INTRODUCTION

The Snow Canyon candidates Research Natural Area (RNA) is located in Alpine County, California on the Amador Ranger District of the Eldorado National Forest. It lies just of the crest of the Sierra Nevada Range and is within the upper watershed of the North Fork of the Mokelumne River.

Snow Canyon was nominated for the RNA designation by the Forest Supervisor to preserve a representative example of western white pine forest as a unique ecosystem in the central Sierra Nevada region (USFS 1988a). The area recommended for RNA status includes examples of other subalpine and alpine plant communities and geologic features that are representative of the region as well.

JUSTIFICATION

Representation of all major plant cover types in good condition is an important goal of the USFA RNA system. Snow Canyon was nominated to fill the western white pine (Pinus monticola) forest type. Western white pine is distributed in the Rocky Mountains from southeastern British Columbia south into Central Idaho and in the Cascade Ranges south into the southern Sierra Nevada (Griffin and Critchfield 1972). In the Sierra, the pine is a common component of upper montane and subalpine forests, but it seldom dominates over large areas or forms pure stands. Nearly pure stands of western white pine occur in the northern Sierra in the Babbit Peak RNA on the boundary of the Tahoe and Toiyabe National Forests (Keeler-Wolf 1990). In the central Sierra, western white pine forms more extensive stands than further north, yet established RNAs do not include pure or nearly pure stands of this forest type. Central Sierran western white pine forests in exemplary condition are in need of representation within the RNA system. The nearly pure stands at Snow Canyon would fill this need.

Research natural areas, in general, and Snow Canyon, in particular, can serve a variety of functions for preservation and research purposes. Genetic, species, and ecosystems-levels of western white pine diversity would be preserved in Snow Canyon. In addition, many other species and communities would be preserved. With a primary focus on research and education, Snow Canyon serves as a base line for measuring long-term ecological changes in western white pine forests and in other plant communities present. The area functions as a control for manipulative research activities in comparable areas. Snow Canyon also protects the habitats of threatened, endangered, and sensitive species.

LOCATION

The Snow Canyon RNA is located west of the main crest of the central Sierra Nevada on the Amador District of the Eldorado National Forest (fig. 1). The area is roughly 80 mi east of Sacramento in Alpine County, California. Longitude and latitude are 119° 59'
West and 38° 37’ North, respectively. Snow Canyon is included on the USGS Pacific Valley and Carson Pass 7.5’ topographic quadrangles. The boundary places the RNA in Township 9 North, Range 18 East, North ½ Section 27, and unsurveyed sections to the North, Mount Diablo Meridian.

The boundary for the Snow Creek RNA is roughly quadrilateral in outline and is defined by topographic features (fig. 2). This boundary defines about 703 ac (284 ha) of area.

**TOPOGRAPHY**

Snow Canyon is within the upper watershed of the North Fork of the Mokelumne River situated immediately adjacent to the main Sierran crest. Elevations within the RNA range from 8,200 ft (2,499 m) in the lower drainage of Snow Canyon to 9,846 ft (3,001 m) along the northern ridgeline. Thus, about 1,650 vertical feet (500 m) of subalpine landscapes are included in the area.

Uppermost elevations include examples of gentle to steep talus slopes, outcrop knolls, and a well-defined ridgeline that drops abruptly to the north. The mostly south-facing slopes below the ridgeline are open, moderately steep and composed of talus and cobble-sized stones. At approximately 9,200 ft (2,804 m) in elevation, a contact between overlying metavolcanic rock and the granitic batholith is readily apparent. Several notable seeps and springs issue from this contact and feed incipient streams.

Topographic features of middle and lower elevations include open, broad slopes, glacially-scoured rock lands, gullies of decomposed granite, knolls, a flat canyon bottom, and several perennial streams. Above 8,800 ft (2,682 m), the landscape is dominated by rocks and only a few scattered trees occur where enough soil accumulates to provide a foothold. Below that elevation a subalpine forest occupies a 500-foot-wide band on gentle to steep slopes. The most common slope directions are west, southwest, south, southeast and east. Numerous south-trending streams drain the middle slopes and merge at about 8,270 ft (2,520 m) where the canyon abruptly flattens at the relatively large alluvial-filled valley floor of Snow Canyon. The main stream meanders south about 0.7 mi (1.1 km) across the alluvium in a channel lined with decomposed granite. A natural constriction turns the creek east toward Meadow Lake and provides a natural feature to define the lower limit of the RNA. In summary, the Snow Canyon RNA includes a diversity of common high elevation landforms and features that are representative of central Sierra Nevadan subalpine scenery. Figures 3 and 4 provide overviews of the Snow Canyon area.

**CLIMATE**

California’s precipitation comes primarily from cyclonic storms off the Pacific Ocean usually between October and June. The Sierra Nevada is a tremendous barrier to the
eastward passage of these storms, and the Mokelumne River canyon provides an
unobstructed avenue for their ascent. As these cyclonic storms are forced over the central
Sierra, they adiabatically expand, cool, condense, and precipitate their moisture as snow.
The storms average about four days in duration, while warmer, clear weather typically
prevails between storms. Snow Canyon lies at about the elevation of assumed maximum
snow accumulation for the west slope of the Sierra (Miller 1955, Major 1977). Winds
may redistribute the snowpack into drifts up to 50 feet (15 m) deep and blow exposed
sites completely free of snow. Deep snowpacks are maintained, especially in the shade of
dense forests until late spring of summer. Summer months are usually dry although
infrequent periods of thunderstorms occur. The amount of precipitation from year to year
occurs because of topographic effects (Klieforth et al. 1983).

No climatic data exist for Snow Canyon itself, but Pacific, Gas and Electric
Company (PG&E) monitors climate at two locations near the RNA. PG&E measures
temperature, precipitation, and snowpack at Blue Lakes about 3.2 mi (5.2 km) east of
Snow Canyon and at Caples Lake about 6.5 mi (10.5 km) northwest. Both stations are at
8,000 ft (2,438 m) in elevation and may be representative of the climatic conditions at
lower elevations within the RNA.

At Blue Lakes and Caples Lake precipitation is greatest in December and January
when monthly averages are 9.5 in (242 mm) of water. Snowfall is greatest in January with
an average of 84 in (2.1 m), and snowpack is deepest in late March. During each of the
summer months (July, August, and September) rainfall is scant, averaging about 0.75 in
(19 mm).

Temperatures are coldest in January when the mean daily temperature is 28.3 ºF
(-2.1 ºC), in contrast to the warmest month, July, when mean daily temperature is 55.9 ºF
(13.3 ºC). During the winter months (January, February, and March) the minimum daily
temperatures average 15.6 ºF (-9.1 ºC), while the maximum daily temperatures average
36.3 ºF (2.4 ºC). In contrast, during the summer months, the maximum daily temperatures
average 66.7 ºF (19.3 ºC), while the minimum daily temperatures average 41.9 ºF (5.5
ºC). Freezing temperatures can occur in any month.

GEOLOGY

The geologic structure of the central Sierra Nevada is the result of a long and
complex geologic history, which is summarized by Bateman and Wahrhaftig (1966). Pre-
Tertiary rocks of western Alpine County in the vicinity of Snow Canyon are treated in
Parker (1959).

Koenig (1963) indicates the presence if two rock types in the Snow Canyon area.
Pliocene volcanic rock predominates on the ridgeline at highest elevations and covers
about 18 percent of the RNA. These volcanics have not been expressly studied and are of
unknown composition. They date from a period governed by eruptions following fault-
blocking when the Sierra uplifted and tilted westward.
SOILS

No comprehensive soil survey has been conducted for the Snow Canyon area. A survey of the adjacent Tahoe Basin area provides soil information, which in general, applies to this (Rodgers 1974).

The higher elevations of Snow Canyon classify as rock land and rock outcrop—they are the result of glaciers scouring volcanic and granite rocks. A thin mantle of soil occurs in crevices, depressions, and on gentle to steep slopes. These shallow soils classify as medial Lithic Cryadepts when formed from volcanic rocks, and as mixed, shallow Typic Cryopsamments, when formed from granite rocks. They support alpine and subalpine barren communities. At somewhat lower elevations, the mixed, shallow, Typic Cryopsamments support an open subalpine forest. These soils are slightly to medium-acid, well-drained, and have low erosion potential. Somewhat deeper soils classify as mixed Typic Cryopsamments and support the somewhat more dense subalpine forest.

Deep soils developed over stratified granitic alluvium on gently sloping to flat sites with hallow water tables classify as sandy, mixed Aquatic Entic Cryumbrepts. They are subject to flooding and support meadow grasses and forbs with occasional lodgepole pines.

VEGETATION

Description of Plant Communities

Six plant communities were recognized within the boundaries of the Snow Canyon RNA. Table 1 provides their areal extent and analogous classifications by Holland (1986), Society of American Foresters (Eyre 1980), and Kuchler (1966). Approximate bounds of five plant communities are shown in figure 5. One plant community, alpine shrub steppe, occurs in very limited extent and is indicated in the figure for location only. Locations of releves are given in figure 5a. Descriptions of all plant communities follow.

Alpine Barrens and Scree

The alpine barrens and scree community is equivalent to alpine talus and scree. Slope(91200, Holland 1986) an Alpine Meadows and Barrens (45, Kuchler 1966). There is no equivalent in the SAF classification (Eyre 1980). Several alpine and alpine steppe communities for the Carson Pass area have been described by Taylor (1977), which may be similar to this community. They include *Haplopappus acailis*, *Polygonum Davisiace-Eriogonum incanum*, and *Antennaria alpina-Penstemon heterodoxus* associations.
Alpine barrens and scree is found at the highest elevations in Snow Canyon on substrates derived from metavolcanic rocks. It occurs on South and Southwest-facing slopes that may be gentle to steep. These slopes are probably wind-swept and snow free in winter. The community covers about 120 ac (48.6 ha) in the Snow Canyon RNA boundary, but is entirely excluded in the original boundary (figs. 6 and 7).

The alpine community is dominated by herbaceous perennials and low-growing shrubs. Plants may cover as little as 2 percent of the area on more exposed sites, but as much as 25 percent on moist, more protected sites. The most common dominants are *Polygonum Davisiae* and *Haplopappus suffruticosus* with cover values of 1 to 25 percent. The following grasses and low growing perennials are commonly scattered throughout the community, but provide little cover:

- *Arabis puberula*
- *Castilleja applegatei var. pallida*
- *C. nana*
- *Crepis modocensis ssp. subacaulis*
- *Eriogonum compositus var. glabratus*
- *Eriogonum incanum*
- *E. ovalifolium var. nivale*
- *Eriophyllum lanatum var. integrifolium*
- *Erysimum perenne*
- *Haplopappus acaulis*
- *Ivesia gordonii*
- *Leucopoa kingii*
- *Melica stricta*
- *Monardella odoratissima ssp. glauca*
- *Penstemon speciosus*
- *Phlox diffusa*
- *Poa cusickii*
- *P. epilis*
- *P. rupicola*
- *Raillardella argentea*
- *Senecio canus*
- *Trisetum spicatum*

**Alpine Shrub Steppe**

Alpine shrub steppe may not be equivalent to Alpine Dwarf Scrub (94000, Holland 1986), which has been named, but not described. It has no parallel in the SAF classification (Eyre 1980) or Kuchler (1966) systems. Taylor (1977) described two shrub steppe communities (*Artemisia tridentata* ssp. *vaseyana*-Eriogonum *umbellatum* and *A. t. ssp. vaseyana-Wyethia mollis*), which may be similar to this one.

Alpine shrub steppe if found at high elevation—about 9,500 ft (2,896 m) on a southwest-facing, moderately-inclined slope. It occurs on meta-volcanic substrates at a windswept site kept moist from seepage from a higher snowbank. The community covers less than one acre (0.4 ha) of the total area within the boundary and is excluded from the original boundary.

Low shrubs dominate the alpine shrub steppe. *Artemesia tripartita* is the most common woody species with 26 to 50 percent cover. Other shrubs present include *Eriogonum umbellatum*, *Haplopappus macronema*, *H. suffruticosus*, and *Leptodactylon pungens* ssp. *pulchiflorum* with cover values of less than 1 to 5 percent. Scattered among the shrubs are herbaceous grasses and broad-leaved perennials common in the adjacent alpine barrens.
Subalpine Barrens and Bedrock

The subalpine barrens and bedrock community has no equivalent in the Holland system—it is a broad ecotone between Subalpine Coniferous Forest and Alpine Boulder and Rock Field (86000 and 91000, respectively, Holland 1986). The *Juniperus occidentalis-Holodiscus microphyllus* association of the shrub steppe community as described by Taylor (1977) is a similar unit.

The subalpine barrens and bedrock community is found at high elevations, about 8,600-9,200 ft (2,621-2,804 m), on granitic substrates sandwiched above the more continuous forest and below the alpine community of metavolcanic substrates. It occurs on southwest, south, and southeast-facing slopes of moderate inclinations. This community covers about 320 ac (129.5 ha) within the boundary of Snow Canyon—the most extensive community coverage in the RNA. It covers about 225 ac (91 ha) within the originally proposed boundary (figs. 8 and 9).

The community is governed by extensive outcrops of bedrock scoured by Pleistocene glacier activity and left exposed to present elements. Very little soil has developed except in crevices and depressions. Accordingly, few trees are present, although scattered individuals of *Juniperus occidentalis* ssp. *austalis*, *Pinus albicaulis*, *P. jeffreyi*, and *P. monticola* occur with little cover. *Holodiscus microphyllus* is a commonly occurring shrub with 1 to 5 percent cover, whereas *Polygonum daviesiae* and *Sitanion hystrix* var. *brevifolium* are the most common perennials also with up to 5 percent cover. Other scattered perennials contributed little to the total plant cover. They include:

- Antennaria rosea
- Colachortus leichtlinii
- Eriogonum incanum
- E. lobbia
- E. umbellatum
- E. wrightii var. subscaposum
- Haplopappus suffruticosus
- Ivesia gordonii
- Lomatium nevadense
- Penstomen davidsonii
- P. newberryi
- Potentilla breweri
- Silene sargentii
- Streptanthus tortuosus var. orbiculatus
- Valeriana capitata

Rundel et al. (1977) provide descriptions of successional development on granite outcrops of the Sierra montane zone that appear to be very descriptive of the subalpine area in Snow Canyon.

Subalpine Western White Pine Forest

The subalpine western white pine forest is equivalent to Sierran mixed Subalpine Coniferous Forest (86200, Holland 1986), California Mixed Subalpine (SAF 256, Eyre 1980), and Lodgepole Pine-Sub alpine Forest (8, Kuchler 1966). Eyre (1980) describes a
western white pine forest type (SAF 215) for the Rocky Mountain and the Intermountain Region, but none of the classification systems specifically describe subalpine forests dominated by western white pine for the Sierra Nevada. Stands of subalpine conifers dominated by western white pine are uncommon in the Sierra although the species is commonly present throughout the upper montane and subalpine zones. The subalpine western white pine forest at Snow Canyon is a good example of this forest type for the central Sierran region.

The western white pine forest is found at middle elevations, 8,250-8,800 ft (2,525-2,682 m) in Snow Canyon on granitic substrates (figs. 10-13). Slopes may be east, southeast, south, southwest, and west-facing with gentle to steep inclinations. The subalpine forest community covers about 195 ac (78.9 ha) in the Snow Canyon RNA boundary. It covers about 175 ac (71 ha) within the originally proposed boundary.

The forest is dominated by Pinus monticola though pure stands are not present. In some areas, Tsuga mertensiana is common—generally, on moister sides with west-facing exposures. Other tree species occurring in low numbers are Abies magnifica, Juniperus occidentalis ssp. australis, Pinus albicaulis, P. contorta var. murrayana and P. jefferyi.

The forest understory may be well-developed with up to 70 percent of the forest floor covered by herbaceous plants. The most common species associated with the western white pine stands are Polygonum davisiae, Festuca viridula, and Poa nervosa, which each may obtain up to 50 percent cover. The following species are commonly present with sparse cover:

- Agoseris glauca var. monticola
- Arctostaphylos nevadensis
- Arnica mOLLIS
- Carex athrostachya
- C. microptera
- C. rossii
- Chrysopsis brueri
- Eriogonum marifolium
- E. nudum var. deductum
- E. umbellatum
- E. Wrightii var. subscaposum
- Juncus parryi
- Ligusticum grayi

- Pedicularis semibarbata
- Phacelia hydrophylloides
- Poa epilis
- P. nevadensis
- Ribes montigenum
- R. velutinum var. glanduliferum
- Senecio integerrimus var. exaltatus
- Sidalcea glaucescens
- Spiraea densiflora
- Symphoricarpos vaccinioides
- Viola purpurea ssp. xerophyt
- Wyethia mollis

Winter conditions in Snow Canyon may be too harsh to allow the zonal climax red fir forest to develop. The western white pine forest has a fairly open canopy throughout its elevational range even on the best sites with good soil development.
Structural characteristics of the western white pine forest were quantitatively sampled at two locations. The upper stand was centrally located in the RNA at about 8,600 ft (2,620 m) on a moderately inclined, southwest-facing slope. The lower stand was near the southern boundary at about 8,350 ft (2,545 m) on a gentle, west-facing slope.

Table 2 provides a stand structure analysis of the two sampled stands. Four species of conifers were measured, but only saplings of Abies magnifica were present. The upper stand was almost pure western white pine. Tsuga mertensiana was present primarily as middle-sized trees, in the lower stand. Forty-four and 47 percent of individuals of all tree species were classed either as saplings or the smallest category of trees with less than 10 cm dbh in the upper and lower sample areas, respectively.

Table 3 provides results of tree density, basal area, and frequency estimates within the western white pine forests. Tree density estimates from these data, 150 and 110 stems ha$^{-1}$ for the upper and lower areas, respectively, show that this subalpine forest is relatively open. Sapling densities per hectare were estimate at 25 for Pinus monticola, 5 for Tsuga mertensiana, and 5 for Abies magnifica.

A relatively pure western white pine forest occurs at the Babbitt Peak RNA in the northern Sierra. At Babbitt Peak RNA, western white pine forest occurs at an elevation of 7,600-8,695 ft (2,316-2,650 m). Slopes are gentle northwest to northeast-facing near the ridge summits. Associated trees include Abies concolor and A. magnifica. Stand density is estimated at 400 stems ha$^{-1}$ with 78 m$^2$ ha$^{-1}$ basal area. In comparison to the forest at Snow Canyon, the forest at Babbitt Peak RNA is lower in elevation, on opposite-facing slopes, and has greater tree densities and basal area (Keeler-Wolf 1989).

Rundel et al. (1977) cite data from Sudworth (1900) for western white pine stands in the southern Sierra in Kings Canyon National Park. Density of western white pine was estimated at 203 stems ha$^{-1}$ (in 4 size classes) and 103 m$^2$ ha$^{-1}$ basal area, but no environmental variables are given.

Subalpine Riparian Scrub

The subalpine riparian scrub community is equivalent to higher elevation variations of Montane Riparian Scrub (63500, Holland 1986). It has no counterpart in the Kuchler (1966) or SAF (Eyre 1980) classifications. Taylor (1977) described a mesic herbaceous and meadow association (Salix eastwoodiana—Senecio triangularis) and Beguin and Major (1975) described a Salix rigida association which are similar to the riparian scrub in Snow Canyon.

Subalpine riparian scrub lines major drainages from low to high elevations at about 8,250-9,100 ft (2,515-2,774 m) in the area. It typically occurs within the larger surroundings of the subalpine western white pine forest and subalpine barrens and bedrock. Riparian scrub sometimes is found in close association with subalpine meadows. It forms narrow corridors of streamside vegetation along little more than 3 mi.
(4.8 m) of perennial streams, yet it encompasses less than 2 ac (0.8 ha) of area within the boundary. The original boundary includes about 1.8 ac (0.75 ha) of subalpine riparian scrub (figs. 14 and 15).

The canopy in subalpine riparian scrub is dominated by shrubs, which may form open or closed thickets. *Salix jepsonii* or *S. orestera* may dominate a given reach with greater than 75 percent cover. *Alnus incana* ssp. *tenuifolia*, *cornus sericea*, *Prunus emarginata*, and *Sambucus racemosa* ssp. *pubens* var. *microbotrys* may co-dominate at middle to lower elevations and may each provide up to 25 percent cover.

Undergrowth may be sparse where canopies are closed or where local geomorphology limits the width of the riparian area. Many herbaceous plants occur where adequate light penetrates. On close inspection, mosses, liverworts, and foliaceous lichens are found at ground level. Some common understory species that may be locally plentiful but usually provide little cover, included:

- *Aquilegia formosa*
- *Carex fructa*
- *C. heteroneura* var. *angustifolius*
- *Festuca viridula*
- *Hackelia jessicae*
- *H. nervosa*
- *Heracleum lanatum*
- *Mimulus guttatus*
- *Senecio triangularis*
- *Thalictrum fendleri*
- *Valeriana capitata*
- *Veratum californicum*

**Subalpine Meadow**

The subalpine meadow community is equivalent to Subalpine and Alpine Meadow (45200, Holland 1986) and Alpine Meadows and Barrens (45, Kuchler 1966). It has no equivalent in the SAF classification (Eyre 1980). Taylor (1977) described three mesic herbaceous and meadow associations (*Vaccinium nivictum—Calamagrostis breweri, Carex scopulorum*, and *Salix arctica-Juncus mertensianus*) while Beguin and Major (1975) described several meadow associations, which may be comparable to subalpine meadows in Snow Canyon.

Subalpine meadows occur from lowest to high elevations, 8,200-9,200 ft (2,499-2,804 m), on flat to gently-sloping terrain in Snow Canyon. At its higher elevational limits, meadows tend to cover small areas at seeps, especially at the interface between meta-volcanic and granitic substrates. Throughout its elevational range, they may be found along gentle drainages within the subalpine barrens or forest complex, and are often associated with the riparian community. At the lowest-most elevations in Snow Canyon, an extensive meadow occurs in the bottom of the drainage with the main creek meandering along its eastern half. Subalpine meadows cover about 65 ac (26.3 ha) within the boundary, whereas they cover about 75 ac (23 ha) within the original boundary of Snow Canyon RNA (figs. 16-19).
Subalpine meadows are dominated by herbaceous plant species that from 1-2 ft tall (0.3-0.6 m). Wet, moist, and dry phases of subalpine meadows occur along a moisture gradient defined by the depth of the water table and distance to flowing water. Drier phases tend to occur at the outer margins of meadow, as where soils are well-drained and soil texture is coarse. Dry phases are dominated by *Polygonum davisiae*, *Penstemon heterodoxus*, and *Calyptridium*, and they have the least total cover by plants.

Moist phases of subalpine meadows are very common and are dominated by species such as *Festuca viridula*, *Lupinus sellulus*, and *Phyllococe breweri*. Wet phases occur in close association with flowing water—soils are saturated throughout the growing season and may have high organic matte content. Graminoids, such as *Carex aquatilis*, *C. nebrascensis*, and *C. scopulorum*, dominate wet meadows. Both moist and wet phases may have up to 100 percent cover by plants, but in wet meadows only a few to one species may contribute that cover. Subalpine meadows can be very diverse communities. The following are species that commonly occur in the meadows of Snow Canyon:

- Antennaria umbrinella  
- Calamagrostis breweri  
- Carex aquatilis  
- *C. luzulaefolia*  
- *C. spectabilis*  
- Claytonis lanceolata var. sessilifolia  
- Collinsia parviflora  
- Deschampsia elongata  
- Dodecatheon alpinum  
- Draba stenoloba var. nana  
- Epilobium oregonense  
- Erigeron coulteri  
- *E. peregrinus* var. angustifolius  
- Juncus chlorocephalus  
- *J. mertensianus*  
- Lupinus polyphyllus ssp. superbus  
- Luzula multiflora ssp. comosa  

- Mimulus floribundus  
- *M. primuloides*  
- Phleum alpinum  
- *Platanthera sparsiflora*  
- *Poa epilis*  
- *P. nevadensis*  
- *P. rupicola*  
- Ramunculus alismaefolius var. alismellus  
- Saxifraga aprica  
- *S. bryophora*  
- *S. punctata* ssp. *arguta*  
- Sibbaldia procumbens  
- Trifolium longipes  
- Trisetum spicatum  
- Vaccinium caespitosum var. paludicola  
- Veronica wormskjoldii ssp. alpina

**FLORA**

Appendix I lists the vascular plant taxa observed at Snow Canyon. The flora is moderately rich for subalpine elevations represented in the RNA. It is a mixture of circumpolar, western North America, Sierra Nevada, and Great Basin species. Eleven species were widespread in Snow Canyon and occurred in almost all of the plant communities present. They include:

- Calyptridium umbellatum  
- Eriogonum Umbellatum  
- Eriophyllum lanatum var. inegrifolium  

- Phlox diffusa  
- *Poa epilis*  
- *Polygonum daviesiae*
No federally listed endangered, threatened or candidate plants are known to occur in the area. One sensitive species, *Silene invisa* is known to occur at middle elevations in the western white pine forest (McDonald *et al.* 1989). It is endemic to California and occurs in the Cascade and Sierra Nevada ranges. The California Native Plant Society puts the species on List 1B: plants rare, threatened, or endangered in California and elsewhere (Smith and Berg 1988). They state that *Silene invisa* is threatened by logging in the red fir forest. Many newly discovered populations have been found on the Eldorado, Plumas, Stanislaus, and Tahoe National Forests recently. An interim species management guide has been developed for its management (USFS 1988b). Because of the increasing number of known occurrences of the plant, the California Natural Diversity Data Base does not rate it highly (R. Bittman, pers. comm.).

**FAUNA**

Appendix II is a list of potential animals for the Snow Canyon RNA. It was compiled by the Forest based on species known to occur in habitats present at these subalpine elevations in the central Sierra Nevada.

Snow Canyon provides habitats for two federally listed endangered birds, the bald eagle (*Haliaeetus leucocephalus*) and peregrine falcon (*Falco peregrinus anatum*). In addition, it provides habitats for a state listed endangered bird, the great gray owl (*Strix nebulosa*), and a state listed rare animal, the wolverine (*Gulo gulo*). Wolverine and peregrine falcon sightings have been made about 4 mi (6.4 km) west and 5 mi (8 km) northwest of Snow Canyon, respectively.

Sensitive species listed by the Forest that may occur in the Snow Canyon area include 3 birds and 2 mammals: northern goshawk (*Accipiter gentilis*), great grey owl (*Strix Nebulosa*), willow flycatcher (*Empidonax traillii*), fisher (*Martes pennanti*), and Sierra Nevada red fox (*Vulpes vulpes necator*).

**IMPACTS AND POSSIBLE CONFLICTS**

Snow Canyon lies within the Mokelumne Wilderness Area. Wilderness and research natural area management essentially pose no conflicts with one another in this setting. Objectives of wilderness and RNA management both seek to maintain natural ecological processes and conditions. A hiking trail (Forest Trail #18E08) to Grouse Lake cuts across the upper elevation slopes in the Snow Canon RNA. Judging by general trail wear traffic appears light—in some areas the trail is obscure from lack of use. Recreational use, such as camping, is light and poses no conflicts with RNA status. The relatively isolated location of Snow Canyon restricts most impacts and conflicts by humans.
Livestock grazing historically occurred in Snow Canyon. The area is within the Indian Valley grazing allotment. The most recent livestock permit, issued for cattle, expired in 1988. It permitted 185 head to graze from 21 July to 20 September. Currently there is no allotment management plan or annual operating plan. There is little evidence of past grazing—older damage to streambanks in the largest meadow is recovering (fig. 19). Occasional drift occurs as evidenced by recent cattle feces (shit).

RECOMMENDATIONS

Boundary

The recommended boundary for the Snow Canyon RNA is shown in figure 2. It represents a 50 percent increase in size from the boundary proposed by the reconnaissance team.

LITERATURE CITED
