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[View Glossary](#)***Botrychium hesperium*** - (Maxon & Clausen) W.H. Wagner & Lellinger

Western Moonwort

Taxonomic Status: Accepted**Related ITIS Name(s):** *Botrychium hesperium* (Maxon & Clausen) W.H. Wagner & Lellinger (TSN 501021)**French Common Names:** botryche de l'Ouest**Unique Identifier:** ELEMENT_GLOBAL.2.157840**Element Code:** PPOPH010Q0**Informal Taxonomy:** Plants, Vascular - Ferns and relatives[Search for Images on Google](#)

Kingdom	Phylum	Class	Order	Family	Genus
Plantae	Filicinophyta	Ophioglossopsida	Ophioglossales	Ophioglossaceae	Botrychium

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Concept Reference Conservation Status **NatureServe Status****Global Status:** G4**Global Status Last Reviewed:** 02Jun2008**Global Status Last Changed:** 02Jun2008**Rounded Global Status:** G4 - Apparently Secure

Reasons: Known from over 120 occurrences thus far; additional occurrences continue to be discovered in many parts of the range. Range includes much of the Rocky Mountains, from the San Francisco Peaks in Arizona through BC and Yukon to the Wrangell-St. Elias Mountains in Alaska, as well as many Pacific Northwest and upper Midwest states and adjacent Canadian provinces, east to Michigan, Ontario, and Quebec and south to South Dakota and Wyoming. Occurrences are very often small and isolated, with counts of aboveground sporophytes rarely exceeding 100; however, additional gametophytes and juvenile sporophytes belowground may add to the size of many occurrences and provide some buffer from environmental stochasticity. Appears to strongly favor open habitats within a forested matrix; threats include succession on the one hand (and suppression of natural disturbances such as fire) and human activities associated with anthropogenically-disturbed habitats on the other (e.g. potential herbiciding of roadside populations).

Nation: United States**National Status:** N3**Nation:** Canada**National Status:** N2N3 (01Jun2011)

U.S. & Canada State/Province Status	
United States	Arizona (S1), Colorado (S2), Michigan (S2), Minnesota (SNR), Montana (S3), Oregon (SNR), Utah (S1), Washington (S1)
Canada	Alberta (SU), British Columbia (S2S3), Ontario (S1), Saskatchewan (S1), Yukon Territory (S1)

Other Statuses

NatureServe Global Conservation Status Factors

Range Extent Comments: Populations are generally highly disjunct, in that most known populations are scattered and often separated by many miles (Anderson and Cariveau 2004). Farrar (2005) believes that *B. hesperium* s.s. ranges from northern Arizona in the San Francisco Peaks northward through the Rocky Mountains (including the Blue and Wallowa Mountains of Oregon) to southern British Columbia and Alberta, Yukon Territory and southeastern Alaska in the Wrangell-St. Elias Mountains. Furthermore, he notes that *B. "michiganense"* has been confirmed from Michigan, Minnesota and Ontario in the Lake Superior region, the Black Hills region of South Dakota and eastern Wyoming, northwestern Montana, eastern Washington, Waterton Lakes in Alberta, the Cypress Hills in Saskatchewan, and possible additional locations in the northern Rocky Mountains not yet re-identified. Subnations reporting the presence of one or both taxa include AZ, CO, ID, MI, MN, MT, OR, UT, WA, WY, AB, BC, ON, QC, SK, and YT; Anderson and Cariveau (2004) also report that *B. "michiganense"* specimens are known from SD, and Farrar includes AK in the range of *B. hesperium* s.s. and ND, SD, MB, and WI in the range of *B. "michiganense"*. Total range extent (without considering any one particular area to be "disjunct") is 3,000,000+ square km.

Area of Occupancy: 126-12,500 4-km² grid cells

Area of Occupancy Comments:

Number of Occurrences: 81 - 300

Number of Occurrences Comments: Over 120 extant occurrences are known, although this is almost certainly an underestimate as only about half of the jurisdictions believed to be part of the range (Farrar 2005) have mapped their occurrences so far, and additional occurrences continue to be discovered in many jurisdictions rangewide. At this time there are an additional 22 unranked occurrences and 12 historical occurrences known.

Population Size Comments: Often occurs as one or a few individuals scattered among other *Botrychium* species; at times occurs in pure stands, sometimes in large numbers. In a detailed analysis of sizes of Colorado populations, Anderson and Cariveau (2004) reported that "known populations in Colorado range in size from 1 individual to somewhere between 50 and 100 individuals, with most reports documenting between 4 and 20 plants." Still, a recent survey estimated the total count of *B. hesperium* in Summit County, CO alone to be 567 (Anderson and Cariveau 2004). In Oregon, 7 known occurrences are estimated to total less than 100 plants overall (smallest: 1 plant, largest: 40 plants); in Montana, many sites are poorly documented in terms of population size or are small in size, though several sites have been observed with >100 plants (S. Mincemoyer, pers. comm. 2008). Further complicating matters, the number of aboveground sporophytes observed in a given year may be a poor indicator of total occurrence size in this species, because a high proportion of an occurrence typically remains underground as gametophytes and juvenile sporophytes; thus a single emergent sporophyte may indicate the presence of a viable occurrence or a recent colonist (Anderson and Cariveau 2004). Farrar (2005) notes that "*Botrychium hesperium* is considered common throughout most of its range, but it may be less abundant than previously thought, due to its confusion with similar taxa, especially *B. echo* in the southern part of its range".

Number of Occurrences with Good Viability/Integrity: Some (13-40) occurrences with good viability

Viability/Integrity Comments: Just 15 of the 120 mapped and ranked extant occurrences are believed to have good or excellent viability. Many populations of this species are small and/or occur in uncertain habitat, where they may be threatened by such factors as succession or detrimental human activities. Many of the EOs thus far ranked as having good viability occur in western Montana, where several sites have been observed with >100 plants.

Environmental Specificity Comments: Depends on disturbance to maintain suitable habitat; current sites are in most cases destined to become unsuitable as a result of natural succession (Anderson and Cariveau 2004). In addition, *Botrychium* species rely upon mycorrhizae in both the sporophytic and gametophytic stages. The ubiquity and low host specificity of AM

fungi suggest that mycorrhizae may not be a limiting factor in the distribution of *B. hesperium*, but changes in the mycoflora during succession may affect habitat quality (Anderson and Cariveau 2004).

Overall Threat Impact: Medium

Overall Threat Impact Comments: Threats to *B. hesperium* are not well understood. Because this species occurs in both naturally and artificially disturbed sites, threats include natural plant succession as well as the same human activities (recreation, road and trail maintenance activities, selection of grazing areas) that have also apparently resulted in suitable habitat (especially when populations are small). Anderson and Cariveau (2004) point out that habitat created by anthropogenic disturbance has not yet been proven to support viable populations in the long-term; it is possible that human-created habitats may become inhospitable later due to processes such as microbial or fungal succession. Agriculture and forestry activities may also threaten this species in some areas. In Colorado, in rough order of decreasing priority, threats are listed as habitat loss, recreation, succession, overgrazing, effects of small population size, sedimentation, timber harvest, exotic species invasion, global climate change, and pollution (Anderson and Cariveau 2004). These authors suggest that minimizing soil disturbance may be important to the species; they note that off-road vehicle use (both motorized and non-motorized) represents a significant threat, and that the use of livestock grazing to enhance habitat is risky. Threats in the Wallowa Mountains of Oregon include fire suppression, pack animal grazing, wood-cutting, and recreation-associated activities (Anderson and Cariveau 2004). In Montana, many populations occur on roadsides or other similarly open or disturbed habitats, leaving them vulnerable to activities such as weed invasion, weed spraying and road maintenance (S. Mincemoyer, pers. comm. 2008).

Intrinsic Vulnerability Comments: This species' tendency to grow in small, somewhat isolated populations with highly variable numbers of individuals may make populations susceptible to local extirpation; however, many populations may be buffered by the presence of underground gametophytes and juvenile sporophytes (Anderson and Cariveau 2004). This species is also very difficult to propagate, which probably precludes restoration efforts (Anderson and Cariveau 2004).

Short-term Trend: Increase of 10-25% to decline of 30%

Short-term Trend Comments: Essentially unknown, as high variation in number of emergent stalks among years makes detection of overall trends very difficult (Anderson and Cariveau 2004). Abundance of *B. hesperium* has been observed to have increased in the vicinity of ski resorts, but the long-term suitability of these habitats is unknown (Anderson and Cariveau 2004). It is possible that fire suppression has decreased availability of suitable habitat, but no data are available to support or refute this idea. There have been no known cases since this species was recognized in which an occurrence was extirpated due to human activities (Anderson and Cariveau 2004).

Long-term Trend: Increase of 10-25% to decline of 30%

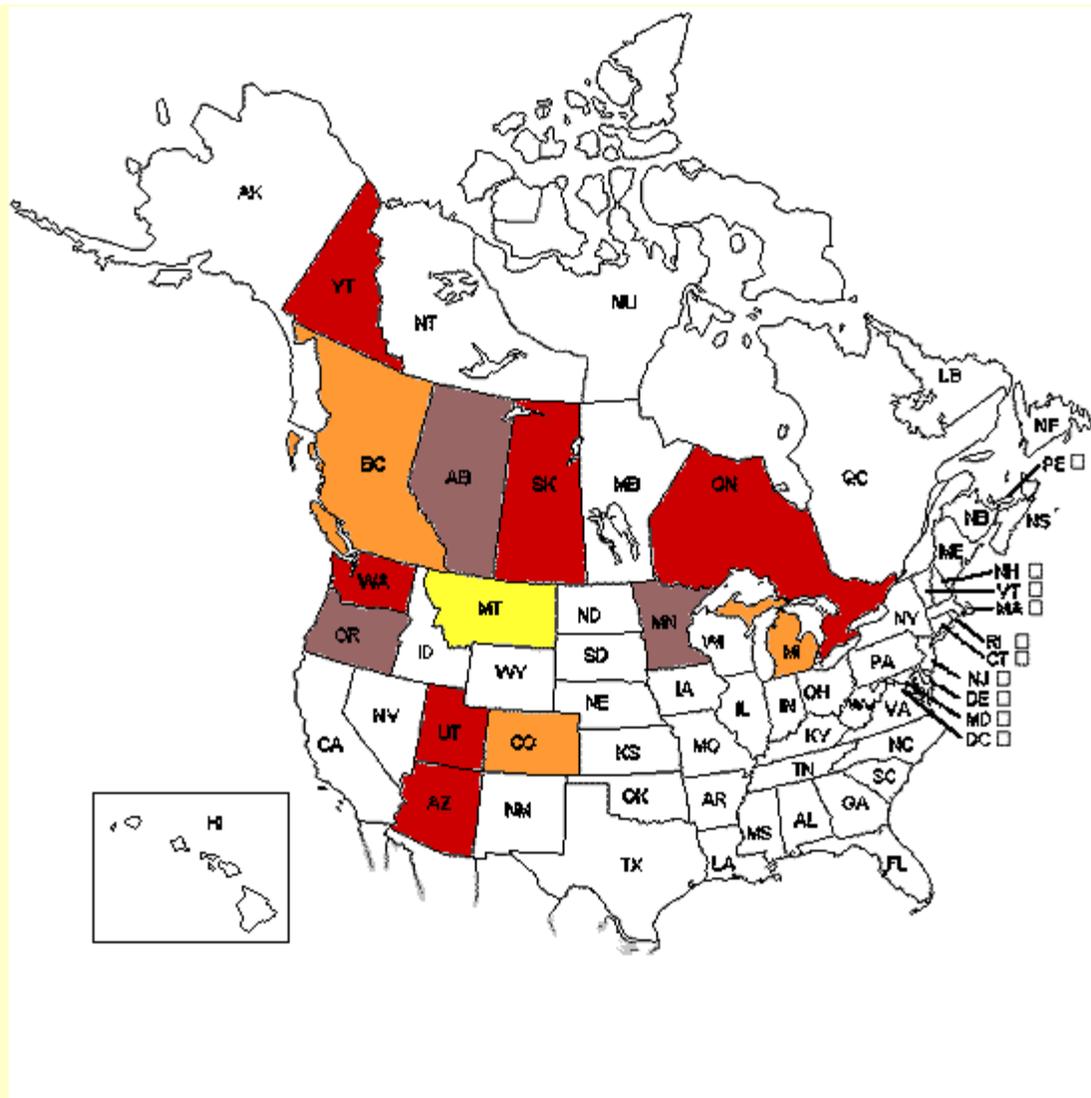
Long-term Trend Comments: In post-settlement times, Kolb and Spribille (2001) (cited in Anderson and Cariveau 2004) hypothesize that the abundance of *Botrychium* has increased due to increased anthropogenic disturbance (associated with ski runs, roads, clear cuts, trails, mine sites, etc.) However, *Botrychium* habitat may also have decreased due to fire suppression and grazing of western grasslands and meadows. Unfortunately, little data are available to address either of these ideas.

Other NatureServe Conservation Status Information

Distribution

Global Range: Populations are generally highly disjunct, in that most known populations are scattered and often separated by many miles (Anderson and Cariveau 2004). Farrar (2005) believes that *B. hesperium* s.s. ranges from northern Arizona in the San Francisco Peaks northward through the Rocky Mountains (including the Blue and Wallowa Mountains of Oregon) to southern British Columbia and Alberta, Yukon Territory and southeastern Alaska in the Wrangell-St. Elias Mountains. Furthermore, he notes that *B. "michiganense"* has been confirmed from Michigan, Minnesota and Ontario in the Lake Superior region, the Black Hills region of South Dakota and eastern Wyoming, northwestern Montana, eastern Washington, Waterton Lakes in Alberta, the Cypress Hills in Saskatchewan, and possible additional locations in the northern Rocky Mountains not yet re-identified. Subnations reporting the presence of one or both taxa include AZ, CO, ID, MI, MN, MT, OR, UT, WA, WY, AB, BC, ON, QC, SK, and YT; Anderson and Cariveau (2004) also report that *B. "michiganense"* specimens are known from SD, and Farrar includes AK in the range of *B. hesperium* s.s. and ND, SD, MB, and WI in the range of *B. "michiganense"*. Total range extent (without considering any one particular area to be "disjunct") is 3,000,000+ square km.

U.S. States and Canadian Provinces



State/Province Conservation Status

- SX: Presumed Extirpated
- SH: Possibly Extirpated
- S1: Critically Imperiled
- S2: Imperiled
- S3: Vulnerable
- S4: Apparently Secure
- S5: Secure
- Not Ranked/Under Review (SNR/SU)

Conservation Status Not Applicable (SNA)

- Exotic
- Hybrid without Conservation Value

U.S. & Canada State/Province Distribution

United States	AZ, CO, MI, MN, MT, OR, UT, WA
Canada	AB, BC, ON, SK, YT

Range Map

No map available.

U.S. Distribution by County

State	County Name (FIPS Code)
CO	Archuleta (08007), Boulder (08013), Clear Creek (08019), Conejos (08021), Eagle (08037), Gilpin (08047), Grand (08049), Huerfano (08055), Jackson (08057), Lake (08065), Larimer (08069), Mineral (08079), Pitkin (08097), Rio Grande (08105), Saguache (08109), San Juan (08111), Summit (08117), Teller (08119)
MI	Alger (26003), Alpena (26007)*, Chippewa (26033)
OR	Umatilla (41059), Union (41061), Wallowa (41063)
WA	Ferry (53019), Pend Oreille (53051), Stevens (53065)

* Extirpated/possibly extirpated

U.S. Distribution by Watershed

Watershed Region	Watershed Name (Watershed Code)
04	Betsy-Chocolay (04020201)+, Tahquamenon (04020202)+, Carp-Pine (04070002)+, Thunder Bay (04070006)+
10	North Platte Headwaters (10180001)+, Upper Laramie (10180010)+, Upper South Platte (10190002)+, Clear (10190004)+, St. Vrain (10190005)+, Big Thompson (10190006)+, Cache La Poudre (10190007)+
11	Arkansas Headwaters (11020001)+, Fountain (11020003)+, Huerfano (11020006)+
13	Rio Grande headwaters (13010001)+, Alamosa-Trinchera (13010002)+, Saguache (13010004)+, Conejos (13010005)+
14	Colorado headwaters (14010001)+, Blue (14010002)+, Eagle (14010003)+, Roaring Fork (14010004)+, Upper San Juan (14080101)+, Animas (14080104)+
17	Pend Oreille (17010216)+, Franklin D. Roosevelt Lake (17020001)+, Kettle (17020002)+, Colville (17020003)+, Sanpoil (17020004)+, Upper Grande Ronde (17060104)+, Wallowa (17060105)+

+ Natural heritage record(s) exist for this watershed

* Extirpated/possibly extirpated

Ecology & Life History

Basic Description: A small, erect, perennial fern. *B. hesperium* is similar to other *Botrychium* spp. but is a duller green color than *B. echo*, and has ovate to oblong lower pinnae. Leaves appear in midspring and die in early fall. Spores are produced in July.

General Description: Western Moonwort is a small perennial fern with a single erect frond, 3-13 cm high. It is divided into a sterile segment and a fertile segment. The sterile segment has a stalk 0-4 mm long, and a broadly lance-shaped to triangular blade that is pinnately divided with 1-6 pairs of closely adjacent leaflets (pinnae). The basal pinnae are usually partly to wholly pinnately divided and are larger than the lobed or entire-margined upper pinnae. The fertile segment is 2-3 times as long as the sterile segment and 1-3 times pinnately divided into linear segments that bear the spores.

Diagnostic Characteristics: *Botrychium* subgenus *Botrychium* is a large group of very similar species, many of which have been recently described. A technical manual should be consulted for positive identification. The deeply pinnately lobed basal pinnae help separate this species from most others in its range. Farrar (2005) provides the following characteristics differentiating *B. "michiganense"* from *B. hesperium* s.s.: *B. "michiganense"* differs in its usually unstalked to short-stalked (< 2mm) trophophore and its abrupt transition from the elongated and deeply dissected basal pinnae to the distinctly smaller and scarcely dissected second pinnae pair. Where the two species co-occur (northern Rocky Mountains), *B. hesperium* var. *fenestratum* further differs from *B. "michiganense"* in having pinnae and pinnules overlapping or nearly so. The typical variety of *B. hesperium* in the southern Rocky Mountains has little to no dissection in pinnae above the first pair and only shallow and narrow dissection in its basal pinnae; however, the typical variety of *B. hesperium* seldom co-occurs with *B. "michiganense"*.

Habitat Comments: In the western portion of its range (i.e. excluding "*michiganense*" material), occurs in the forested montane zone, where the forest is relatively open-canopied and/or within open habitat types, which tend to be subject to periodic disturbance and include subalpine meadows, snow fields, mesic grassy slopes, prairie pothole meadows, edges of lakes, gravel bars, and roadsides. Soils are dry to moist and tend to be coarse and gravelly. Common moonwort associates include *B. paradoxum*, *B. lunaria* and *B. lanceolatum*. Anderson and Cariveau (2004) note that apparently suitable habitat is plentiful within the range but is often not occupied by this species; they hypothesize that this may be due to limitations in successful migration to the site, or the result of other unknown ecological parameters, such as insufficient time since a disturbance event and/or lack of appropriate mycorrhizal symbionts. 1000 - 3500 m. In the eastern portion of its range ("*michiganense*" material), occurs in sand dune habitats, in moist shrubby jack pine forest in dune valleys, in grassy roadsides and fields, and in open-canopied mesic northern forests and woodlands, sometimes dominated by sugar maple, yellow birch, and hemlock. Occurs as low as 200 m.

Economic Attributes

Not yet assessed

Management Summary

Stewardship Overview: Requires at least somewhat open habitat, in the past most likely created by natural disturbance events such as fire. Anthropogenically-disturbed areas such as ski runs have been observed to harbor reasonably large

numbers of individuals, but habitat created by anthropogenic disturbance has not yet been proven to support viable populations in the long-term (Anderson and Cariveau 2004). Mycorrhizal interactions are also of paramount importance to *Botrychium* species, and better understanding of this species' mycorrhizal relationships and requirements will lead to better understanding of management techniques that support those relationships (Anderson and Cariveau 2004).

Population/Occurrence Delineation



Population/Occurrence Viability



U.S. Invasive Species Impact Rank (I-Rank)

Not yet assessed



Authors/Contributors



References



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