

# **Bedrock Meadows in Southern Valhalla Provincial Park and Adjoining Areas: a Preliminary Report**

Report to Valhalla Wilderness Society, 6 Oct 2004

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**Abstract:** *Surveys were carried out in two bedrock meadow habitats in southern Valhalla Provincial Park (West Kootenays, British Columbia) and an adjacent area known as Perry Ridge in spring 2004. Bedrock meadows are species-rich open meadows on shallow soils over bedrock, with a preponderance of herbs and a low dominance of grasses. They are home to some of the highest concentrations of vascular plant diversity in interior British Columbia. The survey confirmed the presence of some of the northernmost bedrock meadows known along the southern fringe of Valhalla Provincial Park, with over 80 species of vascular plants found in a single meadow. One red-listed species and four blue-listed species were found in the Valhalla Park meadow, and one blue-listed species was found in the bedrock meadow on Perry Ridge outside of the park. The significance of bedrock meadows for the conservation of biological diversity in southeastern British Columbia is discussed.*

## **Background: what are bedrock meadows**

In mountain ranges across a large area of southern British Columbia and the adjacent United States, meadows on bedrock slopes surrounded by middle elevation forests or shrublands provide habitat for a remarkably diverse, though little-studied flora. Many of these meadows resulted from glacier-scouring during the last glacial maximum and have in the last ten thousand years failed to accumulate the deep soils that would most likely encourage the growth of forest or shrubland cover. As forests gradually conquered the open post-glacial landscapes, the populations of many species became fragmented and frequently were restricted to open, rocky balds. South of the area of continental glaciation (about 47°N), similar meadows are today surrounded by forest or shrubland in areas where erosion by water seepage prevents the accumulation of deep soils, thereby preventing loss of meadow habitats to forest encroachment. Water seepage is a critical aspect of microsite diversity, with all of the richest meadows supporting complex mosaics of different seasonal seepage regimes. The bedrock types on which these meadows occur are sedimentary, basaltic or metamorphic rock types that are slow to erode, providing further long-term stability to these habitats. The resulting meadows today represent among the most species-rich and yet most poorly-known habitat types in the upper Columbia River region. Because of their meadow character and their propensity to occur on very shallow soils, they have come to be known as “bedrock

meadows”.

Bedrock meadows are surprisingly poorly documented in the scientific literature. The forest/tree-based emphasis of vegetation classification and mapping by the B.C. Ministry of Forests and U.S. Forest Service has seen these sites classified variably as “non-forest”, “non-timber-producing lands” or “open parks”. They were furthermore completely omitted from a recent continent-wide overview of bedrock ecosystems (Anderson et al., 1999). One of the first to recognize them as a distinct ecosystem was Layser (1980) who described them as glacier-scoured rockland and pointed out the rich diversity and high number of species regionally limited to these meadows. They are not a recognized mapping unit in any current ecosystem mapping efforts in British Columbia or in the Upper Columbia River Basin Project (UCRB) in the USA. Because of their poorly known status, efforts have been made in the last two years by the author and other researchers to initiate research on their role as “biodiversity hotspots” in the greater Columbia/Kootenay River region.

## **Materials and methods**

A preliminary independent study was launched in spring 2004 by the author to assess the diversity, structural composition and distribution of bedrock meadows in northwestern Montana and southeastern British Columbia. As a part of this study, one site in southern Valhalla Provincial Park in the Little Slokan River drainage – the northernmost included in the broader study (49°43.319’N 117°33.615’W, 3300 ft/1000 m) – was visited and inventoried. This was a relatively large meadow, >10 hectares, on a south- to southeast-facing slope. A further survey was carried out on Perry Ridge, a long, north-south-trending ridge of the Valhallas outside of the Provincial Park boundary, and a bedrock meadow here was also inventoried (49°40.254’N 117°33.315’W, 4400 ft/1340 m). This was a small site <1 ha on an east-facing slope. The survey of the latter site concentrated on areas within or close to areas of planned timber management.

At each bedrock meadow visited, a full list was made of every vascular plant species found. The list was intended only for assessment of presence/absence data, so no cover estimates were made. In surveying areas in and around the bedrock meadows, special emphasis was given to rare species listed by the British Columbia Conservation Data Centre (CDC). It must be stressed that the survey did not aim to provide a replicable experimental scientific study framework but rather consisted of basic descriptive inventory. Specimens of interesting or critical taxa were collected and will be deposited at the University of British Columbia herbarium (UBC).

## **Survey results**

A list of the species found at the two sites is provided in Table 1. Exactly 100 vascular plant species were documented in both meadows. Eighty-two species were found in the single meadow surveyed at the Little Slokan River site and 42 species at the Perry Ridge bedrock

meadow; 24 species were common to both meadows. One red-listed and four blue-listed species were found at the Little Slocan River bedrock meadow site and one blue-listed species was found at the Perry Ridge bedrock meadow site. No other red- or blue-listed species were found in the forested surroundings or wetlands of the Perry Ridge site.

**Table 1:** Vascular plant species found in two bedrock meadows in Little Slokan Valley and on Perry Ridge, respectively. BC CDC designations as red-listed or blue-listed are marked with highlighting. + indicates species present.

| Site name                      | Perry Ridge | Little Slokan River |
|--------------------------------|-------------|---------------------|
| Elevation                      | 1340 m      | 1000 m              |
| Aspect                         | c. 90°      | c. 180°             |
| Species                        |             |                     |
| • <i>Shrub layer</i>           |             |                     |
| <i>Acer glabrum</i>            |             | +                   |
| <i>Amelanchier alnifolia</i>   | +           | +                   |
| <i>Arctostaphylos uva-ursi</i> | +           |                     |
| <i>Ceanothus velutinus</i>     |             | +                   |
| <i>Holodiscus discolor</i>     |             | +                   |
| <i>Juniperus communis</i>      |             | +                   |
| <i>Mahonia aquifolium</i>      | +           | +                   |
| <i>Mahonia repens</i>          | +           |                     |
| <i>Paxistima myrsinites</i>    | +           | +                   |
| <i>Philadelphus lewisii</i>    |             | +                   |
| <i>Pinus contorta</i>          | +           | +                   |
| <i>Prunus emarginata</i>       |             | +                   |
| <i>Prunus virginiana</i>       |             | +                   |
| <i>Pseudotsuga menziesii</i>   | +           | +                   |
| <i>Rosa gymnocarpa</i>         | +           | +                   |
| <i>Rosa sp.</i>                |             | +                   |
| <i>Rubus idaeus</i>            |             | +                   |
| <i>Rubus parviflorus</i>       |             | +                   |
| <i>Salix scouleriana</i>       |             | +                   |
| <i>Spiraea betulifolia</i>     | +           |                     |
| <i>Symphoricarpos albus</i>    |             | +                   |
| • <i>Herb layer</i>            |             |                     |
| *Grasses/Sedges                |             |                     |
| <i>Bromus tectorum</i>         |             | +                   |

|                                      |   |   |
|--------------------------------------|---|---|
| <i>Calamagrostis purpurascens</i>    |   | + |
| <i>Calamagrostis rubescens</i>       | + | + |
| <i>Carex rossii</i>                  | + | + |
| <i>Danthonia sp. (veg)</i>           |   | + |
| <i>Elymus spicatus</i>               |   | + |
| <i>Koeleria macrantha s.lat.</i>     |   | + |
| <i>Panicum capillare</i>             |   | + |
| <i>Phleum pratense</i>               |   | + |
| <i>Poa gracillima</i>                |   | + |
| <i>Poa sp.</i>                       | + | + |
| <i>Stipa occidentalis var. minor</i> | + |   |
| *Herbs                               |   |   |
| <i>Achillea lanulosa</i>             | + | + |
| <i>Agoseris heterophylla</i>         |   | + |
| <i>Agrostis sp.</i>                  | + |   |
| <i>Antennaria luzuloides</i>         |   | + |
| <i>Antennaria rosea</i>              | + |   |
| <i>Apocynum androsaemifolium</i>     |   | + |
| <i>Arabis holboellii</i>             | + |   |
| <i>Arenaria capillaris</i>           | + |   |
| <i>Aspidotis densa</i>               |   | + |
| <i>Asplenium trichomanes</i>         |   | + |
| <i>Castilleja hispida</i>            |   | + |
| <i>Clarkia sp. (veg)</i>             |   | + |
| <i>Claytonia parvifolia</i>          | + | + |
| <i>Collinsia parviflora</i>          | + | + |
| <i>Collomia linearis</i>             | + | + |
| <i>Cryptantha sp.</i>                |   | + |
| <i>Cryptogramma acrostichoides</i>   | + | + |
| <i>Cystopteris fragilis</i>          |   | + |

|   |   |   |
|---|---|---|
| <i>Delphinium sutherlandii</i>          | + | + |
| <i>Dodecatheon cusickii</i>             |   | + |
| <i>Epilobium angustifolium</i>          |   | + |
| <i>Epilobium brachycarpum</i>           | + | + |
| <i>Epilobium minutum/foliosum group</i> |   | + |
| <i>Epilobium sp.</i>                    | + |   |
| <i>Erythronium grandiflorum</i>         | + |   |
| <i>Fragaria vesca</i>                   | + |   |
| <i>Fragaria virginiana</i>              | + | + |
| <i>Galium bifolium</i>                  |   | + |
| <i>Gayophytum sp.</i>                   |   | + |
| <i>Heterocodon rariflorum</i>           |   | + |
| <i>Heuchera cylindrica</i>              |   | + |
| <i>Hieracium albertinum</i>             | + |   |
| <i>Lithophragma cf parviflora</i>       |   | + |
| <i>Lomatium ambiguum</i>                | + |   |
| <i>Lomatium dissectum</i>               |   | + |
| <i>Lupinus argenteus</i>                | + |   |
| <i>Madia exigua</i>                     |   | + |
| <i>Madia glomerata</i>                  |   | + |
| <i>Madia minima</i>                     |   | + |
| <i>Melilotus sp. (veg)</i>              |   | + |
| <i>Microseris nutans</i>                | + | + |
| <i>Microsteris gracilis</i>             | + | + |
| <i>Mimulus breweri</i>                  | + | + |
| <i>Mimulus guttatus</i>                 |   | + |
| <i>Myosotis scorpioides</i>             |   | + |
| <i>Orobanche nuda</i>                   |   | + |
| <i>Polygonum douglasii</i>              | + | + |
| <i>Polygonum minimum</i>                | + | + |

|  |    |    |
|--|----|----|
| <i>Potentilla glandulosa</i>               |    | +  |
| <i>Prunella vulgaris</i>                   |    | +  |
| <i>Rumex acetosella</i>                    |    | +  |
| <i>Sanicula graveolens</i>                 | +  |    |
| <i>Saxifraga integrifolia aff.</i>         |    | +  |
| <i>Sedum stenopetalum</i>                  | +  | +  |
| <i>Selaginella scopulorum</i>              | +  |    |
| <i>Selaginella wallacei</i>                |    | +  |
| <i>Senecio integerrimus var. exaltatus</i> | +  |    |
| <i>Solidago canadensis</i>                 |    | +  |
| <i>Spiranthes romanzoffiana</i>            | +  | +  |
| <i>Stellaria nitens</i>                    |    | +  |
| <i>Suksdorfia ranunculifolia</i>           |    | +  |
| <i>Taraxacum sect. Erythrosperma</i>       | +  |    |
| <i>Trifolium cf cyathiferum</i>            |    | +  |
| <i>Veronica arvensis</i>                   |    | +  |
| <i>Veronica peregrina var. xalepensis</i>  |    | +  |
| <i>Woodsia scopulina</i>                   |    | +  |
| <i>Zygadenus venenosus</i>                 |    | +  |
| Number of red-listed species               | 0  | 1  |
| Number of blue-listed species              | 1  | 4  |
| Total number of all species                | 42 | 82 |

The survey of the Little Slovan River site took place before the main flowering period

for numerous species; therefore, identification beyond the level of genus is not possible in

several cases. In addition, the identification of two of the blue-listed species (*Clarkia* sp. and *Trifolium cyathiferum*) from the Little Slokan River site is tentative. Both species were found only in the vegetative state and identified based on vegetative characteristics. A return survey later in the year would be required to confirm their identity beyond doubt. The *Taraxacum* sect. *Erythrosperma* from Perry Ridge cannot be readily placed to species; it would key to the exotic *T. laevigatum* but does not resemble this species, but nonetheless bears the reddish fruits characteristic of the section *Erythrosperma*.

The total species number would furthermore be likely to increase by 10-15 with a mid- to late summer survey of both bedrock meadows, especially the one at Little Slokan, as bedrock meadows typically support a second wave of late summer annuals that are not detected in spring surveys.

## Discussion

The presence of numerous bedrock meadow species over 200 km north of the southernmost limit of Pleistocene glaciation is perhaps the most interesting result of the Valhalla/Perry Ridge surveys. While many of the taxa found in the surveys are widespread local plant species, some can be considered to be found primarily or almost exclusively in bedrock meadows. These include *Agoseris heterophylla*, *Calamagrostis purpurascens*, *Clarkia* sp., *Delphinium sutherlandii*, *Dodecatheon cusickii*, *Heterocodon rariflorum*, *Lomatium ambiguum*, *Madia minima*, *Mimulus breweri*, *Orobanche nuda*, *Sanicula graveolens* and *Suksdorfia ranunculifolia*. These species are almost without exception southern species of the Columbia Basin or broader northern Californian geographic element that reach their northernmost limits in southern British Columbia. Their collective presence in such numbers allows the conclusion that the Valhalla bedrock meadows are one of the northernmost outposts of the more southerly distributed bedrock meadow ecosystem.

The discovery of the maidenhair spleenwort (*Asplenium trichomanes*) in the Little Slokan bedrock meadow represents one of only a few reports of the species in interior British Columbia. Aside from a site mapped for the species in the recent Flora of North America project (1993) and discoveries in the Incomappleux River (Spribille, unpubl. 2002), this rare fern is known in British Columbia otherwise only from coastal areas. However, because it is locally frequent in coastal sites it is not listed on the BC red and blue lists (BC Species and Ecosystems Explorer 2003).

The presence of needle-and-thread grass (*Stipa occidentalis* var. *minor*) in the Perry Ridge bedrock meadow was also unexpected. This species is typically found in drier ecosystems such as ponderosa pine steppe and open dry Douglas-fir woodlands. In southern British Columbia, it would be more likely to be found in the dry East Kootenays or Okanagan-

Similkameen regions. It is possible that its occurrence at Perry Ridge is relictual from early time of drier climate.

The species numbers found at the two sites were in keeping with patterns from bedrock meadows in northwestern Montana and northern Idaho. Large bedrock meadows or those found in complexes with other bedrock meadows that result in large surface areas, typically support greater diversity than do small, isolated bedrock meadows such as that on Perry Ridge.

### **Conservation significance and threats**

**Poorly known:** Only a small fraction of the bedrock meadow habitat of the Valhalla Range has been surveyed, and only a single visit has been made to each of the two sites reported on here. Even so, relatively high species numbers have been found: 42 species in one meadow, 82 species in another. By comparison, an ordinary conifer forest in the same area would typically support less than 30 vascular plant species. Further surveys of bedrock meadows are likely to increase the number of species significantly, both in total (all meadows taken together) and in the individual meadows. Survey of the flora late in the season will almost certainly confirm the presence of Harkness' linanthus (*Linanthus harknessii*), a late-flowering annual member of the phlox family that is red-listed in BC and known in the province otherwise only from Idaho Peak/Slocan Valley, and the blue-listed, late-flowering northern linanthus (*L. septentrionalis*) which it resembles. More work is needed to assess the full depth of plant diversity of the Valhalla bedrock meadows.

**Large patches:** The Valhalla bedrock meadows appear to form one of the largest "habitat complexes" – adjacent patches of bedrock meadows over a large area, such as several mountainsides – in the West Kootenays, outside of complexes at lower elevations in the Salmo and Castlegar areas. Large habitat patches and complexes are extremely valuable for conservation because they provide many niches and alternative secondary habitats in the case of localized diebacks, such as in drought years.

**High invertebrate diversity likely:** Bedrock meadows likely support some of the highest concentrations of plant diversity anywhere in the Valhalla/Slocan region. Given the complex pollinator relationships that many bedrock meadow species have, it is likely that there are also rich invertebrate assemblages. Such plant-animal assemblages are very specialized, and due to their isolated, island-like nature, very sensitive, especially to introduction of non-native plants and animals.

**Noxious weeds:** One of the most worrying trends is the spread of non-native cheatgrass (*Bromus tectorum*), yellow hawkweed (*Hieracium caespitosum* aff.) and spotted knapweed (*Centaurea stoebe*). Already, cheatgrass has colonized the lower end of the large bedrock meadow in the Little Slocan and is likely to continue spreading throughout the meadow in future. Cheatgrass is an aggressive Eurasian annual grass whose spread has

devastated biological diversity in large areas of the American Pacific Northwest and southern interior British Columbia. Measures should be taken to ensure these species do not reach or certainly are not carelessly introduced to or spread through the bedrock meadow complex.

### **Acknowledgments**

This survey was funded in part by the Valhalla Wilderness Society. Special thanks to Craig Pettitt and Frank Nixon for guiding me into the Perry Ridge site.

### **References**

- Anderson, R.C., J.S. Fralish & J.M. Baskin (eds.) 1999. *Savannas, barrens and rock outcrop communities of North America*, Cambridge University Press
- BC Species and Ecosystems Explorer (2003) Victoria, British Columbia, Canada. Available at: <http://srmapps.gov.bc.ca/apps/eswp/> (accessed September 2004).
- Layser, E. (1980). *Flora of Pend Oreille County, Washington*. Washington State University Cooperative Extension, Pullman, WA. 180 pp.

Report submitted to VWS by Toby Spribille, 6 Oct 2004