Research Note
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Botanical Reconnaissance of Carlton Ridge Research Natural Area: Mid- to High-Elevation Subalpine Habitats

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Abstract—The Carlton Ridge Research Natural Area, located at the north end of the Bitterroot Mountains, displays many representative and unique qualities of subalpine forest types. As a research natural area, Carlton Ridge is protected for its biological diversity and for its research and educational opportunities. Botanical observations were made on Carlton Ridge during its establishment, but a more complete inventory was needed to provide baseline information that has not been included in previous documentation. A complete plant inventory of the Carlton Ridge Research Natural Area was conducted to provide more detailed information.

Keywords: botanical collection, plant inventory, Bitterroot Mountains, subalpine forest types

The Carlton Ridge Research Natural Area is located at the north end of the Bitterroot Mountains in west-central Montana approximately 19 miles (30 km) southwest of Missoula (fig. 1). Carlton Ridge Research Natural Area lies within the Lolo National Forest, with the Selway-Bitterroot Wilderness and the Bitterroot National Forest marking the southern and eastern boundaries. It typifies the high-elevation subalpine forest habitat types found on north-facing ridges in the Bitterroot Mountains. An old-growth alpine larch (*Larix lyallii*) and whitebark pine (*Pinus albicaulis*) forest stretches across the upper slopes of Carlton Ridge. This research natural area is also unique because it supports alpine and western larch (*Larix occidentalis*) hybrids that result from an unusual species overlap at the middle and lower portions.

Because of its representative and unique qualities, Carlton Ridge is included in the natural area system. Research natural areas are permanently protected for maintaining biological diversity, for conducting nonmanipulative research and data collection, and for fostering education. The Forest Service's national network of research natural areas is designed to set aside unique ecosystems that represent a wide array of ecosystem types (U.S. Department of Agriculture 1992).

Previously, only brief botanical collections of Carlton Ridge have been described by Arno (1968) and Habeck (1987). A more complete inventory was needed to provide baseline information not included in previous documentation.

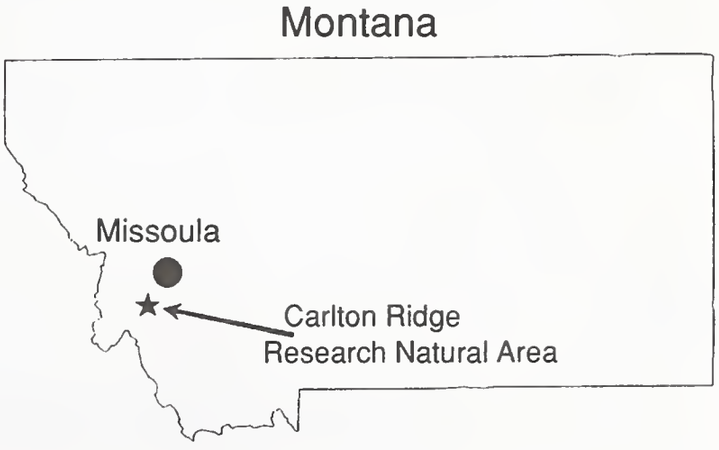

Figure 1—Carlton Ridge Research Natural Area.

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As a research natural area, Carlton Ridge is a useful study site for researchers, naturalists, and the general public. A thorough investigation of the representative plant species interests individuals seeking precise knowledge of the vegetation on Carlton Ridge or general information on middle- to high-elevation subalpine habitats. The objective of this study is to conduct a complete plant inventory of the Carlton Ridge Research Natural Area to provide detailed information on trees, shrubs, graminoids, forbs, and ferns.

Study Area

The Carlton Ridge Research Natural Area encompasses 920 acres (372 ha) of northeast-facing slopes within the Missoula Ranger District of the Lolo National Forest. Elevational range begins at the high point of Carlton Ridge, 8,300 ft (2,500 m), and descends to approximately 5,500 ft (1,636 m). Slope throughout the research area ranges from 35 to 60 percent. Mean annual precipitation ranges from approximately 30 inches (76 cm) at the lowest portions of the research natural area to about 44 inches (113 cm) at the ridge crest (Carlson and others 1990). Average snow depths range from 47 inches (120 cm) at elevations below 6,000 ft (1,800 m) to approximately 118 inches (300 cm) in the upper forests. Temperatures average approximately 50 °F (10 °C) during the summer months and –8 °F (–22 °C) during the winter.

The soils of the Bitterroot range originate from a mile-high granite fault block that forms the Bitterroot Mountain range, part of the Idaho Batholith (Habeck 1987). Throughout the area, the scouring action of alpine glaciation has resulted in upper north slopes characterized by bedrock, boulder fields, and coarse talus. Soils are generally shallow and stony with little soil horizon development (Lackschewitz 1986).

Three forest cover types are represented (Habeck 1987). Carlton Ridge Research Natural Area occupies both high and middle elevations in the subalpine vegetation zones.

1. The whitebark pine SAF forest cover type 208 (Eyre 1980) defines the region above 7,600 ft (2,300 m), dominating between 7,600 ft (2,300 m) and 8,000 ft (2,400 m), whereas alpine larch is dominant at or above 8,000 ft (2,400 m).

2. Engelmann spruce-subalpine fir (*Picea engelmanii–Abies lasiocarpa*) SAF type 206 (Eyre 1980) includes a majority of the research natural area below 7,600 ft (2,300 m).

3. Lodgepole pine (*Pinus contorta*) SAF forest cover type 218 covers the remaining area below 7,600 ft (2,300 m).

Methods

This floristic survey was accomplished using a walk-through method that ensured coverage of the entire research natural area. Plant collections and field observations were made during the 1995 and 1996 growing seasons. Altitude and aspect predispose the area to short spring and summer growing seasons. Snow often covers the ground from October to late June or July at high elevations so that optimum times for plant collection are late June/July to September. Collecting trips in 1995 were conducted in late July through late August. Final collections took place in early July 1996, rather than June, because of an exceptionally long winter and spring.

A field reconnaissance was conducted without transects to ensure that no plant specimens were overlooked. Collection points were chosen by slope, aspect, forest cover type, changing plant associates, changing overstory density and composition, and changing soil moisture. The majority of specimens were identified during the winter of 1995-1996. Specimens collected in July 1996 were identified in July and August of 1996. All specimen identifications were cross-checked with samples on hand in the Intermountain Research Station's MRC Herbarium at the Forestry Sciences Laboratory in Missoula, MT, that is maintained by Peter Stickney, Forest Succession Plant Ecologist. Another list of documented species used for cross-checking was provided by Stephen F. Arno (1968), Research Forester in the Fire Effects Unit, Intermountain Research Station, also in Missoula.

Results and Discussion

Low temperatures, snow, and wind in higher elevations of the whitebark pine forest cover type on Carlton Ridge have molded the landscape. These climatic conditions have a strong influence on the upper slopes of the research natural area, creating "ribbon forest" and "snow glade" patterns that are prominent features of Carlton Ridge. Patterns are established when stands of alpine larch and whitebark pine occur in strips or ribbons, following the direction of the wind. Snow accumulates in large drifts behind the ribbon of trees, which prevents forest growth and creates open areas or "snow glades" (Billings 1969).

Another feature of the high-elevation region is an alpine larch-dominant, parklike forest covering approximately 2 miles (3 km) of the ridge crown and upper slope. At the highest elevations of the research natural area, alpine larch forms pure stands with heights averaging 50 to 60 ft (15 to 18 m), with stature

diminishing to the ridge crest (Habeck 1987). The understory is open and sunlight easily penetrates to the forest floor. Understory vegetation is relatively profuse, and moisture is available throughout most of the short growing season. The whitebark pine/alpine larch forest caps a gentle slope at the upper portion of Carlton Ridge.

The soil composition where the larch park is found, and throughout the upper portion of the stand above 7,600 ft (2,300 m), is well-developed brown Podzolic with volcanic ash as secondary parent material. The deep loamy residual soils are formed by frost churning, a common occurrence on high mountain divides. The ash component in the research natural area and throughout the Bitterroot range originated from Mount Mazama (Crater Lake) in south-central Oregon (Carlson 1995) about 6850 B.P. Drainage is generally subsurface through fractured bedrock and extremely rocky subsoils (Sasich and Lamotte-Hagen 1989). Springs and first-order streams originate at somewhat lower elevations where the slope breaks to a steeper landform. Alpine larch is typically found where the soils are moist, coarse, and acidic; standard habitats are coarse talus slopes and high windswept summits (Arno and Habeck 1972). Although a large alpine larch stand growing on well-developed soils is a rarity, it is a primary ecological feature of the Carlton Ridge Research Natural Area.

Prominent understory species in the upper subalpine region include pink mountain heather (*Phyllodoce empetriformis*), smooth woodrush (*Luzula hitchcockii*), grouse whortleberry (*Vaccinium scoparium*), and western white heather (*Cassiope mertensia*) (appendix). A substantial quantity of snow accumulation remains until mid-summer, which provides ample moisture to the relatively dense vegetation found at this high elevation. Ephemeral streams and moist areas are common throughout the research natural area, rendering microsites for plants adapted to more mesic environments. The upper levels of these moist microsites commonly feature Canby's licorice root (*Ligusticum canbyi*), twisted stalk (*Streptopus amplexifolius*), alpine willow-herb (*Epilobium alpinum*), and heart-leaf twayblade (*Listera cordata*) (appendix).

Further down in elevation, a shift to the Engelmann spruce-subalpine fir forest cover type occurs. Featured within this spruce-fir type is a region characterized by an elongated, north-facing outcrop and talus slope extending from 5,900 ft (1,800 m) to 6,600 ft (1,985 m). The lowest growing alpine larch found in the Bitterroot range dominates this outcrop and talus slope. Western larch grows abundantly within range of alpine larch, and the two species thrive among the rocky, relatively open slopes in varying age classes (Habeck 1987). This unique overlap zone of alpine and western larch opens a window to hybridization between the species. Intensive studies (Carlson and others 1990) have shown that hybrid larch (*Larix lyallii* x *Larix occidentalis*) is propagating within the overlap area.

Multiple conifer species are found along the outcrop and talus slope next to the larch species. This unusual diversity contributes yet another ecological feature to the research natural area. On the outcrop at approximately 6,300 ft (1,900 m), nine different species of conifer are found: hybrid larch, western larch, alpine larch, whitebark pine, Engelmann spruce (*Picea engelmannii*), subalpine fir (*Abies lasiocarpa*), Douglas-fir (*Pseudotsuga menziesii*), lodgepole pine (*Pinus contorta*), and ponderosa pine (*Pinus ponderosa*).

The area surrounding the outcrop and the talus slope is characteristic of the Engelmann spruce-subalpine fir forest cover type in which fir is dominant, except in the more moist pockets where spruce dominates. Vegetation is sparse beneath the dense overstory where little sunlight penetrates to the forest floor. A thick duff layer is overlaid by abundant rotting logs and sporadic vegetation.

Soils throughout the research natural area are formed in volcanic ash influenced loess. Soil composition of the outcrop and talus slope is a Cryochrepts complex, and soil depth varies from shallow to moderately deep. Soils are well drained and moderately coarse to medium textured. Below 7,500 ft (2,250 m), soil composition is Andic Cryochrept, generally well drained and coarse (Sasich and Lamotte-Hagen 1989).

Understory species collected along the outcrop are a mixture of subalpine, mountain, and rock-dwelling plant species: fool's huckleberry (*Menziesia ferruginea*), pinegrass (*Calamagrostis rubescens*), rose angelica (*Angelica roseana*), pink mountain heather, grouse whortleberry, beargrass (*Xerophyllum tenax*), and spotted saxifrage (*Saxifraga bronchialis*) (appendix). Small pockets of Rocky Mountain maple (*Acer glabrum*) also inhabit the area.

The lodgepole pine forest cover type displays a patchy overstory that proportionately controls the amount of sunlight reaching the forest floor. Common overstory tree species include lodgepole pine, Douglas-fir, western larch, and Engelmann spruce with subalpine fir as the indicated climax species in the forest's lower portions (Habeck 1987). Understory density varies with overstory openings; closed patches are typically devoid of vegetation while open patches are populated with a large variety of plant species. The forest floor throughout this region demonstrates a high density of down and rotten woody debris similar to the spruce-pine type.

The understory vegetation collected from spur ridges and draws in areas below 7,021 ft (2,140 m) is primarily composed of subalpine and mountain plant species.

Some common understory plants include kinnikinnick (*Arctostaphylos uva-ursi*), sweetscented bedstraw (*Galium triflorum*), twinflower (*Linnaea borealis*), blue huckleberry (*Vaccinium globulare*), prince's pine (*Chimaphila umbellata*), grouse whortleberry, and beargrass (appendix).

During the study, 77 species of vascular plants were observed, of which 68 were collected. No samples of the larger conifers were collected, but their presence was observed and recorded. Three species of fern, 11 tree species, 19 shrub species, nine graminoid species, and 35 forb species were observed and collected (appendix).

The plant checklist (appendix) documents family, genus, and species—listed in alphabetical order. Nomenclature follows Hitchcock and Cronquist (1973) and Lackschewitz (1991). The vascular flora of Carlton Ridge Research Natural Area consists of 77 species representing 65 genera in 27 families of angiosperms (flowering plants), gymnosperms (conifers), and pteridophytes (ferns and fern allies).

Acknowledgments

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Appendix—Plants Checklist

Scientific name	Common name
Aceraceae	
Acer glabrum Torr. var. *douglasii* (Hook.) Dippel	Rocky Mountain maple
Betulaceae	
Alnus sinuata (Regel) Rydb.	Sitka alder
Campanulaceae	
Campanula parryi Gray var. *idahoensis* McVaugh	Parry bellflower
Caprifoliaceae	
Linnaea borealis L. var. *longiflora* Torr.	Twinflower
Lonicera utahensis Wats.	Utah honeysuckle
Sambucus racemosa L. var. *melanocarpa* (Gray) McMinn	Red elderberry
Celastraceae	
Pachistima myrsinites (Pursh) Raf.	Pachistima
Compositae	
Achillea millefolium L. ssp. *lanulosa* (Nutt.) Piper var. *alpicola* (Rydb.) Garrett	Common yarrow
Antennaria lanata (Hook.) Greene	Woolly pussy-toes
Antennaria mycrophylla Rydb.	Rosy pussy-toes
Antennaria racemosa Hook.	Woods pussy-toes
Arnica latifolia Bong.	Broadleaf arnica
Cirsium scariosum Nutt.	Elk thistle
Erigeron acris L.	Bitter fleabane
Hieracium cynoglossoides Arv.-Touv.	Houndstongue hawkweed
Hieracium scouleri Hook.	Woollyweed
Senecio triangularis Hook. var. *triangularis*	Arrowleaf groundsel
Crassulaceae	
Sedum leibergii Britt.	Leiberg's stonecrop
Cruciferae	
Arabis drummondii Gray	Drummond's rockcress
Cupressaceae	
Juniperus communis L.	Common juniper
Cyperaceae	
Carex rossii Boott	Ross sedge
Ericaeae	
Arctostaphylos uva-ursi (L.) Spreng.	Kinnikinnick
Cassiope mertensia (Bong.) G. Don var. *gracilis* (Piper) Hitchc.	Western white heather
Chimaphila umbellata (L.) Bart. var. *occidentalis* (Rydb.) Blake	Prince's pine
Ledum glandulosum Nutt. var. *glandulosum*	Trapper's tea
Menziesia ferruginea Smith	Fool's huckleberry
Vaccinium globulare Rydb.	Blue huckleberry

(con.)

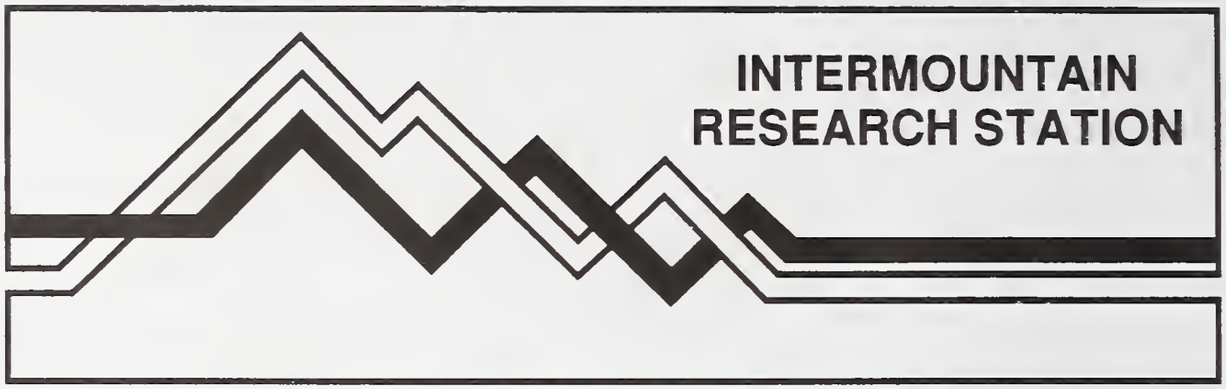
Appendix (Con.)

Scientific name	Common name
Vaccinium scoparium Leib.	Grouse whortleberry
Phyllodoce empetriformis (Sw.) D. Don	Pink mountain-heather
Pterospora andromeda Nutt.	Woodland pinedrops
Pyrola asarifolia Michx. var. *asarifolia*	Pink wintergreen
Pyrola picta Smith	White-vein pyrola
Rhododendron albiflorum Hook.	White rhododendron
Gramineae	
Agrostis idahoensis Nash	Idaho bentgrass
Calamagrostis rubescens Buckl.	Pinegrass
Festuca idahoensis Elmer	Idaho fescue
Poa pratensis L.	Kentucky bluegrass
Trisetum spicatum (L.) Richter	Spike trisetum
Trisetum wolfii Vasey	Wolf's trisetum
Grossulariaceae	
Ribes lacustre (Pers.) Poir.	Swamp current
Juncaceae	
Juncus drummondii E. Meyer var. *drummondii*	Drummond's rush
Luzula hitchcockii Hamet-Ahti	Smooth woodrush
Liliaceae	
Allium cernuum Roth	Nodding onion
Stenanthium occidentale Gray	Western stenanthium
Streptopus amplexifolius (L.) D. C. var. *chalazatus* Fassett	Clasping-leaved twisted-stalk
Trillium ovatum Pursh	White wake-robin
Veratrum viride Ait.	Green false hellebore
Xerophyllum tenax (Pursh) Nutt.	Beargrass
Onagraceae	
Epilobium alpinum L. var. *clavatum* (Trel.) Hitchc.	Alpine willow-herb
Epilobium angustifolium L.	Fireweed
Orchidaceae	
Goodyera oblongifolia Raf.	Western rattlesnake-plantain
Listera cordata (L.) R. Br.	Heart-leaf twayblade
Pinaceae	
Abies lasiocarpa (Hook.) Nutt.	Subalpine fir
Larix lyallii Parl.	Alpine larch
Larix lyallii x *occidentalis*	Hybrid larch
Larix occidentalis Nutt.	Western larch
Picea engelmannii Parry	Engelmann spruce
Pinus albicaulis Engel.	Whitebark pine
Pinus contorta Dougl.	Lodgepole pine
Pinus ponderosa Dougl.	Ponderosa pine
Pseudotsuga menziesii (Mirbel) Franco	Douglas-fir

(con.)

Appendix (Con.)

Scientific name	Common name
Polemoniaceae	
Polemonium pulcherrimum Hook. var. *pulcherrimum*	Skunk-leaved polemonium
Polypodiaceae	
Cryptogramma crispa (L.) R. Br. var. *acrostichoides* (R. Br.) Clarke	Rockbrake
Polystichum lonchitis L. Roth	Mountain hollyfern
Woodsia oregana D. C. Eat.	Oregon woodsia
Primulaceae	
Dodecatheon jeffreyi van Houtte	Tall mountain shooting star
Ranunculaceae	
Thalictrum occidentale Gray	Western meadowrue
Rosaceae	
Rubus idaeus L. var. *gracilipes* Jones	Red raspberry
Rubus parviflorus Nutt.	Thimbleberry
Sorbus scopulina Greene var. *scopulina*	Cascade mountain-ash
Spirea densiflora Nutt.	Subalpine spirea
Rubiaceae	
Galium triflorum Michx.	Sweetscented bedstraw
Saxifragaceae	
Saxifraga bronchialis L. var. *austromontana* (Wieg.) Jones	Spotted saxifrage
Heuchera parvifolia Nutt. var. *dissecta* Jones	Little-leaf alumroot
Umbelliferae	
Angelica roseana Hend.	Rose angelica
Ligusticum canbyi Coult. & Rose	Canby's licorice-root



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