

**CHROME-IRON MOUNTAIN  
BOTANICAL REPORT.  
BIG TIMBER RANGER DISTRICT,  
GALLATIN NATIONAL FOREST.**



***Botrychium paradoxum* (paradox moonwort) from the  
Chrome/Iron Mountain project site.**

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## Introduction

This report documents the findings of botanical collections performed at the Chrome–Iron Mountain. Three species of moonworts (*Botrychium*) were found within the collection site, and two species were found on Contact Mountain immediately north of the Chrome–Iron Mountain site. *Botrychium* species found within the site include:

- *Botrychium paradoxum*. Region 1 Sensitive species, ranked G2S2.
- *Botrychium hesperium* var. *hesperium*. Region 1 Sensitive species, ranked G3G4 S2.
- *Botrychium lanceolatum* var. *lanceolatum*. Not ranked in Montana.

Species found at Contact Mountain include:

- *Botrychium ascendens*. Region 1 Sensitive species, ranked G2G3 S1S2
- *Botrychium hesperium* var. *hesperium*. Region 1 Sensitive species, ranked G3G4 S2.

Moonworts are often found in populations composed of several species called a genus community (Anderson 2003). Since moonworts are difficult to locate and identify, and because they may fail to produce above-ground structures each year (Anderson 2003), the presence of other moonwort species at the site, including Region 1 sensitive species, cannot be ruled out. Additional unsurveyed moonwort habitat is located within the Chrome–Iron Mountain site, and undiscovered populations of the moonwort species listed above are likely located within the project boundary.

## Collection Methods

Collections of plant material were made throughout the area during the summer field seasons, with a goal of providing relatively even coverage of the entire area. All species were collected at a given site; care was taken to obtain specimens with flowers and fruit. Relevant ecological and locational data was recorded. Plants were placed in plastic bags and put in a cooler with ice to prevent wilting. Plants were pressed in newspaper the following day and placed on a plant dryer for 24–48 hours. Once dry, the specimens were bundled for transportation to the RM where they are stored until being processed. Processing involves identification, labeling, mounting, and entry of data into the plant database.

Due to the interest expressed by the U.S. Forest Service in this project area, the collection intensity was increased. This area was the most intensively collected site within the approximately 4,800 square mile Master's project area. Four site visits were made at various times during the blooming season (see Table 1) by different botanists. A total of 663 collections were made at the site. Due to the size of the full Master's area project (approximately 4,800 square miles), the Chrome–Iron Mountain site did not receive a complete survey, and unsurveyed habitat remains. In particular, due to the rigorous and time-consuming survey/collection protocols for moonworts additional populations of moonworts could likely be located within the Chrome–Iron Mountain project area.

**Table 1: Summary of field work performed at Chrome–Iron Mountain site.**

Collector(s)	Date	Number of Collections
B.E. Nelson	31 July, 2007	66
B.E. Nelson	1 August, 2007	148
Emily Elliott	27, 28, 29 July, 2008	300
Emily and Brian Elliott	20 August, 2008	149

## Site Description

During the summers of 2007–2008 four site visits were made at the Chrome–Iron Mountain site. Sites were selected to maximize the number of species collected. This was accomplished by collecting in each habitat type noted in the area, and by collecting at different times of year during the blooming season to capture both early and late blooming species.

Raw field notes indicate that the following habitat types were found within the project area:

- Krumholz forest of whitebark pine and spruce.
- Drier meadow above the springs.
- Wet meadow and among spring channels.
- Road.
- Dry, open lodgepole pine forest.
- Stony bottom of shallow dry pond.
- Rocky river bank and bars.
- Old spoil piles.
- Mixed conifer forest.
- Small meadow in mixed conifer forest.
- Moist to wet meadows and slopes.
- Drier slopes.
- Stony limestone saddle with scattered whitebark pine and spruce.
- Sloping limestone pavement.
- Steep slopes below limestone cliffs.
- Stony limestone saddle with scattered whitebark pine and spruce.
- Dry meadow dominated by introduced grasses.
- Forb dominated meadow surrounded by *Pseudotsuga menziesii* and *Pinus contorta*.
- Stream bank and saturated area around pond.
- Meadow dominated by forbs, located on steep slope at base of a dolomite cliff.
- Moist drainage.
- Mixed conifer forest dominated by *Pinus contorta* and *Picea* with scattered openings.
- Saturated soil.
- Mixed conifer forest dominated by *Pinus contorta* and *Picea* with scattered openings.
- Talus slopes and scattered alpine tundra near tree line.
- Small moist meadows within the mixed conifer forest.
- Moist, sub-alpine meadow.

- Dry sagebrush meadow with scattered clumps of *Pseudotsuga menziesii* and *Pinus flexilis*, area disturbed by heavy recreation and cattle use.
- Rock outcrop and stabilized talus slopes.
- Moist to wet meadow with abundant white *Platanthera*.
- Dry alpine tundra and talus slopes.
- Open scabby area in saddle with red soil.
- Rocky slope.
- Wet hummocks dominated by *Carex* spp.

**Map 1: The Chrome–Iron Mountain project area.**

MAP REMOVED FOR WEB VERSION

## Results

Six hundred and sixty-three collections were made within the project area. Identification of these collections is ongoing. Moonwort collections were sent to Dr. Don Farrar, noted North American moonwort specialist. Based on identifications performed at the University of Wyoming and verified by Dr. Farrar, the following moonwort species are known from the project area:

**Table 2: *Botrychium* Collections made by Emily Elliott.**

Date	Collection Number	Species	Status*	Site
28 July, 2008	6645	<i>B. hesperium</i> var. <i>hesperium</i>	S	LOCALITY REMOVED FOR WEB VERSION
28 July, 2008	6646a	<i>B. hesperium</i> var. <i>hesperium</i>	S	
28 July, 2008	6646b	<i>B. ascendens</i>	S	
20 August, 2008	7636	<i>B. paradoxum</i>	S	
20 August, 2008	7637	<i>B. hesperium</i> var. <i>hesperium</i>	S	
20 August, 2008	7638	<i>B. lanceolatum</i> var. <i>lanceolatum</i>	none	

\*S = Region 1 sensitive species. Species status from Montana Natural Heritage Program website and U.S. Forest Service 2004.

### ***Botrychium paradoxum* - paradox moonwort**

Paradox moonwort is a perennial herb in the adder's-tongue fern family (Ophioglossaceae). It is an inhabitant of mesic to wet subalpine meadows. It ranges from southwestern Canada to Montana, Idaho, and Utah. Populations are small and widely scattered. Paradox moonwort is ranked G2, and S1 in Idaho and Utah. Montana ranks the species S2. This rank indicates that the species is considered imperiled to vulnerable globally and in Montana, and is critically imperiled in Idaho and Utah. This plant is small, easily over-looked, and may not produce above-ground structures every year. Threats to the species include road maintenance and construction, mining, mine reclamation activities, trampling by hikers or ATVs, over-collection, and alteration of soil and hydrological regimes (Beatty, Jennings, and Rawlinson 2003).

*Botrychium paradoxum* is one of a few species of moonworts that produces two sporophores rather than a sporophore and a tropophore. While several species of moonworts will occasionally be found with an anomalous individual possessing two sporophores, *B. paradoxum* apparently never produces a tropophore. Plants discovered within the Chrome–Iron Mountain project area were sent to Dr. Don Farrar and their identity was confirmed by electrophoresis, negating the possibility that these few individuals were anomalous individuals of another species.

The Montana Natural Heritage Program (Montana Natural Heritage Program 2009a) currently shows 26 occurrences of *B. paradoxum* in the state. This collection (Emily Elliott 7636) represents a Sweet Grass County record and is the southernmost site in the state. It is disjunct from the nearest site in Jefferson County by approximately 125 miles.

Approximately eight *B. paradoxum* individuals were located. Plants were collected by cutting at ground level. Moonworts bear a small bulb-like structure underground that possesses the

next year's structures. Cutting the plant at ground level does not impact these structures and a new set of sporophores will emerge the following year.

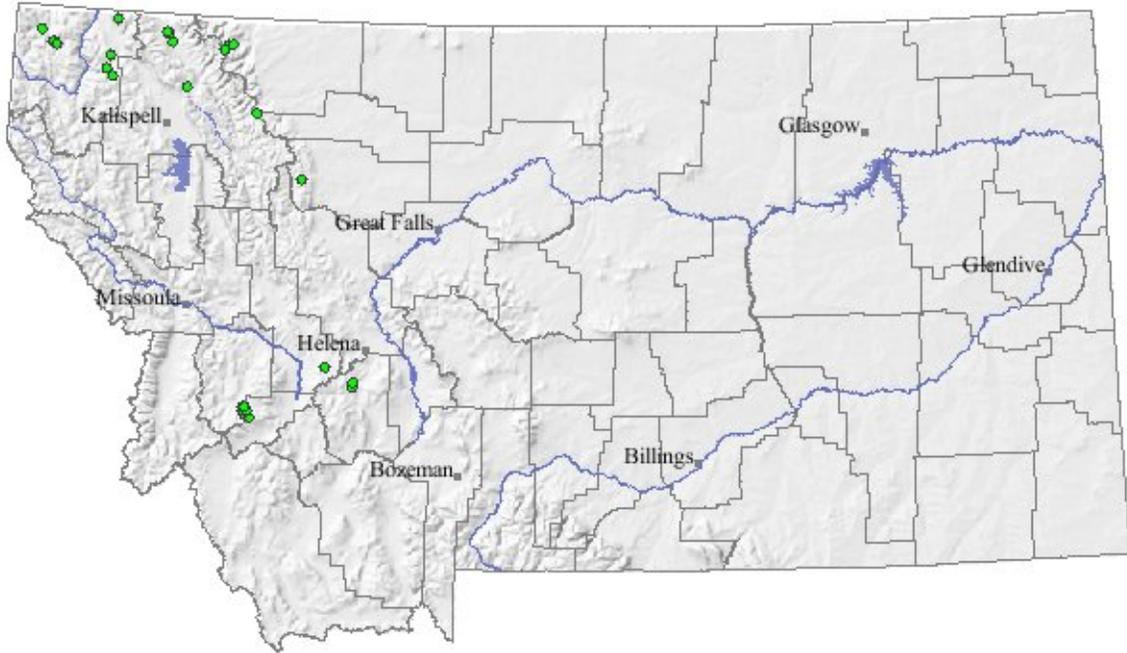
**Photo 1: *Botrychium paradoxum*.** The two sporophores are clearly evident.



**Photo 2: *Botrychium paradoxum* habitat.**



**Map 2: Distribution of *Botrychium paradoxum* in Montana.**



Map from Montana Natural Heritage Program (2009a).

**Map 3: Location of *Botrychium paradoxum* within the Chrome-Iron Mountain site.**

MAP REMOVED FOR WEB VERSION  
BOPA = *Botrychium paradoxum*

**MTNHP Form 1 *Botrychium paradoxum*.**

**Plant Observation/Species of Concern Survey Form**

Montana Natural Heritage Program

2008 Revision

P.O. Box 201800, 1515 E. Sixth Avenue, Helena, MT 59620-1800

At a minimum complete Scientific Name, Date, Observer, Observation Data and provide specific location data; preferably GPS coordinates and/or the observed area drawn on a photocopy of a topographic map or equivalent. Please provide as much detail as possible for the remaining fields. For additional information or questions: Visit [mtnhp.org](http://mtnhp.org) or contact the MTNHP Botanist: 406-444-2817

**Scientific Name:** *Botrychium paradoxum*

**Survey Date:** 20 August, 2008

**Observer(s):** Emily and Brian Elliott

**Site Name/SO Number:** Chrome-Iron Mountain

**Observation Data:** Approximately eight *B. paradoxum* individuals were located; all had sporophores and were located in a genus community with at least two other *Botrychium* species.

**Habitat Data:** This site was located on a stable, vegetated talus slope. The community was dominated by *Carex* spp. and *Salix* sp. (probably *S. petrophila*) with associated forbs.

**Survey Comments:** Threats to the species include mining, road maintenance and construction, trampling by hikers, over-collection, and alteration of soil and hydrological regimes. Weeds were not located at this site but, with the road so close the chance of introducing them is high. This location was intensively collected. However, since the project was intended to produce vouchers, plants without flower or fruit were neither collected nor identified.

**Voucher Specimens:** Emily Elliott 7636, Rocky Mountain Herbarium.

**ID Verified by:** Dr. Don Farrar and their identity was confirmed by electrophoresis.

**Photo Available:** See Photo 1: *Botrychium paradoxum*, Photo 2: *Botrychium paradoxum* habitat.

**Comments:** There is a good chance that there are other sites and taxa of *Botrychium* in this area.

**Associated Species and Exotic Species:** Associated species were *Vaccinium coccinea*, *Salix petrophila*, *Solidago* sp. *Saxifraga caespitosa*, *Penstemon* sp., *Hieracium* sp., *Antennaria* sp., *Frasera* sp. and a gray lichen.

**Dominant Species:** A) *Salix petrophila*

**Exotic Species:** none found

LOCALITY DATA REMOVED FOR WEB VERSION

## ***Botrychium ascendens* - trianglelobe moonwort**

Trianglelobe moonwort is a perennial herb in the adder's-tongue fern family (Ophioglossaceae). Circumscription of *Botrychium* habitat is difficult, as many of the species are considered habitat generalists and habitat types vary considerably between known sites. In many cases, however, moonworts (including *B. ascendens*) are found in open sites with little competition. Frequently these sites are associated with old disturbance (20–50 year-old events) such as roadsides, trails, earthen dams, ski runs, and mines. *Botrychium ascendens* is widespread geographically and is known from, Yukon Territory, British Columbia, Alberta, Saskatchewan, Ontario, Oregon, Washington, Idaho, California, Nevada, Montana, and Wyoming (NatureServe 2008). However, sites are widely scattered and often contain few individuals. Thus, the species is globally ranked G2G3, indicating that it is between imperiled and vulnerable. The Montana Natural Heritage Program (2009b) ranks the species S1S2, indicating that it is critically imperiled to imperiled in the state.

In the photograph below spore cases can be seen on the tropophore. All species of *Botrychium* may occasionally produce spore cases on the tropophore with the most extreme case is seen in *Botrychium paradoxum*, in which the entire tropophore is replaced by a sporophore. *Botrychium ascendens* forms spore cases on the tropophore more often than other *Botrychium* species. However, this character is not diagnostic since *Botrychium ascendens* may also be found without spore cases on the tropophore.

The Montana Natural Heritage Program (Montana Natural Heritage Program 2009b) currently shows 19 occurrences of *B. ascendens* in the state. However, all known sites are from the northwestern portion of the state. This collection (Emily Elliott 6646b) represents a Sweet Grass county record and is the southernmost site in the state. It is disjunct from the nearest site in Flathead County by approximately 220 miles.

Approximately four *B. ascendens* individuals were located. Plants were collected by cutting at ground level. Moonworts bear a small bulb-like structure underground that possesses the next year's structures. Cutting the plant at ground level does not impact these structures and a new sporophore and tropophore will emerge the following year.

**Photo 3: *Botrychium ascendens*.**

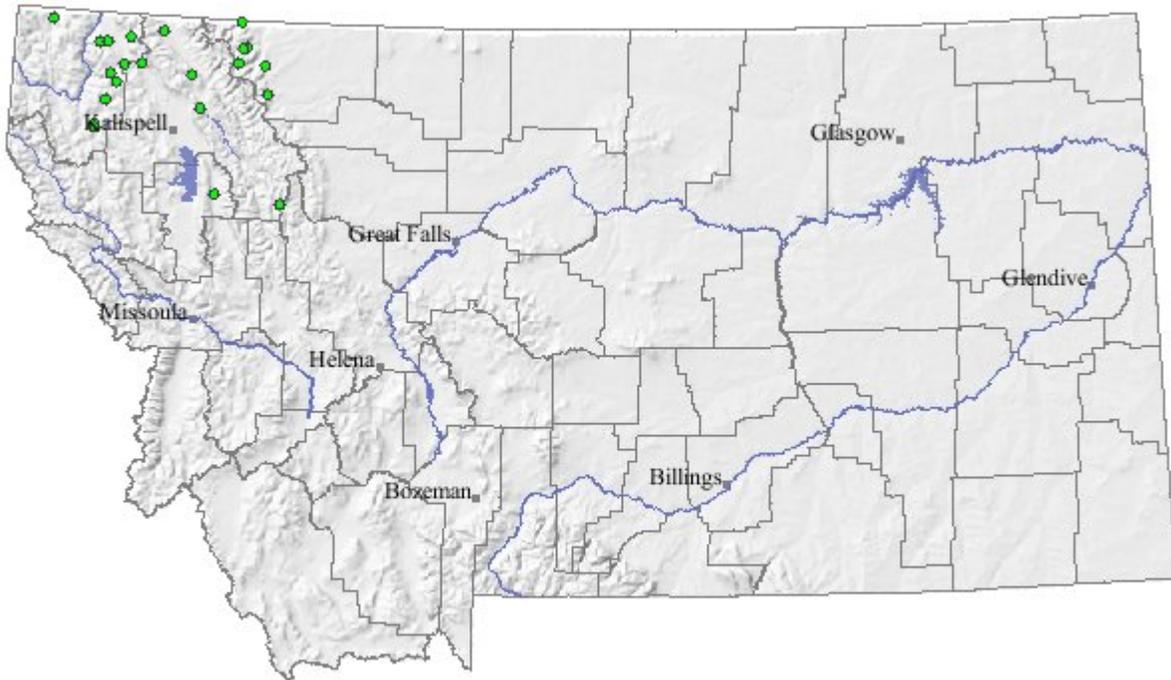
Note the presence of spore cases on the tropophore. Although this specimen superficially resembles *Botrychium paradoxum*, the tissue of the tropophore is evident.



**Photo 4: *Botrychium ascendens* habitat.**



**Map 4: Distribution of *Botrychium ascendens* in Montana.**



Map from Montana Natural Heritage Program (2009b).

**Map 5: Location of *Botrychium ascendens*.**

MAP REMOVED FOR WEB VERSION  
BOAS = *Botrychium ascendens*

## MTNHP Form 2 *Botrychium ascendens*.

### Plant Observation/Species of Concern Survey Form

Montana Natural Heritage Program

2008 Revision

P.O. Box 201800, 1515 E. Sixth Avenue, Helena, MT 59620-1800

At a minimum complete Scientific Name, Date, Observer, Observation Data and provide specific location data; preferably GPS coordinates and/or the observed area drawn on a photocopy of a topographic map or equivalent. Please provide as much detail as possible for the remaining fields. For additional information or questions: Visit [mtnhp.org](http://mtnhp.org) or contact the MTNHP Botanist: 406-444-2817

**Scientific Name:** *Botrychium ascendens*

**Survey Date:** 28 July, 2008

**Observer(s):** Emily Elliott

**Site Name/SO Number:** Chrome-Iron Mountain

**Observation Data:** Approximately four *B. ascendens* individuals were located; all had sporophores and were located in a genus community with one other *Botrychium* species.

**Habitat Data:** This site was located on stable, vegetated talus near tree line. The community was dominated by graminoides and forbs.

**Survey Comments:** Threats to the species include mining, road construction, trampling by hikers, over-collection, and alteration of soil and hydrological regimes. Weeds were not located at this site. This location was intensively collected. However, since the project was intended to produce vouchers, plants without flower or fruit were neither collected nor identified.

**Voucher Specimens:** Emily Elliott 6646b, Rocky Mountain Herbarium.

**ID Verified by:** Dr. Don Farrar.

**Photo Available:** See Photo 3: *Botrychium ascendens*, Photo 4: *Botrychium ascendens* habitat.

**Comments:** There is a good chance that there are other sites and taxa of *Botrychium* in this area.

**Associated Species and Exotic Species:** Associated species were *Solidago* sp., *Caryophyllaceae*, *Polygonum bistortoides*, *Potentilla* sp., and *Poaceae*.

**Dominant Species:** (highest % cover):

**Exotic Species:** none found

LOCALITY DATA REMOVED FOR WEB VERSION

***Botrychium hesperium* var. *hesperium* - western moonwort**

Western moonwort is a perennial herb in the adder's-tongue fern family (Ophioglossaceae). It ranges from southeastern Alaska to the western portions of Canada and the U.S. Knowledge of its distribution has been accumulating in recent years, and it is now known from most of the Rocky Mountain states as well as Oregon and Washington. The Montana Natural Heritage Program (Montana Natural Heritage Program 2009c) states that approximately 20–25 sites are known from the state from Deer Lodge, Flathead, Glacier, Granite, and Lincoln counties. The collections (Emily Elliott 6645, 6646a, 7637) represent a Sweet Grass County record and are the southernmost sites in the state. They are disjunct from the nearest site, on the border between Granite and Deer Lodge counties, by approximately 160 miles.

Approximately fifteen *B. hesperium* var. *hesperium* individuals were located. Plants were collected by cutting at ground level. Moonworts bear a small bulb-like structure underground that possesses the next year's structures. Cutting the plant at ground level does not impact these structures and a new sporophore and trophophore will emerge the following year.

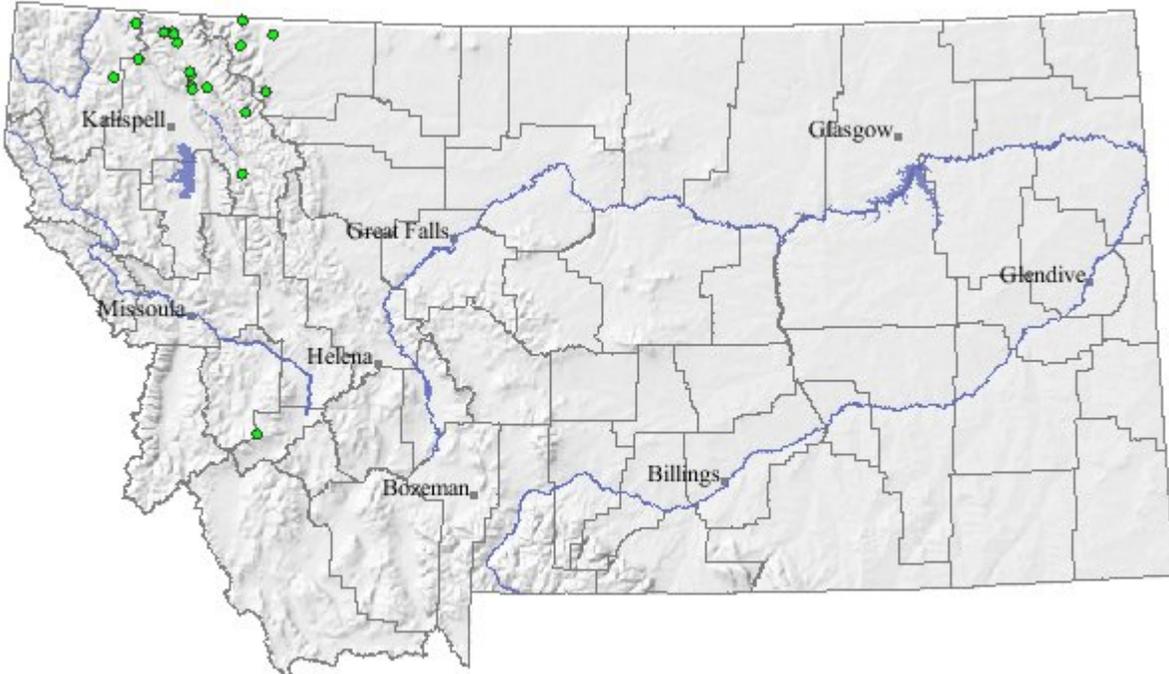
**Photo 5: *Botrychium hesperium* var. *hesperium***



**Photo 6: *Botrychium hesperium* var. *hesperium* habitat.**



**Map 6: Distribution of *Botrychium hesperium* var. *hesperium* in Montana.**



Map from Montana Natural Heritage Program (2009c).

**Map 7: Location of *Botrychium hesperium* var. *hesperium*.**

MAP REMOVED FOR WEB VERSION

BOHE = *Botrychium hesperium*.

### MTNHP Form 3 *Botrychium hesperium* var. *hesperium*.

#### Plant Observation/Species of Concern Survey Form

Montana Natural Heritage Program

2008 Revision

P.O. Box 201800, 1515 E. Sixth Avenue, Helena, MT 59620-1800

At a minimum complete Scientific Name, Date, Observer, Observation Data and provide specific location data; preferably GPS coordinates and/or the observed area drawn on a photocopy of a topographic map or equivalent.

Please provide as much detail as possible for the remaining fields. For additional information or questions: Visit [mtnhp.org](http://mtnhp.org) or contact the MTNHP Botanist: 406-444-2817

**Scientific Name:** *Botrychium hesperium* var. *hesperium*

**Survey Date:** Two sites were located; A on 28 July 2008 and site B on 20 August, 2008.

**Observer(s):** Emily and Brian Elliott

**Site Name/SO Number:** Chrome-Iron Mountain

**Observation Data:** A total of approximately fifteen *B. hesperium* var. *hesperium* individuals were located; all had sporophores and were located in a genus community with one to two other *Botrychium* species.

**Habitat Data:**

SITE A: This site was located on a stable, vegetated talus near tree line. The community was dominated by graminoides and forbs.

SITE B: This site was located on a stable, vegetated talus slope. The community was dominated by *Carex* spp. and *Salix* sp. (probably *S. petrophila*) with associated forbs.

**Survey Comments:** Threats to the species include mining, road maintenance and construction, trampling by hikers, over-collection, and alteration of soil and hydrological regimes. Weeds were not located at these sites. These locations were intensively collected. However, since the project was intended to produce vouchers, plants without flower or fruit were neither collected nor identified.

**Voucher Specimens:**

SITE A: Emily Elliott 6645 and 6646a, Rocky Mountain Herbarium.

SITE B: Emily Elliott 7637, Rocky Mountain Herbarium.

**ID Verified by:** Dr. Don Farrar and their identity was confirmed by electrophoresis.

**Photo Available:** See Photo 5: *Botrychium hesperium* var. *hesperium*, Photo 6: *Botrychium hesperium* var. *hesperium* habitat.

**Comments:** There is a good chance that there are other sites and taxa of *Botrychium* in this area.

**Associated Species and Exotic Species:**

SITE A: Associated species were *Solidago* sp., *Caryophyllaceae*, *Bistort bistortoides*, *Potentilla* sp., and *Poaceae*.

SITE B: Associated species were *Vaccinium coccinea*, *Salix petrophila*, *Solidago* sp. *Saxifraga caespitosa*, *Penstemon* sp., *Hieracium* sp., *Antennaria* sp., *Frasera* and a gray lichen.

**Dominant Species:** SITE A: *Salix petrophila*

**Exotic Species:** none found

LOCALITY DATA REMOVED FOR WEB VERSION

***Botrychium lanceolatum* var. *lanceolatum* - lanceleaf moonwort**

Lanceleaf moonwort is one of the more common moonwort species. It ranges from Alaska to northern New Mexico and Arizona. While it is not a tracked species by the Montana Natural Heritage Program, it is of interest because it indicates that a moonwort “genus community” is present at the survey site. Several *Botrychium* species are commonly found growing together in close proximity. This is an unusual phenomenon in the plant world as members of the same plant genus often do not occur together. This is likely a result of detrimental competitive interactions that might occur between them. Furthermore, species may have become adapted to a particular niche that is difficult for other members of the same genus to occupy. The noted moonwort researchers, W.F. and S.H. Wagner, coined the term “genus community” to describe these unusual assemblages of *Botrychium* species (Wagner and Wagner 1983).

Four species of moonwort were found at the site. As a result of the genus community phenomena described above, it is possible that other moonwort species are present in the Chrome-Iron mountain site.

**Photo 7: *Botrychium lanceolatum* var. *lanceolatum*.**



**Photo 8: *Botrychium lanceolatum* var. *lanceolatum* habitat.**



## References

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- Beatty, B.L., W.F. Jennings, and R.C. Rawlinson (2003, November 12). *Botrychium ascendens* (trianglelobe moonwort), *B. crenulatum* (scalloped moonwort), and *B. lineare* (narrowleaf grapefern): a technical conservation assessment. USDA Forest Service, Rocky Mountain Region.
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## Appendix 1: Codes and Ranks

Codes and ranks describing Federal or State legal status, as well as the G-code and S-code used to describe abundance used by Natural Heritage Programs and NatureServe are described below.

### 1. Federal Status: U.S. Fish and Wildlife Service

- E:** Endangered: taxa formally listed as endangered.
- T:** Threatened: taxa formally listed as threatened.
- C:** Candidate: taxa for which the Service has on file sufficient information on biological vulnerability and threat(s) to support proposals to list them as endangered or threatened species.
- C1:** Formerly used to indicate Notice of Review, Category 1: taxa for which substantial biological information exists on file to support proposing to list as endangered or threatened.
- C2:** Formerly used to indicate Notice of Review, Category 2: taxa for which current information indicates that proposing to list as endangered or threatened is possible, but appropriate or substantial biological information is not on file to support an immediate rulemaking.
- C2\*:** Formerly used to indicate taxa believed to be possibly extirpated in the wild.
- 3A:** Formerly used to indicate taxa for which the USFWS has persuasive evidence of extinction.
- 3B:** Formerly used to indicate names that based on current taxonomic knowledge do not represent taxa meeting the Endangered Species Act's definition of a species.
- 3C:** Formerly used to indicate Notice of Review, Category 3C: taxa that have proven to be more abundant or widespread than was previously believed, and/or those that are not subject to any identifiable threat.

### 2. Federal Status: U.S.D.A Forest Service

- S: Sensitive.** Those plant and animal species identified by the Regional Forester for which population viability is a concern as evidenced by a significant current or predicted downward trend in population numbers or density, or significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.

### 3. The Nature Conservancy and State Natural Heritage Program Ranking System

**GLOBAL RANK (G):** based on range-wide status of a species.

- G1:** Critically imperiled globally because of extreme rarity (5 or fewer occurrences, or very few remaining individuals), or because of some factor of its biology making it especially vulnerable to extinction. (Critically endangered throughout its range).
- G2:** Imperiled globally because of rarity (6 to 20 occurrences) or because of other factors demonstrably making it very vulnerable to extinction throughout its range. (Endangered throughout its range).

- G3:** Vulnerable throughout its range or found locally in a restricted range (21 to 100 occurrences). (Threatened throughout its range)
- G4:** Apparently secure globally, though it might be quite rare in parts of its range, especially at the periphery.
- G5:** Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.
- GX:** Presumed extinct.
- GQ:** Indicates uncertainty about taxonomic status.
- GU:** Unable to assign rank due to lack of available information.
- G?:** Indicates uncertainty about an assigned global rank.
- T:** Trinomial rank used for subspecies or varieties. These taxa are ranked on the same criteria as G1-G5.

**STATE RANK (S):** based on the status of a species in an individual state. S ranks may differ between Colorado and neighboring states based on the relative abundance of a species in each state.

- S1:** Critically imperiled in state because of extreme rarity (5 or fewer occurrences, or very few remaining individuals, or because of some factor of its biology making it especially vulnerable to extirpation from the state. (Critically endangered in state)
- S2:** Imperiled in state because of rarity (6 to 20 occurrences) or because of other factors demonstrably making it very vulnerable to extirpation from the state. (Endangered or threatened in state).
- S3:** Vulnerable in state (21 to 100 occurrences).
- S4:** Apparently secure in the state, although it may be rare at the edge of its range.
- S5:** Demonstrably secure in the state, although it may be rare in parts of its, especially at the periphery.
- S?:** Indicates uncertainty about an assigned state rank.
- SH:** Of historical occurrence, not documented in the state since 1920.