86. Sugar Creek (Keeler-Wolf 1984d, 1989f, Sawyer and Thornburgh 1971)

Location

This candidate RNA is on the Klamath National Forest. The area is located largely within the Russian Wilderness and is about 6 miles (9.7 km) W. of Callihan. It occupies portions of sects. 18, 19, 20, 29, 30, and 31 T40N, R9W and sects. 25 and 36 T40N, R10W MDBM (41°17'N., 122°56'W.), USGS Eaton Peak quad (*fig. 171*). Ecological subsection – Upper Salmon Mountains (M261Ag).

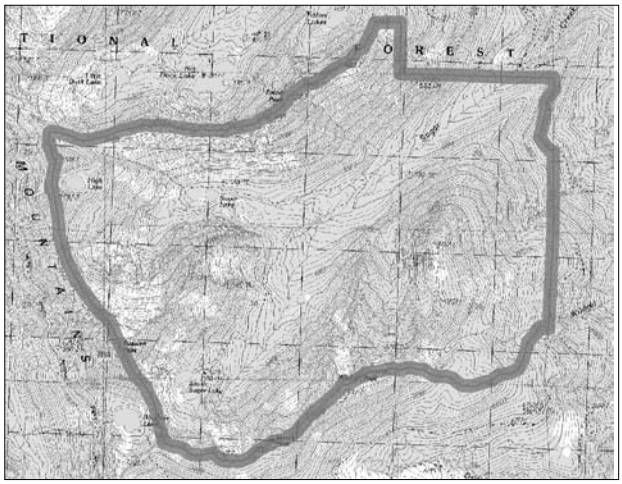

Figure 171—Sugar Creek cRNA

Target Elements

Enriched Conifer Forest and Mixed Conifer Forest

Distinctive Features

Enriched Conifer Forest: This RNA (hereafter referred to as SCRNA) was selected primarily to preserve the richest known assemblage of conifers in the world. It contains 17 species of conifers within one square mile (2.59 km^2). This diversity and composition cannot be duplicated elsewhere (*fig. 172*).

The diversity of the coniferous forests at SCRNA is a result of several factors. The presence of relict species such as Brewer spruce (*Picea breweri*ana), Engelmann spruce (*Picea engelmanii*), subalpine fir (*Abies lasiocarpa*), foxtail pine (*Pinus balfouriana*), and whitebark pine (*Pinus albicaulis*), in conjunction with the typical overall regional dominant trees of the white fir (*Abies concolor*), Shasta red fir (*Abies magnifica* var. *shastensis*), and mountain hemlock (*Tsuga mertensiana*) forests have much to do with the enrichment. Although not unique to the area, the abrupt alternes between mesic, hydric, and xeric habitats and the great range in elevation (and thus, climate) over short distances also contribute to the diversity. These last two factors allow the juxtaposition of numerous species that are normally separated from one another in California. Although Holland (1986) and others have defined an enriched mixed conifer forest type to characterize these locally diverse forests, Sawyer (1987) has argued that the diversity of conifers in the area does not constitute a single forest type. The fact that these forests are not replicated throughout the E. Klamath Mountains or even in adjacent drainages with very similar environments suggests that Sawyer's contention is correct. It appears that they are agglomerations of species brought together by the vagaries of present-day climate and historical forces.

The highest conifer diversity in a single stand of uniform habitat at SCRNA is 10 species. This occurs in several sites between 5400 and 6000 ft (1645-1829 m) along the major branches of Sugar Creek where Engelmann spruce tends to dominate and a mixture of upper and lower elevation conifers are subdominants. In general, average stands in this forest contain seven or eight conifer species.

Surprisingly, xeric exposures at high elevations may also contain high diversities of conifers. An open subalpine forest on a S. exposure at 7200 ft (2195 m) contains up to nine species of conifers in a stand. Such forests understandably have little species overlap with the mesic creekside forests and contain such xerophytic subalpine species as foxtail pine, whitebark pine, and *Juniperus communis*.

Type Locality for Klamath Montane Vegetation: As a result of research by Sawyer and Thornburgh (1969, 1970, 1971), a great deal of data was collected on the vegetation of the area. More than 200 stands were sampled in the vicinity of the cRNA, and a vegetation classification system based on the data collected locally has become widely accepted as the standard way of viewing the vegetation of the entire montane and subalpine zone of the Klamath Mountains (Sawyer and Thornburgh 1977). Thus, this area provides not only a unique diversity of conifers but also exemplifies the typical vegetation zonation for the entire ecological section.

Rich Flora: In addition to the diversity of conifers in the area, the vascular flora in general is rich. Nearly 400 taxa of vascular plants are known from the cRNA. This wealth of species is due in large part to the diversity of habitats ranging from xeric to hydric and from lower montane to subalpine. Sawyer and Thornburgh (1971) describe 15 forest associations from the area, and Keeler-Wolf (1984d) indicates 26 mapping units.

Sierran Mixed Conifer Forest: This mixed conifer forest is characteristic of the lower elevation slopes in the area. It has a variety of subtypes, including ponderosa pine (*Pinus ponderosa*)-, white fir-, and Douglas-fir (*Pseudotsuga menziesii*)- dominated types. California black oak (*Quercus kelloggii*) is occasional on lower xeric sites, and sugar pine (*Pinus lambertiana*) and incense-cedar (*Libocedrus decurrens*) are widespread. The mixed conifer forest is represented by large old-growth stands and by younger successional stands associated with past crown fire.

Rare Plants: Several rare plants are known from the area. Subalpine fir and Engelmann spruce are both members of CNPS List 2. *Angelica arguta*, *Cypripedium fasciculatum*, *Draba howellii*, *Poa rhizomata*, and *Lomatium engelmanii* are all members of CNPS List 4.

Entire Basin Included: The SCRNA encompasses the entire upper drainage of Sugar Creek. It includes three major subwatersheds, each of which has essentially remained unchanged by humans since before the European colonization of California. This not only gives the area excellent ecological integrity but also enables watershed studies of various sorts to be carried out.

Physical Characteristics

The area covers 3963 acres (1604 ha). Elevations range from 4800 to 8196 ft (1463-2498 m). The cRNA is dominated by Russian Peak on the W. with two roughly equal-sized glacial valleys (S. Sugar and the main Sugar Creek drainages) incising the Salmon-Scott Divide immediately to the N. and S. of the peak. These valleys converge about 2 miles (3.2 km) NE. of Russian Peak and form the main Sugar Creek Valley, which continues northeastward another mile (1.6 km) to the E. edge of the cRNA. The ridges bounding these valleys have several points rising above 7600 ft (2317 m), creating valley depths more than 2000 ft (610 m) in many places. Upper and middle slopes are typically steep with gradually sloping valley floors. Slope aspects are primarily NW.- and SE.-facing. The effects of Pleistocene glaciation are widespread. Two ponds above the S. side of the main valley were formed by a lateral moraine dam. South Sugar Lake and High Lake lie in glacially scoured cirque bowls. The small tarn, about 0.65 miles (1 km) NNE. of Russian Peak, and Sugar Lake, about 1 mile (1.6 km) downstream, together constitute a short series of paternoster lakes.

The entire area is underlain by granitic rock (Russian Peak Pluton). Soils have been divided into six mapping units with the most extensive being

Teewinot-Endlich families association and the Gerle family-Entic Xerumbrepts association. The Nanny family occupies the valley bottom morainal deposits. Precipitation is estimated at 30-50 inches annually (762-1270 mm) with snow as the major form.

Association Types

Sawyer and Thornburgh (1971) and Keeler-Wolf (1984d) treat the vegetation differently. Sawyer and Thornburgh base their summary on extensive sampling (221 releves analyzed) of the four major forested vegetation zones in the area. Keeler-Wolf bases his mapping units on canopy dominance of various forest types and, in addition, treats the nonforest vegetation. This present summary of the vegetation is the same as that used in Keeler-Wolf (1989f) and relies largely upon the Holland classification system (1986). One type, the mountain mahogany scrub, is not described by Holland and more closely resembles Kuchler's (1966) type 31. Another type, the Brewer spruce woodland, is described as a result of the fieldwork for the establishment report. It has no Holland, Kuchler, or SAF (Eyre 1980) analog. Comparisons to the Sawyer and Thornburgh (1971) and Keeler-Wolf (1984d) types are made. References to "S and T" signify Sawyer and Thornburgh (1971), whereas mention of "K-W" refers to Keeler-Wolf (1984d).

Red Fir Forest (85310, 86100): 1053 acres (426 ha). This forest dominates on mid-elevation mesic slopes and upper-elevation xeric slopes with well-developed soil. The most extensive essentially pure Shasta red fir forests occur on E.- and W.-facing exposures between 6800 and 7200 ft (2073-2195 m). These forests are typically dense, with relatively even-aged canopies and abundant reproduction only in sunny openings. These are mapped as RF (red fir) in K-W. K-W maps several additional types with red fir as an important canopy member. Many of these are transitional forests between true red fir and types from lower or upper elevations. These include WF-RF (white fir-red fir), RF-WF-MH (red fir-white fir-mountain hemlock), RF-LP-WF (red fir-lodgepole pine [*Pinus contorta* ssp. *murrayana*]-white fir), RF-MH (red fir-mountain hemlock), RF-MH-WP (red fir-mountain hemlock-western white pine [*Pinus monticola*]), MH-RF, and RF-WP-LP. These forests vary from open to closed and from relatively mesic to xeric.

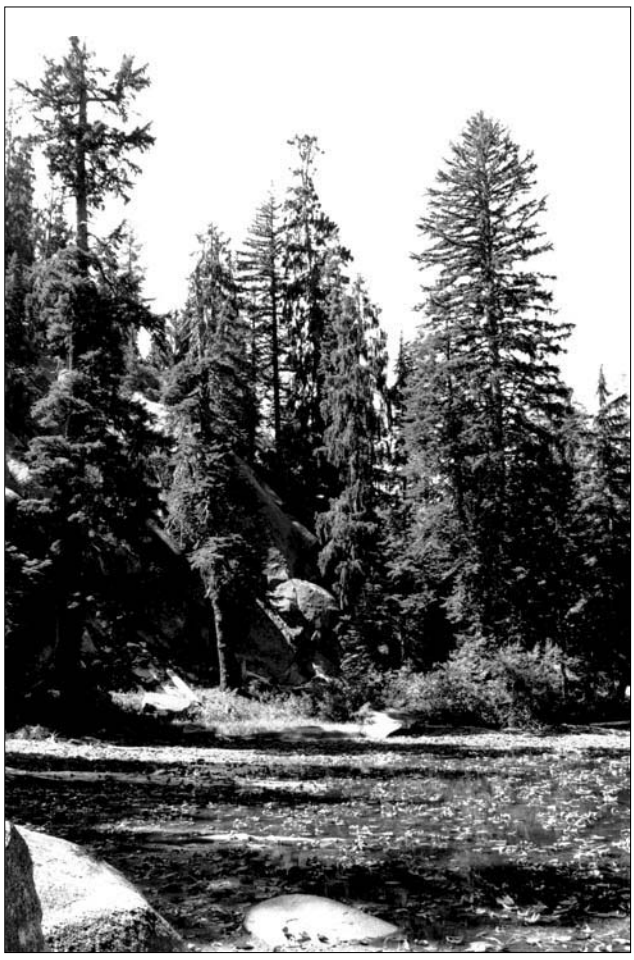

Figure 172—Sugar Creek, enriched conifer forest in Sugar Creek cRNA adjacent to small lateral moraine-dammed pond. Trees in photo include Englemann and Brewer spruces, Shasta red and white firs, western white pine, mountain hemlock, and lodgepole pine. (1988)

S and T describe red fir-dominated forests from both their Shasta red fir and mountain hemlock zones. Their *Abies magnifica* var. *shastensis*/*Quercus vaccinifolia* type includes the relatively open forests with montane chaparral-dominated understory. S and T also include the species-rich forests of the mesic valley bottoms (treated herein as enriched conifer forest) and the shrub-dominated montane chaparral as part of the red fir zone. Their closed forests dominated by red fir are included as part of the mountain hemlock zone. Their type most descriptive of the closed, well-developed fir-dominated forests is termed *Abies magnifica* var. *shastensis*/*Pyrola picta*. This type occurs on fairly deep, high elevation soils. The related *Tsuga mertensiana*/*Pyrola picta* type occurs under

similar conditions at higher elevations or more mesic sites. Both types have trees averaging 80 ft (24.4 m) tall and canopy cover approaching 90 percent. Shrub and herb cover is light.

Whitebark Pine-Mountain Hemlock Forest (86210): 921 acres (373 ha). The forests of the highest mesic slopes are dominated by mountain hemlock. These may be dense, shady groves or range to open and rocky. Typically, these forests occur on relatively sheltered slopes except at the highest elevations, as on the summit area of Russian Peak, where they may occupy S.-facing slopes. The typical closed forest is described as *Tsuga mertensiana/Pyrola picta* by S and T and called mountain hemlock (MH) by K-W. Canopy dominance may be shared with Shasta red fir on less mesic slopes. Shrubs are scattered and associated with openings. Herbs are typically sparse. Characteristic understory species include *Luetkea pectinata*, *Cassiope mertensiana*, *Phyllodoce empetriformis*, *Vaccinium scoparium*, *V. arbuscula*, *Pyrola secunda*, and *P. picta*.

Whitebark pine is typically not an important constituent except on the steep N. slopes of Russian Peak where it occurs scattered with hemlock among the granite slabs and boulders. Western white pine is occasional throughout in more open stands.

Sierran Mixed Coniferous Forest (84230, 84210): 857 acres (347 ha). One of the two target elements, this is an extensive forest at the lower elevations (<6000 ft, 1829 m). This association includes K-W map units MCF-pp (mixed conifer forest-ponderosa pine dominant) and MCF-wf (mixed conifer forest-white fir dominant). S and T consider all forests of this type in the cRNA to be in the white fir zone. They define two types, the *Abies concolor/Berberis nervosa* type and the *Abies concolor/Ceanothus prostratus* type. The latter is analogous to MCF-pp of K-W, and the former is equivalent to MCF-wf.

On warm sunny exposures, ponderosa pine dominates the canopy, with white fir and Douglas-fir as secondary species. Also present are sugar pine (*Pinus lambertiana*) and incense-cedar (*Libocedrus decurrens*). A subcanopy of scattered California black oak and canyon live oak (*Quercus chrysolepis*) is common, especially along ridges. Shrubs such as *Chrysolepis sempervirens*, *Quercus vaccinifolia*, and *Ceanothus prostratus* form a scattered to dense understory. Herbs are uncommon and include *Pyrola picta*, *Apocynum pumilum*, and *Goodyera oblongifolia*. Certain areas on the SE.-facing slopes above Sugar Creek have been affected by crown fire in the past 100 years and have dense even-aged young ponderosa pine.

On mesic slopes with deep soils, white fir dominates the canopy and reproduction. The other four typical mixed conifer species are subordinate. Ponderosa pine is represented by the largest individuals, but has poor reproduction except in openings. This is a moderately dense forest with characteristic shared dominance of the canopy species. Productivity is high, and trees commonly attain heights of 165 ft (50.3 m) and dbh of 5 ft (1.5 m). The ground layer is moderately developed and includes *Campanula prenanthoides*, *Disporum hookeri* var. *trachyandrum*, *Chimaphila umbellata* var. *occidentalis*, *Hieracium albiflorum*, *Pteridium aquilinum*, and *Linnaea borealis*.

A third type dominated by Douglas-fir occurs in the lowest elevation valley bottoms (below 5000 ft, 1524 m). This type is alluded to in S and T but not discussed in K-W (similar to Holland 84110). In addition to other typical conifers of the zone, it contains scattered Engelmann spruce in semi-riparian areas.

Alpine Talus and Scree Slope (91200, 91300): 310 acres (126 ha). This association occurs on all open rocky substrates at the upper elevations. It is not discussed by S and T but is called RO (rock outcrop) in K-W. Although sparsely vegetated, this association is an important constituent of the area. It may be divided into xeric (S.-facing) and mesic (N.-facing) types. Although many species are shared between the two subtypes, there is a well-defined split. Typical taxa of N.-facing

outcrops include *Saxifraga tolmiei*, *S. ferruginea*, *S. nidifica*, *Juncus drummondii*, *Luetkea pectinata*, *Polemonium pulcherrimum*, *Sibbaldia procumbens*, *Penstemon davidsonii*, and *Phyllodoce empetriformis*. Species of S.-facing outcrops include *Arenaria congesta*, *Sedum obtusatum* ssp. *boreale*, *Arabis platysperma*, *Juncus parryi*, *Koeleria macrantha*, *Eriogonum umbellatum*, *Melica stricta*, *Stipa californica*, and *Penstemon newberryi* ssp. *berryi*.

Salmon-Scott Enriched Conifer Forest (85420): 195 acres (79 ha). This type occurs along the valley bottoms and moist, sheltered slopes from low to mid-elevations in the cRNA. It is a poorly defined vegetation association with variable mixture of species. In general, it is characterized by the presence of Engelmann spruce or subalpine fir, or both, along with numerous other conifers overlapping from adjacent habitats, including red fir, white fir, mountain hemlock, western white pine, lodgepole pine, Brewer spruce, incense-cedar, sugar pine, ponderosa pine, and Jeffrey pine (*Pinus jeffreyi*). The mesophilic Pacific yew (*Taxus brevifolia*) is a characteristic subcanopy species of lower elevations. K-W map-units analogous to this association include ES (Engelmann spruce), ES-SF (Engelmann spruce-subalpine fir), and SF (subalpine fir). Analogs in S and T are *Abies magnifica/Leucothoe davisiae*, *Abies magnifica/ Linnaea borealis*, and *Tsuga mertensiana/Phyllodoce empetriformis*.

Stand density in one 2000-m^2 sample dominated by Engelmann spruce (Sawyer and Thornburgh 1969) is 1515 trees/ha and basal area is 71.8 m^2/ha. Stand density in a subalpine fir-dominated area sampled by Sawyer and Thornburgh (1969) is 1710 trees/ha with a basal area of 53.8 m^2/ha. Upper (rocky) elevations typically are dominated by subalpine fir; lower (poorly drained) elevations are dominated by Engelmann spruce. This pattern reflects the dominance patterns of these two species as they occur in their extensive range in the central and N. Cascades and mountains of Idaho and Montana (Alexander 1980).

The understory is typically well developed with a diversity of mesophyllic species. Thirty-eight shrub species are listed by S and T for the *Abies magnifica/Leucothoe* type alone. Among the most important species are *Leucothoe davisiae*, *Ribes lacustre*, *Alnus tenuifolia*, *Vaccinium scoparium*, *V. membranaceum*, and *Berberis nervosa*. The herb layer is also rich with such species as *Linnaea borealis*, *Anemone deltoidea*, *Adenocaulon bicolor*, *Clintonia uniflora*, *Disporum hookeri*, *Mitella pentandra*, *Streptopus amplexifolius*, *Viola glabella*, and *Senecio triangularis*.

Mixed Montane Chaparral (37510): 156 acres (63 ha). This vegetation occurs on xeric exposures within the red fir zone of S and T. It is dominated by a number of shrubs that generally cover 70-80 percent of the surface. These include *Quercus vaccinifolia*, *Arctostaphylos patula*, *A. nevadensis*, *Ceanothus velutinus*, and *Holodiscus microphyllus*, among others. Herbs are scattered and include *Senecio integerrimus*, *Monardella odoratissima*, *Phlox diffusa*, *Castilleja applegatei*, and *Penstemon newberryi*. This association is called *Quercus vaccinifolia/Arctostaphylos patula* by S and T and is included in map units MC (mountain chaparral), MC-JP-RF-WF (mountain chaparral-Jeffrey pine-red fir-white fir), and MC-JP-WP-RF-LP (mountain chaparral-Jeffrey pine-western white pine-red fir-lodgepole pine) of K-W.

Jeffrey Pine-Fir Forest (85100, 85210): 125 acres (51 ha). This is an open forest typical of shallow soils and xeric exposures. It is discussed by K-W as Jeffrey pine-red fir-white fir-lodgepole pine forest. It occurs in similar situations as mixed montane chaparral (open, rocky understory on S.- and SE.-facing slopes) but usually in areas with somewhat deeper soil. Typically, Jeffrey pine dominates the scattered canopy, but fir species (red fir at higher, and white fir at lower elevations) dominate the reproduction layers. Lodgepole pine is occasional. All species of shrubs typical of montane chaparral occur.

Sierran White Fir Forest (84240): 88 acres (35 ha). This forest is not well developed in the cRNA. Mature stands strongly dominated by white fir typically occur on mid- and lower E.-facing exposures between mixed coniferous and red fir-dominated vegetation. Some dense young stands are the result of recent crown fire. This type is included in K-W MCF-WF and WF-RF (white fir-red fir) and is included within the *Abies concolor/Berberis nervosa* type in the white fir zone of S and T.

Montane Riparian Scrub (63500): 46 acres (19 ha). This shrub-dominated association lines the sunnier seeps and creeks. The typical dominants are *Alnus tenuifolia* and *Salix commutata*, both species forming extensive thickets. Characteristic species above about 6000 ft (1829 m) include *Sambucus microbotrys*, *Spiraea douglasii*, *Lonicera conjugialis*, and the willow *Salix lemmonii*. In general, willows dominate on warmer SE. exposures while mountain alder dominates on E. and N. exposures. At lower elevations, between 5000 and 6000 ft (1524-1829 m), the riparian zone along Sugar Creek is shaded by surrounding coniferous forest, and the numerous large boulders and frequent scouring floods restrict riparian growth. In this area *Alnus sinuata* may dominate with other relatively shade-tolerant species such as *Salix scouleriana*, *Cornus stolonifera*, and *Sorbus scopulina*.

Brewer Spruce Woodland (no Holland equivalent): 46 acres (19 ha). This type is distinctive for its strong dominance by Brewer spruce. The trees form an open woodland on extremely steep, rocky, NW.-facing slopes between 6400 and 7200 ft (1951-2195 m) above the main Sugar Creek valley. Scattered western white pine, mountain hemlock, and red fir are of low importance, and in many stands Brewer spruce (BS) is the only tree. Shrubs and herbs are typical of mesic rock outcrops. This type is included within MH-BS-WP-RF of K-W and may be considered part of *Abies magnifica/Quercus vaccinifolia* or *Tsuga mertensiana/Abies magnifica/Pyrola picta* of S and T.

Whitebark Pine Forest (86600): 42 acres (17 ha). This is the forest with the most severe climate in the cRNA. It occupies ridgetops and adjacent upper slopes of the highest parts of the Sugar Creek drainage from 7500 to 8200 ft (2286-2499 m). Mountain hemlock is the principal tree associate. Trees are typically low, gnarled, and twisted, with multiple crowns. Shrubs include *Haplopappus greenei*, *Holodiscus microphyllus*, *Cercocarpus ledifolius*, and *Chrysolepis sempervirens*. Herbs are similar to the next described association. This association is called WBP-MH (whitebark pine-mountain hemlock) in K-W and *Pinus albicaulis/Holodiscus microphyllus* in S and T.

Foxtail Pine Forest (86300): 30 acres (12 ha). This forest is restricted to two groves: One is on rocky shallow soil on a S.-facing slope, and the other is on deep, decomposed granite on an E.-facing exposure. Both stands are small and marginally dominated by foxtail pine. The S.-facing stand has a higher diversity of subdominant species including red fir, mountain hemlock, lodgepole pine, western white pine, Jeffrey pine, whitebark pine, and white fir. The E.-facing stand has red fir and *Cercocarpus ledifolius* as the principal associates. Stand density for two samples in the S.-facing stand is 260 and 658/ha, and basal area is 19.0 and 29.3 m^2/ha (Sawyer and Thornburgh 1969).

Understory species are sparse in the E.-facing stand and include *Arctostaphylos patula*, *Stipa occidentalis*, *Lupinus breweri*, and *Eriogonum ovalifolium*. In the S.-facing grove, mountain chaparral species such as *Arctostaphylos patula*, *A. nevadensis*, and *Holodiscus microphyllus* dominate the understory. Other species include *Juniperus communis*, *Arenaria congesta*, *Achillea lanulosa*, *Senecio integerrimus*, *Phlox diffusa*, *Lewisia leana*, and *Penstemon newberryi*.

Mountain Mahogany (*Cercocarpus ledifolius*) Scrub (no Holland equivalent): 16 acres (7 ha). This association is not discussed by either K-W or S and T. It occupies a small area of steep, windy, rocky W.-facing slopes at 7000-7300 ft (2134-2225 m) to the W. of the E.-facing foxtail pine grove. The soil is virtually nonexistent, and the substrate is dominated by fractured granitic boulders. Reproduction of the dominant *C. ledifolius* is moderate. Other species in this association include red fir, *Arctostaphylos patula*, and *Ceanothus velutinus*.

Wet Montane Meadow (45100, 45210, 51110, 51200): 9 acres (4 ha). Wet meadow associations occur along narrow riparian borders, seeps, and lakesides. K-W discusses three types: Seep— dominated by *Aster* spp., *Dodecatheon* spp., *Ligusticum grayi*, *Carex spectabilis*, and so forth; open meadow— dominated by such species as *Carex gymnoclada*, *C. interior*, *Juncus mertensianus*, *J. dubius*, *Perideridia gairdneri*, and so forth; and bog (fen)— dominated by *Kalmia polifolia* var. *microphylla*, *Ledum glandulosum* var. *californicum*, *Drosera rotundifolia*, *Narthecium californicum*, *Tolfieldia glutinosa* ssp. *occidentalis*, and so forth. The best developed bog and meadow complex occurs around the shallow tarn NNW. of Russian Peak.

Montane Freshwater Marsh (52430): 7 acres (3 ha). This association occurs in several shallow ponds with muddy bottoms and fluctuating water levels. It is also well developed at Sugar Lake. This type was mapped as L (shallow lake) in K-W. Characteristic species include *Carex rostrata*, *Sparganium angustifolium*, *Nuphar polysepalum*, *Callitriche verna*, *Isoetes occidentalis*, and *Ranunculus aquatalis*.

Plant Diversity

Three hundred eighty-six species are listed in the establishment record.

Conflicting impacts

The area receives light recreational use. The wilderness status of most of the area precludes other multiple-use impacts.