Vascular Flora of the Upper Rock Creek Watershed, Eastern Sierra Nevada, California

Joy D. England
Rancho Santa Ana Botanic Garden, Claremont, CA

Follow this and additional works at: https://scholarship.claremont.edu/aliso

Recommended Citation
Available at: https://scholarship.claremont.edu/aliso/vol36/iss2/2
VASCULAR FLORA OF THE UPPER ROCK CREEK WATERSHED, EASTERN SIERRA NEVADA, CALIFORNIA

JOY D. ENGLAND
Rancho Santa Ana Botanic Garden and Claremont Graduate University, 1500 N. College Avenue, Claremont, California 91711 (jenglund@rsabg.org)

ABSTRACT

The upper Rock Creek watershed is located on the east slope of the Sierra Nevada in Inyo and Mono counties. It is ca. 36.5 square miles (94.5 square km) in area and varies in elevation from 7360 to 13,750 ft (2243 to 4191 m). Quaternary glacial erosion and deposition produced striking landscape features, including alpine fellfields and numerous small lakes. Previous floristic inventories in Rock Creek recorded a combined 396 minimum-rank taxa (species, subspecies, varieties, named hybrids) but were restricted to Little Lakes Valley and the surrounding high areas. An updated, annotated checklist of vascular plants is presented, based on preexisting specimens and new collections. I conducted intensive fieldwork from 2012 through 2016, resulting in 1506 collections (including two collections from a brief 2018 visit). More than 1000 historical collections were examined. The resulting checklist contains 591 taxa, of which 25 (4.2%) are non-native to California and 32 (5.4%) are special-status plants. My fieldwork resulted in 128 taxa previously undocumented for the watershed. Eighty-one species historically collected were not rediscovered and are noted as such in the checklist. Nine taxa are new county records. The flora is represented by 77 families, 248 genera and 572 species. For each taxon, the checklist cites at least one collection and indicates the vegetation type(s) where it has been documented and its abundance in the watershed. A brief review of botanical exploration in the watershed during the past century is presented, along with geology, climate, vegetation and history of human activity.

Key words: alpine plants, California, eastern Sierra Nevada, flora, floristics, John Muir Wilderness, plant collections, rare plants, Rock Creek.

INTRODUCTION

Floristic inventories that utilize herbarium collections as their basis serve as important baselines of information about plants and the environments in which they occur. Studies of local floras are crucial to our understanding of biodiversity amid the realities of climate change and human impacts to the environment. With growing digitization of collections data, floristic datasets are proving to be increasingly useful and especially rich due to their breadth of information at spatial and temporal scales (Wolf et al. 2016).

The upper Rock Creek watershed is situated on the east slope of the Sierra Nevada mountain range (Inyo and Mono counties, California, USA) in the Inyo National Forest. Historical collections from Rock Creek contributed several additions to the California flora: four new taxa were described in the previous century, including Tonesta peirsonii (as Haplopappus eximius) H.M. Hall subsp. peirsonii D.D. Keck (Asteraceae), Draba sierra (Brassicaceae), Castilleja peirsonii (Orobanchaceae) and Festuca brachyphylla subsp. breviculmis (Poaceae).

In spite of the great number of collections from the upper Rock Creek watershed prior to this study (>1000), and two previously published floristic checklists—F. W. Peirson (1938, 1942) and J. T. Howell (1946)—no collections-based floristic work had ever focused on the entire geographic area forming the upper watershed, i.e., Rock Creek Canyon (Fig. 1). The earlier checklists were restricted to the Little Lakes Valley area.

The main goal of the present study was to produce an updated vascular flora of the watershed combining pre-existing herbarium specimens and new collections.

PHYSICAL SETTING

Location and Features

The upper Rock Creek watershed (Fig. 1, 2–5) is located ca. 25 road miles (40 km) northwest of Bishop and ca. 19 miles (30 km) southeast of the town of Mammoth Lakes, California. A single-paved road, Rock Creek Road, enters the canyon mouth ca. 1 mile (1.6 km) southwest of the road’s junction with U.S. Route 395 (US-395) at Tom’s Place. A secondary entry route, Sand Canyon Road (Forest Rd 5S08/30E302), is a four-wheel-drive (4WD) road accessible from the community of Swall Meadows that enters the area from the northeast. Two additional access points into the watershed are via hiking/pack trails traversing Mono Pass and Morgan Pass. The watershed is ca. 36.5 square miles (94.5 square km; 23,360 acres) in area, ca. 56% of which lies within the John Muir Wilderness (Fig. 1). The elevation ranges from 7360 to 13,750 ft (2243 to 4191 m).

The study boundary is the nearly continuous ridgeline that encompasses Rock Creek Canyon on the east, west and south (Fig. 1). Its northern boundary is the canyon mouth at the 7360 ft (2243 m) contour (37.5508 N, 118.6833 W), which is ca. 500 m north-northeast of the water tank along Rock Creek Road, near French Campground. Rock Creek continues its course downstream from this point, outside the study area, for ca. 1 mile (1.6 km) to Tom’s Place before it turns sharply east into lower
Fig. 1. Map of the upper Rock Creek watershed. The red line is the study area boundary. Plant collection sites are shown on the satellite image at upper left: England sites (yellow) 2012–2018 and other collector sites (blue). Locality data for historical collections were obtained from georeferenced specimen records in the Consortium of California Herbaria (CCH) online database, accessed 18 Feb 2013. Feature names were obtained from the USGS Geographic Names Information System (GNIS) database; some place names for collection localities are informal. Peak elevations were obtained from the USGS 7.5’ map quad. Base map layers were used with permission (Source: CalTopo, OpenStreetMap contributors, Thunderforest, USDA).
Rock Creek and eventually, farther southeast, into the Owens River. Hereafter my use of the name Rock Creek implies the upper watershed, i.e., Rock Creek Canyon, unless otherwise noted.

Numerous high peaks are situated along the rim of the watershed, including 13,704 ft (4177 m) Mount Abbot on the south rim (Fig. 1, 4) and 12,835 ft (3912 m) Mount Starr on the west (Fig. 1). The highest point in the study area is the summit of Mount Morgan at 13,748 ft (4190 m) (Fig. 1, 3). Northwest of Mount Morgan is Transverse Ridge, which runs crosswise to the long axis of the watershed and is a collection locality on some F. W. Peirson herbarium specimens (Fig. 1). Wheeler Ridge (Fig. 1, 2) is a long, north-south ridge that divides the watershed from the Owens Valley. Mono Mesa (Pointless Peak) (Fig. 1, 5), ca. 12,256 ft (3736 m), is an unglaciated plateau above and west of Rock Creek Lake (Fig. 1).

Lakes and pools are abundant; the largest, Rock Creek Lake (Fig. 1), is nearly 59 acres (34 ha) in size. Little Lakes Valley (Fig. 1, 3–4) contains eight named lakes or groups of lakes; there are 12 additional named lakes in the watershed and several unnamed lakes. Rock Creek has two main divisions: a primary channel that flows northward from headwaters at ca. 13,000 ft (3962 m) above Little Lakes Valley, and the East Fork that originates near 12,200 ft (3718 m) above the Tamarack Lakes (Fig. 1). Mosquito Flat is an open area along a calm stretch of the main creek near the entry point to the John Muir Wilderness at ca. 10,328 ft (3148 m) (Fig. 1).

Geology and Geomorphology

Rock types.—The bedrock of the study area is primarily Mesozoic granite with a scattering of small Paleozoic metamorphic outcrops, as mapped by several studies (Bateman et al. 1965; Lockwood and Lydon 1975; Langenheim et al. 1982; Bateman 1992). Light-colored biotite granite and granodiorite are the most abundant rock types, followed by older formations of quartz monzonite. Secondary, infrequent plutonic outcrops include diorite, quartz diorite and gabbro: these dark, gray-colored rocks are common in the Tamarack Lakes area (Fig. 1, 11). Metasedimentary rock is uncommon and occurs only as small outcrops on the east side of the canyon along ridges between Mount Morgan and the north terminus of Wheeler Crest (Fig. 1). Reddish brown micaceous quartzite is visible on the high escarpment northwest of Tamarack Lakes and on Wheeler Ridge east of Dorothy Lake. Marble occurs only as a single small
Fig. 6–14. Vegetation and habitats in the upper Rock Creek watershed.—6. Alpine meadow at margin of unnamed lake near 11,490 ft/3502 m. Krummholz Pinus albicaulis pictured on rocky slopes above lake.—7. Spring-fed pool near 10,715 ft/3266 m. Whitebark pine forest pictured in background.—8. Alpine fellfield on summit of Red Mountain, ca. 11,470 ft/3496 m.—9. Whitebark pine forest near Francis Lake, ca. 10,870 ft/3313 m.—10. Dry meadow on Tamarack Bench near 9900 ft/3018 m. Sagebrush scrub in background with scattered conifers.—11. Alpine lake margin at Tamarack Lakes, ca. 11,600 ft/3536 m.—12. Sagebrush scrub (foreground), East Fork Campground area, ca. 8930 ft/2722 m. Lodgepole pine forest at left.—13. Alpine ridgetop, west rim of study area above Mono Pass, ca. 12,680 ft/3865 m. Polemonium eximium in foreground.—14. Wet meadow at edge of lodgepole pine forest and riparian woodland near East Fork Campground, ca. 9000 ft/2743 m. Salix spp. and Pinus contorta subsp. murrayana in background. Photo credit: Travis Columbus, Fig. 8–9, 11.
of soils in the area is predominantly decomposed granitic rock through sediment buildup from stream activity. Composition where bedrock is exposed, becoming deeper in the bottomlands from weathered rock and organic matter. Soils are absent or thin on slopes are generally more stable and have finer-textured soils in the topography of the study area. Bedrock outcrops at the northeast base of the Sierra Nevada, with multiple advances and retreats (Birman 1964; Phillips et al. 2009; Hildreth and Fierstein 2016). These glaciations deposited successive moraines in Rock Creek Canyon. Two examples of lateral moraines from the moraine are the Tamarack and the northeast-facing slopes of the eastern Sierra Nevada. Small remnant glaciers have been found on the northeast fields of Mount Abbot and Mount Mills (Fig. 4) (Birman 1964; Lockwood and Lydon 1975). Some talus fields, including one at the northwest base of the ridge dividing Little Lakes Valley from the Tamarack Bench, are rock glaciers with reservoirs of slowly melting ice (Birman 1964; Bateman et al. 1965). Sedimentary deposits of alluvium by glacial meltwaters are abundant across the canyon floor and just outside its mouth.

Topography and soils.—The landforms of the study area are typical of eastern Sierra Nevada canyons heavily modified by glacial activity and faulting. The watershed descends in elevation from south to north. Steep rugged scarps form the walls of Rock Creek Canyon which, in contrast to most major canyons in the Sierra Nevada, is oriented north-south. Smaller ridges and benches are scattered in the interior, creating a variety of orographic contours and elevational heterogeneity. The majority of the principal ridge line is 11,000–13,000 ft (3353–3962 m) in elevation and is dominated by jagged, crumbling microforms (Birman 1964; Bateman et al. 1965). Sedimentary deposits of alluvium by glacial meltwaters are abundant across the canyon floor and just outside its mouth.

Vascular Flora, Upper Rock Creek Watershed

Thousands of years of Quaternary glacial erosion and deposition have markedly influenced landforms in the study area. There is general consensus that at least seven glaciations occurred in the Sierra Nevada with multiple advances and retreats (Birman 1964; Phillips et al. 2009; Hildreth and Fierstein 2016). These glaciations deposited successive moraines in Rock Creek Canyon. Two examples of lateral moraines from the Little Lakes Valley from the Tamarack Bench, are rock glaciers with reservoirs of slowly melting ice (Birman 1964; Bateman et al. 1965). Sedimentary deposits of alluvium by glacial meltwaters are abundant across the canyon floor and just outside its mouth.

Glaciation.—Thousands of years of Quaternary glacial erosion and deposition have markedly influenced landforms in the study area. There is general consensus that at least seven glaciations occurred in the Sierra Nevada with multiple advances and retreats (Birman 1964; Phillips et al. 2009; Hildreth and Fierstein 2016). These glaciations deposited successive moraines in Rock Creek Canyon. Two examples of lateral moraines from the Tamarack and the northeast-facing slopes of the eastern Sierra Nevada. Small remnant glaciers have been found on the northeast fields of Mount Abbot and Mount Mills (Fig. 4) (Birman 1964; Lockwood and Lydon 1975). Some talus fields, including one at the northwest base of the ridge dividing Little Lakes Valley from the Tamarack Bench, are rock glaciers with reservoirs of slowly melting ice (Birman 1964; Bateman et al. 1965). Sedimentary deposits of alluvium by glacial meltwaters are abundant across the canyon floor and just outside its mouth.

Topography and soils.—The landforms of the study area are typical of eastern Sierra Nevada canyons heavily modified by glacial activity and faulting. The watershed descends in elevation from south to north. Steep rugged scarps form the walls of Rock Creek Canyon which, in contrast to most major canyons in the Sierra Nevada, is oriented north-south. Smaller ridges and benches are scattered in the interior, creating a variety of orographic contours and elevational heterogeneity. The majority of the principal ridge line is 11,000–13,000 ft (3353–3962 m) in elevation and is dominated by jagged, crumbling microforms (Birman 1964; Bateman et al. 1965). Sedimentary deposits of alluvium by glacial meltwaters are abundant across the canyon floor and just outside its mouth.

Vascular Flora, Upper Rock Creek Watershed

Thousands of years of Quaternary glacial erosion and deposition have markedly influenced landforms in the study area. There is general consensus that at least seven glaciations occurred in the Sierra Nevada with multiple advances and retreats (Birman 1964; Phillips et al. 2009; Hildreth and Fierstein 2016). These glaciations deposited successive moraines in Rock Creek Canyon. Two examples of lateral moraines from the Tamarack and the northeast-facing slopes of the eastern Sierra Nevada. Small remnant glaciers have been found on the northeast fields of Mount Abbot and Mount Mills (Fig. 4) (Birman 1964; Lockwood and Lydon 1975). Some talus fields, including one at the northwest base of the ridge dividing Little Lakes Valley from the Tamarack Bench, are rock glaciers with reservoirs of slowly melting ice (Birman 1964; Bateman et al. 1965). Sedimentary deposits of alluvium by glacial meltwaters are abundant across the canyon floor and just outside its mouth.

Glaciation.—Thousands of years of Quaternary glacial erosion and deposition have markedly influenced landforms in the study area. There is general consensus that at least seven glaciations occurred in the Sierra Nevada with multiple advances and retreats (Birman 1964; Phillips et al. 2009; Hildreth and Fierstein 2016). These glaciations deposited successive moraines in Rock Creek Canyon. Two examples of lateral moraines from the Tamarack and the northeast-facing slopes of the eastern Sierra Nevada. Small remnant glaciers have been found on the northeast fields of Mount Abbot and Mount Mills (Fig. 4) (Birman 1964; Lockwood and Lydon 1975). Some talus fields, including one at the northwest base of the ridge dividing Little Lakes Valley from the Tamarack Bench, are rock glaciers with reservoirs of slowly melting ice (Birman 1964; Bateman et al. 1965). Sedimentary deposits of alluvium by glacial meltwaters are abundant across the canyon floor and just outside its mouth.

Topography and soils.—The landforms of the study area are typical of eastern Sierra Nevada canyons heavily modified by glacial activity and faulting. The watershed descends in elevation from south to north. Steep rugged scarps form the walls of Rock Creek Canyon which, in contrast to most major canyons in the Sierra Nevada, is oriented north-south. Smaller ridges and benches are scattered in the interior, creating a variety of orographic contours and elevational heterogeneity. The majority of the principal ridge line is 11,000–13,000 ft (3353–3962 m) in elevation and is dominated by jagged, crumbling microforms (Birman 1964; Bateman et al. 1965). Sedimentary deposits of alluvium by glacial meltwaters are abundant across the canyon floor and just outside its mouth.

Vascular Flora, Upper Rock Creek Watershed

Thousands of years of Quaternary glacial erosion and deposition have markedly influenced landforms in the study area. There is general consensus that at least seven glaciations occurred in the Sierra Nevada with multiple advances and retreats (Birman 1964; Phillips et al. 2009; Hildreth and Fierstein 2016). These glaciations deposited successive moraines in Rock Creek Canyon. Two examples of lateral moraines from the Tamarack and the northeast-facing slopes of the eastern Sierra Nevada. Small remnant glaciers have been found on the northeast fields of Mount Abbot and Mount Mills (Fig. 4) (Birman 1964; Lockwood and Lydon 1975). Some talus fields, including one at the northwest base of the ridge dividing Little Lakes Valley from the Tamarack Bench, are rock glaciers with reservoirs of slowly melting ice (Birman 1964; Bateman et al. 1965). Sedimentary deposits of alluvium by glacial meltwaters are abundant across the canyon floor and just outside its mouth.

Glaciation.—Thousands of years of Quaternary glacial erosion and deposition have markedly influenced landforms in the study area. There is general consensus that at least seven glaciations occurred in the Sierra Nevada with multiple advances and retreats (Birman 1964; Phillips et al. 2009; Hildreth and Fierstein 2016). These glaciations deposited successive moraines in Rock Creek Canyon. Two examples of lateral moraines from the Tamarack and the northeast-facing slopes of the eastern Sierra Nevada. Small remnant glaciers have been found on the northeast fields of Mount Abbot and Mount Mills (Fig. 4) (Birman 1964; Lockwood and Lydon 1975). Some talus fields, including one at the northwest base of the ridge dividing Little Lakes Valley from the Tamarack Bench, are rock glaciers with reservoirs of slowly melting ice (Birman 1964; Bateman et al. 1965). Sedimentary deposits of alluvium by glacial meltwaters are abundant across the canyon floor and just outside its mouth.

Glaciation.—Thousands of years of Quaternary glacial erosion and deposition have markedly influenced landforms in the study area. There is general consensus that at least seven glaciations occurred in the Sierra Nevada with multiple advances and retreats (Birman 1964; Phillips et al. 2009; Hildreth and Fierstein 2016). These glaciations deposited successive moraines in Rock Creek Canyon. Two examples of lateral moraines from the Tamarack and the northeast-facing slopes of the eastern Sierra Nevada. Small remnant glaciers have been found on the northeast fields of Mount Abbot and Mount Mills (Fig. 4) (Birman 1964; Lockwood and Lydon 1975). Some talus fields, including one at the northwest base of the ridge dividing Little Lakes Valley from the Tamarack Bench, are rock glaciers with reservoirs of slowly melting ice (Birman 1964; Bateman et al. 1965). Sedimentary deposits of alluvium by glacial meltwaters are abundant across the canyon floor and just outside its mouth.

Glaciation.—Thousands of years of Quaternary glacial erosion and deposition have markedly influenced landforms in the study area. There is general consensus that at least seven glaciations occurred in the Sierra Nevada with multiple advances and retreats (Birman 1964; Phillips et al. 2009; Hildreth and Fierstein 2016). These glaciations deposited successive moraines in Rock Creek Canyon. Two examples of lateral moraines from the Tamarack and the northeast-facing slopes of the eastern Sierra Nevada. Small remnant glaciers have been found on the northeast fields of Mount Abbot and Mount Mills (Fig. 4) (Birman 1964; Lockwood and Lydon 1975). Some talus fields, including one at the northwest base of the ridge dividing Little Lakes Valley from the Tamarack Bench, are rock glaciers with reservoirs of slowly melting ice (Birman 1964; Bateman et al. 1965). Sedimentary deposits of alluvium by glacial meltwaters are abundant across the canyon floor and just outside its mouth.
high temperatures (U.S. Geological Survey 2017a). Snowpack measurements for April (typically taken on April 1) are used by hydrologists to calculate total amount of winter precipitation in high mountain areas of California where most precipitation falls as snow (MCCDDPD 2007). Long-term April snow depth records from three weather stations in the Rock Creek watershed indicate that average annual snowfall from 2012 to 2016 was significantly below historical averages (Table 1).

Wind and air temperature.—Based on the experience of the author, the majority of the watershed is not subject to strong winds during summer. Wind on exposed ridgelines can be gusty, especially during the night, and in May and June it can be mildly to moderately windy down canyon, usually below 9000 ft (2740 m). In winter, passing storms presumably create windy conditions.

Air temperature in the watershed fluctuates widely on a seasonal and daily basis. Daytime highs during winter often remain below freezing. Nighttime lows can drop below 32°F (0°C) any time of year, though uncommon in summer (MCCDDPD 2007). January tends to be the coldest month and July the warmest. Historical temperature records for the study area are limited, but daily air temperature data from two weather stations—one within the study area and one just outside—were obtained for a recent ten-year period (Table 2). Temperature ranges at elevations above 9700 ft (2960 m) in the study area during the same period in January and July were not available, but are expected to have been cooler than those recorded at lower elevations.

Growing season.—In North America, the annual growing season is defined as the period between the last spring date and first autumn date on which temperatures below 32°F (0°C) are experienced (Walsh et al. 2014). This frost-free period is negatively correlated with elevation; consequently, the growing season in the study area, as in other areas near the Sierra Nevada crest, is relatively short and varies with elevation. Plants occurring above 12,000 ft (3658 m) have only a few weeks to complete their annual growth cycle. It is important to note that freezing temperatures can occur any time of the year in the high Sierra Nevada but are less common in summer. In Rock Creek and nearby drainages of the region, consistently freezing temperatures typically begin in October with the arrival of snowfall and persist until April (MCCDDPD 2007).

On 21 May 2012 in the study area, Ruby Lake at 11,100 ft (3380 m) was completely covered with surface ice, and shoreline vegetation had not yet leafed out, while some shrubs and herbaceous species on south-facing slopes below 9000 ft (2740 m) were flowering (J. England, pers. obs.). The growth period of plants in the study area varies widely depending on aspect: species on south-facing aspects begin flowering weeks earlier than those on north aspects at similar elevation. It is not uncommon for snow to linger into July on north aspects above 11,000 ft. During 2012–2016, peak flowering in the study area began in June at the lowest elevations and progressed along an upward elevation gradient, peaking in August at elevations above treeline (J. England, pers. obs.).

Wildfire and Other Landscape Disturbances

Numerous small wildfires have been recorded in the watershed since 1950, the majority from natural causes (U.S. Geological Survey 2017b). In July 2002, the Birch Fire burned a large area near the northern part of the study area (MCCDDPD 2007). Over 2500 acres (1012 ha) of National Forest were burned in this human-caused fire, from the west side of lower Rock Creek across Birch Creek, Whiskey and Sand canyons, to Rock Creek Road. The western edge of the fire burned ca. 300 acres (121 ha) of the study area on a steep, west-facing slope above the canyon mouth. I observed severe impacts to pinyon pine woodland vegetation on the hillsides within the burn; hundreds of Cercocarpus ledifolius plants did not survive, nor the majority of Pinus monophylla trees.

Table 2. Daily air temperature ranges in the upper Rock Creek watershed region. Recordings from two weather stations were obtained from the California Department of Water Resources data portal (CDEC 2017). “RKC” and “RCK” are the station names provided by the CDEC. The RKC station is located outside the study area, ca. one air mile (1.6 air km) northeast of the study boundary; the RCK station is located within the study area. Summary of typical minimum and maximum temperature ranges for January and July is based on station recordings during 2006–2016. No January or July recordings at RKC were available for 2012–2014. No July data were available for RCK in 2016.

<table>
<thead>
<tr>
<th>Station ID (elevation-ft/m)</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>1926–2016 average</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RC1 (8700/2652)</strong></td>
<td>6 in./15 cm</td>
<td>3 in./7.5 cm</td>
<td>1 in./2.5 cm</td>
<td>0</td>
<td>6 in./15 cm</td>
<td>20.8 (±17.4) in. 52.8 (±44.2) cm</td>
</tr>
<tr>
<td><strong>RC2 (9050/2758)</strong></td>
<td>10 in./26 cm</td>
<td>11 in./28 cm</td>
<td>8 in./20 cm</td>
<td>0</td>
<td>15 in./38 cm</td>
<td>27.8 (±20.6) in. 70.6 (±52.3) cm</td>
</tr>
<tr>
<td><strong>RC3 (10,000/3048)</strong></td>
<td>13 in./33 cm</td>
<td>14 in./36 cm</td>
<td>9 in./23 cm</td>
<td>0</td>
<td>21 in./53 cm</td>
<td>40.1 (±21.7) in. 101.9 (±55.1) cm</td>
</tr>
</tbody>
</table>

Table 1. Snow depth (standard deviation in parentheses), measured on April 1, from three weather stations in the study area over a 90-year period. Measurements are from the California Department of Water Resources data portal (CDEC 2017). “RC1,” “RC2,” and “RC3” are the station names provided by the CDEC. For 1986, the March measurement was used in the 90-year average calculation because data for April were not available. No records were available for 1927.

<table>
<thead>
<tr>
<th>Station ID (elevation-ft/m)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RKC (7040 ft/2146 m)</strong></td>
<td>0–27°F (-18 to -3°C)</td>
<td>32–49°F (0–9°C)</td>
<td>-3 to 15°F (-19 to -13°C)</td>
<td>25–39°F (4–4°C)</td>
</tr>
<tr>
<td><strong>RCK (9700 ft/2957 m)</strong></td>
<td>45–60°F (7–15°C)</td>
<td>82–91°F (28–33°C)</td>
<td>40–47°F (4–8°C)</td>
<td>66–73°F (19–23°C)</td>
</tr>
</tbody>
</table>
Fire suppression in the canyon dates to the early twentieth century, at least in the more accessible and developed areas. Presuppression wildfires presumably occurred on a somewhat regular basis historically as a result of lightning strikes.

In addition to fire, historic natural causes of disturbance in forested areas of the region include insects and disease (Millar 1996), rock slides (J. England, pers. obs. 2012–2016) and avalanches such as the February 1986 snow slides (Birkeland and Mock 2001) which felled dozens of trees and destroyed a campground near Mosquito Flat (Jim King, pers. comm.).

**BOTANICAL SETTING**

**Floristic Provinces**

The watershed is geographically situated at the confluence of two floristic provinces circumscribed by the Jepson Flora Project (2018) that represent major biogeographical transitions: the California Floristic Province and the Great Basin Province. Floristic elements of both are evident in the study area. The Great Basin component, part of the East of the Sierra Nevada floristic region, is the smaller of the two in terms of species composition in the study area. The remainder of the study area is within the California Floristic Province, specifically the High Sierra Nevada floristic region.

**Vegetation and Habitats**

Describing vegetation is challenging. Efforts have been made to classify California’s vegetation at a statewide level (e.g., Holland and Keil 1995; Sawyer et al. 2009). These treatments use terms such as communities and/or alliances to describe associations of species often found growing together which form repeated patterns of vegetation. The challenge of using such a classification system to describe a local flora is that vegetation can resemble a blended mixture of types across the landscape. This is certainly true of the upper Rock Creek watershed, which varies greatly in elevation and topography. Therefore, no attempt is made here to describe all of the plant associations and habitats encountered during fieldwork for this study. However, some vegetation types widely recognized by authors (e.g., Holland and Keil 1995) were encountered: Jeffrey pine forest; pinyon pine woodland; riparian woodland; lodgepole and Keil 1995) were encountered: Jeffrey pine forest; pinyon pine woodland; riparian woodland; lodgepole

**Jeffrey pine forest.—**Pinus jeffreyi forms the backbone of the scarcest vegetation type in the study area. It is open in structure and has a woody understory dominated by sagebrush (Artemisia tridentata subsp. vaseyana). It covers the canyon bottom for a distance of roughly 1.5 miles (2.4 km) near the canyon mouth, in a narrow belt along both sides of the riparian woodland, and can best be seen between French Campground and “third crossing” (Fig. 1). DOMINANT: Pinus jeffreyi. SHRUBS AND TREES: Artemisia tridentata subsp. vaseyana, Cercocarpus ledifolius var. intermontanus, Chamaebataria millefolium, Chrysothamnus viscidiflorus subsp. puberulus, Ericameria nauseosa var. speciosa, Opuntia polyacantha var. hystricina, Prunus emarginata, Purshia tridentata var. tridentata, Symphoricarpos rotundifolius var. rotundifolius. HERBACEOUS: Angelica lineariloba, Astragalus purshii var. luteus, Bromus carinatus var. marginatus, Dieteria canescens var. canescens, Eriastrum wilcoxii, Eriogonum breweri var. breweri, Gayophytum diffusum subsp. parviflorum, Lomatium dissectum var. multifidum, Phacelia bicolor, Stephanomeria exigua subsp. coronaria, Weythia mollis.

**Pinyon pine woodland.—**Dry rocky faces on the lower east and west slopes of the canyon are characterized by open woodland of single leaf pinyon pine (Pinus monophylla). The understory and open areas between individual trees are typically inhabited by scattered woody and herbaceous species growing in decomposing granitic soils. Pinyon pine woodland is best represented on rocky slopes along Rock Creek Road between “first crossing” and “third crossing” (Fig. 1). DOMINANT: Pinus monophylla. SHRUBS AND TREES: Artemisia tridentata subsp. vaseyana, Cercocarpus ledifolius var. intermontanus, Chrysothamnus viscidiflorus subsp. puberulus, Ericameria nauseosa var. speciosa, Juniperus grandis, Purshia andersonii, Purshia tridentata var. tridentata. HERBACEOUS: Abronia turbinata, Argemone munita, Chamaesara arida (Fig. 26), Elymus elymoides var. elymoides, Eremogone ferrisiae, Eriogonum nudum var. westonii, E. umbellatum var. nevadense, Linanthus pungens, Lupinus argenteus var. heteranthus, Mentzelia congesta, Puckera cana, Penstemon patens, Phacelia ramosissima, Stipa hymenoides, S. speciosa.

**Sagebrush scrub.—**Artemisia tridentata subsp. vaseyana (mountain sagebrush) is the dominant species of sagebrush scrub (Fig. 12), which is patchy in distribution and has a wide elevation range in the study area. It commonly occurs in dry forest openings where trees are sparse, usually on rocky flats and gentle to moderately steep slopes up to ca. 10,000 ft (3048 m). Sagebrush scrub is well represented along Sand Canyon Road and on open slopes in the Rock Creek Lake vicinity. DOMINANT: Artemisia tridentata subsp. vaseyana. SHRUBS AND TREES: Cercocarpus ledifolius var. intermontanus, Chrysothamnus viscidiflorus subsp. puberulus,
Ericameria nauseosa var. speciosa, Purschia tridentata vars. HERBACEOUS: Apocynum androsaemifolium, Castilleja linariifolia, Elymus elymoides var. californicus, Ericameria discoidea, Eriogonum umbellatum var. nevadense, Leptosiphon nuttallii subsp. pabescens, Monardella odoratissima subsp. glauca, Muhlenbergia richardsonis, Penstemon rostriflorus, Silene bernardina, Stipa spp.

Riparian woodland.—This vegetation dominates the stream banks of the main channel of Rock Creek (which runs more or less parallel to Rock Creek Road) along a corridor extending from the canyon mouth up to Mosquito Flat. It is not uncommon for aspens to form dense stands of tall trees and provide canopy for other plant species. In places where moisture is abundant, it is not unusual for aspens to form dense stands of tall trees and provide canopy for other plant species. This vegetation is best observed along the creek between “first crossing” and Aspen Campground (Fig. 1). The upper riparian woodland is distinguished by different Salix species mixed with lodgepole pine and aspen. It is best represented along the creek between Big Meadow Campground and Rock Creek Lake. DOMINANTS BELOW 8500 FT: Betula occidentalis, Populus trichocarpa, Salix lasiandra var. caudata, S. lutea. SHRUBS AND TREES: Cornus sericea subsp. sericea, Prunus emarginata, Rosa woodii subsp. gratissima. HERBACEOUS: Artemisia douglasiana, Calamagrostis canadensis var. canadensis, Carex microptera, C. pelilta, Glyceria elata, Lilium kelleyanum, Maianthemum stellaratum. DOMINANT ABOVE 8500 FT: Pinus contorta subsp. murrayana, Populus tremuloides. SHRUBS AND TREES: Lonicera involucrata var. involucrata, Salix planifolia. HERBACEOUS: Agrostis idahoensis, Alopecurus aequalis var. aequalis, Aquilegia formosa, Carex abrupta, C. utriculata, Cystopteris fragilis, Deschampsia cespitosa subsp. cespitosa, Equisetum arvense, Heracleum maximum.

Aspen groves.—Populus tremuloides is found in a variety of mesic habitats throughout the study area from lower to middle elevations, becoming less common above 10,200 ft (3110 m). Aspen trees are common associates in the riparian woodland and lodgepole pine forest, and the species can be co-dominant with Pinus contorta subsp. murrayana in wetter areas. In places where moisture is abundant, it is not unusual for aspens to form dense stands of tall trees and provide habitat for other plant species. Populus tremuloides tolerates a range of exposures and substrates in the study area, and exhibits different growth forms depending on habitat. Tall upright forms occur in canyon bottoms, but on steep, exposed slopes the species typically has a dwarfish, shrubby appearance. Aspen groves are best represented along the canyon bottom between Aspen Campground and East Fork Campground. DOMINANT: Populus tremuloides. SHRUBS AND TREES: Ribes cerereum var. cereum, Symphoricarpos rotundifolius var. rotundifolius. HERBACEOUS: Alliun bisceptrum, Bromus porteri, Carex douglasii, C. praegracilis, Elymus spp., Ipomopsis aggregata, Maianthemum stellaratum.

Lodgepole pine forest.—At middle elevations along the canyon bottom and on mesic slopes, Pinus contorta subsp. murrayana is the dominant species (Fig. 12, 14). Occasionally, P. contorta forms dense stands, but frequently the forest is patchy and interspersed with other vegetation/habitats, such as riparian woodland, meadows, seeps, aspen groves, and dry rocky slopes vegetated by sagebrush and scattered conifers such as Juniperus grandis and Pinus flexilis. Lodgepole pine forest is best observed between East Fork Campground and Mosquito Flat. DOMINANT: Pinus contorta subsp. murrayana. SHRUBS AND TREES: Artemisia tridentata subsp. vaseyana, Cercocarpus ledifolius var. intermontanus, Holodiscus discolor var. microphyllus, Populus tremuloides, Ribes cerereum var. cereum, R. montigenum, Symphoricarpos rotundifolius var. rotundifolius. HERBACEOUS: Achillea millefolium, Agrostis idahoensis, Aquilegia formosa, Camerion angustifolium subsp. circumvagum, Deschampsia cespitosa subsp. cespitosa, Elymus elymoides var. californicus, Epilobium spp., Equisetum arvense, Fragraaria virginiana, Ipomopsis aggregata subsp. aggregata, Koeleria macrantha, Leptosiphon nuttallii subsp. pabescens, Lapinus pratensis var. pratensis, Osorhiza berteroi, Sphenosciadium capitellatum, Stipa occidentalis var. occidentalis.

Meadows, lake and stream margins, seeps.—A profusion of mesic habitats in the study area contain a highly variable association of species due to differences in elevation and other microenvironmental factors. Meadows in the lodgepole pine forest, for example, have different species associations than meadows in the whitebark pine forest. Lakeside vegetation at Rock Creek Lake differs from that of lake margins in Little Lakes Valley. Therefore the reader should take note that describing a single vegetation type each for meadows, lake and stream margins, and seeps is not practical in the context of this study.

Meadows in the watershed are patchy in distribution and have different associations of species depending on moisture regime, but are typically dominated by grasses, sedges, and rushes (Fig. 6, 10, 14). Willows and other scattered shrubs occasionally occur in meadows. Meadow margins at lower to middle elevations are often densely vegetated by willows, aspen groves, lodgepole pine forest and riparian woodland (Fig. 14). DOMINANT: Carex spp., Juncus spp., Poaceae spp. SHRUBS AND TREES: Artemisia cana subsp. bolanderi, Kalma polifolia, Phyllodoce breweri, Salix spp., Vaccinium spp. HERBACEOUS: Achillea millefolium, Agrostis idahoensis, Antennaria spp., Calamagrostis miriana, Carex abrupta, C. aurea, C. microptera, Castilleja spp. including C. petersonii (Fig. 19), Danthonia intermedia subsp. intermedia, Deschampsia cespitosa subsp. cespitosa, Drymocallis lactea var. lactea, Erythranthe primuloides, Gentianopsis hofstetala, Iris missouriensis, Juncus mexicanus, J. nevadensis var. nevadensis, Lacyula orester, Orostemma alpigenum var. anderssonii, Pedicularis attollens, Penstemon heterodoxus var. heterodoxus, Perideridia parishii, Potentilla spp., Primula tetrandra, Solidago multiadriata.

Lakes are widely scattered in the study area from 9400 ft (2865 m) and higher, commonly encountered in the John Muir Wilderness (Fig. 1, 3–4, 6, 11). Runoff from rock glaciers and
snowmelt provides year-round moisture to Little Lakes Valley, where numerous lakes are interconnected by permanent streams. Smaller pools of water (Fig. 7) and rivulets of gently flowing or trickling water (streamlets and seeps) are frequently encountered in the whitebark pine forest and alpine region. Seeps, pools, and margins of lakes and streams host a wide variety of species but are typically dominated by sedges and rushes. DOMINANT: Carex spp. including C. aquatilis var. aquatilis, C. spectabilis and C. utriculata, Juncus spp. including J. nevadensis var. nevadensis. SHRUBS AND TREES: Dasiphora fruticosa, Kalma polifolia, Phyllodoce brevata, Rhodosedron columbinum, Salix leucostachys, S. oreastera, S. petrophila, S. planifolia, Vaccinium alpinum subsp. occidentale. HERBACEOUS: Alismatifolium, Botrychium simplex var. compostum (Fig. 15), Deschampsia cespitosa, Erythranthe tilingii, Isoetes bolanderi, Lupinus lepidus var. confer tus, Luzula oreastera, Micranthes odontoloma, Mahlenbergia fili formis, Pheum alpinum, Platanthera dilatata var. leucostachys, Potentilla spp., Solidago multiradiata, Thalictrum spp., Ver atrum californicum, Veronica wormsijoldii.

Whitebark pine forest.—Above the lodgepole pine forest, Pinus albicaulis is the dominant species of the highest forested vegetation zone in the watershed. At the ecotone between whitebark pine forest and alpine vegetation, Pinus albicaulis exhibits a gradient of growth forms from upright trees to dwarf, stunted (Krummholz) forms (Fig. 6). The forest has a very open structure with scattered trees and shrubs. Dry rocky slopes with large boulders and loose, decomposing granite soils characterize much of the whitebark pine forest (Fig. 9), but there are extensive patches of mesic vegetation—especially in Little Lakes Valley—such as meadows and margins of streams, lakes and pools that support taxa not found in the drier areas of the forest.

Whitebark pine forest is well represented in the John Muir Wilderness from Little Lakes Valley (Fig. 3–4) to Morgan Pass and along the Mono Pass trail to Ruby Lake. It is prevalent on the Tamarack Bench and the high eastern and western slopes of Rock Creek Canyon. DOMINANT: P. albicaulis. SHRUBS AND TREES: Almannelcher utahensis, Artemisia tridentata subsp. vaseyana, Dasiphora fruticosa, Holodiscus discolor subsp. microphyllus, Jamesia americana var. rosea, Purshia tridentata var. glandulosa, Ribes cereum var. cereum, Spirea splendens. HERBACEOUS: Angelica lineariloba, Aquilegia pubescens, Boechera spp., Calamagrostis purpurascens, Calyptridium umbellatum, Cassi ope mertensiana (Fig. 16), Castilleja spp., Cystopteris frigilis, Draba spp., Elymus elymoides var. californicus, Ericameria spp., Erigeron spp., Eriogonum spp. including E. lobbii (Fig. 25), Koelera macrantha, Linanthus pungens, Monardella odoratissima subsp. glauca, Mahlenbergia richardsonis, Penstemon newberryi var. newberryi, Phacelia hastata var. compacta, Poa spp., Pyrocoma apargioide, Rhodiola integrifolia subsp. integrifolium (Fig. 28), Selaginella watsonii, Trisetum spicatum.

Plant Geography

A helpful synthetic discussion of various studies that address the origin of the High Sierra Nevada flora was provided by Sawyer and Keeler-Wolf (2007). Stebbins (1982) hypothesized four origins of the high montane, subalpine and alpine flora of the High Sierra Nevada south of Donner Summit, which he termed Old Cordilleran (39% of the flora), Circumboreal (26%), Lowland Cismontane California (19%) and Great Basin (16%). Stebbins’ analysis, informed in part by fossil flora records, generally aligns with previous work by Smiley (1921), Chabot and Billings (1972) and Raven and Axelrod (1978). Of the four floristic sources, one—Lowland California—consists of an endemic element that evolved in California. The other elements are said to have arrived via migration from areas pre-dating the Sierra Nevada, outside the state. The most commonly proposed route for the majority of the Old Cordilleran invaders is from the north along the Cascade–Sierra Nevada axis; most of these species’ relatives are found in North America. The presence of Rocky Mountain disjuncts in the Sierras has led some to propose a westward migration route for certain taxa associated with the Old Cordilleran group (e.g., Major and Bamberg 1963). The Circumboreal group is composed of cosmopolitan species believed by Stebbins to have had multiple migration pathways; this group contains a large number of woody taxa including Salix. He proposed that the Great Basin element originated from the desert and Basin and Range floras east of the Sierra.
This generalized way of thinking about how California’s flora originated has provided a useful groundwork for discussion. However, growing use of molecular phylogenetic data and genomic tools to explore what have been longstanding biogeographical questions are showing that the story is much more complex than can be summarized here (Baldwin 2014).

**HUMAN ACTIVITY**

**Prior to the Twentieth Century**

*Indigenous groups.*—Relatively little information is known about the presence of prehistoric humans in the high Sierra Nevada, but there is evidence that alpine sites in the Sierra were traversed during early hunting and gathering forays, and for commerce between human groups (Arkush 1993; Stevens 2005). Artifacts from “Paleoindian” encampments in nearby Long Valley date to the early Holocene (Basgall 1989). The only evidence of indigenous people in Rock Creek Canyon is documentation by archaeological surveyors of obsidian flake detritus indicative of historical tool making and at least one projectile point (MCCDDPD 2013).

*European-American settlers.*—By the middle of the nineteenth century, Euro-Americans had begun to lay claim to the valleys adjacent to the study area, settling and making a livelihood from cattle and sheep ranching as well as farming. Basque sheep herders made their mark (quite literally, as discussed below) in the eastern Sierra Nevada during the peak of the state’s wool industry in the 1880s and 1890s (Busby et al. 1980). Herders typically brought flocks over the Sierra from the west side, moving the animals to summer forage in eastern montane meadows. Numerous arborglyphs were carved by the Basque on trees—usually aspen, occasionally pines—depicting humans and other figures. There are a number of glyphs on trees in Rock Creek Canyon, some with dates from the late 1800s (McNeill 2016), suggesting that the herders brought sheep on multiple occasions into the study area for grazing.

**Twentieth Century Until Present**

*Road construction.*—Sand Canyon Road (Forest Rd 5008/30E302) is a 4WD road that is accessible from the community of Swall Meadows and enters the study area from the northeast. It runs south, along the base of Wheeler Ridge, for ca. 5 miles (8 km) and terminates near the wilderness boundary on Tamarack Bench (Fig. 1, 2). The road was originally constructed in 1918 as a route to transport mining equipment to Morgan Pass and the Pine Creek prospects just outside the study area, and served as the primary route up the canyon until Forest Highway 89/Rock Creek Road was built shortly thereafter (Kurtak 1998).

Rock Creek Road winds ca. 10.5 miles (16.9 km) up the canyon and now terminates at the Mosquito Flat trailhead (the old section of the road from Mosquito Flat to Morgan Pass was permanently closed to vehicles following the Wilderness Act in the 1960s). The Little Lakes Valley hiking trail follows the route of the old road to Morgan Pass, and remnants of discarded mining equipment are evident along the trail.

Nine miles (14.5 km) of Rock Creek Road underwent construction for improvements in 2014 and 2015, including the addition of a bicycle lane (MCCDDDPD 2013). The only other vehicle-accessible road within the study area is Wheeler Ridge Mine Road (Forest Rd 30E301), a steep east-west 4WD route between Sand Canyon Road and the crest of Wheeler Ridge (Fig. 1).

*Recreation.*—Tourism and recreation in Inyo and Mono counties began to grow substantially in the 1930s, and by the 1960s had become the mainstay of the region’s economy (Busby et al. 1980). Two resorts, a pack station and 12 developed campgrounds were constructed in Rock Creek Canyon (Fig. 1) (MCCDDPD 2013). Horseback riding (sometimes with pack mules), hiking, backpacking, cross-country skiing, fishing and camping are among the recreational activities popular in the watershed.

*Land management.*—The study area has been under federal administration since 1893 with the establishment of the Sierra Forest Reserve, and was incorporated into the Inyo National Forest 14 years later (Inyo National Forest 2014). The John Muir Wilderness was established under the Wilderness Act in 1964, which aimed to preserve much of the Sierra Nevada wildlands from negative human impacts (SierraWild.gov 2017). The Wilderness encompasses ca. 20 square miles (52 sq. km) (56%) of the watershed including all but two of the lakes, and contains several hiking and pack trails. In extra-Wilderness areas of Rock Creek, monitoring of sensitive habitats, selective trimming of roadside vegetation and removal of hazardous trees in developed campgrounds are ongoing Forest Service activities as part of the Multiple Resource Area Management Prescription (Inyo National Forest 2014).

*Commercial and residential use.*—The author’s research yielded no evidence of historical commercial timber harvesting and mining within the study area, although as noted above, a road was built through the study area to access the Pine Creek mines in the adjacent watershed. Two resorts and a pack guide outfitters have been operating in Rock Creek Canyon since the early twentieth century, and presumably rely on local water sources for necessary operations. A small number of private cabins are used for seasonal residences; all cabins today are outside the Wilderness.

**HISTORY OF BOTANICAL DOCUMENTATION**

*Previously Published Checklists*

The first known collections in the watershed were made in 1930 by Frank W. Peirson in the Little Lakes Valley area. Peirson made a total of eight collecting trips to “Rock Creek Lake Basin” between 1930 and 1940, resulting in 822 collections that I was able to locate through searches of online databases, the majority of which are housed at RSA/POM (SEINet Portal Network [SEINet] 2016; Consortium of California Herbaria [CCH] 2018). The earliest day and month Peirson recorded in his journal for any of those trips was July 17, and the latest was August 22. Peirson published the first checklist for the watershed in 1938: *Plants of Rock Creek Lake Basin, Inyo County,* followed by a short addendum list in 1942. Both lists were restricted to Little Lakes Valley and the surrounding high areas, from 10,500 ft (3200 m) and above. His highest documented collection locality was above Mono Pass at 12,500 ft (3810 m)
A second inventory was carried out during a Sierra Club trip led by John T. Howell in July 1946. Howell's publication, *Base Camp Botany, 1946*, in which he presents his species checklist, does not provide exact dates of that trip. However, his specimen labels for those collections—housed at CAS/DS and other herbaria—are dated from July 14 to July 29 (SEINet 2016; CCH 2018). Howell’s checklist for Rock Creek was restricted to the same general region that Peirson documented in 1903 (3139 m) contour. His highest collections in the study area were from Mono Mesa at 12,200 ft (3718 m). His specimen labels for those collections—housed at CAS/DS and other herbaria—are dated from July 14 to July 29 (SEINet 2016; CCH 2018). Howell’s checklist for Rock Creek was restricted to the same general region that Peirson documented in 1903 (3139 m) contour. His highest collections in the study area were from Mono Mesa at 12,200 ft (3718 m) (e.g., *Cystopteris fragilis*, Howell 22752, CAS). Howell (1946) reported 313 taxa for the Rock Creek “basin,” including 52 species not recorded by Peirson, which he noted were mostly found in the Mosquito Flat vicinity, not surveyed by Peirson. All together, Peirson and Howell recorded 396 minimum-rank taxa for the study area.

**Other Collections**

Sporadic botanical documentation by others from the 1930s to the early 2000s resulted in over 400 additional herbarium records that I was able to locate (SEINet 2016; CCH 2018). Significant contributions, in order of earliest to most recent, were made by R. Woglum, A. Crafts & M. Halperin, E. Robinson, C. Sharsmith, R. Ferris, J. Thomas and G. Wallace. Except for the last two, the collections were made before 1950.

**Type Localities**

Type specimens I encountered from the watershed include *Castilleja peirsonii* Eastw. (Orobanchaceae; Fig. 19), *Peirson 9078* (CAS-BOT-BC32643, holotype); *Draba sierrae* Sharsm. (Brassicaceae; Fig. 22), *Sharsmith 3058* (UC624298, holotype); *Festuca brachychytra* Schult. & Schult. f. subsp. breviculmis Fred. (Poaceae), *Howell 22706* (CAS-BOT-BC123977, holotype); and *Tomentes peirsonii* (D.D. Keck) G.L. Nesom & D.R. Morgan (Asteraceae; Fig. 29), *Peirson s.n.* 5 Aug 1933 (UC511812, holotype) (as *Haplopappus eximius* H.M. Hall subsp. *peirsonii* D.D. Keck). Locality data from these type specimens are presented in the annotated checklist (Appendix 1).

**PROJECT OBJECTIVES AND METHODS**

The primary objective of the study was to produce a vascular plant checklist based on preexisting and new collections. I spent 89 days in the study area from 2012 to 2016 and made 1506 collections (including two collections made during a short visit in 2018). An effort was made to document as many taxa as possible by surveying as much of the watershed as time, resources, and accessibility allowed. Early and late season taxa were documented in 2012 and 2013, the two years that fieldwork was conducted at regular intervals throughout the growing season (May–Sep). Areas targeted for fieldwork include those poorly documented based on records in the SEINet and CCH data portals (SEINet 2016; CCH 2018) (Fig. 1: left inset). Examples of undercollected areas were the high peaks, the eastern half of the watershed and areas below 10,000 ft (3048 m).

Locality data were recorded in the field at each collection site, including coordinates obtained from a Global Positioning System (GPS) unit, elevation, abundance, habitat description and associated taxa. Duplicates were collected for later distribution to herbaria, with a full set deposited at RSA. I examined, verified and annotated more than 1000 pre-existing collections housed in the following herbaria: ASC, CAS/DS, CDA, GH, LA, NMC, NY, PASA, RSA/POM, SBBG, SD, UC/JEPS, UCD and UCR. Taxonomy follows the Jepson Flora Project (2018) with the following exceptions: family classification for Boraginales is according to the Boraginales Working Group (2016); recent treatments in *Cryptantha* (Hasenstab-Lehman and Simpson 2012) and *Luzula* (Zika et al. 2015) were also followed. Additional resources were consulted for help with identification, including Flora of North America (FNA Editorial Committee 1993+) and Intermountain Flora (Cronquist et al. 1972–2012) for various plant groups, Correll and Correll (1975) for aquatic plants and Isely (1998) for Fabaceae. The author relied heavily on the RSA collection for identifying plants in challenging taxonomic groups, especially specimens recently annotated by taxonomic specialists. The determinations of some specimens were confirmed by experts in the groups as needed.

**RESULTS AND DISCUSSION**

**Summary of Floristic Results**

The vascular plant inventory includes 591 minimum-rank taxa (including 25 non-native) represented by 77 families (three non-native), 248 genera (13 non-native) and 572 species (25 non-native) (Table 3). Nineteen species have multiple varieties and subspecies present in the study area. Collecting efforts by the author resulted in 128 taxa previously undocumented for the watershed, including two species new to the Sierra Nevada and nine new county records. However, 81 taxa documented by previous collectors were not rediscovered (discussed below). The five largest families are Asteraceae (72 native taxa plus three non-native), Poaceae (65 plus 11 non-native), Cyperaceae (54), Rosaceae (33) and Brassicaceae (31 plus one non-native). The largest genera are *Carex* (47 native), *Boechera* (16), *Eriogonum* (15), *Sipua* (12), *Poa* (11 plus three non-native), *Penstemon* (ten), *Epilobium* (ten), *Erigeron* (ten), *Juncus* (ten), *Potentilla* (ten), *Draba* (nine) and *Salix* (nine).

The remarkably rich composition of grasses (65 native taxa) is noteworthy when comparing the Rock Creek flora with several other floras in the eastern Sierra Nevada region (Table 4), as is the relatively high diversity of Rosaceae (33 taxa) and *Carex* (47). Rock Creek is the only one of these floras to have Rosaceae among the five largest families represented. Rock Creek shares notable similarities with the two study areas closest in geographic distance—the Glass Mountain Region flora (Honer 2001) and the San Joaquin Roadless Area flora (Constantine-Shull 2000)—in having *Carex, Boechera* and *Eriogonum* as the three largest genera represented. It should be noted that these two study areas are geologically dissimilar to Rock Creek in having primarily volcanic substrates in contrast to granitic.

Thirty-two taxa (5%) in the study area are rare (special-status) plants recognized by California and/or the California...
Table 3. Numerical summary of the flora of the upper Rock Creek watershed.

<table>
<thead>
<tr>
<th>Total Flora</th>
<th>Total taxa</th>
<th>% of total flora</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(non-native)</td>
<td></td>
</tr>
<tr>
<td>Families</td>
<td>77 (3)</td>
<td></td>
</tr>
<tr>
<td>Genera</td>
<td>248 (13)</td>
<td></td>
</tr>
<tr>
<td>Species</td>
<td>572 (25)</td>
<td></td>
</tr>
<tr>
<td>Minimum-rank taxa</td>
<td>591 (25)</td>
<td></td>
</tr>
<tr>
<td>Native/Non-Native</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Native</td>
<td>566</td>
<td>95.8</td>
</tr>
<tr>
<td>Non-native</td>
<td>25</td>
<td>4.2</td>
</tr>
<tr>
<td>Largest Families</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poaceae</td>
<td>76 (11)</td>
<td>12.9</td>
</tr>
<tr>
<td>Asteraceae</td>
<td>75 (5)</td>
<td>12.7</td>
</tr>
<tr>
<td>Cyperaceae</td>
<td>54</td>
<td>9.1</td>
</tr>
<tr>
<td>Rosaceae</td>
<td>33</td>
<td>5.6</td>
</tr>
<tr>
<td>Brassicaceae</td>
<td>32 (1)</td>
<td>5.4</td>
</tr>
<tr>
<td>Largest Genera</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carex</td>
<td>47</td>
<td>7.9</td>
</tr>
<tr>
<td>Boechera</td>
<td>16</td>
<td>2.7</td>
</tr>
<tr>
<td>Eriogonum</td>
<td>15</td>
<td>2.5</td>
</tr>
<tr>
<td>Poa</td>
<td>14 (3)</td>
<td>2.4</td>
</tr>
<tr>
<td>Stipa</td>
<td>12</td>
<td>2.0</td>
</tr>
<tr>
<td>Annuals/Short-Lived Perennials</td>
<td>74 (11)</td>
<td>12.5</td>
</tr>
<tr>
<td>Endemic to High Sierra Nevada</td>
<td>19</td>
<td>3.2</td>
</tr>
<tr>
<td>Region</td>
<td>Special-Status</td>
<td>32</td>
</tr>
</tbody>
</table>

Native Plant Society (California Natural Diversity Database [CNDDB] 2018; CNPS 2018), including 11 previously undocumented in Rock Creek (Table 5). Nineteen taxa are endemic to the High Sierra Nevada region, representing 3% of the total flora (Table 6). Twenty-five non-native taxa constitute 4% of the flora. Seventy-four taxa are annuals or short-lived perennials (13%); 57 (77%) of these are obligate annuals and 11 (15%) are non-native (Jepson Flora Project 2018). Twenty (35%) of the obligate annuals were documented as high as the whitebark pine forest (10,200–11,100 ft/3110–3380 m). Only one obligate annual—*Rorippa curvisiliqua* (Brassicaceae)—was found above treeline, where it was seen at one locality at 11,624 ft (3543 m).

**Noteworthy Collections**

**New records for the Sierra Nevada.**—According to online database collection records (SEINet 2016; CCH 2018), two taxa collected during this study are evidently the first records for the Sierra Nevada; both are special-status species listed in the CNPS Inventory of Rare and Endangered Plants (online edition, v8-03, 2018) (Table 5).

*Carex stevenii* (Steven’s sedge; Cyperaceae) previously had only been documented from the White Mountains (the species is also found outside California, in the southern Rocky Mountains [Zika et al. 2015b]). In the study area there is a single known occurrence of *C. stevenii*—a small population was found in 2012 near Rock Creek Lodge (Fig. 1).

*Penstemon cinicola* (ash beardtongue; Plantaginaceae) was documented in 2012 and 2013 at several sites above 9800 ft (2987 m) in the study area. It was previously known to occur only on volcanic soils, at locations north of the study area such as the Glass Mountain region, Modoc Plateau, Warner Mountains and southern Cascade Range (Wetherwax and Holmgren 2012). The nearest known population is in the Glass Mountain area ca. 25 miles (40 km) to the north. There is a collection record (Woodland 2627, NY) (CCH 2018) of *P. cinicola* from the west slope of the Sierra Nevada in El Dorado County, a likely misidentification.

**New records for Inyo and Mono counties.**—A total of nine collections made during this study are evidently new county records (SEINet 2016; CCH 2018). Four plants collected within the Inyo County boundary (*Cerastium arvense* subsp. *strictum*, Caryophyllaceae; *Juncus hemiendytus* var. *hemiendytus*, Juncaceae; *Poa bolanderi*, Poaceae; *Spergularia rubra*, Caryophyllaceae, non-native) and five within Mono County (*Lathyrus lanszwertii* var. *lanszwertii*, Fabaceae; *Lonicera cururiana*, Caprifoliaceae; *Oreanana clementis*, Apiaceae; *Primula jeffreyi*, Primulaceae; *Ulmus pumila*, Ulmaceae, non-native) are the first collection records for these taxa for these counties of which I am aware.

**New records from previously surveyed areas of the watershed.**—Eight taxa collected during this study from areas previously surveyed by Peirson and Howell were not recorded in earlier checklists (Peirson 1938, 1942; Howell 1946). These...
Table 4. Comparison of several floristic, collections-based studies in the eastern Sierra Nevada region. Taxonomy was not made uniform for these comparisons.

<table>
<thead>
<tr>
<th>Study location</th>
<th>Reference</th>
<th>Air distance from Rock Creek in mi. (km)</th>
<th>Area in sq. mi. (sq. km)</th>
<th>Highest elevation in ft (m)</th>
<th>Elevation gain in ft (m)</th>
<th>Total minimum-rank taxa</th>
<th>% Non-native</th>
<th>Largest families (no. taxa)</th>
<th>Largest genera (no. taxa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Rock Creek Watershed, Inyo Co./Mono Co., California (37°27'N, 118°44'W)</td>
<td>This study</td>
<td>0</td>
<td>36.5 (94.5)</td>
<td>13,750 (4191)</td>
<td>6391 (1948)</td>
<td>591 (4)</td>
<td>4</td>
<td>Poaceae (76)</td>
<td>Carex (47)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Asteraceae (75)</td>
<td>Boechera (16)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cyperaceae (54)</td>
<td>Eriogonum (15)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Rosaceae (33)</td>
<td>Poa (14)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Brassicaceae (32)</td>
<td>Silpa (12)</td>
</tr>
<tr>
<td>Glass Mountain Region, Mono Co., California (37°46'N, 118°43'W)</td>
<td>Honer (2001)</td>
<td>22 (36)</td>
<td>280 (725)</td>
<td>11,123 (3390)</td>
<td>4718 (1438)</td>
<td>489 (3)</td>
<td>3</td>
<td>Asteraceae (87)</td>
<td>Eriogonum (22)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Poaceae (46)</td>
<td>Carex (18)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Brassicaceae (37)</td>
<td>Anabis (14)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Polygonaceae (31)</td>
<td>Astragalus (11)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Fabaceae (25)</td>
<td>Lupinus (11)</td>
</tr>
<tr>
<td>San Joaquin Roadless Area, Mono Co., California (37°42'N, 119°01'W)</td>
<td>Constantine-Shull (2000)</td>
<td>24 (38)</td>
<td>17 (44)</td>
<td>11,601 (3536)</td>
<td>3727 (1136)</td>
<td>446 (1)</td>
<td>1</td>
<td>Asteraceae (73)</td>
<td>Carex (30)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Poaceae (50)</td>
<td>Anabis (12)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cyperaceae (32)</td>
<td>Eriogonum (12)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Scrophulariaceae (29)</td>
<td>Lupinus (11)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Brassicaceae (27)</td>
<td>Epilobium (11)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Polygonaceae (20)</td>
<td>Poa (10)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Poaceae (29)</td>
<td>Minutia (12)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Polygonaceae (29)</td>
<td>Phacelia (12)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Polemoniaceae (25)</td>
<td>Cryptantha (10)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Scrophulariaceae (23)</td>
<td>Camissonia (8)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Fabaceae (21)</td>
<td></td>
</tr>
<tr>
<td>Kiavah Wilderness, Kern Co., California (35°39'N, 118°06'W)</td>
<td>Gardner (2017)</td>
<td>129 (207)</td>
<td>137 (354)</td>
<td>7294 (2200)</td>
<td>3937 (1200)</td>
<td>477 (6)</td>
<td>6</td>
<td>Asteraceae (73)</td>
<td>Gilia (18)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Poaceae (36)</td>
<td>Eriogonum (17)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Polemoniaceae (35)</td>
<td>Phacelia (13)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Polygonaceae (25)</td>
<td>Cryptantha (12)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Fabaceae (24)</td>
<td>Lupinus (8)</td>
</tr>
</tbody>
</table>
Table 5. Special-status plants in the upper Rock Creek watershed (CNDDB 2018; CNPS 2018). Rare plants previously undocumented in the study area are indicated by a cross (†). Taxa verified from previous collections but not rediscovered during the study are also indicated by a diamond (♦).

<table>
<thead>
<tr>
<th>Taxon</th>
<th>CNPS List</th>
<th>California State List</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agrostis humilis†</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Allium atrorubens var. cristatum†</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Antennaria pulchella</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Astragalus kentrophyta var. danaus†</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Astragalus monoensis</td>
<td>1B</td>
<td>Rare</td>
</tr>
<tr>
<td>Boechera tularensis•</td>
<td>1B</td>
<td></td>
</tr>
<tr>
<td>Botrychium crenulatum</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Calyptridium pygmaeum</td>
<td>1B</td>
<td></td>
</tr>
<tr>
<td>Carex baushaumii</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Carex congonii</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Carex idahoensis‡</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Carex incurviformis•</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Carex stevenii‡</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Carex taboensis</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Cryptantha glomeriflora</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Draba cana•</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Draba praecalita‡</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Draba sierrae</td>
<td>1B</td>
<td></td>
</tr>
<tr>
<td>Festuca minutiflora•</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Fritillaria pinetorum•</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Jamesia americana var. rosea</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Lapinus padre-crowley•</td>
<td>1B</td>
<td>Rare</td>
</tr>
<tr>
<td>Minuartia obasiloba•</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Minuartia stricta</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Penstemon cinicola•</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Penstemon papillatus</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Podistera nevadensis†</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Potamogeton robinsis†</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Subalaria aquatica subsp. americana</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Thalictrum alpinum•</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Tonestus peisonii</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Triglochin palustris</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Taxon</th>
<th>CNPS List</th>
<th>California State List</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agrostis humilis</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Allium atrorubens var. cristatum</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Antennaria pulchella</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Astragalus kentrophyta var. danaus</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Astragalus monoensis</td>
<td>1B</td>
<td>Rare</td>
</tr>
<tr>
<td>Boechera tularensis</td>
<td>1B</td>
<td></td>
</tr>
<tr>
<td>Calamagrostis muiriana</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Caliscirpus brachythrix</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Carex congdonii</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Carex idahoensis</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Carex incurviformis</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Carex stevenii</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Carex taboensis</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Cryptantha glomeriflora</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Draba cana†</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Draba praecalita†</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Draba sierrae†</td>
<td>1B</td>
<td></td>
</tr>
<tr>
<td>Festuca minutiflora†</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Fritillaria pinetorum†</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Jamesia americana var. rosea</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Lapinus padre-crowley†</td>
<td>1B</td>
<td>Rare</td>
</tr>
<tr>
<td>Minuartia obasiloba†</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Minuartia stricta</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Penstemon cinicola</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Penstemon papillatus</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Podistera nevadensis</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Potamogeton robinsis</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Subalaria aquatica subsp. americana</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Thalictrum alpinum</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Tonestus peisonii</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Triglochin palustris</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

Table 6. Taxa of limited distribution: plants documented from the upper Rock Creek watershed with ranges limited to the High Sierra Nevada (SNH) region, or with ranges extending from the SNH to the East of Sierra Nevada region (SNE) and/or the White and Inyo mountains (W&I) (Baldwin et al. 2012). Rarity category is provided if applicable (CNPS 2018); categories are explained in Table 5. Taxa verified from previous collections but not rediscovered during the study are indicated by a diamond (♦).

<table>
<thead>
<tr>
<th>Taxa endem to SNH, or extending only to SNE and/or W&amp;I</th>
<th>CNPS List</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquilegia pubescens</td>
<td>4</td>
</tr>
<tr>
<td>Astragalus kentrophyta var. danaus (+ SNE)</td>
<td>4</td>
</tr>
<tr>
<td>Astragalus lentiginosus var. ineptus (+ SNE)</td>
<td>1B</td>
</tr>
<tr>
<td>Botrychium crenulatum†</td>
<td>2</td>
</tr>
<tr>
<td>Calamagrostis muiriana</td>
<td>4</td>
</tr>
<tr>
<td>Caliscirpus brachythrix</td>
<td>4</td>
</tr>
<tr>
<td>Carex congdonii</td>
<td>4</td>
</tr>
<tr>
<td>Castilleja nana (+ W&amp;I)</td>
<td>4</td>
</tr>
<tr>
<td>Delphinium polycodon (+ W&amp;I)</td>
<td>4</td>
</tr>
<tr>
<td>Draba lemmonei</td>
<td>4</td>
</tr>
<tr>
<td>Draba sierrae</td>
<td>1B</td>
</tr>
<tr>
<td>Drymocallis pseudopurpurestris var. crumiana (+ W&amp;I)</td>
<td>4</td>
</tr>
<tr>
<td>Erigolium nudum var. scapigerum</td>
<td>4</td>
</tr>
<tr>
<td>Festuca brachyphylla subsp. brevicalmis (+ SNE, W&amp;I)</td>
<td>4</td>
</tr>
<tr>
<td>Fraera puberenta (+ W&amp;I)</td>
<td>4</td>
</tr>
<tr>
<td>Galium hypotrichium subsp. hypotrichicum (+ SNE)</td>
<td>4</td>
</tr>
<tr>
<td>Ivesia leucopodoideae var. megalopetala</td>
<td>4</td>
</tr>
<tr>
<td>Ivesia leucopodoideae var. scandarius (+ W&amp;I)</td>
<td>4</td>
</tr>
<tr>
<td>Ivesia muirii</td>
<td>4</td>
</tr>
<tr>
<td>Leptosiphon pachyphyllus (+ SNE)</td>
<td>4</td>
</tr>
<tr>
<td>Lewisia glandulosa (+ SNE)</td>
<td>4</td>
</tr>
<tr>
<td>Lilium kelleyanum</td>
<td>4</td>
</tr>
<tr>
<td>Lilium parvum</td>
<td>4</td>
</tr>
<tr>
<td>Lomatium torreyi†</td>
<td>4</td>
</tr>
<tr>
<td>Lupinus lepidus var. ramosus (+ SNE)</td>
<td>4</td>
</tr>
<tr>
<td>Lupinus padre-crowley (+ SNE)</td>
<td>1B</td>
</tr>
<tr>
<td>Lupinus pratensis var. pratensis (+ SNE)</td>
<td>4</td>
</tr>
<tr>
<td>Luzula oreaster</td>
<td>4</td>
</tr>
<tr>
<td>Oreonana clements</td>
<td>4</td>
</tr>
<tr>
<td>Penstemon papillatus (+ SNE)</td>
<td>4</td>
</tr>
<tr>
<td>Pou keckii (+ SNE)</td>
<td>4</td>
</tr>
<tr>
<td>Pou stephenianni</td>
<td>4</td>
</tr>
<tr>
<td>Polemonium eximium</td>
<td>4</td>
</tr>
<tr>
<td>Potentilla pseudosierice (+ SNE, W&amp;I)</td>
<td>4</td>
</tr>
<tr>
<td>Spitula kingii</td>
<td>4</td>
</tr>
<tr>
<td>Tonestus peisonii (+ W&amp;I)</td>
<td>4</td>
</tr>
<tr>
<td>Trichophorum clementis</td>
<td>4</td>
</tr>
</tbody>
</table>

Rare taxa.—Thirty-two taxa in the study area are listed in the CNPS Inventory of Rare and Endangered Plants (v8-03, 2018) (Table 5). The inventory employs a ranking system based on degree of rarity. Five taxa in the study area are Rank 1B: they are California endemics and rare throughout their ranges. Ten taxa are Rank 2: they are rare throughout their range in California but are more common elsewhere. Seventeen are Watch List taxa (Rank 4).

Special Status Species and Taxa of Limited Distribution

include a fern (Athyrium distentifolium var. americanum, Athyriaceae), a conifer (Tsuga mertensiana, Pinaceae), four perennial dicots (Cerastium arvense subsp. strictum, Caryophyllaceae; Draba praecalata, Brassicaceae; Micranthes tolmiei, Saxifragaceae; Penstemon cinicola, Plantaginaceae) and two perennial grasses (Agrostis humilis, Torreyochloa pallida var. paucijflora, Poaceae). Two of these newly documented plants—Agrostis humilis and Penstemon cinicola—are special-status species (Table 5).

Herbarium searches (SEINet 2016; CCH 2018) revealed one additional perennial dicot (Gentianopsis simplex, Gentianaceae) not recorded in earlier checklists. Elizabeth Butler documented this species from Heart Lake in the 1930s (s.n., Jul 1931, PASA187) during the same year and month that Peirson made one of his visits to Heart Lake. Butler’s remains the only known collection from the watershed.
Two legumes, *Astragalus monoensis* and *Lupinus padre-crowleyi*, are officially listed as Rare under the California Endangered Species Act (CESA) (CNDDB 2018). No federally listed taxa are known from the watershed; however, as of April 2018, *Pinus albicaulis* is a candidate species (i.e., under review) for listing under the Federally Endangered Species Act (FESA) due to its rapid decline throughout its range in North America (U.S. Department of the Interior, Fish and Wildlife Service 2018).

### Narrowly distributed taxa

Thirty-seven taxa in the Rock Creek flora have relatively narrow ranges as circumscribed by Baldwin et al. (2012) (Table 6). Known distributions of these taxa are limited to the High Sierra Nevada region, or extend only to the East of Sierra Nevada region and/or the White and Inyo mountains.

### Sensitive species

Taxa recognized as sensitive by the State of California (CNDDB 2018), CNPS (2018) and/or the Inyo National Forest due to threats and/or extreme rarity warrant a brief discussion. *Botrychium crenulatum* (scalloped moonwort; Ophioglossaceae), a diminutive fern, is only known in the watershed from a single population on a wet slope along the margin of a horse pasture near Rock Creek Lodge, ca. 9500 ft (2895 m) elevation. This species (CNPS List 2 [endangered in CA; more common elsewhere]) is listed as threatened by grazing and trampling within its range. Horses were observed in the pasture during fieldwork for this study. It is possible that *B. crenulatum* occurs in suitable habitat elsewhere in the watershed; the species is inconspicuous even to a trained botanical eye, and could be easily overlooked.

*Boechera tularensis* (Tulare rockcress; Brassicaceae) (CNPS List 1B [rare, threatened, or endangered in CA or elsewhere]) is possibly threatened by recreational activities and vehicles within its range. In the study area it is only known from a single historical collection (*Alexander, Bailey & Urban 647A, B [NMC]*). It was documented in 2008 at ca. 10,500 ft (3200 m) along the trail between Mosquito Flat and Ruby Lake. It was not rediscovered during the present study.

*Calyptridium pygmaeum* (Fig. 18) (pygmy pussypaws; Montiaceae) (CNPS List 1B [rare, threatened, or endangered in CA or elsewhere]) is possibly threatened by recreational activities and vehicles within its range. In the eastern Sierra Nevada, it has only been recorded from the Rock Creek and Cottonwood Creek watersheds. Statewide there are 27 collections I am aware of (although I have not verified the determinations for all), that represent ca. 15 occurrences (CCH 2018). The species was first documented in the study area at Heart Lake in the 1930s (*Peirson 13457, RSA*) but wasn’t recorded again until the present study. It was found at Heart Lake and Rock Creek Lakes Resort in 2013, and at Rock Creek Lake in 2015. All sites where *C. pygmaeum* has been documented in the watershed receive considerable impact from human traffic. The latter two locations are noteworthy in that they are developed sites—at Rock Creek Lake the species was found growing in a road pavement crack and at the Resort it was found in a dirt parking area. It is likely that *C. pygmaeum* occurs elsewhere in the study area—there appears to be plenty of suitable habitat—but the plants are small, ephemeral and easily overlooked.

*Lupinus padre-crowleyi* (Father Crowley’s lupine; Fabaceae) (CNPS List 1B [rare, threatened, or endangered in CA or elsewhere]; State List Rare) is a very rare Sierra Nevada endemic only known from Inyo, Mono and Tulare counties. This species is known in the study area from a single occurrence, found in 2013 on Wheeler Ridge at ca. 11,000 ft (3353 m). This locality is currently the northernmost known occurrence of the species (CCH 2018).

*Botrychium crenulatum* (Mono milkvetch; Fabaceae) (CNPS List 1B; State List Rare) is threatened by road maintenance, vehicles and sheep grazing within its range. Interestingly, the Rock Creek plants are disjunct—the closest occurrence is ca. 14 air miles (22.6 air km) northwest, near Hot Creek at the edge of the species’ primary area of distribution, where it occurs on volcanically derived soils. It is unclear whether the Rock Creek plants are a natural population, or perhaps arrived via human-mediated transportation, e.g., seeds mixed with gravel brought in for road work, or lodged in the cracks of automobile tire treads. The author only found the species along Rock Creek Road (ca. 13 plants observed; *England 260, 291*) and at the Palisades day parking area (Fig. 1) (ca. 100 plants observed, *England 1647*), both sites subject to vehicular disturbance. In fact, some of the Palisades plants had clearly been driven over and damaged by vehicles (J. England & T. Columbus, pers. obs. 2016). There are two historical collections of *Astragalus monoensis* from Rock Creek in 1992 and 1994 (*Fredendall 6335, 6413, RSA*). Both collections, annotated during the present study, were originally determined as *A. lemmonii A. Gray*. The locality data are vague for these collections; the provided elevation of 9400 ft (2865 m) would place them uproot from the Palisades population (8885 ft /2708 m).

The Palisades site was used as a staging area for road maintenance in 2014 and 2015, when Rock Creek Road was widened to accommodate a bicycle lane. Temporary negative impacts to roadside vegetation were anticipated by the planning agencies, but the long-term viability of the Palisades population of *A. monoensis* was determined not to be threatened by the project (MCCDDPD 2013). However, in June 2012, the author documented 13 plants along the road shoulder between Big Meadow and Palisades, near a pullout (*England 260, RSA*). Unfortunately, the Biological Assessment conducted in July 2012 to assess potential impacts to rare species from the planned road work reported that *A. monoensis* was not present along the roadway. The plants documented along the road during this study were growing within four feet (ca. 1 m) of the west pavement edge and the majority did not survive the bicycle lane addition—in August 2018 I resurveyed the collection site and found only three individuals.

### Regional Endemism

Although no taxa were found to be restricted to the study area, 19 taxa in the Rock Creek flora are endemic to the High Sierra Nevada bioregion (Baldwin et al. 2012) (Table 6). The Sierra Nevada has been recognized as a hot spot of botanical diversity within California (Raven and Axelrod 1978; Thorne et al. 2009). Burge et al. (2016) reported 299 minimum-rank taxa endemic to the Sierra Nevada. Shevock (1996) estimated as many as 405 Sierra Nevada endemics, but his geographical boundaries for the region were broader than those of Baldwin et al. (2012), which were used by the Burge et al. (2016) study. Shevock noted that more than half of all Sierra endemics are considered rare by governmental agencies and/or conservation organizations. He also...
observed that among eastern Sierra Nevada river drainages, the Owens River Basin is noteworthy for its relatively high species diversity and numbers of endemic and rare taxa. Raven and Axelrod (1978) suggested that major climatic change at high elevations during the Pleistocene drastically limited the opportunities for plant speciation during that time period; therefore, endemics that occur in the high Sierra are of relatively recent origin and special interest. The Pleistocene period in the Rock Creek watershed, as in much of the Sierra Nevada, was marked by repeated glacial advances and retreats (Hildreth and Fierstein 2016).

Non-Native Taxa

Twenty-five taxa are not native to the study area (Jepson Flora Project 2018). All non-native taxa documented previously were encountered except for *Festuca myuros* (Poaceae), which was recorded from a single collection at Rock Creek Lake in 1947 (Benson 12577, POM). It may still be present in the study area but, if so, it is likely uncommon. The most widespread and abundant naturalized species is *Bromus tectorum* (cheat grass; Poaceae), which is common up to ca. 9500 ft (2890 m) along roadways and in frequently disturbed areas adjacent to roads. I documented *B. tectorum* as high as Rock Creek Lake (9800 ft/2990 m) and it may infrequently occur higher along the road. A collection of *B. tectorum* from Ruby Lake at 11,150 ft (3400 m) (Peirson 11308, RSA) is correctly identified but appears to be an anomaly; no evidence of cheat grass in the Wilderness Area was found during the present study. The Wilderness appears to be little impacted by non-natives; only two were documented: *Podocarpus macrophyllus* (Araucariaceae; endemic) and *Myrica gale* (Myricaceae; abundant naturalized species is *Phleum pratense* (Poaceae; fairly common, usually along roads and in small numbers) and *Polemonium eximium* (Polemoniaceae; rare). There are several historical collections of *Poa pratensis* subsp. *pratensis* (Poaceae) from the study area, all from 1946 or earlier (Halperin 515, CAS; Howell 22374, CAS; Peirson 10817, RSA). However, I did not encounter this species.

Perhaps most noteworthy with regard to non-natives is the unusually high elevations at which some were recorded. *Elymus ponticus* (Poaceae; 9400 ft/2865 m), *Matricaria discoidea* (Asteraceae; 9700 ft/2960 m), *Plantago lanceolata* (Plantaginaceae; 9900 ft/3020 m), *Portulaca oleracea* (Portulacaceae; 9750 ft/2970 m) and the aforementioned *B. tectorum* (9800 ft/2990 m and 11,150 ft/3400 m) have no previous collections in California from such high elevations (SEINet 2016; CCH 2018). All of these records except for Peirson’s are along Rock Creek Road, apparently the highest paved road (10,240 ft/3121 m) in the Sierra Nevada and undoubtedly a corridor for plant dispersal, natives and non-natives alike. Undocumented weeds probably exist in the campgrounds along Rock Creek Road (I was not permitted to make collections within campgrounds). Trails presumably are also natural corridors for dispersal of non-natives such as *Taraxacum officinale*.

**Taxa Not Rediscovered**

Eighty-one taxa vouchered by previous collections were not rediscovered. There are several possible explanations for this. First, below-average precipitation was recorded in all years the author conducted fieldwork. Some taxa not rediscovered may be more abundant in wetter years. Second, although I attempted to achieve excellent geographic coverage during field surveys, it was not possible to search the entire area. Evanescent plants or those that were present in only one year may have been missed. Some taxa may have been present but were overlooked, particularly those very small in stature, and those such as sedges, rushes and grasses that tend to “blend in” with similar-looking species. Lastly, some taxa present historically in the watershed may no longer be present; taxa that were rare in the 1930s would have been especially vulnerable. Many of the taxa not rediscovered are known from a single historical collection, which suggests that they may have been uncommon in the watershed when they were collected. A question is whether or not climate change, recreational activities, and/or other impacts have led to the disappearance of previously documented species.

**Noteworthy Absences**

Red fir, *Abies magnifica* A. Murray var. *magnifica* (Pinaceae) and white fir, *A. concolor* (Gordon & Glend.) Lindl. ex Hildebr., have not been recorded in the study area to my knowledge. Collections of *Abies* on the east slope of the central Sierra Nevada are relatively sparse (CCH 2018); many records of *A. magnifica* exist from the east slope of the northern Sierra and for *A. concolor* on the east slope of the northern and southern Sierra. However, *A. magnifica* is a common forest species on the slopes of Mammoth Mountain, ca. 15 air miles (24 km) northwest of Rock Creek, and *Abies concolor* has also been documented both in the Mammoth area (Howald 2000) and at several sites in the Glass Mountain region ca. 22 air mi. (36 km) north of Rock Creek (Honer 2001). The presence of *Abies* in the Mammoth region might be attributed in part to the relatively wetter conditions around Mammoth Pass (ca. 9370 ft/2866 m) which sits low on the Sierra crest, allowing more moisture from winter storms to reach the east slopes (Sawyer and Keeler-Wolf 2007).

**Threats to the Flora**

**Climate change.**—Warming annual temperatures are likely the greatest medium- to long-term threat to the flora, especially to taxa that grow on mountaintops as they have “nowhere to go” (Loarie et al. 2009). *Podastera nevadensis* (Apiaceae), *Draba sierrae* (Fig. 22) (Brassicaceae), *Astragalus kentrophyta* var. *danaus* and *Lupinus padre-crowleyi* (Fabaceae) are rare, narrow-ranging taxa that are uncommon and limited to ridgetops within the watershed. Suitable habitat for these species may contract in the future if climate change projections come to pass. A century ago, the alpine region of the Sierra Nevada was observed by Smiley (1921) to be fragmentary in its distribution. One could postulate that alpine-restricted species such as *Hulsea algida* (Asteraceae) and *Polemonium eximium* (Fig. 13, 27) (Polemoniaceae) will suffer population decline if alpine habitats are altered by warming. The topographic and micro-climatic heterogeneity within the watershed, however, could provide refugia for some taxa (Loarie et al. 2009). Warming temperatures may increase the amount of suitable habitat for some natives and also for non-natives, leading to potential range shifts if other climatic variables are relatively stable. *Bromus tectorum*, well established along Rock Creek Road below 9500 ft (2895 m), could potentially advance farther up the canyon if present temperature barriers are relaxed (Griffith and Loik 2010). Many non-native species from lower areas in California have already moved higher in elevation over the past century in response to climate change, with ca. 27% of non-native taxa exhibiting sig-
significant range shifts toward higher elevations (compared to ca. 12% of endemic taxa showing a similar pattern) (Wolf et al. 2016).

Drought and wildfire.—A span of dry years in the past decade has resulted in significant impacts to the forests (Inyo National Forest 2014). I observed significant mortality of *Pinus albicaulis* (Pinaceae) at its lower elevations, particularly in the Tamarack Bench and Hilton Bench areas. Millar et al. (2012) conducted surveys of *P. albicaulis* stands in the Rock Creek watershed containing dead trees, and attributed high mortality rates in the plot sites to mountain pine beetle (*Dendroctonus ponderosae*) infestations associated with successive years of drought during the first decade of the current century. Large wildfires such as the 2002 Birch Fire that burned part of the study area are potentially grave threats to the flora. Conversely, the practice of fire suppression in the more accessible areas of the watershed, especially near the resorts and campgrounds, has potentially changed forest composition and fuel structure in those areas, perhaps increasing the risk of catastrophic fire (Inyo National Forest 2014).

Recreation.—Increased recreational use on the Inyo National Forest is projected, based on rising urban populations in southern California (Inyo National Forest 2014). This is a matter of concern for sensitive ecosystems in the study area such as wetlands and meadows adjacent to hiking trails and campgrounds. Overnight camping in the John Muir Wilderness is restricted by a limited number of Wilderness entry permits per day. However, day hiking in the Wilderness is not presently regulated by permit nor limited to maximum number of visitors per day.

I observed some habitat degradation along the edges of trails and lakes due to trampling from foot traffic, horses and mules. The most popular destinations in Little Lakes Valley are the easily accessible lakes such as Heart Lake, Long Lake and Gem Lakes. Shorelines and meadow areas along these and other lakes have already received a moderate level of disturbance. The Inyo Forest has attempted to dissuade repeated trampling of some meadow areas by posting signage such as “Restoration Area” at a few sites. Streamside vegetation in the riparian zone near campgrounds was also observed to have received a significant amount of disturbance from fishermen and campers. It is recommended that the Inyo National Forest monitor these impacts toward control, reduction and mitigation.

ACKNOWLEDGEMENTS

This study is based on a master’s thesis submitted by the author to Claremont Graduate University (CGU) in 2017. Funding for this research was provided by CGU, Rancho Santa Ana Botanic Garden, Valentine Eastern Sierra Reserve, the California Native Plant Society Bristlecone Chapter, Southern California Botanists, and Ann Howald. I thank J. Mark Porter, Lucinda McDade and J. Travis Columbus for their guidance and academic oversight. I am indebted to numerous friends and colleagues who generously volunteered their time to assist with fieldwork. Sue Weis and Michèle Slaton of the Inyo National Forest Bishop Office facilitated collection permits and provided information for some species occurrences. I gratefully acknowledge the following herbaria for access to and/or loan of specimens: ASC, CAS/DS, CDA, GH, LA, NMC, NY, PASA, RSA/POM, SBBG, SD, UC/JEPS, UCD and UCR. Sincere thanks to Mare Nazaire, Administrative Curator at RSA, for facilitating specimen loans. Dean W. Taylor sent me useful information on early botanical work in Rock Creek. Special recognition to Cathy Rose, Stephen Ingram and Jim King for sharing their knowledge of the local flora. I gratefully acknowledge the following people for their help with identifications: Travis Columbus (Poaceae), Naomi Fraga (Phrymaceae), Carolyn Ferguson and Mark Mayfield (*Phlox*), LeRoy Gross (various taxa), Matt Guiffins (*Calyptridium*), Noel Holmgren (*Penstemon*), Diana Jolles (*Pyrola*), Jason Koontz (*Delphinium*), Mark Porter (*Polygonaceae*), Tommy Stoughton and Michael Windham (*Boechera*), Debra Trock (*Packera*) and Peter Zike (*Carex* and *Luzula*). Many thanks to Ann Howald, Travis Columbus, Vanessa Ashworth and an anonymous reviewer for their input and assistance with the manuscript. Lastly, I thank Gary Wallace for drawing my attention to the need of an updated plant checklist for Rock Creek Canyon.

LITERATURE CITED


APPENDIX I

ANOTATED CATALOG OF THE VASCULAR FLORA

The following 591 minimum-rank vascular plant taxa were documented from the upper Rock Creek watershed. This catalog is a result of intensive fieldwork conducted from 2012 through 2016 (two collections were made during a one-day visit in 2018), and herbarium searches using the Consortium of California Herbaria (CCH) and SEINet Portal Network databases (accessed on multiple occasions 2012–2018). A full set of specimens collected during this study is housed at Rancho Santa Ana Botanic Garden (RSA). Specimens cited are housed at RSA unless otherwise indicated. More than 1000 pre-existing collections were examined, verified, and annotated from the following herbaria: ASC, CS/DS, CDA, GH, LA, NMC, NY, PASA, RSA/POM, SBBD, SG, UC/JEPS, UCD and UCR. Identifications were made by the author or by an expert in the taxonomic group. For each taxon, the catalog cites at least one collection and indicates the vegetation type(s) where it has been documented and its abundance in the watershed.

Family classification for Boraginales is according to the Boraginales Working Group (2016); other authorities followed include recent treatments in Cryptantha (Hansensteb-Lehman and Simpson 2012) and Luzula (Zika et al. 2015a). All other taxonomy follows the Jepson Flora Project (2018).

Abundance terms are defined typically as follows: rare = a single collection site, not observed elsewhere; uncommon = narrowly distributed, seldom observed; occasional = variably distributed, infrequently observed; locally common = narrowly distributed, commonly observed within its range; common = broadly distributed, commonly observed.

Non-native taxa are denoted by an asterisk (*) and may include waif occurrences of California natives. Special-status taxa listed in the CNPS Inventory of Rare and Endangered Plants (online edition, v8-03) and State Listed taxa are denoted by a dagger (†). CNPS rarity ranks: 1B: Plants rare, threatened, or endangered in California or elsewhere; 2: Plants rare, threatened or endangered in California but more common elsewhere; 4: Plants of limited distribution (watch list). Plants designated Rare by the California Fish and Game Commission (CNDDB 2018): CA-Rare.

Taxa identified from previous collections but not rediscovered during fieldwork for this study are denoted by a diamond (♦). New collections from areas previously surveyed by Peirson (1938, 1942) and/or Howell (1946) but not recorded in those checklists are noted. See Fig. I for place name locations.

FERNs AND FERN ALLIES

LYCOPHYTES

ISOTeciAE


ISOETes OCCIDENTALIS L.F. Hend. Whitebark pine forest. In lake shallows. Uncommon. Hidden Lakes, Fremd 6. Isoetes collections from Rock Creek exhibit significant character overlap (e.g., leaf shape and size of female spores) between I. bolanderi and I. occidentalis, which are known to hybridize, according to the descriptions by Taylor and Keeley (2012). A hybrid specimen was collected from the Hidden Lakes during the present study (Fremd 7).

SELAGINELLACEAE


FERNS

Athyriaceae


Cystopteridaceae

VOLUME 36(2) 67

Vascular Flora, Upper Rock Creek Watershed

Dennstaedtiaceae


Equisetaceae


Ophioglossaceae


†Botrychium simplex E. Hitchc. var. compositum (Lasch) Milde. Lodgepole and whitebark pine forests, alpine. Moist meadows, other mesic sites, often around lake edges. Locally common but cryptic. England 1416.

Pteridaceae

Adiantum aleuticum (Rupr.) C.A. Paris. Whitebark pine forest. Rare. “West shore Long Lake; along stream but in full sunlight. The only colony found in region.” Peirson s.n. 18 September 1933 (UC).


Woodsiaceae


Gymnospermae


Pinaceae


ANGIOSPERMS

Eudicots

APOCYNACEAE


ASTERACEAE


Agoseris aurantiaca (Hook.) Greene var. aurantiaca. Whitebark pine forest. Rare. Full locality data not provided. “Rocky Creek Lake Basin, 10,750 ft.” Peirson 9164.


Arnica parish A. Gray. Lodgepole pine forest. Rare. Near Rock Creek Lake, Robinson 883.


Crepis acuminata Nutt. Whitebark pine forest. Rare. Long Lake vicinity, Peirson 9514.


*Erigeron tener (A. Gray) A. Gray. Whitebark pine forest. Rare. S slope of Transverse Ridge, Peirson 11289.


*Gaillardia aristata Pursh. Lodgepole pine forest. Road edges. Uncommon. Below East Fork day parking area, England 1112; near Aspen Campground, Taylor 16896 (JEPS). Waif, possibly introduced at the same time as Penstemon eutoni var. eutoni (Plantaginaceae). Possibly escaped from cultivation or seeds brought in with gravel/soil used for road maintenance.

Gnaphalium palustre Nutt. Lodgepole pine forest. Gravelly areas disturbed by vehicle traffic. Uncommon. Rock Creek Lakes Resort, England 925. The location of England 925 at ca. 9700 ft (2957 m) is >1000 ft (305 m) higher than previously documented for the state (Kern Plateau, Kern County [CCH 2016]).


Plagiobothryum spinosum (Nutt.) Rydb. Jeffrey pine forest. Dry rocky slopes. Rare. W side of Rock Creek Road near second creek crossing, England 422.


Boechera pinnatiformis (Tidest.) Windham & Al-Shehbaz. Lodgepole pine forest. Rare. Mosquito Flat, Halperin 582A (CAS).


Boechera retrofracta (Graham) Á. Löve & D. Löve. Whitebark pine forest. Uncommon. S base of Transverse Ridge, Peirson 12183 (JEPS); Ruby Lake, England 1280.


Caulanthus sp. ("Caulanthus sierrek") R.E. Buck ined.). Pinyon pine woodland. Dry rocky sites. Uncommon. Rock Creek Road, 0.25 mile S of jct. with U.S. Hwy 395, Bautista 1809; W side of Rock Creek Road at canyon mouth, England 118. This Caulanthus is easily mistaken for C. pilosus S. Watson. Roy E. Buck in the 1993 Jepson Manual treatment includes a remark under C. pilosus: "Pls from c&x SNH with dark purple sepals and seeds > 2 mm are an undescribed sp."


Erysimum perenne (S. Watson ex Coville) Abrams. Lodgepole pine forest. Rare. Trail from Ruby Lake/Mono Pass, ca. 11,000 ft (3353 m). Not recorded by Peirson (1938, 1942) or Howell (1946). Evidently the only record for Inyo County (CCH 2016; SEINet 2016).


*Draba cana Rydb. CNPS List 2. Whitebark pine forest. Rare. Heart Lake area, Peirson 15523.


Eriogonum perenne (S. Watson ex Coville) Abrams. Lodgepole pine forest transition to whitebark pine forest. Rare. Mosquito Flat, Bowes 701. Evidently the only record for Inyo County (CCH 2016; SEINet 2016).


*Cerastium arvense L. subsp. stratum Gaudin. Whitebark pine forest. Wet area in shelter of rocks. Rare. Along trail at Heart Lake foot bridge. Not recorded by Peirson (1938, 1942) or Howell (1946). England 1499. Evidently the only record for C. arvense in Inyo County and in the eastern Sierra Nevada. There are few collection records from the mountain range (CCH 2016; SEINet 2016).


*Minuartia rubella (Wahlenb.) Hieron. Alpine. Talus slopes, fellﬁelds. Uncommon, only recorded >11,900 ft (3627 m). Mono Mesa, Howell 22774 (DS); Mount Morgan, England 1067b.


*Spergularia rubra (L.) J. Presl & C. Presl. Lodgepole pine forest. Road shoulders. Occasional. Rock Creek Road near Pine Grove Campground,


- STELLARIA UMBELLATA Turcz. ex Kar. & Kir. Lodgepole pine forest transition to whitebark pine forest. Rare. Mosquito Flat, Howell 22335 (CAS).

CHENOPODIACEAE


MONOLEPHI NUTILLIANA (Schult.) Greene. Lodgepole pine forest. Disturbed ground in horse pasture. Rare. Rock Creek Lodge at the corral, England 565.


CORNACEAE


CRASSULACEAE


EREITIACEAE


ERIACEAE


CASSIOPE MERTENSIANA (Bong.) G. Don (these plants can be ascribed to subsp. california Piper). Whitebark pine forest, alpine. Rock outcrops. Occasional. England 1590.


RHODODENDRON COLUMBIANUM (Piper) Harmaja. Lodgepole and whitebark pine forests, alpine. Lake shores, most rocky slopes. Locally common >9000 ft (2743 m), England 905.


FABACEAE


ASTRAGALUS MONOENSIS Barnes. CNPS List 1B. CA-Rare. Lodgepole pine forest. Road shoulders, +/- disturbed sites with coarse, dry gravelly soils. Uncommon. Palisade day parking area, England 1647; along Rock Creek Road between Big Meadow and Palisade campgrounds, England 291. The latter occurrence on the W road shoulder near pavement edge, collected prior to 2015 construction of bicycle lane. This locality was re-visited in Aug 2018 and only three individuals were located (13 plants were recorded prior to the road work).


LATHYRUS LANSZWERTII Kellogg var. LANSZWERTII. Jeffrey and lodgepole pine forests. Damp sites. Uncommon. Rock Creek Road near third creek crossing, England 741; Big Meadow area, England 287. Evidently the only record for Mono County (CCH 2016; SEINet 2016).


LUPINUS LEPIDUS Douglas ex Lindl. var. CONFERENS (Kellogg) C.P. Sm. Lodgepole and whitebark pine forests. Meadows, moist areas. Locally common, ubiquitous in Little Lakes Valley, England 533. Collections from the watershed that were historically identified as L. gracilens Greene (a CNPS List 1B species [2018]) are L. lepidus var. conferens. My determinations are based in part on examination of the original material of L. gracilens collected from Tuolumne County by Chestnut & Drew in 1889.


- LUPINUS PAPYRACEUS C.P. Sm. CNPS List 1B; CA-Rare. Whitebark pine forest. Dry slopes. Rare. Top of Wheeler Ridge ca. 150 m N of Wheeler Ridge Mine Road, England 809.


Trifolium wormskjoldii Lehm. Lodgepole pine forest. Wet drainage. Rare. Along Rock Creek Road just S of Inyo/Mono county line, England 1424.

Gentianaceae

Gentianopsis simplex (A. Gray) H.H. Iltis. Whitebark pine forest. Rare.

Gentianella amarella (L.) Börner subsp. acuta (Michx.) J.M. Gillett.

Gentiana newberryi A. Gray var. tiogana (A. Heller) J.S. Pringle.


Trifolium wormskjoldii Lehm. Lodgepole pine forest. Wet drainage. Rare. Along Rock Creek Road just S of Inyo/Mono county line, England 1424.

Fabaceae


Geraniaceae


Grossulariaceae


Ribes inermis Rydb. var. inermis. Whitebark pine forest. Rare. W of Heart Lake. Peirson 9136.


Hydrangeaceae


Ribes inermis Rydb. var. inermis. Whitebark pine forest. Rare. W of Heart Lake. Peirson 9136.


Hydrophyllaceae

Nemophila spatulata Coville. Jeffrey and lodgepole pine forests. Road sides on sandy/gravelly soils. Uncommon. Along Rock Creek Road, Raci- galapi & Constance 3806 (JEPS); Rock Creek Lakes Resort parking area, England 1486.


Hypericaceae


Lamiaceae

Monardella odoratissima Wallr. Lodgepole pine forest. Roadside in damp site. Rare. Rock Creek Road below East Fork day parking area, England 1250.

Loasaceae


Malvaceae


Menyanthaceae

*Menyanthes trifoliata L. Whitebark pine forest. Rare. Heart Lake area, Peirson s.n. 22 Aug 1933.
Vascular Flora, Upper Rock Creek Watershed

**Montiacae**


**Namaceae**

**Nama densa** Lemmon var. densa. Lodgepole pine forest. Dry sandy/gravelly site on disturbed soils. Rare. East Fork day parking area, England 322.

**Nyctaginaceae**


**Onagraceae**


**Epilobium lactiflorum** Hausskn. Lodgepole pine forest transition to whitebark pine forest. Rare. Mosquito Flat, Howell 22235.


**Epilobium saximontanum** Hausskn. Lodgepole pine forest transition to whitebark pine forest. Rare. Mosquito Flat, Howell 22234.


**Orobanchaceae**


**Castilleja chromosa** A. Nelson. Pinyon pine woodland. Dry rocky slopes. Rare. Ridge top above and W of Rock Creek Road, SW of French Campground, England 780.


**Castilleja linearifolia** Benth. Sagebrush scrub, lodgepole and whitebark pine forests. Dry Rocky slopes. Locally common to ca. 10,000 ft (3048 m). England 1406.


**Pedicularis groenlandica** Rete. Lodgepole and whitebark pine forests. Rare to very wet sites. Occasional. England 996.


**Papaveraceae**

**PARNASSIACEAE**

Erythranthe lewisii (Pursh) G.L. Nesom & N.S. Fraga. Lodgepole pine forest.

Erythranthe guttata (Fisch. ex DC.) G.L. Nesom. Riparian woodland.

Erythranthe suksdorfii (A. Gray) N.S. Fraga. Whitebark pine forest.

Erythranthe primuloides (Benth.) G.L. Nesom & N.S. Fraga. Whitebark pine forest.

Penstemon eatonii A. Gray var. eatonii. Lodgepole pine forest.

Penstemon davidsonii Greene var. davidsonii. Whitebark pine forest.

Penstemon heterodoxus A. Gray var. heterodoxus. Lodgepole and whitebark pine forests.

Penstemon newberryi A. Gray var. newberryi. Whitebark pine forest.


**PHYRMACEAE**

Diplacus leptaleus (A. Gray) G.L. Nesom. Whitebark pine forest.

Diplacus mephiticus (Greene) G.L. Nesom. Lodgepole and whitebark pine forests.

**PLANTAGINACEAE**

Callitriche heterophylla Pursh var. bolanderi (Hegelm.) Fassett. Lodgepole and whitebark pine forests.

Collinsia parviflora Lindl. Lodgepole and whitebark pine forests.


**POLEMINIACEAE**


**POLYGONACEAE**


Gilia congesta (Torr.) V.E. Grant. roadside. Locally common. England 1279.

Gilia leucantha (Pursh) V.E. Grant. Roadsides.

**POLYGONACEAE**


**POLYGONACEAE**


Gilia congesta (Torr.) V.E. Grant. roadside. Locally common. England 1279.

POLYGONACEAE


ERIOGONUM CERNUUM Nutt. Lodgepole pine forest. Rare. Rock Creek Road at Iris Meadow Campground, Barbe, Howell & Fuller 3470 (UC).

ERIOGONUM ELATUM Bentham var. ELATUM. Pinyon pine woodland. Dry slopes. Rare. Mouth of Rock Creek Canyon near water tank, England 662.


OXYTHECA DENDROIDEA Nutt. subsp. DENDROIDEA. Lodgepole pine forest. Rare. Iris Meadow area, Howell, Fuller & Barbe 54998 (CAS).

PENSTEMON GAVIARELE var. DEPRESSUM (Gentry) Arcang. Lodgepole pine forest. Open sandy/gravelly areas. Uncommon. Along Rock Creek Road opposite Big Meadow, England 699.


PORTULACACEAE

PORTULACOCEREA L. Lodgepole pine forest. Cracks in road pavement. Rare. Rock Creek Lake, England 1645b. This occurrence at ca. 9730 ft (2966 m) evidently the highest on record in California (CCH 2016; SEINet 2016).

PRIMULACEAE


RANUNCULACEAE


ANEMONE DRUMMONDI S. Watson var. DRUMMONDI. Alpine. Rare. Gorge below Mono Pass, Peirson 10795.


RANUNCULUS ESCHICHTZLII Schltdl. var. ESCHICHTZLII. Alpine. Wet streamside among rocks. Rare. Drainage S of Francis Lake, England 1083.


RHAMNACEAE

CEANOTHUS PAUCIFLORUS DC. (C. vestitus Greene). Pinyon pine woodland. Dry open sites. Rare. NW of Rock Creek Road at third creek crossing, England 255.

Rosaceae


Horkelia fusca Lindl. var. parviflora (Nutt. ex Hook. & Arn.) Wawra. Lodgepole pine forest transition to whitebark pine forest. Wet meadow. Rare. Mosquito Flat, Robinson 65. Evidently the only record for Inyo County (CCW 2016; SEINet England 384). England 279.

Horkelia congdonii (Rydb.) Rydb. Lodgepole pine forest. Moist meadow. Rare. Iris Meadow area, England 578.


Potentilla jeppsonii Erter. Whitebark pine forest. Rocky areas. Uncommon. Along trail above Mack Lake, Taylor & Erter 15296 (JEPS); Heart Lake, Peirson 9474.


Prunus andersonii A. Gray. Pinyon pine woodland. Dry slopes. Locally common <8200 ft (2499 m). NW of Rock Creek Road near third creek crossing, England 121.


Rubiaceae


Galium multiflorum Kellogg. Pinyon pine woodland. Dry rocky slopes. Rare. Along Rock Creek Road at first creek crossing, England 244.


Salicaceae


Salix leucophila Nutt. var. exigua. Lodgepole pine forest. Rare. Heart Lake, Howell 22837.


A specimen of Salix nitida Hook. (Peirson 11207 [RSA]) was mislabeled with the locality of Ruby Lake, Rock Creek Lakes Basin, Inyo County. It was collected in the Virginia Lakes Watershed of Mono County, as evidenced by Peirson’s collection notebook entry for 11207, and by duplicates in other herbaria (HSC, NY, SBBG, SD, POM). Salix nitida is not known to occur in the Rock Creek watershed.

**SAXIFRAGACEAE**


**SCHOPHULARIACEAE**


**SOLANACEAE**


**ULMACEAE**

ULMUS PUMILA L. Riparian woodland. Rocky slope. Rare. A juvenile tree found alongside guard rail at second creek crossing along Rock Creek Road, England 1440. Evidently the only record for Mono County (CCH 2016; SEINet 2016).

**URTICACEAE**


**VIOlaceAE**


**VISCACEAE**

PHORADENDRON JUNIPERINUM A. Gray. Jeffrey pine forest. In tree canopy; parasitic on Juniperus grandis. Rare (single occurrence documented; likely occurs occasionally <9700 ft [2957 m] where host species is common). Along Rock Creek Road at third creek crossing, England 561.

**MONOCOTs**

**ALLIACEAE**


**CYPERACEAE**


CAREX AQUATILIS Wahlenb. var. AQUATILIS. Whitebark pine forest. Wet margins of lakes and streams, locally common. England 1408.


Carex multicostata Mack. Whitebark pine forest. Uncommon. Mosquito Flat, Howell 22217 (CAS); Heart Lake, Peirson 10849.


Carex proposita Mack. Whitebark pine forest, alpine. Dry rocky areas. Uncommon, historically found > 10,500 ft (3200 m). Little Lakes Valley, Peirson 10844 (CAS); Treasure Lakes, Howell 22286.


Juncus bryoides F.J. Herm. Lodgepole pine forest transition to whitebark pine forest. Rare. Mosquito Flat, Howell 22490.


Juncus macrandrus Coville. Lodgepole pine forest. Wet meadows, other mesic sites. Uncommon. Rock Creek Lake vicinity, Crafts & Halperin 502 (UCD); along Rock Creek Road ca. 1 mile (1.6 km) N of county line, G.K. Helmkamp & E. Helmkamp 5898 (UCR).


Luzula cascadenensis Z. K. Lodgepole and whitebark pine forests. Lake shores, stream margins. Occasional. W shore of Ruby Lake, Peirson 12778 (CAS); Francis Lake, England 1091. Collections historically identified as L. comosa F.J. Herm. were reidentified by PF. Zika to be the recently described L. cascadenensis (Zika et al. 2015).


Juncaginaceae


Juncaginaceae


Melanthiaceae


Orchidaceae


Spiranthes romanzenoffiana Cham. Lodgepole and whitebark pine forests. Wet meadows, seeps, stream margins. Uncommon. W side of Long Lake, Conrad 12968; along Rock Creek Road near county line, England 1422. Only two known collections from the watershed; both specimens exhibit intermediate floral characters between S. romanzenoffiana and S. porrifolia Lindl.

Poaceae

*Agropyron cristatum (L.) Gaertn. subsp. pectinatum (M. Bieb.) Tzvelev. Jeffrey pine forest. Road shoulder. Rare. Rock Creek Road just below third creek crossing, England 657.


Bromus tectorum L. Pinyon pine woodland, Jeffrey, lodgepole and whitebark pine forests. Road shoulders, areas disturbed by vehicles and foot traffic. Common <10,000 ft (3048 m). England 1342. This collection from Rock Creek Lake at 9800 ft (2987 m) and Peirson 11308 from Ruby Lake at 11,150 ft (3399 m) evidently the highest elevations recorded for B. tectorum in California (CCH 2016; SEINet 2016). Peirson's collection is perplexing—the alpine habitat of Ruby Lake is not likely to have supported a population. The species was not found there, nor anywhere within the Wilderness Area, during fieldwork for this study.

Liliaceae


**Calamagrostis rupestris** Michx. & H. L. W. Whitebark pine forest, alpine. Meadows, moist depressions in meadows. Locally common. > 10,000 ft (3048 m). England 667.


*Elymus glaucus* Buckley subsp. glaucus. Whitebark pine forest. Rare.


*Elymusponticus* (Podp.) N. Snow. Lodgepole pine forest. Sandy/gravelly soils. Rare.

*Elymus elymoides* (Raf.) Swezey var. elymoides. Pinyon pine woodland.


**Holcus jubatum** L. subsp. jubatum. Whitebark pine forest. Rare. “Roadside at Heart Lake.” Peirson 9410. This collection was made in 1931 when the road from Mosquito Flat to Morgan Pass existed.


**Pileum alpinum** L. Lodgepole and whitebark pine forests, alpine. Moist places in forest understorey, grassy lake shores, meadows. Common > 10,000 ft (3048 m). England 1157.

**Pileum pratense** L. Lodgepole and whitebark pine forests, meadows, moist grassy areas. Uncommon. Between pack station and Mosquito Flat, England 482; SW end of Box Lake, England 1420.

**Poa annua** L. Riparian woodland, lodgepole and whitebark pine forests, alpine. Moist places in forest understorey, grassy lake shores, meadows. Common > 10,000 ft (3048 m). England 647.

**Poa bolanderi** Vasey. Lodgepole pine forest. Beneath tree canopy. Rare. Near entrance to Rock Creek Lake along foot trail downslope toward the creek, England 1648. Evidently the only record for Inyo County (CCH 2016; SEINet 2016).


**Poa fendleriana** (Steud.) Vasey subsp. longiligula (Scribn. & T.A. Williams) Soreng. Lodgepole pine forest, dry rocky slopes. Rare. SW of East Fork Campground below Rock Creek Road, England 225.


**Poa pratensis** L. subsp. pratensis. Riparian woodland, lodgepole and whitebark pine forests, Roadsides, stream and lake margins. Common in moist areas disturbed by vehicles and foot traffic. Heart Lake, Peirson 10817; along Rock Creek Road below Big Meadow, England 288.

**Poa sieberi** Halv. subsp. sieberi. Alpine. Rare. Gorge below Mono Pass, England 1046; Evidently the only record for Inyo County (CCH 2016; SEINet 2016).


**Poa virens** L. subsp. virens. Alpine. Rare. Known only from two collections: E side of Little Lakes Valley, Peirson 12938; N slope of Mount Morgan, England 1066.


**Poa pratensis** L. subsp. pratensis. Riparian woodland, lodgepole and whitebark pine forests, Roadsides, stream and lake margins. Common in moist areas disturbed by vehicles and foot traffic. Heart Lake, Peirson 10817; along Rock Creek Road below Big Meadow, England 288.

**Poa sieberi** Halv. subsp. sieberi. Alpine. Rare. Gorge below Mono Pass, England 1046; Evidently the only record for Inyo County (CCH 2016; SEINet 2016).

Poaceae


**Stipa bloomeri** Bol. (= *S. hymenoides* × *S. occidentalis* var. *occidentalis*). Jeffrey pine forest. Dry sandy/gravelly site partially shaded by pines. Rare. Along Rock Creek Road below third creek crossing, England 658.


**Stipa nevadensis** B.L. Johnson. Lodgepole to whitebark pine forest. Uncommon. Rock Creek Canyon, Wallace 2033; Mosquito Flat, Howell 22260 (CAS).


**Trisetum wolfii** Vasey. Lodgepole pine forest transition to whitebark pine forest. Rare. Mosquito Flat, Howell 22282 (CAS).

Potamogetonaceae

**Potamogeton pusillus** L. Lodgepole pine forest. Large stream-fed pool; plants completely submerged in shallow water, anchored in soft deep mud. Rare. Tamarack Bench at terminus of Sand Canyon Road, England 536.

**Potamogeton robbinsii** Oakes. CNPS List 2. Lodgepole pine forest. Lake shallows with gravelly bottoms; plants completely submerged. Rare. W shore of Rock Creek Lake, England 440.

Ruscaceae


Tofieldiaceae


Typhaceae
