (small duckweed) on the surface of the water at the spring opening. This floating aquatic perennial herb is native, and acts as a filter for removing excess nitrogen and phosphorus. Livestock will readily eat it, and we found none in the grazed Big Meadow or Horse Meadow. July 28, 2020.



Untrampled springhead with floating small duckweed (*Lemna minor*) and clean, crystal-clear water bubbling up out of sand and gravel substrate free of sediment overload and turbidity. July 28, 2020.



Undisturbed springhead with moss, duckweed (*Lemna*), rush (*Juncus*), wiregrass sedges (*Eleocharis*), and tufted hairgrass bunches (*Deschampsia cespitosa*). July 28, 2020. This kind of structural habitat complexity with numerous taxa of plants and mosses was not encountered in the grazed and trampled springs of Horse and Big Meadows.



A liverwort at the springhead, showing start-like reproductive structures (gametophores). Manter Meadow, ungrazed. July 28, 2020. Heavy cattle grazing and trampling at springs in Horse and Big Meadows likely eliminated all traces of these delicate nonvascular plants if they were present.



Spring brook with floating duckweed (*Lemna* sp.), rushes (*Juncus* sp.), and wire-grass sedges (*Eleocharis* sp.). July 28, 2020. Notice the lack of bare ground and the tall meadow vegetation. Even though rushes and sedges are less favored as forage by cattle because of their fibrous, coarse nature, structural damage from hoof action can degrade patches of these plants. Cattle will eat them down, especially when more palatable plants have been grazed out. This ungrazed Manter Meadow landscape shows dense, tall meadow vegetation and a narrow, cold, clear springbrook.



Sedges (*Carex* sp.) in ungrazed meadow around spring brooks, ungrazed Manter Meadow. July 28, 2020. Note that in the heavily-grazed meadows even the sedges were grazed down to short heights.



Meadow with large slender wheatgrass bunches (*Elymus trachycaulus* ssp. *trachycaulus*), rush (*Juncus* sp.), sedge (*Carex* sp.), and white yarrow (*Achillea millefolium*). These slender wheatgrass bunches look large and healthy in an ungrazed state. They are a decreaser with heavy cattle grazing, and we found only a few small plants in Horse Meadow with cattle grazing. Its short roots cannot withstand grazing pressure, and it will tend to disappear when cattle are allowed to graze the plants during flowering and seed set.⁶ Thus slender wheatgrass could be useful as an indicator species of meadow ranges in a declining state. July 28, 2020.

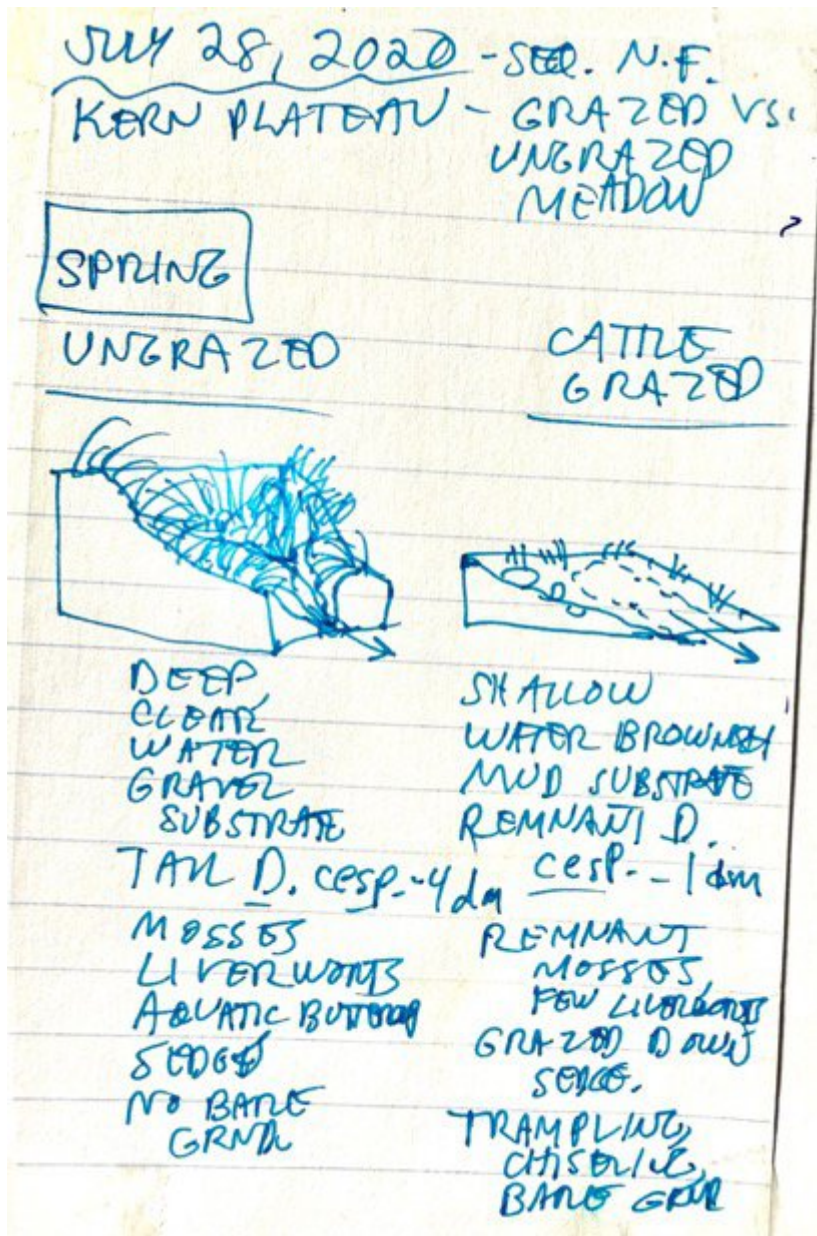
Discussion and Recommendations

Comparison with an ungrazed meadow was instructive to see changes caused by cattle grazing in similar and adjacent meadows. Ungrazed meadows such as Manter Meadow can be used as reference sites in order to better understand how to manage grazed meadows towards functioning condition following land use plans.

Early warning signs of downward trends such as patches of bare ground, cheatgrass, and water quality should continue to be monitored with public participation. In addition, we found

⁶ See <https://www.fs.usda.gov/database/feis/plants/graminoid/elytra/all.html>

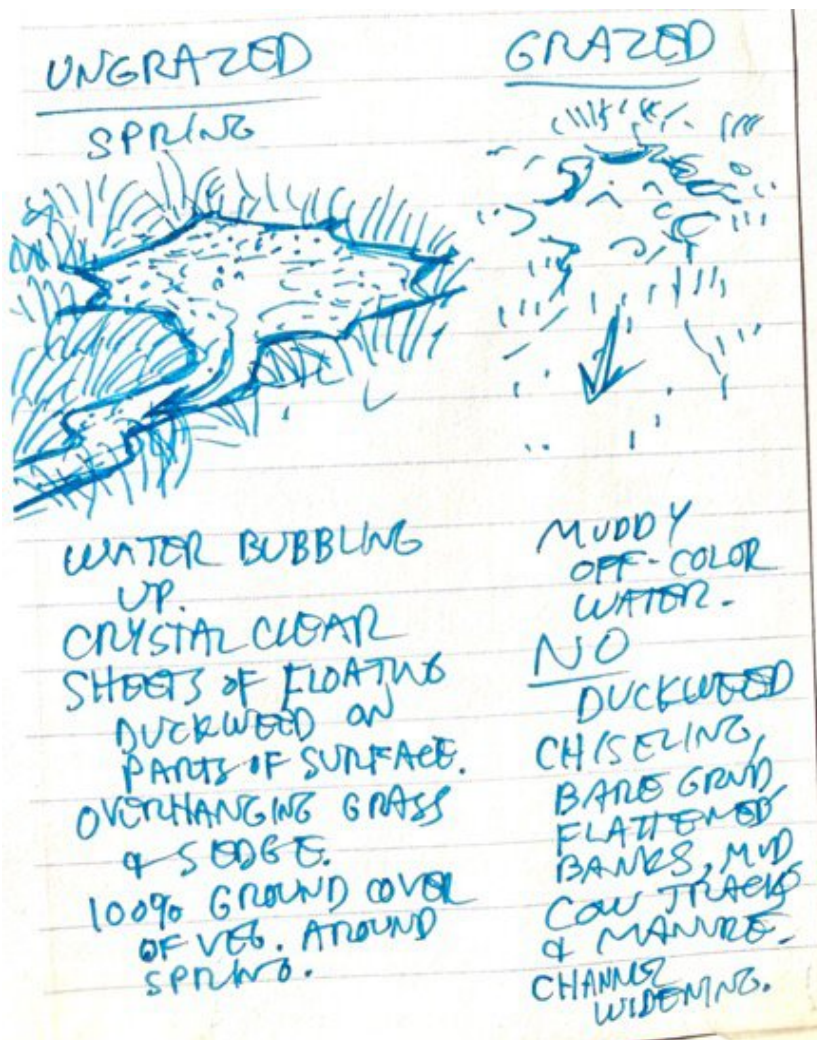
certain indicator plants in our floristics research that can be used to assess meadow condition and give information on possible restoration.



Notes and sketches comparing generalized ungrazed meadow-edge spring (such as observed in Manter Meadow) with a cattle-grazed spring (such as observed next to Horse Meadow). Tall tufted hairgrass (*Deschampsia cespitosa* ssp. *cespitosa*) dominated ungrazed springs, while only remnant small grazed tufted hairgrass was found in grazed spring habitats. This meadow grass should be used as an indicator species for grazing pressure.



Photo pair 1. Left: ungrazed spring with tufted hairgrass and sedge, Manter Meadow. Right: cattle-grazed spring near Horse Meadow.



Field notes comparing meadow-edge springs in ungrazed (Manter Meadow) with grazed springs (Horse Meadow). Floating duckweed (*Lemna* sp.), crystal-clear water, and overhanging grass

(including tufted hairgrass) and sedge (*Carex* sp.) characterized the ungrazed spring. The grazed spring had bare ground, no duckweed, no overhanging grasses and sedges, chiseled edges, and muddy turbid water.



Photo pair 2. Left: ungrazed spring opening with deep, clear, cold water, Manter Meadow. Right: cattle-grazed and trampled spring near Horse Meadow, with shallow mud.



Field notes comparing ungrazed spring brooks and streams in meadows (Manter Meadow) to grazed spring brooks and streams in Horse Meadow and Big Meadow. Ungrazed springs were narrow and deep with overhanging vegetation and even liverworts. Water was clear and cold. Trout cover habitat was present. Grazed meadow streams were flattened and widened by cattle trampling and bank destabilization, erosion, and elimination of vegetation holding soils together. Water color was turbid and brownish, and sediment could be seen filling gravels in runs and riffles.



Photo pair 3. Left: deep, trough-like narrow stream with densely vegetated banks and overhanging plants. Water is clear and cold. Manter Meadow. Right: cattle-grazed stream that is wide and shallow with bare ground on banks, short-grazed vegetation, and hoof-chiseling that is destabilizing banks. Water is warmer and murkier. Horse Meadow.



Photo pair 4. Left: ungrazed deep, narrow stream with overhanging banks supported by well-rooted plants. Channel is sinuous. Manter Meadow. Right: wide, shallow stream grazed and trampled by cattle. Banks are showing bare ground, and hoof action is causing bank collapse and erosion. Plants are short and overgrazed with shallower roots and cannot hold the banks together.

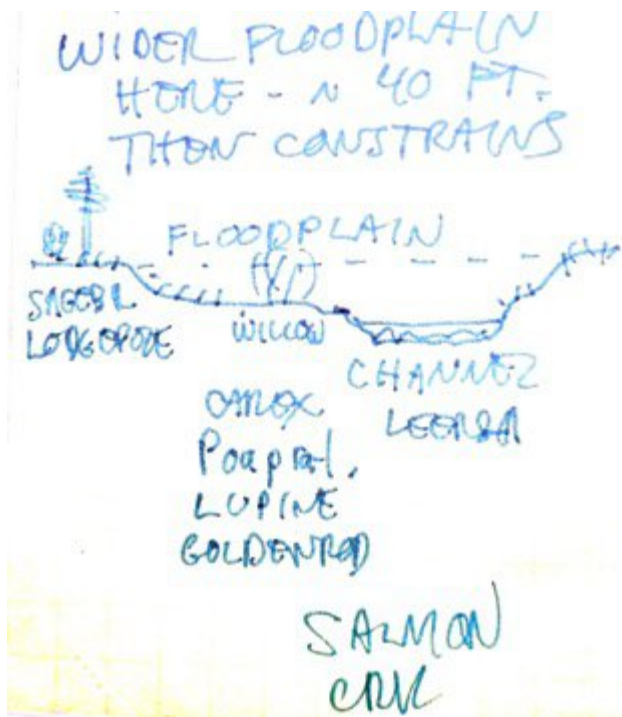
The channel has become straighter, losing its sinuosity—floodwaters will speed through this channel faster. Horse Meadow.



Photo pair 5. Left: ungrazed stream that is narrow with cold, clear water and plenty of overhanging grasses, sedges, and forbs. Stream substrate has clean gravel. Manter Meadow. Right: wide, shallow stream that is grazed by cattle. Vegetation is grazed short and parts of the streambank are beginning to erode into the water. Stream substrate is full of silt from erosion, and high organic matter feeds aquatic plant growth that smothers trout spawning gravels.



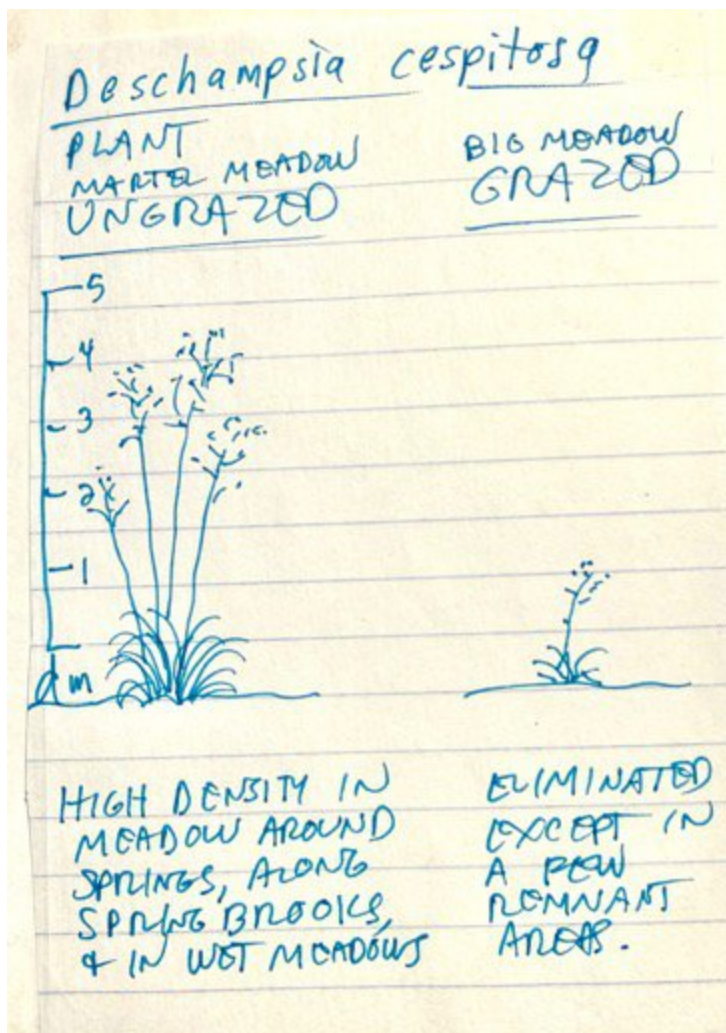
Photo pair 6. Left: ungrazed deep pool with gravel-cobble substrate and overhanging vegetated bank. Manter Meadow. Right: wide, shallow pool that is grazed and trampled by cattle, showing eroded silt and sediments clogging the gravel and cobble substrate. Horse Meadow.



Field sketch showing Salmon Creek in Horse Meadow with a wide floodplain, and a possible remnant beaver pool with rice cutgrass (*Leersia oryzoides*). This could be a site where beaver reintroduction could be considered in order to repair stream damage and a trend towards floodplain disconnection.



Former traces of an old beaver pond? Rice cutgrass in a shallow pool in a grazed meadow, Horse Meadow.



Field notes showing qualitative observations of height (in decimeters) and plant vigor of ungrazed and grazed tufted hairgrass (*Deschampsia cespitosa* ssp. *cespitosa*). This deep-rooted native perennial bunchgrass helps to hold soils together and stabilize streambanks, but when excessively grazed it shrinks in size, forms smaller roots, and is finally eliminated with heavy chronic grazing. This should be considered for use as an indicator species for range management.



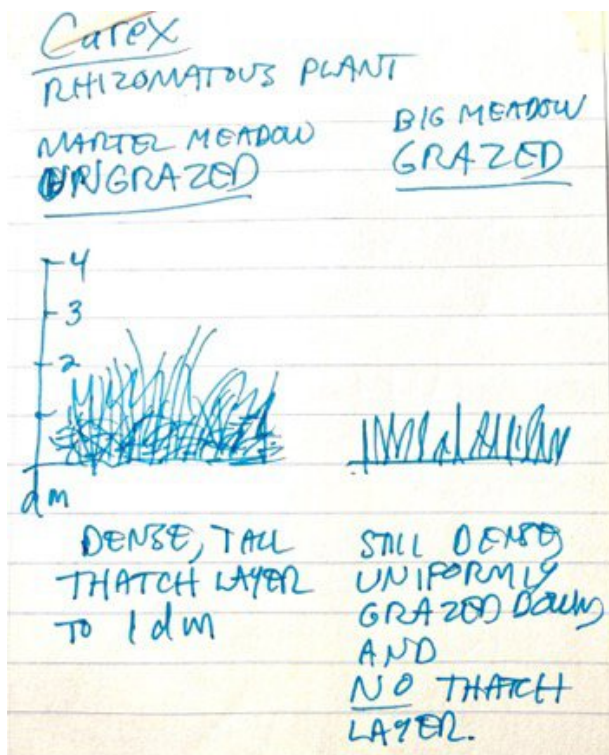
Photo pair 7. Left: Tall healthy tufted hairgrass seedheads in ungrazed Manter Meadow, at shoulder height. Right: one small tufted hairgrass plant at knee height, grazed Horse Meadow.



Ungrazed Manter Meadow with tall tufted hairgrass.



Tall ungrazed healthy tufted hairgrass, Manter Meadow.



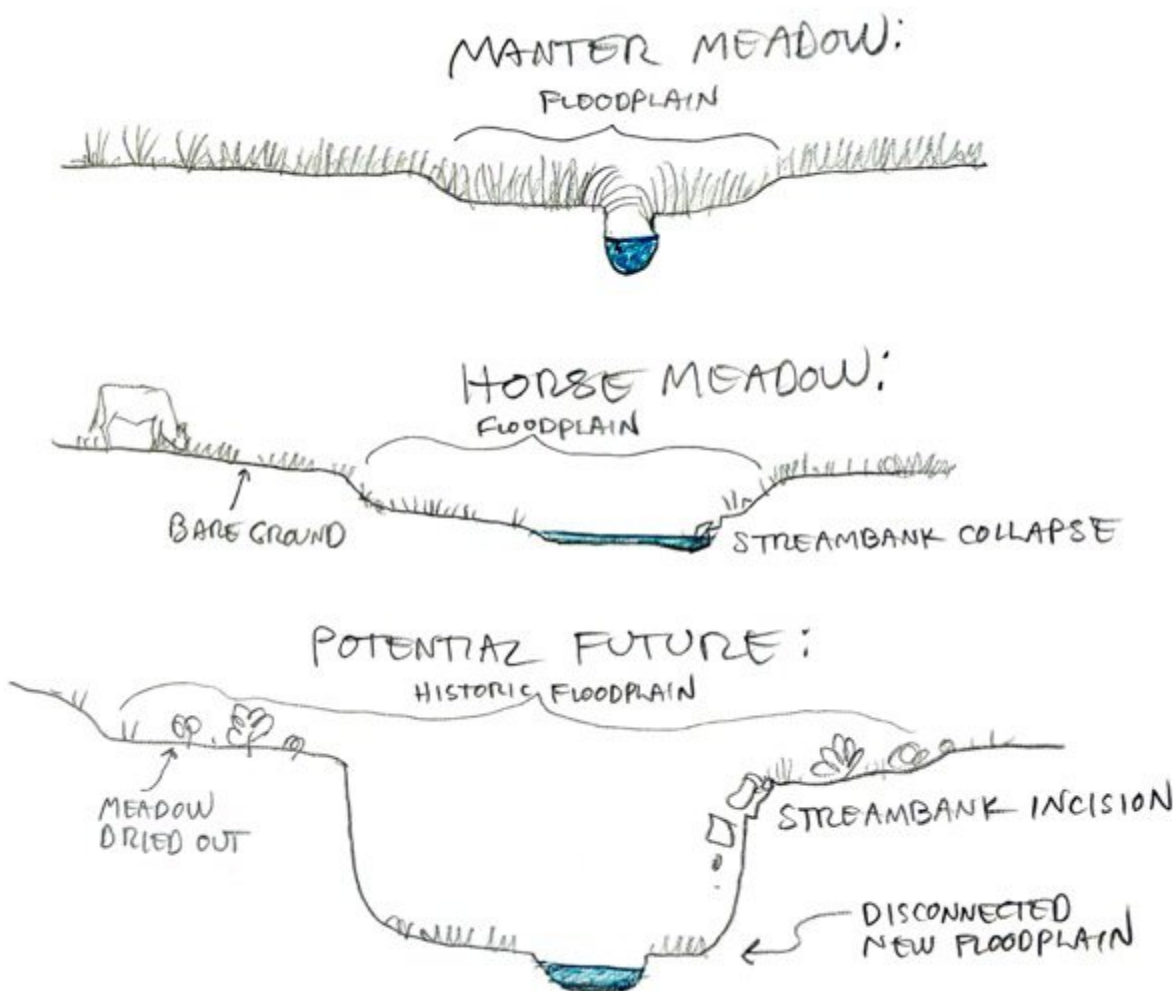
Field notes of Nebraska sedge (*Carex nebrascensis*), a native rhizomatous perennial sedge that dominates wet meadows. Ungrazed sedges are higher (sketch shows decimeters) and have thatch—dead and old leaf and stem material which forms a protective groundcover. Roots are vigorous and prevent erosion. Big Meadow had *Carex* stands with less height, no thatch, and some bare ground. Horse Meadow has a higher percentage of bare ground and less vigorous *Carex* stands, with more dry meadows where this sedge does not grow. Nebraska sedge is an important forage species and should be used as a key species to determine grazing pressure. Heavier grazing can cause increased bare ground, stream entrenchment, and lowering of the meadow water table which will decrease the extent of Nebraska sedge in meadows as dry-adapted meadow species and upland plants move in. This may be happening in Horse Meadow.



Photo pair 8. Left: sedge (*Carex*) in wet meadow at Big Meadow, lightly accessed by cattle. Right: sedge (*Carex*) grazed down by cattle in Horse Meadow. The sedges here are disappearing because of the over-utilization by livestock.



Photo pair 9. Left: Ungrazed Manter Meadow in July showing diverse and lush grasses and sedges and no bare ground. Soils are springy and spongy. Right: similar cattle-grazed meadow with very-closely grazed sedges and grasses, with bare ground and soil compaction. Heavily used parts of Horse Meadow in July.



Sketches of meadow and floodplain profiles for Salmon Creek as it appeared in Big Meadow and Horse Meadow. The bottom profile is a hypothetical future if erosion and streambank collapse is allowed to happen over time. We have seen this type of floodplain disconnection in other parts of the Sierra Nevada.

We observed higher plant and cryptobiotic crust diversity in Manter Meadow. We found certain indicator plants in our floristics research that can be used to assess meadow condition and give information on possible restoration. Some native meadow grasses disappeared with even moderate grazing, such as alkali bluegrass (*Poa secunda* ssp. *juncifolia*), but they may be able to return rather quickly from the seedbed with rest from cattle.

Mosses and liverworts were observed regularly in the meadow and stream banks in Manter Meadow, and only a few mosses in Horse and Big Meadow (with the exception of a fen).

For Riparian Conservation Areas, the Forest Plan states:

Standards (WTR-RCA-STD)

10 Assess the hydrologic function of riparian areas, meadows, fens, and other special aquatic features during rangeland management analysis. Ensure that characteristics of special features are, at a minimum, at proper functioning condition or functioning at-risk and trending toward proper functioning condition, as defined in appropriate technical reports. If systems are functioning at-risk, ensure that grazing practices are not retarding rates of natural recovery and assess appropriate actions to move toward proper functioning condition. (18)

We encourage the Forest to undertake proposed and possible actions listed in the 2023 Land Management Plan. We understand that these are “proposed and probable actions that may take place on the Sequoia National Forest at the project or activity level to help maintain existing conditions or achieve the desired conditions described in the plan” (Appendix B at 159). We list the proposed and possible actions below, along with our notes:

Water, Soils, and Watershed

- Plan and implement restoration actions in priority watersheds. Implement best management practices on all projects and continue to conduct best management practices monitoring to ensure water quality objectives are being met.
 - Reconstruct or restore riparian function to springs identified as not in proper functioning condition.
 - Restore nonfunctioning or functioning-at-risk riparian areas so they are in or moving toward proper functioning condition.
 - Evaluate fens (peatlands) using the regional fen proper functioning condition protocol 12; determine and implement actions to restore fens and sustain peat formation if necessary.
 - Coordinate with other government agencies to protect water quality and protect aquatic ecosystems from invasive plants and animals. Restore wetlands that are not in proper functioning condition.
 - Collaborate with partners and stakeholders on meadow and riparian restoration, connectivity, and education.
- (USDA Forest Service, Sequoia National Forest 2023a at 159.)

Big Meadow and Horse Meadow have early warning signs of water quality impairment with streams having bank destabilization and trampling, along with increased turbidity. The previously restored Big Meadow is in better condition, while Horse Meadow appears to be on a downward trend for bare ground, streambank collapse, and poor water quality. The riparian area of Salmon Creek at Horse Meadow is functioning at risk and could benefit from fencing to exclude cattle from the floodplain. Consider a river crossing where cattle can pass and drink which is armored to decrease erosion and trampling.

We found a few small springs near Horse Meadow that could benefit from fencing to exclude cattle and allow for restoration.

Fens could similarly use better protection from cattle trampling and grazing.

We would be happy to collaborate on meadow and riparian restoration as stakeholders.

Aquatic and Riparian Ecosystems

- Restore wetlands that are not in proper functioning condition.
- Coordinate with the California Department of Fish and Wildlife and U.S. Fish and Wildlife Service on the management of sport and native fishes.
- Reconstruct or restore riparian function to springs identified as not in proper functioning condition.
- Restore nonfunctioning or functioning at-risk riparian areas so they are in or moving toward proper functioning condition.
- Distribute information to the media and the public focused on the unique properties of meadows and appropriate activities within meadows.
- Collaborate with partners and stakeholders on meadow and riparian restoration, connectivity, and education.
- Reroute system trails away from meadows and springs. Discourage dispersed recreation sites and user-constructed trails on the meadow edge. Discourage winter motorized recreation in riparian conservation areas and eliminate it where possible from meadows and within 100 feet of streams.
- Coordinate with the California Department of Fish and Wildlife on objectives for wildlife conservation, education, and habitat restoration and improvements, particularly regarding Kern River rainbow trout, California golden trout, and Little Kern golden trout.

(USDA Forest Service, Sequoia National Forest 2023a at 160.)

Meadows along Manter Creek in ungrazed wilderness appear to have recovered very well from historic grazing, and light grazing by pack livestock has not in our observation caused any downward trends in proper functioning condition. Water quality is clear and appears excellent. Manter Meadow and the stream there can serve as a reference site to help guide restoration and monitoring of other meadows in the region.

Big Meadow appears to be largely in proper functioning condition but with some early warning signs such as bare ground areas where cattle concentrate, and sediment loads in the stream caused by cattle trampling and erosion. The fence panel grazing exclosure should be reconstructed and monitored. When will the Forest next undertake vegetation and soil transects at Big Meadow?

Horse Meadow is in worse condition, with more widespread bare ground, greater utilization of sedges and grasses, and Salmon Creek in the meadow has brown water color and actively collapsing streambanks. This area should be high priority for management actions to help stabilize erosion and restore meadows, riparian areas, springs, and water quality.

Invasive Species

- Maintain a current inventory of invasive exotic species on National Forest System lands, access roads, and trails.
- Continue invasive weed treatments in high-priority areas.
(*id.*)

Cheatgrass (*Bromus tectorum*) patches are a concern in Big Meadow, Horse Meadow, and Manter Meadow. These should be inventoried and a treatment plan enacted to prevent spread in heavy use areas such as trails.

Range

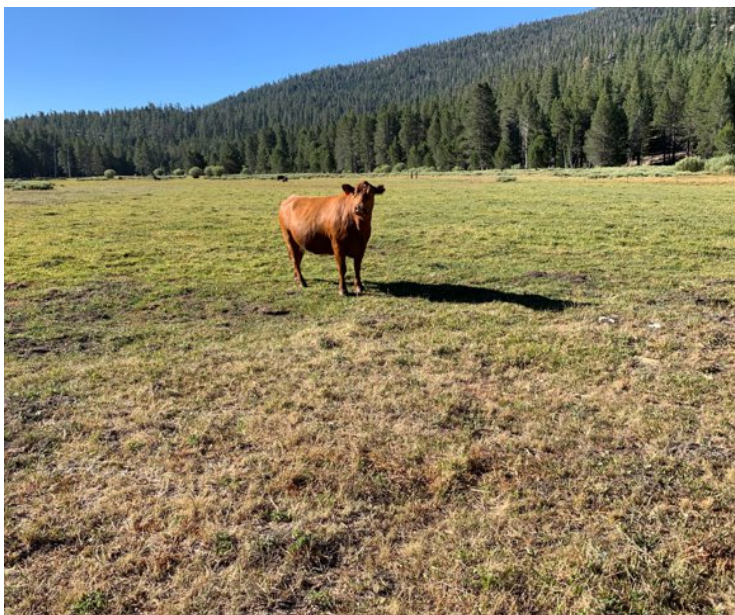
- Implement the Sequoia's Federal Land Policy Management Act Schedule for grazing allotment environmental analysis to update allotment management plans accordingly [43 U.S.C. 1752(i)].
- Review active allotment management plans on a regular basis.
- Maintain and replace fencing, water troughs and other range improvements.
(USDA Forest Service, Sequoia National Forest 2023a at 161.)

We recommend following these guidelines required under the Federal Land Policy Management Act in order to gather data on allotments, allow public input on these public lands, identify and correct problem areas, and update allotment management plans with the best available science.

We recommend that the Domeland Wilderness continue to be managed for no livestock and that the A. Brown Allotment continue to be managed as vacant.

It is important to note that meadows listed as “ungrazed” from a livestock perspective are still grazed by native herbivores, including grasshoppers, pocket gophers, pikas, ground squirrels, voles, mule deer, and bighorn sheep. Livestock grazing managed by the Forest Service are allocated 40% of the edible forage in meadows. Each cow-calf pair grazes away vegetation sufficient to feed two elk (historically present in the Sierra Nevada) and six mule deer (Ogle and Brazee 2009), so livestock-grazed meadows would be expected to support far smaller populations of native wildlife, from the herbivores to the carnivores that prey on them. It is notable that meadows grazed by native herbivores only appear far healthier and more biodiverse than the meadows observed to be grazed by cattle. This is because native herbivores co-evolved with these ecosystems and their component plants for hundreds of thousands if not millions of years, adapting to each other so that plants, animals, insects, and amphibians thrived in a dynamic natural balance. Cattle were imported from Europe, evolved with different plants alien to the Sierra Nevada, and therefore tend to exert disproportionately negative ecological impacts and their current heavy levels of grazing encourages the spread of nonnative invasive weeds.

Perhaps beavers could be restored to Horse Meadow to provide stream and meadow restoration function. Beavers are a keystone species in stream ecosystems, and their activities stimulate native biodiversity and help retain groundwater and stream flows.



Left: native grazer--grasshopper in Manter Meadow. Right: cow in Horse Meadow.

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ANNOTATED CATALOG OF THE VASCULAR FLORA

The following is a vascular checklist of the meadows of the Manter and Salmon Creek watersheds in the southern Sierra Nevada, Tulare County, California. These include prominent meadows such as Big Meadow, Deadwood Meadow, Horse Meadow, Little Manter Meadow, and Manter Meadow, and their immediate borders. The flora of small, nameless meadows, as well as other meadow-like habitats in the watersheds (i.e. seeps, fens, lodgepole pine forest, etc.) are also included. A total of 294 minimum-rank taxa are listed here. The checklist is based on fieldwork done between the months of April and September in 2019-2021. Additional specimens were accrued from herbaria searches via Consortium of California Herbaria (CCH1 and CCH2 2020), SEINet Portal Network (2020), and the California Natural Diversity Database (CNDDDB 2020).

This checklist is a subset of a larger annotated checklist of the entire Manter and Salmon Creek watersheds, which can be found in House (2026). A full set of specimens collected during this larger study is housed at the California Botanic Garden (RSA), except for two *Cryptantha* specimens (House 1219 and 1335) that were sent to the herbarium at UCSD for identification by an expert in the Boraginaceae group. Those specimens not housed at RSA are noted with the herbarium they reside at. Of the 1,142 total historical collections from the Manter and Salmon Creek watersheds, ca. 250 were annotated from the following herbaria: CAS, UC/JEPS, RSA, SBBG, UCR, DAV, GH, UCSB, CDA, and SFV. These specimens were prioritized for examination because they represented taxa that were not encountered during field work or were easily accessible at the home herbarium of the researcher (RSA). Examining historically collected rare taxa was also prioritized. All identifications were made by the author or by an expert in the group.

Nomenclature and classification mainly follow the Jepson Flora Project (2026), though the Flora of North America (1993+) was also consulted. With each taxon listed in this catalog, there follows an herbarium specimen citation, the lifeform, vegetation type, and abundance in the watersheds. The following terms are typically used to define abundance: rare, uncommon, occasional, locally common, and common. Non-native taxa are denoted by an asterisk (*). Taxa collected historically but not rediscovered during this flora are denoted with a diamond (♦). Those species listed in the CNPS Inventory of Rare and Endangered Plants (online edition, v9-01 1.5) and State Listed taxa are symbolized with a dagger (†).

FERNS AND FERN ALLIES

EQUISETACEAE

Equisetum arvense L. Field Horsetail.

Perennial herb. Locally common in montane riparian habitats above 1981 m (6500 ft). In and around creeks. *House, Le, & Purdy 794* (RSA).

Equisetum laevigatum A. Braun. Smooth Scouring Rush.

Perennial herb. Occasional on streambanks in mixed conifer forests and montane meadows. Moist, sandy and gravelly soil. *House, Le, & Purdy 767* (RSA).

GYMNOSPERMS

PINACEAE

Abies magnifica A. Murray bis var. ***critchfieldii*** Lanner.

Tree. Common in mixed conifer forest and subalpine forest. Frequently observed in most other habitat types, in less abundance. *House & Fraga* 279 (RSA).

Pinus contorta Loudon subsp. ***murrayana***. Lodgepole Pine.

Tree. Common at the edge of montane meadows and in wet, flat areas of mixed conifer forest. *House & Fraga* 292.

Pinus jeffreyi Grev. & Balf. Jeffrey Pine.

Tree. Common at dry edges of montane meadows, and in surrounding mixed conifer forests. *House* 482 (RSA).

ANGIOSPERMAE – MONOCOTS

ALLIACEAE

Allium validum S. Watson. Swamp Onion.

Geophyte. Uncommon in seeps, in understory of mixed conifer forest. Historically collected in meadow margins, but this was not observed during this study. *House & Schaefer* 1250 (RSA).

ARACEAE

Lemna minuta Kunth. Least Duckweed.

Aquatic. Common in montane meadows and streams. Stagnant or shallow water. *House & Fraga* 310 (RSA).

Lemna trisulca L. Star Duckweed.

Aquatic. Occasional in montane meadows and streams. Stagnant or shallow water. *House* 1610 (RSA).

CYPERACEAE

♦ ***Carex abrupta*** Mack. Abrupt Beaked Sedge.

Perennial grasslike herb. Uncommon in montane meadows. *Howell & True* 48462A (CAS).

Carex athrostachya Olney. Long-Bracted Sedge.

Perennial grasslike herb. Occasional in montane meadows. Seasonally moist areas. *House* 977 (RSA).

Carex aurea Nutt. Golden Sedge.

Perennial grasslike herb. Uncommon in wet montane meadows and on streambanks above 7000ft (2134m). *House 981* (RSA).

Carex douglasii Boott. Douglas' Sedge.

Perennial grasslike herb. Uncommon at dry edges of montane meadows. *House & Cunningham 1027* (RSA).

♦ **Carex filifolia** Nutt. var. **erostrata** Kük. Thread Leaf Sedge.

Perennial grasslike herb. Rare in montane meadows. West side of Big Meadow. *Howell & True 47010* (CAS).

Carex filifolia Nutt. var. **filifolia**. Thread-Leaved Sedge.

Perennial grasslike herb. Rare in lodgepole pine forest. Dry areas. Big Meadow. *House 922* (RSA).

Carex fracta Mack. Fragile-Sheathed Sedge.

Perennial grasslike herb. Locally common in montane meadows. Occasional on streambanks above 7000ft (2134m). *House & Morse 701* (RSA).

Carex heteroneura W. Boott. Smooth-Fruited Sedge.

Perennial grasslike herb. Locally common in montane meadows. Occasional on streambanks above 7000ft (2134m). *House 499* (RSA).

Carex integra Mack. Smooth-Beaked Sedge.

Perennial grasslike herb. Uncommon in lodgepole pine forest and montane meadows. Seasonally moist area. South end of Big Meadow. *House, Morse, & Tollet 1428* (RSA).

Carex jonesii L.H. Bailey. Jones' Sedge.

Perennial grasslike herb. Occasional in montane meadows and streambanks above 6500ft (1981m). *House, E. House, & T. House 845* (RSA).

Carex lemmonii W. Boott. Saw-Toothed Sedge.

Perennial grasslike herb. Occasional in montane meadows. Wet areas. *House & Cunningham 1020* (RSA).

Carex luzulina Olney. Woodrush Sedge.

Perennial grasslike herb. Uncommon from seeps and streambanks in mixed conifer forest. Wet areas. *House 887* (RSA).

Carex mariposana Mack. Mariposa Sedge.

Perennial grasslike herb. Rare from montane meadow. Dry, open area. Manter Meadow. *House & Cunningham 1023* (RSA).

♦ **Carex microptera** Mack. Small Wing Sedge.

Perennial grasslike herb. Rare from montane meadow. Big Meadow. *Howell & True 47173* (CAS).

Carex nebrascensis Dewey. Nebraska Sedge.

Perennial grasslike herb. Common in montane meadows. Forms dense monocultures in moist areas; dominant sedge in most meadows. *House & Comito 1499* (RSA).

Carex pellita Willd. Woolly Sedge.

Perennial grasslike herb. Uncommon in montane meadows. Wet, marshy areas. *House, Purdy, Columbus, England, & Pearson 1594* (RSA).

♦ ***Carex praegracilis*** W. Boott. Field Sedge.

Perennial grasslike herb. Uncommon in montane meadow. Moist places. West side of Big Meadow. *Howell, Fuller, & Barbe 53775* (CAS).

Carex rossii Boott. Ross' Sedge.

Perennial grasslike herb. Occasional in lodgepole pine forest and montane meadows. *House, Morse, & Tollet 1427* (RSA).

Carex simulata Mack. Short-Beaked Sedge.

Perennial grasslike herb. Uncommon in montane meadows. Wet, often boggy areas. *House & Varnava 1464* (RSA).

Carex subfusca W. Boott. Rusty Broomsedge.

Perennial grasslike herb. Occasional in montane meadows and montane riparian habitats above 6500ft (1981m). Seasonally wet areas. *House, Purdy, Columbus, England, & Pearson 1585* (RSA).

Carex utriculata Boott. Southern Beaked Sedge.

Perennial grasslike herb. Occasional in montane meadows. Grows in large patches, in wet areas. Big Meadow. *House, Morse, & Tollet 1353* (RSA).

♦ ***Eleocharis bella*** (Piper) Svenson. Beautiful Spikerush.

Perennial grasslike herb. Uncommon in montane meadow. Wet, bare soil. Big Meadow. *Twisselmann 7529* (CAS).

♦ ***Eleocharis quinqueflora*** (Hartmann) O. Schwarz. Fewflower Spikerush.

Perennial grasslike herb. Uncommon in montane meadows. Big Meadow and Horse Meadow. *Twisselmann 12496* (CAS).

Eleocharis suksdorfiana Beauverd. Suksdorf's Spikerush.

Perennial grasslike herb. Uncommon in montane meadows. Wet areas. Big Meadow and Little Manter Meadow. *House, Posa, & Bickford 1198* (RSA).

Scirpus microcarpus J. Presl & C. Presl. Small Fruited Bulrush.

Perennial grasslike herb. Occasional along streambanks in mixed conifer forest. *House & Comito 1472 (RSA)*.

IRIDACEAE

Sisyrinchium idahoense E.P. Bicknell var. ***occidentale*** (E.P. Bicknell) Douglass M. Hend.
Idaho Blue Eyed Grass.

Perennial herb. Rare in montane meadows. Moist, grassy places. Manter Meadow. *House 969 (RSA)*.

JUNCACEAE

Juncus balticus Willd. subsp. ***ater*** (Rydb.) Snogerup. Baltic Rush.

Perennial grasslike herb. Locally common in montane meadows. Dry, often disturbed areas. *House & Layfield 1338 (RSA)*.

Juncus macrandrus Coville.

Perennial grasslike herb. Rare on streambanks in mixed conifer forest. Manter Creek.
House, Purdy, Columbus, England, & Pearman 1577 (RSA).

Juncus nevadensis S. Watson var. ***nevadensis***. Sierran Rush.

Perennial grasslike herb. Common in montane meadows and in montane riparian habitats above 6500ft (1981m). *House & Morse 699 (RSA)*.

Juncus orthophyllus Coville. Straightleaved Rush.

Perennial grasslike herb. Occasional in montane meadows and in montane riparian habitats above 6500ft (1981m). *House, Le, & Purdy 777 (RSA)*.

Luzula comosa E. Mey. var. ***laxa*** Buchenau. Hairy Wood Rush.

Perennial grasslike herb. Uncommon in montane meadows and streambanks above 7000ft (2134m). *House & Comito 1498 (RSA)*.

LILIACEAE

† ***Fritillaria pinetorum*** Davidson. Pine Fritillary.

Geophyte. Uncommon in montane meadows. Open, sunny areas. Big Meadow and Manter Meadow. *House 489 (RSA)*.

Lilium kelleyanum Lemmon. Kelley's Lily.

Geophyte. Locally common on hillside seeps and on streambanks above 6000ft (1829m). Moist places. *House & Layfield 1315 (RSA)*.

MELANTHIACEAE

Veratrum californicum Durand var. ***californicum***. California Corn Lily.

Perennial herb. Common in montane meadows and on streambanks above 7000ft (2134m). Often forms dense stands. *House, E. House, & T. House 863 (RSA)*.

ORCHIDACEAE

Platanthera dilatata (Pursh) Lindl. ex L.C. Beck var. ***leucostachys*** (Lindl.) Luer. White-Flowered Bog-Orchid.

Perennial herb. Occasional in montane meadows and streambanks above 7000ft (2134m). Wet, generally open places. *House, Le, & Purdy 808* (RSA).

Platanthera sparsiflora (S. Watson) Schltr. Sparse-Flowered Bog-Orchid.

Perennial herb. Rare from wet montane meadow. Sirretta Trail. *House & Fraga 1542* (RSA).

Spiranthes perexilis (Sheviak) M.C. Pace. Slender Starry Ladies' Tresses.

Perennial herb. Rare from montane meadow. Wet, boggy area. Big Meadow. *House & Varnava 1465* (RSA).

POACEAE

* ***Agropyron cristatum*** (L.) Gaertn. subsp. ***pectinatum*** (M. Bieb.) Tzvelev. Crested Wheatgrass.

Perennial grasslike herb. Rare in mixed conifer forest. Disturbed roadside. Cherry Hill Road, north end of Big Meadow. *House 893* (RSA).

Agrostis exarata Trin.

Perennial grasslike herb. Occasional in mixed chaparral, montane chaparral, and mixed conifer forest. Seasonally moist areas, streambanks, dry washes. *House & Layfield 1309* (RSA).

♦ * ***Agrostis gigantea*** Roth. Creeping Bentgrass.

Perennial grasslike herb. Rare in mixed conifer forest. Roadsides, disturbed areas. Big Meadow. *Twisselmann 13641* (CAS).

♦ † ***Agrostis humilis*** Vasey. Mountain Bent Grass.

Perennial grasslike herb. Uncommon in montane meadow. Moist to dry areas. Big Meadow. *Howell & True 41929* (CAS).

Agrostis idahoensis Nash. Idaho Redtop.

Perennial grasslike herb. Occasional in montane meadows and lodgepole pine forest. Open, moist areas. *House & Comito 1495* (RSA).

Agrostis pallens Trin. Dune Bent Grass.

Perennial grasslike herb. Uncommon in montane meadows and lodgepole pine forest. Dry, gravelly edges of meadows. *House, Le, & Purdy 793* (RSA).

Agrostis scabra Willd. Rough Bent Grass.

Perennial grasslike herb. Common in montane meadows and seasonally wet places above 6500ft (1981m). Streambanks, dry washes, dry meadows. *House 941* (RSA).

♦ ***Alopecurus aequalis*** Sobol. var. ***aequalis***. Shortawn Foxtail.
Perennial grasslike herb. Occasional in montane meadows. Wet areas. *Twisselmann* 16884 (CAS).

Bromus sitchensis Trin. var. ***carinatus*** (Hook. & Arn.) R.E. Brainerd & Otting. California Brome.
Perennial grasslike herb. Common in montane meadows, mixed conifer forest, and montane chaparral. Seasonally moist areas, tolerant of disturbance. *House, E. House, & T. House* 869 (RSA).

Bromus sitchensis Trin. var. ***marginatus*** (Nees) B. Boivin. Mountain Brome.
Perennial grasslike herb. Common in montane meadows, mixed conifer forest, and montane chaparral. Seasonally moist areas, tolerant of disturbance. *House & Morse* 652 (RSA).

* ***Bromus tectorum*** L. Cheat Grass.
Annual grasslike herb. Common in mixed chaparral, montane chaparral, and montane coniferous forest. Open, disturbed areas, especially along roadsides and trails. *House* 370 (RSA).

♦ * ***Dactylis glomerata*** L. Orchardgrass.
Perennial grasslike herb. Rare in montane meadow. Moist, disturbed area. Big Meadow. *Howell* 46817 (CAS).

Deschampsia cespitosa (L.) P. Beauv. subsp. ***cespitosa***. Tufted Hairgrass.
Perennial grasslike herb. Common in montane meadows and springs above 7000ft (2134m). Lush, wet areas. *House* 963 (RSA).

♦ ***Deschampsia danthonioides*** (Trin.) Munro. Annual Hairgrass.
Annual grasslike herb. Uncommon in montane meadows and on streambanks above 7000ft (2134m). Moist areas. *Howell* 46719 (CAS).

Deschampsia elongata (Hook.) Munro. Slender Hair Grass.
Perennial grasslike herb. Common from montane meadows, streambanks, and seasonally wet areas throughout study site. *House & Morse* 716 (RSA).

Elymus trachycaulus (Link) Gould ex Shinnars subsp. ***trachycaulus***. Slender Wheat Grass.
Perennial grasslike herb. Locally common in montane meadows. Dry, disturbed areas. *House & Schaefer* 1276 (RSA).

Elymus triticoides Buckley. Perennial grasslike herb. Creeping Wild-Rye.
Occasional in mixed conifer forest and Jeffrey pine forest. Seasonally moist areas, dry washes 1981–2286 m (6500–7500 ft). *House & Cunningham* 1015 (RSA).

Festuca microstachys Nutt. Small Fescue.

Annual grasslike herb. Uncommon in montane meadows and on streambanks above 7000ft (2134m). Wet areas. *House, Le, & Purdy 788* (RSA).

◆ * ***Festuca perennis*** (L.) Columbus & J.P. Sm. Italian Rye Grass.

Annual grasslike herb. Rare in lodgepole pine forest. Dry, disturbed areas. *Howell & True 46930* (CAS).

Glyceria elata (Nash ex Rydb.) M.E. Jones.

Perennial grasslike herb. Common in montane riparian habitats above 2134 m (7000 ft). Wet areas such as streams and streambanks. Occurs less commonly in dry, shaded understory of mixed conifer forest. *House & Cunningham 1039* (RSA).

◆ * ***Holcus lanatus*** L. Common Velvetgrass.

Perennial grasslike herb. Rare in montane meadow. Moist areas. Manter Meadow. *Howell & True 48427* (CAS).

Hordeum brachyantherum Nevski subsp. ***brachyantherum***.

Perennial grasslike herb. Uncommon on streambanks in mixed conifer forest. Wet areas. *House 996* (RSA).

◆ * ***Hordeum murinum*** L. subsp. ***glaucum*** (Steud.) Tzvelev. Foxtail.

Annual grasslike herb. Rare in montane meadow. Moist, disturbed areas. Manter Meadow. *Twisselmann & Bedell 13973* (CAS).

Koeleria macrantha (Ledeb.) Schult. June Grass.

Perennial grasslike herb. Common in montane meadows, mixed conifer forest, and montane chaparral. Dry, open areas. *House & Cunningham 1011* (RSA).

◆ ***Muhlenbergia andina*** (Nutt.) Hitchc. Foxtail Muhly.

Perennial grasslike herb. Rare from montane meadows. Wet areas. Big Meadow. *Howell & True 41942* (CAS).

◆ ***Muhlenbergia filiformis*** (Thurb. ex S. Watson) Rydb. Slender Muhly.

Annual grasslike herb. Uncommon in montane meadow. Moist areas. Big Meadow. *Howell 47162* (CAS).

Muhlenbergia richardsonis (Trin.) Rydb. Mat Muhly.

Perennial grasslike herb. Locally common in lodgepole pine forests, montane meadows, and on streambanks above 7000ft (2134m). Open, dry to moist areas. *House, Morse, & Tollet 1344* (RSA).

Phleum alpinum L. Alpine Timothy.

Perennial grasslike herb. Uncommon in montane meadows. Wet areas. North end of Big Meadow. *House 892* (RSA).

◆ * ***Phleum pratense*** L. Common Timothy.

Perennial grasslike herb. Uncommon in montane meadows. Disturbed areas. *Twisselmann 13656* (CAS).

♦ * ***Poa annua*** L. Annual Blue Grass.

Annual grasslike herb. Uncommon in montane meadow. Disturbed, moist areas. Big Meadow. *Howell 47223* (CAS).

Poa bolanderi Vasey. Bolander's Bluegrass.

Annual grasslike herb. Common in montane meadows and mixed conifer forest. Dry, open areas. *House & Fraga 532* (RSA).

* ***Poa pratensis*** L. subsp. ***pratensis***. Kentucky Blue Grass.

Perennial grasslike herb. Common in mixed conifer forest and dry edges of montane meadows. Open, dry and disturbed habitats. *House & Morse 709* (RSA).

Poa secunda J. Presl subsp. ***juncifolia*** (Scribn.) Soreng. Rush Blue Grass.

Perennial grasslike herb. Common in mixed conifer forest and dry edges of montane meadows. Open, dry and disturbed habitats. *House & Morse 627* (RSA).

Poa secunda J. Presl subsp. ***secunda***. One-Sided Blue Grass.

Perennial grasslike herb. Occasional in mixed chaparral, mixed conifer forest, and montane meadows. Dry, rocky slopes to wet meadows. *House & Varnava 1158* (RSA).

Stipa nelsonii Scribn. var. ***dorei*** (Barkworth & J.R. Maze) Dorn. Mountain Needle Grass.

Perennial grasslike herb. Uncommon in montane meadows. From dry, disturbed areas to standing water. *House & Cunningham 2021* (RSA).

Stipa occidentalis Thurb. ex S. Watson var. ***californica*** (Merr. & Burt Davy) C.L. Hitchc. Western Needle Grass.

Perennial grasslike herb. Rare in mixed conifer forest. Open, dry areas. Along the North Manter Trail. *House & Cunningham 1014* (RSA).

♦ ***Torreyochloa pallida*** (Torr.) G.L. Church var. ***pauciflora*** (J. Presl) J.I. Davis. Mannagrass.

Perennial grasslike herb. Rare in montane meadow. Wet areas. Big Meadow. *Twisselmann 16902* (UCD).

♦ ***Trisetum spicatum*** (L.) K. Richt. Narrow Oatgrass.

Perennial grasslike herb. Uncommon in montane meadows. Dry to moist areas. Horse Meadow. *Howell & True 41705* (CAS).

POTAMOGETONACEAE

Potamogeton foliosus Raf. subsp. ***foliosus***. Leafy Pondweed.

Aquatic. Uncommon in ponds, 7700ft (2347m). Stagnant to slow-moving water. Big Meadow. *House, Morse, & Tollet 1352* (RSA).

Potamogeton natans L. Floating-Leaved Pondweed.

Aquatic. Locally common in ponds and streams, 7700ft (2347m). Stagnant, mucky water. Big Meadow. *House, Morse, & Tollet 1351* (RSA).

RUSCACEAE

Maianthemum stellatum (L.) Link. Starry False Lily Of The Valley.

Perennial herb. Occasional from wet, shaded seeps and streambanks in mixed conifer forest. From 6500-7500ft (1981-2286m). *House, Le, & Purdy 730* (RSA).

ANGIOSPERMAE - EUDICOTS

APIACEAE

† ***Angelica callii*** Mathias & Constance. Call's Angelica.

Perennial herb. Occasional on streambanks, in montane meadows and conifer forests. *House, Morse & Tollet 1381* (RSA).

Angelica capitellata A. Gray. Ranger Buttons.

Perennial herb. Locally common on streambanks in mixed conifer forest. *House & Fraga 301* (RSA).

Berula erecta (Huds.) Coville.

Perennial herb. Uncommon on streambanks, in Jeffrey pine forest. Manter Creek. Likely more broadly distributed than observed. *House, Purdy, Columbus, England, & Pearman 1551* (RSA).

Oxypolis occidentalis J. M. Coult. & Rose. Western Cow Bane.

Perennial herb. Occasional on streambanks, in mixed conifer forest. *House 219* (RSA).

Perideridia parishii (J. M. Coult. & Rose) A. Nelson & J. F. Macbr. subsp. ***latifolia*** (A. Gray) T. I. Chuang. Parish's Yampah.

Perennial herb. Locally common in montane meadows and on streambanks. Tolerant of cattle disturbance. *House, Le, & Purdy 734* (RSA).

ASTERACEAE

Achillea millefolium L. Common Yarrow.

Perennial herb. Common in moist places, especially montane meadows, lodgepole pine forests, and riparian corridors in all habitat types. Disturbed, dry areas. *House & Jesus 196* (RSA).

Agoseris × elata Nutt. Tall Agoseris.

Perennial herb. Rare in dry edges of montane meadows. Manter Meadow. *House, Le, & Purdy 772* (RSA).

♦ ***Agoseris monticola*** Greene. Mountain Agoseris.

Perennial herb. Uncommon in margins of montane meadows. Big Meadow. *Twisselmann 16900* (CAS).

Anisocoma acaulis Torr. & A. Gray. Scalebud.

Annual herb. Rare in dry edges of montane meadows. Manter Meadow. *House, Posa, & Bickford 1172* (RSA).

Antennaria dimorpha (Nutt.) Torr. & A. Gray.

Perennial herb. Rare in montane meadows. Sandy drainage in Big Meadow. *House & Varnava 1222* (RSA).

Antennaria rosea Greene subsp. ***confinis*** (Greene) R.J. Bayer. Rosy Pussytoes.

Perennial herb. Locally common in lodgepole pine forest. Dry, shaded places. *House, Le, & Purdy 781* (RSA).

Antennaria rosea Greene subsp. ***rosea***. Rosy Pussytoes.

Perennial herb. Locally common in lodgepole pine forest. Dry, shaded places. *House, Morse, & Tollet 1347* (RSA).

Arnica chamissonis Less. Chamisso Arnica.

Perennial herb. Locally common on streambanks above 7000ft and in damp montane meadow margins. Dense, wet areas. *House 923* (RSA).

♦ ***Arnica mollis*** Hook. Cordilleran Arnica.

Perennial herb. Narrowly distributed in montane meadows and on streambanks. Horse Meadow. *Howell & True 41727* (CAS).

Artemisia douglasiana Besser. Mugwort.

Perennial herb. Common in montane riparian habitat, throughout the study site. Found both streamside and in surrounding shaded understory. *House, Morse, & Tollet 1379* (RSA).

Artemisia dracunculus L.

Perennial herb. Common in mixed conifer forest, montane chaparral, and montane riparian habitats. Disturbed areas, dry washes. *House & Varnava 1440* (RSA).

♦ ***Artemisia ludoviciana*** Nutt. subsp. ***incompta*** (Nutt.) D.D. Keck. Western Mugwort.

Perennial herb. Occasional in mixed conifer forest and montane riparian habitats. Collected historically in several locations, including: southwest end of Big Meadow, Manter Creek, along the trail from Big Meadow to Manter Meadow, etc. *Howell & True 47024* (CAS).

Artemisia rothrockii A. Gray. Rothrock Sagebrush.

Shrub. Locally common at the dry edges of montane meadows. Especially prominent in Big Meadow and Horse Meadow. Tolerant of cattle. *House & Varnava 1460* (RSA).

Cirsium scariosum Nutt. var. ***americanum*** (A. Gray) D.J. Keil. Dinnerplate Thistle.
Perennial herb. Uncommon in montane meadows. All collections from east side of Manter Meadow, in moist places around springs and creek. *House, Posa, & Bickford 1207* (RSA).

♦ ***Ericameria nauseosa*** (Pursh) G.L. Nesom & G.I. Baird var. ***mohavensis*** (Greene) G.L. Nesom & G.I. Baird. Mojave Rabbitbrush.
Shrub. Rare in mixed conifer forest. Dry areas. North end of Big Meadow. *Twisselmann 19256* (CAS).

Ericameria nauseosa (Pursh) G.L. Nesom & G.I. Baird var. ***speciosa*** (Nutt.) G.L. Nesom & G.I. Baird. Showy Rabbitbrush.
Shrub. Rare in montane coniferous forest. Summit of Cannell Peak, historically collected at the north end of Big Meadow. *House & Fraga 280* (RSA).

Ericameria parryi (A. Gray) G.L. Nesom & G.I. Baird var. ***vulcanica*** (Greene) G.L. Nesom & G.I. Baird. Vulcan Rabbitbrush.
Shrub. Uncommon in mixed conifer forest. Dry, open areas. *House & Comito 1479* (RSA).

♦ ***Ericameria suffruticosa*** (Nutt.) G.L. Nesom. Heath Goldenrod.
Shrub. Rare in mixed conifer forest. Dry, rocky slopes and ridges. Saddle north of Deadwood Meadow. *Sherrell 26* (RSA).

♦ ***Erigeron breweri*** A. Gray var. ***breweri***. Brewer's Daisy.
Perennial herb. Uncommon in mixed conifer forest, in open, rocky habitats. Historically collected twice in the study site: on the east side of Big Meadow, and at Cannell Peak. *Howell & True 47038* (CAS).

Erigeron coulteri Porter. Coulter's Fleabane.
Perennial herb. Uncommon in montane meadows and montane riparian habitats. *House & Comito 1493* (RSA).

♦ ***Erigeron glacialis*** (Nutt.) A. Nelson var. ***glacialis***.
Perennial herb. Rare in montane riparian habitat, 2134--2438 m (7000--8000 ft). One historical collection along Salmon Creek. Not re-encountered during this study. *Hall & Babcock 5151* (CAS).

Erigeron lonchophyllus Hook. Short-Rayed Fleabane.
Perennial herb. Locally common in montane meadows. Moist, flat areas with little to no disturbance. *House, Le, & Purdy 774* (RSA).

Gnaphalium palustre Nutt. Lowland Cudweed.
Annual herb. Rare in montane meadow. Open, sandy and drainage areas. *House & Varnava 1469* (RSA).

Helenium bigelovii Torr. & A. Gray. Bigelow's Sneezeweed.

Perennial herb. Common along streambanks and in wet montane meadows, above 6500ft (1981m). *House 216* (RSA).

Hymenoxys hoopesii (A. Gray) Bierner.

Perennial herb. Occasional on streambanks and in wet areas of montane meadows. *House 894* (RSA).

Madia elegans D. Don. Common Madia.

Annual herb. Common in montane meadows. Dry places, disturbed edges. *House & Morse 708* (RSA).

Madia gracilis (Sm.) D.D. Keck & J.C. Clausen ex Applegate.

Annual herb. Rare in disturbed flood zone of montane riparian habitat. A single collection from along Manter Creek. *House, Purdy, Columbus, England, & Pearman 1602* (RSA).

♦ ***Matricaria discoidea*** DC. Pineapple Weed.

Annual herb. Rare at disturbed edge of montane meadow. West side of Big Meadow. *Howell & True 46941* (CAS).

Oreostemma alpigenum (Torr. & A. Gray) Greene var. ***andersonii*** (A. Gray) G.L. Nesom.
Tundra aster.

Perennial herb. Occasional in moist edges of montane meadows and in understory of lodgepole pine forest. *House, Morse, & Tollet 1345* (RSA).

Orochaenactis thysanocarpha (A. Gray) Coville. Mountain Pincushion.

Perennial herb. Locally common in mixed conifer forest and montane chaparral. Less commonly observed from dry edges of montane meadows. Sunny, open areas of decomposed granite. *House 504* (RSA).

Pseudognaphalium thermale (E.E. Nelson) G.L. Nesom.

Perennial herb. Rare in disturbed flood zone of montane riparian habitat, in montane chaparral. Manter Creek. *House, Purdy, Columbus, England, & Pearman 1600* (RSA).

♦ ***Psilocarphus tenellus*** Nutt. Slender Woolly Heads.

Annual herb. Occasional in montane meadows. Restricted to open, sunny places that are seasonally moist. Big Meadow. *Howell 47165* (CAS).

Senecio serra Hook. var. ***serra***. Tall Ragwort.

Perennial herb. Rare in montane riparian habitat. Shallow section of the Salmon Creek. *House & Fraga 313* (RSA).

Senecio triangularis Hook. Arrowleaf Ragwort.

Perennial herb. Locally common on streambanks in montane riparian habitats. Collected only along the Salmon Creek, at elevations above 7500ft (2286m). *House 888* (RSA).

♦ ***Solidago multiradiata*** Aiton. Northern Goldenrod.

Perennial herb. Rare in montane meadows. West side of Big Meadow. *Howell & True* 46960 (CAS).

Solidago velutina DC. subsp. ***californica*** (Nutt.) Semple. California Goldenrod.

Perennial herb. Occasional in montane riparian habitats, in mixed conifer forest or montane meadows. *House* 266 (RSA)

Stephanomeria tenuifolia (Raf.) H.M. Hall. Narrow-Leaved Wire-Lettuce.

Annual herb. Occasional in mixed conifer forest. Most collections from east side of Big Meadow, roadside in decomposed granite. *House* 927 (RSA).

Symphotrichum ascendens (Lindl.) G.L. Nesom. Western Aster.

Perennial herb. Rare in disturbed edges of montane meadows. Horse Meadow. *House* 274 (RSA).

Symphotrichum foliaceum (Lindl. ex DC.) G.L. Nesom var. ***parryi*** (D.C. Eaton) G.L.

Nesom. Parry's Aster.

Perennial herb. Occasional in montane riparian habitats, and moist areas of montane meadows. *House, Le, & Purdy* 802 (RSA).

Symphotrichum spathulatum (Lindl.) G.L. Nesom var. ***spathulatum***. Western Mountain Aster.

Perennial herb. Locally common in montane meadows. Dry, flat areas, at disturbed edges. *House* 897.

Symphotrichum spathulatum (Lindl.) G.L. Nesom var. ***yosemitanum*** (A. Gray) G.L.

Nesom. Western Bog Aster.

Perennial herb. Locally common in montane meadows. Dry, flat areas, at disturbed edges. *House & Fraga* 302 (RSA).

* ***Taraxacum officinale*** F.H. Wigg. Common Dandelion.

Perennial herb. Occasional in montane meadows and on streambanks in montane riparian habitats above 7000ft. Most collections from Big Meadow and Manter Meadow. *House & Fraga* 508 (RSA).

* ***Tragopogon dubius*** Scop. Yellow Salsify.

Perennial herb. Rare in montane chaparral. North end of Manter Meadow, in dirt trail. *House & Cunningham* 1017 (RSA).

BORAGINACEAE

♦ † ***Cryptantha glomeriflora*** Greene. Truckee Cryptantha.

Annual herb. Rare at dry edge of montane meadow. West side of Big Meadow. *Howell, Fuller, & Barbe* 53772 (CAS).

Greeneocharis circumscissa (Hook. & Arn.) Rydb. var. ***circumscissa***. Cushion Greeneocharis.

Annual herb. Occasional in Jeffrey pine forest and montane chaparral. Often found in large patches at the dry edges of montane meadows. In open, disturbed areas, growing in gravelly soil. *House & Layfield 1307* (RSA).

Hackelia micrantha (Eastw.) J.L. Gentry Jessica's Stickseed.

Perennial herb. Uncommon in dry montane meadow. Deadwood Meadow. Growing in dry, disturbed area next to trail. *House, E. House, & T. House 868* (RSA).

Mertensia ciliata (Torr.) G. Don var. ***stomatechoides*** (Kellogg) Jeps. Streamside Bluebell.

Perennial herb. Occasional on streambanks in montane riparian habitats and in wet rocky areas, above 7000ft (2134m). *House, Le, & Purdy 807* (RSA).

* ***Myosotis discolor*** Pers. Changing Forget-Me-Not.

Annual herb. Rare from montane meadow. East side of Manter Meadow, growing from seep on hillside. *House, Posa, & Bickford 1188* (RSA).

Plagiobothrys hispidulus (Greene) I. M. Johnst. Harsh Popcornflower.

Annual herb. Occasional in montane meadows. At dry edges, in disturbed places. *House, Le, & Purdy 752* (RSA).

Plagiobothrys torreyi (A. Gray) A. Gray var. ***diffusus*** I.M. Johnst.

Annual herb. Uncommon in dry, decomposed granite in montane meadows. In trampled, disturbed areas. *House & Schaefer 1241* (RSA).

BRASSICACEAE

♦ * ***Arabidopsis thaliana*** (L.) Heynh. Arabidopsis.

Annual herb. Rare from edge of montane meadow. West side of Big Meadow. *Barbe, Howell, & Fuller 2893* (CAS).

Arabis pycnocarpa M. Hopkins var. ***pycnocarpa***. Hairy Fruit Rock Cress.

Perennial herb. Rare in dry montane meadow. Deadwood Meadow. Growing in dry, disturbed areas. *House & Comito 1508* (RSA).

Barbarea orthoceras Ledeb. Winter Cress.

Perennial herb. Uncommon in wet montane meadows, in seasonally wet areas, and on streambanks in mixed conifer forest. Often found infected by a mold that turns the fruits and flowers purple and grotesque. *House & Schaefer 1265* (RSA).

♦ ***Cardamine breweri*** S. Watson. Brewer's Bitter Cress.

Perennial herb. Uncommon in montane meadows. Several historical collections from Big Meadow and Horse Meadow. *Howell & True 41763* (CAS).

Descurainia incana (Fisch. & C.A. Mey.) Dorn. Mountain Tansy Mustard.

Perennial herb. Uncommon in montane meadows and mixed conifer forests. In dry, open areas; often disturbed. *House 1046*.

◆ * ***Descurainia sophia*** (L.) Webb ex Prantl. Herb Sophia.

Annual herb. Rare from montane meadow. West side of Big Meadow. *Howell & True 46943* (CAS).

Draba albertina Greene. Alberta Whitlow Grass.

Perennial herb. Occasional in montane meadows and on streambanks in montane riparian habitats between 7000 and 8000ft (2134-2438m). *House, Le, & Purdy 803* (RSA).

* ***Draba verna*** L.

Annual herb. Uncommon in disturbed, seasonally moist places. Collected in montane chaparral and montane riparian habitats. *House, Posa, & Bickford 1196* (RSA).

◆ ***Erysimum perenne*** (S. Watson ex Coville) Abrams. Sanddune Wallflower.

Perennial herb. Uncommon in mixed conifer forest and subalpine forest. Historically collected near Big Meadow and Sirretta Pass. *Twisselmann 15766* (CAS).

* ***Hirschfeldia incana*** (L.) Lagr.-Fossat. Mustard.

Perennial herb. Uncommon in mixed chaparral and montane meadows. Disturbed areas. *House, Berkowitz, & Layfield 318* (RSA).

◆ * ***Lepidium appelianum*** Al-Shehbaz. Hairy Whitetop.

Perennial herb. Rare in montane meadows. East side of Big Meadow. *Twisselmann & McMillan 14706* (CAS).

Lepidium virginicum L. subsp. ***menziesii*** (DC.) Thell. Robinson's Pepper Grass.

Annual herb. Occasional in disturbed, open areas throughout study site. Most common in mixed conifer forest, Jeffrey pine forest, montane meadows, and montane chaparral. *House & Morse 707* (RSA).

Nasturtium officinale W.T. Aiton. Water Cress.

Aquatic. Occasional in shallow streams, in montane meadows. *House, Le, & Purdy 806* (RSA).

Rorippa curvisiliqua (Hook.) Bessey ex Britton. Curvepod Yellow Cress.

Annual herb. Uncommon in montane meadows. In disturbed, bare areas. Tolerant of cattle activity. *House, & Schaefer 1277* (RSA).

◆ ***Turritis glabra*** L. Tower Rockcress.

Perennial herb. Rare in lodgepole pine forest. East side of Big Meadow. *Howell & True 48421* (CAS).

CAMPANULACEAE

Porterella carnosula (Hook. & Arn.) Torr. Fleshy Porterella.

Annual herb. Occasional in moist montane meadow. Only observed in Big Meadow. Can form dense patches. *House & Schaefer 1238* (RSA).

CAPRIFOLIACEAE

Lonicera conjugialis Kellogg. Double Honeysuckle.

Shrub. Uncommon in understory of mixed conifer forest. In moist, rocky drainages and along streambanks. *House & Schaefer 1259* (RSA).

Lonicera involucrata (Richardson) Spreng. var. ***involucrata***. Twinberry Honeysuckle.

Shrub. Rare on streambank in mixed conifer forest. Several collections from west side of Big Meadow, at historical "Pipe Spring" location. *House 905* (RSA).

CARYOPHYLLACEAE

****Cerastium fontanum*** Baumg. subsp. ***vulgare*** (Hartm.) Greuter & Burdet. Common Mouse-Ear Chickweed.

Perennial herb. Rare from moist, disturbed streambank in montane riparian habitat. North end of Big Meadow. *House & Fraga 1544* (RSA).

♦***Sabulina californica*** (A. Gray) Dillenb. & Kadereit.

Annual herb. Rare in mixed conifer forest. Gravelly, sandy slopes. Manter Meadow Trail. *Hardham 12094b* (CAS).

Sagina saginoides (L.) H. Karst. Arctic Pearlwort.

Perennial herb. Uncommon in montane meadows. Often next to streams or in seasonally wet areas. *House & Morse 718* (RSA).

† ***Silene aperta*** Greene. Naked Catchfly.

Perennial herb. Rare in lodgepole pine forest. In open, moist understory. South end of Big Meadow. *House, Morse, & Tollet 1423* (RSA).

♦ ***Stellaria borealis*** Bigelow subsp. ***sitchana*** (Steud.) Piper & Beattie. Boreal Starwort.

Perennial herb. Rare from streambank in mixed conifer forest. North end of Big Meadow. *Howell & True 47197* (CAS).

♦ ***Stellaria calycantha*** (Ledeb.) Bong. Northern Bogwort.

Perennial herb. Rare from streambank in mixed conifer forest. West side of Big Meadow. *Howell & True 41932* (CAS).

Stellaria longipes Goldie ***longipes***. Goldie's Starwort.

Perennial herb. Occasional in montane meadows. Wet, lush areas. *House, Le, & Purdy 775* (RSA).

****Stellaria media*** (L.) Vill.

Annual herb. Rare in montane riparian habitat, in montane chaparral. Rincon Trail, at Salmon Creek crossing. *House & Varnava 1140* (RSA).

CORNACEAE

Cornus sericea L. subsp. ***sericea***.

Shrub. Locally common in montane riparian habitats above 1829 m (6000 ft). Grows in and around creeks. *House & Schaefer 1224* (RSA).

ERICACEAE

Arctostaphylos patula Greene. Greenleaf Manzanita.

Shrub. Common around the edges of montane meadows, in mixed conifer forest, alpine forest, and montane chaparral. Forms dense stands in burn scars with *Ceanothus cordulatus*. *House & Schaefer 1255* (RSA).

Rhododendron columbianum (Piper) Harmaja. Western Labrador Tea.

Shrub. Rare at edge of montane meadow, in mixed conifer forest. Above 8000ft (2438m). East slope of Sirretta Peak. *House & Fraga 547* (RSA).

EUPHORBIACEAE

Euphorbia serpillifolia Pers. subsp. ***serpillifolia***. Thyme Leafed Spurge.

Annual herb. Rare in montane meadow. Disturbed, dry areas. Big Meadow. *House & Varnava 1461* (RSA).

FABACEAE

Acmispon americanus (Nutt.) Rydb. var. ***americanus***. American Bird's Foot Trefoil.

Annual herb. Occasional in montane meadows, montane chaparral, and dry washes (6500-8000ft; 1981-2438m). Disturbed areas. *House 919* (RSA).

Hosackia oblongifolia Benth. var. ***oblongifolia***. Narrow Leaved Lotus.

Perennial herb. Locally common on streambanks in montane riparian habitats (6000-9000ft; 1829-2743m). *House, E. House, & T. House 864* (RSA).

Lupinus albicaulis Douglas.

Perennial herb. Occasional in mixed conifer forest and on streambanks (1981--2896 m/6500--9500 ft). *House, Le, & Purdy 721* (RSA).

Lupinus lepidus Douglas ex Lindl. var. ***confertus*** (Kellogg) C.P. Sm. Clustered Tidy Lupine.

Perennial herb. Locally common in montane meadows. Occasionally found in other seasonally moist places. *House, Morse, & Tollet 1385* (RSA).

Lupinus polyphyllus Lindl. var. ***burkei*** (S. Watson) C. L. Hitchc. Burke's Lupine. Perennial herb. Locally common on streambanks in mixed conifer forest. Occasional on dry edges of montane meadows. *House 935* (RSA).

Trifolium longipes Nutt. subsp. ***hansenii*** (Greene) J.M. Gillett. Hansen's Clover. Perennial herb. Uncommon in montane meadows and on streambanks in mixed conifer forest. *House & Schaefer 1270* (RSA).

Trifolium monanthum A. Gray subsp. ***monanthum***. Carpet Clover. Perennial herb. Occasional in montane meadows and lodgepole pine forest, and on streambanks in mixed conifer forest. *House, Le, & Purdy 742* (RSA).

Trifolium variegatum Nutt. Variegated Clover. Annual herb. Occasional in montane meadows and on streambanks in mixed conifer forest. Moist areas. *House & Jesus 200* (RSA).

Trifolium wormskioldii Lehm. Cow Clover. Perennial herb. Occasional in montane meadows and on streambanks in mixed conifer forest. Moist areas. Difficult to distinguish from *Trifolium variegatum* var. *variegatum*. *House 997* (RSA).

GENTIANACEAE

Gentiana calycosa Griseb. Perennial herb. Uncommon in montane riparian habitats (2134--2591 m/7000--8500 ft). Dry washes and streambanks. *House & Varnava 1439* (RSA).

Gentiana newberryi A. Gray var. ***tiogana*** (A. Heller) J.S. Pringle. Sierra Alpine Gentian. Perennial herb. Rare in montane meadow. Dry, disturbed areas. Big Meadow. *House & Comito 1475* (CAS).

♦ ***Gentianella amarella* subsp. *acuta*** Northern Gentian. Annual herb. Uncommon in montane meadows. Big Meadow. *Stewart 813* (RSA).

GERANIACEAE

* ***Erodium cicutarium*** (L.) L'Hér. Redstem Filaree. Annual herb. Historically collected at the north end of Manter Meadow. Observed in mixed chaparral and montane chaparral, below 7000ft (2134m), during this study. Open, disturbed areas. *House, Morse, & Tollet 1407* (RSA).

Geranium californicum G. N. Jones & F. L. Jones. California Geranium. Perennial herb. Occasional in montane meadows and on streambanks above 7000ft (2134m). Moist areas. *House 462* (RSA).

GROSSULARIACEAE

Ribes cereum Douglas var. ***cereum***. Wax Currant.

Shrub. Locally common in mixed conifer forest, subalpine forest, and lodgepole pine forest. Dry understory. *House 457* (RSA).

♦ ***Ribes inerme*** Rydb. var. ***inerme***. White Stemmed Gooseberry.

Shrub. Occasional in lodgepole pine forest and streambanks above 7000ft (2134m). *Howell 48422* (CAS).

Ribes nevadense Kellogg. Mountain Pink Currant.

Shrub. Occasional in mixed conifer forest, lodgepole pine forest, and montane riparian habitats (4000-9000ft; 1219-2743m). Moist areas. *House & Fraga 546* (RSA).

HYDROPHYLLACEAE

♦ ***Nemophila pedunculata*** Douglas ex Benth. Meadow Nemophila.

Annual herb. Rare from edge of montane meadow. Manter Meadow. *DeDecker 2912* (RSA).

Nemophila spatulata Coville. Sierra Nemophila.

Annual herb. Rare from montane meadow. Small meadow off road #23S41. *House & Morse 719* (RSA).

Phacelia mutabilis Greene. Changeable Phacelia.

Perennial herb. Uncommon on dry edge of montane meadow. Typically found in mixed conifer forest and montane chaparral. Dry, open to rocky slopes. *House & Morse 666* (RSA).

† ***Phacelia orogenes*** Brand. Mountain Phacelia.

Annual herb. Rare in montane chaparral. Moist places, meadow edges. Apparently collected more widely in the past, only observed once during this study. *House, Le, & Purdy 749* (RSA).

HYPERICACEAE

Hypericum anagalloides Cham. & Schltld. Tinker's Penny.

Annual herb. Occasional in montane meadows. Moist areas. *House & Comito 1490* (RSA).

Hypericum scouleri Hook. Scouler's St John's Wort.

Perennial herb. Locally common in montane meadows and on streambanks above 6500ft (1981m). Moist areas. *House 890* (RSA).

LAMIACEAE

Stachys albens A. Gray. Cobwebby Hedge Nettle.

Perennial herb. Locally common in montane riparian habitats above 7000ft (2134m).
Occasional on streambanks below 7000ft (2134m). *House & Comito 1481* (RSA).

Trichostema austromontanum H. Lewis subsp. ***austromontanum***. Southern Bluecurls.
Annual herb. Uncommon in lodgepole pine forest, montane chaparral, montane riparian
habitats above 6500ft (1981m). Seasonally moist areas. *House & Layfield 1322* (RSA).

LENTIBULARIACEAE

♦ † ***Utricularia minor*** L. Lesser Bladderwort.
Aquatic. Rare in montane riparian habitat. Submerged in small pond, in center of Big
Meadow. *Twisselmann 16232* (CAS).

MALVACEAE

Sidalcea ranunculacea Greene. Checker Mallow.
Perennial herb. Locally common in montane meadows and on streambanks above 7000ft
(2134m). Moist areas. *House, E. House, & T. House 841* (RSA).

MONTIACEAE

Calyptridium monospermum Greene. Pussy Toes.
Perennial herb. Common in dry, disturbed areas of decomposed granite at the edge of
montane meadows. Typically found in mixed conifer forest and subalpine forest. *House*
441 (RSA).

♦ † ***Calyptridium pygmaeum*** Parish ex Rydb. Pygmy Pussypaws.
Annual herb. Rare in lodgepole pine forest. Sandy to gravelly soil. West side of Big
Meadow. *Twisselmann 16891* (RSA).

Claytonia rubra (Howell) Tidestr. subsp. ***rubra***. Red Stemmed Miner's Lettuce.
Annual herb. Occasional in montane meadows and lodgepole pine forest. Seasonally
moist places. *House & Fraga 516* (RSA).

Lewisia nevadensis (A. Gray) B.L. Rob. Nevada Lewisia.
Perennial herb. Occasional in montane meadows. Moist, open edges. *House 444* (RSA).

Lewisia pygmaea (A. Gray) B.L. Rob. Dwarf Lewisia.
Perennial herb. Rare in montane meadows and lodgepole pine forests. Moist, shaded flat
on trail #33E32. *House, Le, & Purdy 800* (RSA).

Montia chamissoi (Spreng.) Greene. Toad Lily.
Perennial herb. Uncommon from montane meadows and seeps (3500-8000ft; 1067-
2438m). Moist areas. *House & Fraga 517* (RSA).

NAMACEAE

Nama rothrockii A. Gray. Rothrock's Nama.

Perennial herb. Rare from dry edge of montane meadow, transitioning into Jeffrey pine forest/montane chaparral. East side of Manter Meadow. Growing in sandy, gravelly soil on hillside. *House, Le, & Purdy 771*.

ONAGRACEAE

Chamerion angustifolium (L.) Holub subsp. ***circumvagum*** (Mosquin) Hoch. Fireweed.

Perennial herb. Occasional from seeps and streambanks in mixed conifer forests. Typically in burn areas. *House 948* (RSA).

Epilobium brachycarpum C. Presl.

Annual herb. Rare in montane riparian habitats, especially disturbed streambanks. *House, Purdy, Columbus, England, & Pearman 1607* (RSA).

Epilobium ciliatum Raf. subsp. ***ciliatum***. Willow Herb.

Perennial herb. Occasional in montane meadows and montane riparian habitats (6500-8500ft; 1981-2591m). Moist, often disturbed areas. *House, E. House, & T. House 849* (RSA).

Epilobium hallianum Hausskn. Hall's Willowherb.

Perennial herb. Occasional in montane meadows and montane riparian habitats (6500-9000ft; 1981-2743m). From dry washes to moist, boggy areas. Difficult to distinguish from *E. densiflorum*. *House & Morse 711* (RSA).

♦ ***Epilobium lactiflorum*** Hausskn.

Perennial herb. Rare from streambanks in mixed conifer forest. Moist areas. *Hall & Babcock 5145* (UC/JEPS).

Epilobium oregonense Hausskn. Slimstem Willowweed.

Perennial herb. Occasional in montane meadows. Moist, boggy areas. Difficult to distinguish from *E. densiflorum*. *House 238* (RSA).

Gayophytum diffusum Torr. & A. Gray subsp. ***parviflorum*** H. Lewis & Szweyk. Small Flowered Groundsmoke.

Annual herb. Common in mixed conifer forest, lodgepole pine forests, montane meadows, and montane riparian habitats (7000-8500ft; 2134-2591m). Open, dry and flat areas. *House & Fraga 569* (RSA).

Gayophytum eriospermum Coville. Woolly Seeded Groundsmoke.

Annual herb. Occasional in mixed conifer forest and lodgepole pine forest. Dry, often disturbed areas. *House & Schaefer 1271* (RSA).

OROBANCHACEAE

Aphyllon californicum Cham. & Schltdl. subsp. ***feudgei*** (Munz) Heckard. California Broomrape.
Parasitic perennial herb. Rare from montane meadow. Open, dry edge. On *Artemisia tridentata*. *House 254* (RSA).

Castilleja miniata Douglas ex Hook. subsp. ***miniata***. Giant Red Indian Paintbrush.
Perennial herb. Uncommon from montane meadows and streambanks above 7000ft (2134m). Wet areas. *House & Comito 1470* (RSA).

Castilleja minor (A. Gray) A. Gray subsp. ***spiralis*** (Jeps.) T.I. Chuang & Heckard.
Annual herb. Rare from montane riparian habitats (1829--2134 m/6000--7000 ft).
Streambanks and wet areas. Manter Creek. *House, Purdy, Columbus, England, & Pearman 1591* (RSA).

♦ ***Castilleja pilosa*** (S. Watson) Rydb. Pilose Paintbrush.
Perennial herb. Occasional in montane meadows. Dry edges, in sagebrush scrub. Difficult to distinguish from *Castilleja praeterita*. Big Meadow and Horse Meadow. *Twisselmann 8729* (CAS).

Castilleja praeterita Heckard & Bacig. Salmon Creek Indian Paintbrush.
Perennial herb. Occasional in montane meadows. Dry edges, in sagebrush scrub. Difficult to distinguish from *Castilleja pilosa*. Big Meadow and Horse Meadow. *House 258* (RSA).

Castilleja tenuis (A. Heller) T.I. Chuang & Heckard. Hairy Owl's Clover.
Annual herb. Rare in Jeffrey pine forest and at dry edges of montane meadows. Dry washes. *House, Le, & Purdy 741* (RSA).

♦ ***Pedicularis groenlandica*** Retz.
Perennial herb. Uncommon on moist streambanks. Collected historically on western edge of Big Meadow. *Twisselmann 17959* (UC/JEPS).

PHRYMACEAE

Diplacus mephiticus (Greene) G.L. Nesom. Skunky Monkeyflower.
Annual herb. Occasional in montane meadows and montane chaparral. Open, disturbed sites of decomposed granite. *House, Morse, & Tollet 1413* (RSA).

Erythranthe barbata (Greene) N.S. Fraga. Bearded Monkeyflower.
Annual herb. Locally common in decomposed granite at edges of montane meadows and streambanks (7000-8000ft; 2134-2438m). *House 442* (RSA).

Erythranthe breweri (Greene) G.L. Nesom & N.S. Fraga. Brewer's Monkeyflower.
Annual herb. Uncommon in seasonally moist areas. Streambanks and seeps. *House & Morse 698* (RSA).

Erythranthe corallina (Greene) G.L. Nesom. Coralline Monkeyflower.

Perennial herb. Locally common in montane riparian habitats above 7000ft (2134m). Wet areas: streambanks, seeps, springs, and meadows. *House, E. House, & T. House 872* (RSA).

♦ ***Erythranthe discolor*** (A.L. Grant) N.S. Fraga.

Annual herb. Occasional from one small montane meadow along Cherry Hill Road. Dry, disturbed areas. *Grossenbacher & Green 875* (UCD)

Erythranthe guttata (DC.) G.L. Nesom.

Perennial herb. Occasional in montane riparian habitats. Wet areas, streambanks. *House 944* (RSA).

Erythranthe microphylla (Benth.) G.L. Nesom.

Annual herb. Occasional in montane chaparral and mixed chaparral. Growing on streambanks and cracks in granitic boulders. *House & Schaaf 1113* (RSA).

Erythranthe moschata (Lindl.) G.L. Nesom. Musk Monkeyflower.

Perennial herb. Occasional in montane riparian habitats above 6500ft (1981m). Seeps, streambanks; partial shade. *House 979* (RSA).

Erythranthe primuloides (Benth.) G.L. Nesom & N.S. Fraga. Primrose Monkeyflower.

Perennial herb. Occasional in montane meadows and lodgepole pine forest. Wet areas. *House 500* (RSA).

PLANTAGINACEAE

Collinsia tinctoria Benth.

Annual herb. Occasional in mixed conifer forest and montane chaparral. Streambanks and dry washes. *House, Le, & Purdy 736* (RSA).

Collinsia torreyi A. Gray var. ***wrightii*** (S. Watson) I.M. Johnst. Wright's Collinsia.

Annual herb. Occasional in mixed conifer forest and lodgepole pine forest. Sandy, granitic soil. *House & Jesus 209* (RSA).

Penstemon heterodoxus A. Gray var. ***cephalophorus*** (Greene) N.H. Holmgren. Sierra Beardtongue.

Perennial herb. Occasional in montane meadows and streambanks above 7000ft (2134m). Moist areas. *House, Le, Purdy & 798* (RSA).

Veronica americana Schwein. ex Benth. American Brookline.

Perennial herb. Rare from streambanks. Wet areas, 8000ft (2438m). Big Meadow. *House & Comito 1471* (RSA).

♦ ***Veronica peregrina*** L. subsp. ***xalapensis*** (Kunth) Pennell. Speedwell.

Annual herb. Uncommon from montane meadows. Moist areas. Big Meadow. *Twisselmann 7525* (SBBG).

Veronica serpyllifolia L. subsp. ***humifusa*** (Dicks.) Syme. Sprawling Speedwell.
Perennial herb. Occasional on streambanks. Moist areas, 7000-8000ft (2134-2438m).
House & Schaefer 1274 (RSA).

POLEMONIACEAE

Collomia linearis Nutt. Narrow-Leaf Mountain Trumpet.
Annual herb. Uncommon from montane meadows. Dry, open areas. Deadwood Meadow.
House, E. House, & T. House 874 (RSA).

Ipomopsis aggregata (Pursh) V.E. Grant subsp. ***bridgesii*** (A. Gray) Scarlet Gilia
Perennial herb. Occasional in mixed conifer forest and sagebrush scrub at edge of
montane meadows. Open, dry areas. *House, E. House, & T. House 870 (RSA).*

Microsteris gracilis (Hook.) Greene. Slender Phlox.
Annual herb. Occasional in montane meadows. Dry to moist areas, typically found around
streams and at gravelly edges. *House, Posa, & Bickford 1173 (RSA).*

Polemonium occidentale Greene. Great Polemonium.
Perennial herb. Rare from streambank in montane meadow. Wet, lush areas. Manter
Meadow, 7100ft (2164m). *House 962 (RSA).*

POLYGONACEAE

Bistorta bistortoides (Pursh) Small. Western Bistort.
Perennial herb. Locally common in montane meadows and on lush streambanks, 7000-
8000ft (2134-2438m). Manter Meadow. *House, E. House, & T. House 840 (RSA).*

Eriogonum davidsonii J.A. Clark. Davidson's Wild Buckwheat.
Annual herb. Locally common from dry, disturbed edges of montane meadows. Little
Manter Meadow. *House, Purdy, Columbus, England, & Pearson 1572 (RSA).*

Eriogonum spergulinum A. Gray var. ***reddingianum*** (M.E. Jones) J.T. Howell.
Annual herb. Locally common in mixed conifer forest, Jeffrey pine forest, and dry edges of
montane meadows. Dry, open patches of decomposed granite. Often forms dense
patches. *House & Morse 626 (RSA).*

Eriogonum spergulinum A. Gray var. ***spergulinum***.
Annual herb. Occasional in mixed conifer forest, Jeffrey pine forest, and dry edges of
montane meadows. Dry, open patches of decomposed granite. Often forms dense
patches. *House & Fraga 295 (RSA).*

* ***Polygonum aviculare*** L. subsp. ***depressum*** (Meisn.) Arcang. Prostrate Knotweed.
Perennial herb. Uncommon in montane meadows. Dry, disturbed areas. *House & Schaefer
1239 (RSA).*

Polygonum douglasii Greene. Douglas' Knotweed.

Annual herb. Locally common in montane meadows. Dry to moist, disturbed areas. *House 901* (RSA).

Polygonum polygaloides Meisn. subsp. ***kelloggii*** (Greene) J.C. Hickman. Kellogg's Knotweed.

Annual herb. Locally common in montane meadows. Seasonally moist, disturbed areas. *House & Schaefer 1242* (RSA).

Rumex californicus Rech. f. California Dock.

Perennial herb. Occasional in montane meadows and on streambanks throughout the study site. Moist areas. *House 933* (RSA).

♦ ***Rumex paucifolius*** Nutt. Few Leaved Dock.

Perennial herb. Uncommon in montane meadow. Moist places. *Twisselmann 16877* (CAS).

♦ ***Rumex salicifolius*** Weinm. Willow Leaved Dock.

Perennial herb. Rare from montane meadow. Wet places. Horse Meadow. *Hall & Babcock 5166* (UC/JEPS).

♦ † ***Sidothea caryophylloides*** (Parry) Reveal. Chickweed Oxytheca.

Annual herb. Rare from dry, gravelly edges of montane meadow. Manter Meadow. *Twisselmann 16733*.

PRIMULACEAE

Primula jeffreyi (Van Houtte) Mast & Reveal. Sierra Shooting Star.

Perennial herb. Occasional in montane meadows and on streambanks in mixed conifer forest, above 7000ft (2134m). Wet areas. *House & Schaefer 1266* (RSA).

Primula tetrandia (Suksd. ex Greene) Mast & Reveal. Alpine Shooting Star.

Perennial herb. Occasional in montane meadows and on streambanks in mixed conifer forest, above 7000ft (2134m). Wet areas. *House 902* (RSA).

RANUNCULACEAE

Aconitum columbianum Nutt. subsp. ***columbianum***. Columbian Monkshood.

Perennial herb. Occasional from streambanks and hillside seeps. Wet areas above 7000ft (2134m). *House 1047* (RSA).

Actaea rubra (Aiton) Willd. Red Baneberry.

Perennial herb. Uncommon from streambanks. Wet areas, 7100ft (2164m). *House & Fraga 308* (RSA).

Aquilegia formosa Fisch. ex DC. Columbine.

Perennial herb. Locally common in montane meadows and on streambanks. Occasional in seasonally moist areas. From dry washes to wet meadows, 6500-8000ft (1981-2438m). *House, E. House, & T. House 848* (RSA).

- ♦ ***Delphinium depauperatum*** Nutt. Few Flowered Larkspur.
Perennial herb. Rare in montane meadow. Moist areas. Manter Meadow. *Twisselmann 16774* (CAS).

Delphinium hansenii (Greene) Greene subsp. ***kernense*** (Davidson) Ewan. Kern County Larkspur.
Perennial herb. Uncommon in mixed conifer forest, especially near montane meadows and trails. Dry, duffy understory, 6500-8000ft (1981-2438m). *House 460* (RSA).

- ♦ ***Delphinium patens*** Benth. subsp. ***montanum*** (Munz) Ewan. Spreading Larkspur.
Perennial herb. Rare from montane meadow. Dry areas. Big Meadow. *Twisselmann 12494* (CAS).

Delphinium polycladon Eastw. High Mountain Larkspur.
Perennial herb. Rare from montane meadow. Seasonally moist area. Deadwood Meadow. *House, E. House, & T. House 867* (RSA).

Ranunculus alismifolius Geyer ex Benth. var. ***alismellus*** A. Gray. Slender Buttercup.
Perennial herb. Occasional in shallow streams and on streambanks, in montane meadows. Flat areas, slow-flowing water. Both aquatic and terrestrial plants present. Manter Creek, Manter Meadow. *House & Fraga 559* (RSA).

Ranunculus aquatilis L. var. ***diffusus*** With. White Water Butter Cup.
Aquatic. Locally common in stream, in montane meadow. Flat areas, slow-flowing water. Manter Creek, Manter Meadow. *House, Le, & Purdy 792* (RSA).

Thalictrum fendleri Engelm. ex A. Gray.
Perennial herb. Occasional in riparian corridors, from mixed chaparral and mixed conifer forest. Moist, shaded areas. *House & Schaefer 1210* (RSA).

- ♦ ***Thalictrum sparsiflorum*** Turcz. ex Fisch. & C.A. Mey.
Perennial herb. Uncommon in riparian corridors, from mixed chaparral and mixed conifer forest. Moist, shaded areas. *Howell & True 41935* (CAS).

RHAMNACEAE

Frangula californica (Eschsch.) A. Gray subsp. ***cuspidata*** (Greene) Kartesz & Gandhi.
Shrub. Occasional on streambanks in montane chaparral, below 2438 m (8000 ft). *House, Morse, & Tollet 1388* (RSA).

ROSACEAE

Amelanchier utahensis Koehne.

Shrub. Occasional on streambanks and shaded slopes in understory of mixed conifer forest, 1981--2134 m (6500--7000 ft). *House 464* (RSA).

Drymocallis glandulosa (Lindl.) Rydb. var. ***glandulosa***. Sticky Cinquefoil.

Perennial herb. Occasional from montane chaparral, montane meadows, and montane riparian areas throughout the study site. Shady, moist areas. *House & Morse 680* (RSA).

Drymocallis lactea (Greene) Rydb. var. ***lactea***. Sierran Woodbeauty.

Perennial herb. Occasional in moist, rocky places at edges of montane meadows. Closely associated with mixed conifer forest. *House 487* (RSA).

Geum macrophyllum Willd. var. ***perincisum*** (Rydb.) Raup. Largeleaf Aven.

Perennial herb. Occasional in montane meadows and on lush streambanks. Wet areas, 7000-8000ft (2134-2438m). *House & Schaefer 1273* (RSA).

Horkelia fusca Lindl. var. ***parviflora*** (Nutt. ex Hook. & Arn.) Wawra. Tawny Horkelia.

Perennial herb. Common in montane meadows and lodgepole pine forest. Less commonly observed in montane chaparral, mixed conifer forest, and Jeffrey pine forest. Seasonally moist, disturbed areas; dry washes, 7000-8000ft (2134-2438m). *House 498* (RSA).

Horkeliella purpurascens (S. Watson) Rydb. Purple False Horkelia.

Perennial herb. Occasional in mixed conifer forest and lodgepole pine forest. Seasonally moist, disturbed areas. *House 244* (RSA).

♦ † ***Ivesia campestris*** (M.E. Jones) Rydb. Field Ivesia.

Perennial herb. Rare from edge of montane meadow. Big Meadow. *Barbe, Howell & Fuller 2890* (CAS).

Ivesia lycopodioides A. Gray var. ***megalopetala*** (Rydb.) Ertter & Reveal. Clubmoss Ivesia.

Perennial herb. Occasional from montane meadows. Dry, disturbed areas. *House & Comito 1477* (RSA).

Potentilla gracilis Hook. var. ***elmeri*** (Rydb.) Jeps. Elmer's Cinquefoil.

Perennial herb. Rare from montane meadow. Dry area. Manter Meadow. *House 235* (RSA).

Potentilla gracilis Hook. var. ***fastigiata*** (Nutt.) S. Watson. Slender Cinquefoil.

Perennial herb. Common in montane meadows, lodgepole pine forest, and on streambanks. Dry areas, 7000-8000ft (2134-2438m). *House 446* (RSA).

♦ ***Potentilla wheeleri*** S. Watson. Wheeler's Cinquefoil.

Perennial herb. Occasional in montane meadows. Sandy, moist areas. Big Meadow and Manter Meadow. *Shevock 9673* (CAS).

♦ ***Rosa woodsii*** Lindl. subsp. ***gratissima*** (Greene) W.H. Lewis & Ertter. Mojave Rose. Shrub. Rare from moist edge of montane meadow. Manter Meadow. *Shevock 9922* (RSA).

Rosa woodsii Lindl. subsp. ***ultramontana*** (S. Watson) Roy L. Taylor & MacBryde. Shrub. Common from montane riparian habitats and mixed conifer forest. Moist or seasonally wet places, 1981–2438 m (6500–8000 ft). *House & Morse 688* (RSA).

RUBIACEAE

Galium bifolium S. Watson. Low Mountain Bedstraw. Annual herb. Occasional in montane meadows. Moist, disturbed places. Big Meadow. *House & Morse 714* (RSA).

SALICACEAE

Populus trichocarpa Torr. & A. Gray. Black Cottonwood. Tree. Occasional in montane riparian habitats, in mixed conifer forest and montane chaparral. Streambanks. *House 483* (RSA).

Salix geyeriana Andersson. Geyer's Willow. Shrub. Locally common from montane meadows, along streambanks. Wet areas. *House 967* (RSA).

Salix gooddingii C.R. Ball. Goodding's Black Willow. Shrub. Uncommon from streambanks in mixed conifer forest. Wet areas, 7500-9000ft (2286-2743m). Small meadow on trail #34E12 (Sirretta Trail). *House 950* (RSA).

Salix laevigata Bebb. Red Willow. Tree. Uncommon from riverbanks and seepage areas, from mixed chaparral to mixed conifer forest. Wet areas. *House 994* (RSA).

♦ ***Salix lasiandra*** Benth. var. ***lasiandra***. Pacific Willow. Tree. Rare from montane meadow. Wet areas. Horse Meadow. *Howell & True 41743* (CAS).

Salix lasiolepis Benth. Arroyo Willow. Tree. Common from montane meadows and streambanks throughout the study site. Marked morphological diversity. *House 459* (RSA).

Salix lemmonii Benth. Lemmon's Willow. Shrub. Common from montane meadows and streambanks in mixed conifer forest. Wet areas, 7000-8000ft (2134-2438m). *House & Varnava 1170* (RSA).

♦ ***Salix orestera*** C.K. Schneid.

Shrub. Occasional from streambanks in mixed conifer forest. Wet areas. *Twisselmann & Bedell 14020* (CAS).

♦ ***Salix scouleriana*** Hook. Scouler Willow.

Shrub. Occasional from montane meadows, streambanks, and mixed conifer forest. Dry to moist areas, 7000-8500ft (2134-2591m). *Twisselmann & Bedell 13971* (CAS).

SAXIFRAGACEAE

♦ ***Lithophragma glabrum*** Nutt. Bulbed Woodland Star.

Perennial herb. Rare from montane meadow. Dry, gravelly edges. Big Meadow. *Twisselmann 16889* (CAS).

♦ ***Micranthes oregana*** (Howell) Small. Bog Saxifrage.

Perennial herb. Uncommon from montane meadow. Wet areas. Big Meadow. *Howell, Fuller, & Barbe 53777* (CAS).

VALERIANACEAE

Valeriana californica A. Heller. Perennial herb. Uncommon from mixed conifer forest.

Shaded, moist slopes, 2347 m (7700 ft). West of Big Meadow; Salmon Creek. *House & Schaefer 1215* (RSA).

VIBURNACEAE

Sambucus mexicana C. Presl ex DC.

Shrub. Common on streambanks and in open areas of mixed conifer forest and chaparral. *House, Le, & Purdy 746* (RSA).

VIOLACEAE

Viola adunca Sm. subsp. ***adunca***. Western Dog Violet.

Perennial herb. Occasional in montane meadows. Seasonally moist areas. Manter Meadow. *House & Fraga 523* (RSA).

Viola macloskeyi F.E. Lloyd. Macloskey's Violet.

Perennial herb. Occasional from montane meadows and streambanks. Moist areas, 7000-8000ft (2134-2438m). *House 449* (RSA).

VISCACEAE

♦ ***Arceuthobium americanum*** Engelm. American Dwarf Mistletoe.

Parasitic perennial herb. Rare from lodgepole pine forest. On lodgepole pine. Big Meadow. *Howell & True 47048* (CAS).