

SPECIES: Scientific [common]	<i>Botrychium paradoxum</i> [peculiar aka puzzling moonwort]
Forest:	Bridger-Teton National Forest
Forest Reviewer:	Rose Lehman; Trevor Bloom
Date of Review:	3/28/2021; 3/25/2025
Forest concurrence (or recommendation if new) for inclusion of species on list of potential SCC: (Enter Yes or No)	Yes

FOREST REVIEW RESULTS:

1. The Forest concurs or recommends the species for inclusion on the list of potential SCC:
Yes No
2. Rationale for not concurring is based on (check all that apply):
 Species is not native to the plan area _____
 Species is not known to occur in the plan area _____
 Species persistence in the plan area is not of substantial concern _____

FOREST REVIEW INFORMATION:

1. Is the Species Native to the Plan Area? Yes No
 If no, provide explanation and stop assessment.
2. Is the Species Known to Occur within the Planning Area? Yes No
 If no, stop assessment.

Table 1. All Known Occurrences, Years, and Frequency within the Planning Area

Year Observed	Number of Individuals	Location of Observations (USFS District, Town, River, Road Intersection, HUC etc.)	Habitat Description	Source of Information ¹
2023	50	Bridger-Teton National Forest: Pinedale Ranger District. Found in the vicinity of Union Pass and FS Road 600, and the vicinity of FS Road 680 near Little Sheep Mountain	Mesic meadows. 50 individuals found across 5 sites.	Survey conducted by Ben Legler (Legler 2024).
8/8/2024	5	NW of Twin Lakes accessed from the Big Sandy Trailhead, Pinedale District,	Mesic meadow with <i>Potentilla glaucophylla</i> ,	Survey conducted by Ben Legler (Rocky Mountain

		Bridger-Teton National Forest.	<i>Achillea millefolium</i> , and <i>Fragaria vesca</i> .	Herbarium), Trevor Bloom (BTNF), and Michael Daines (CTNF). Recorded in NRM/TESP and reported by RMH (Legler, 2025).
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a. Are all Species Occurrences Only Accidental or Transient?

Yes___ No_X_

If yes, document source for determination and stop assessment.

b. For species with known occurrences on the Forest since 1990, based on the number of observations and/or year of last observation, can the species be presumed to be established or becoming established in the plan area?

Yes_X_ No___

If no, provide explanation and stop assessment

c. For species with known occurrences on the Forest predating 1990, does the weight of evidence suggest the species still occurs in the plan area?

Yes___ No___

Provide explanation for determination

If determination is no, stop assessment



Puzzling Moonwort
Bridger-Teton National Forest

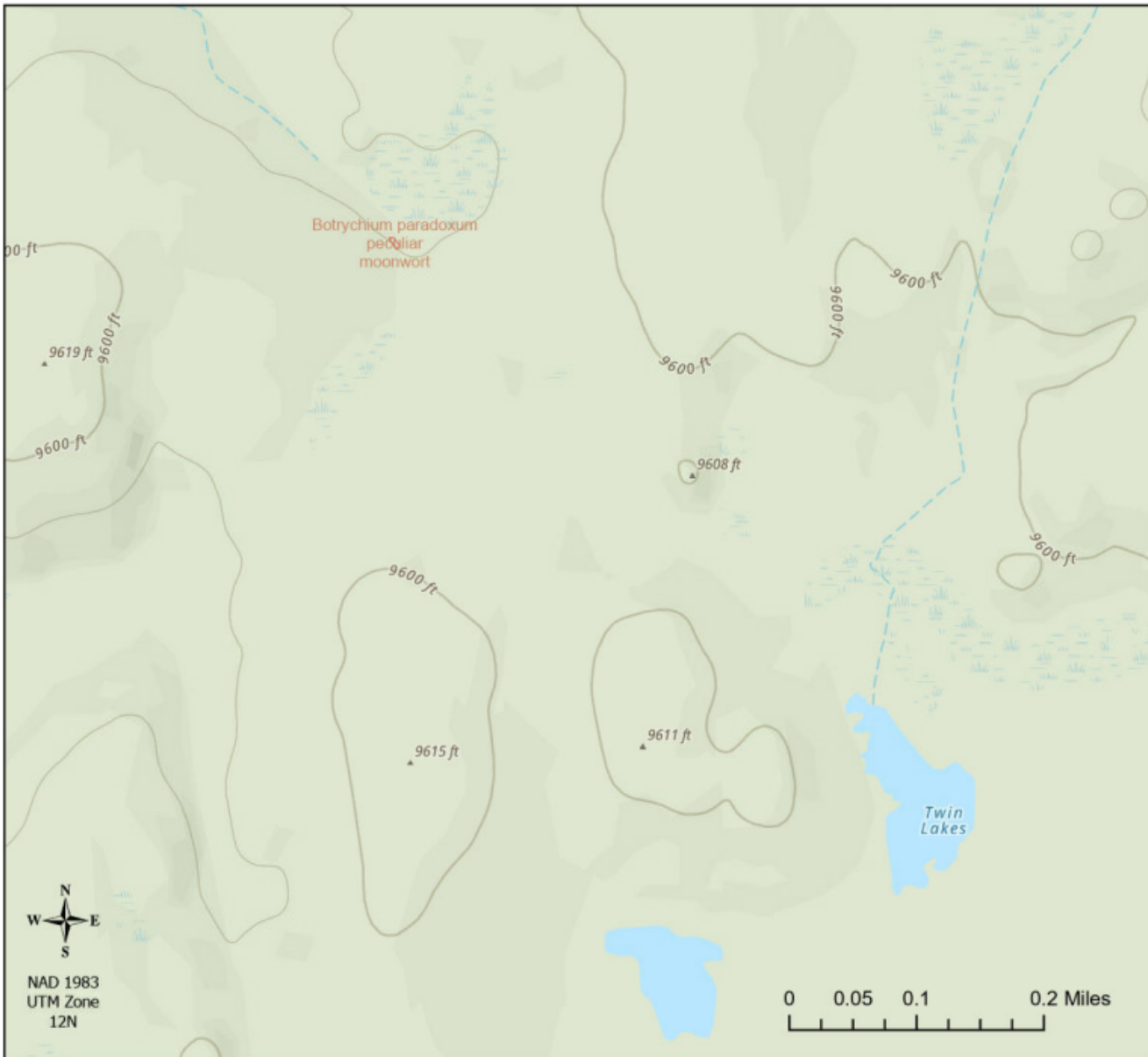


Figure 1: One of only six known populations of *Botrychium paradoxum* found on the Bridger-Teton National Forest. All populations were discovered in 2023 and 2024.

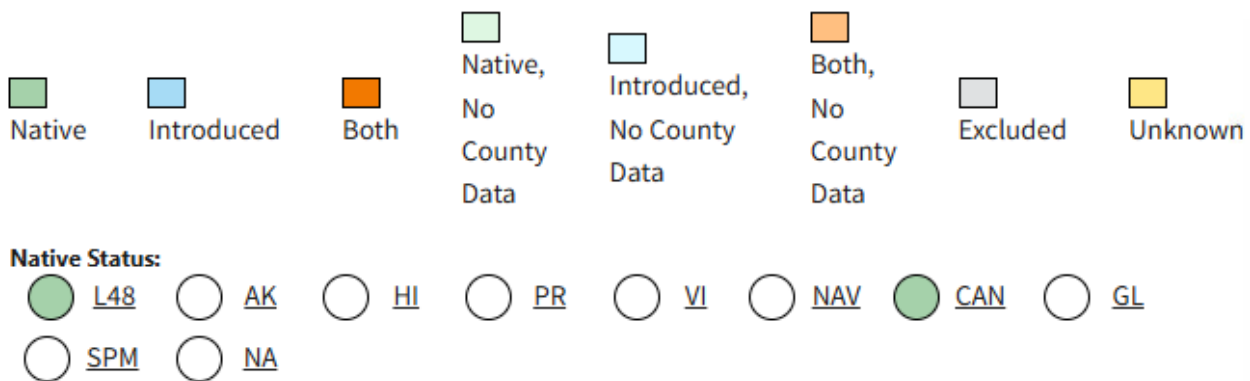
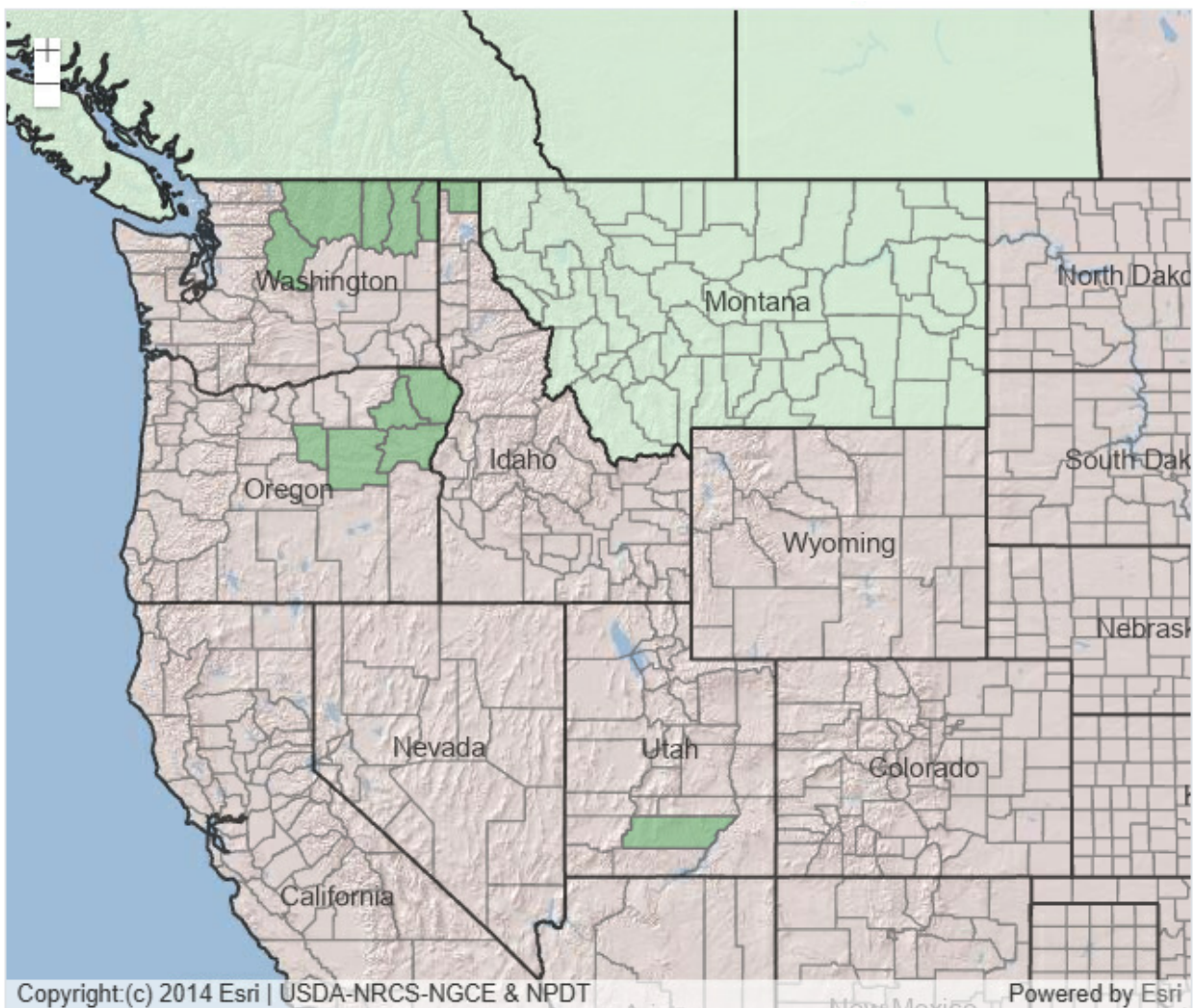


Figure 2: *Botrychium paradoxum* range in Region 4 and surrounding states (USDA Plants 2025). This map needs to be updated to reflect recent findings in Wyoming.

3. Is There Substantial Concern for the Species' Capability to persist Over the Long-term in the Plan Area Based on Best Available Scientific Information?

Table 2. Status summary based on existing conservation assessments

Entity	Status/Rank (include definition)
NatureServe Global Status	<p>G3G4 — Vulnerable/ Apparently Secure</p> <p><i>At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors/ At fairly low risk of extinction or elimination due to an extensive range and/or many populations or occurrences, but with possible cause for some concern as a result of local recent declines, threats, or other factors.</i></p>
NatureServe State Status	<p>S2 — Imperiled</p> <p><i>At high risk of extirpation in the jurisdiction due to restricted range, few populations or occurrences, steep declines, severe threats, or other factors.</i></p>
WYNDD	<p>Plant Species of Concern</p> <p><i>Species vulnerable to extirpation at the global or state level due to:</i></p> <ul style="list-style-type: none"> <i>a. their rarity (e.g., restricted distribution, small population size, low population density)</i> <i>b. inherent vulnerability (e.g., specialized habitat requirements, restrictive life history)</i> <i>c. threats (e.g., significant loss of habitat, sensitivity to disturbances)</i> <p>(Wyoming Natural Diversity Database – Plant Species of Concern) (TB: checked 3/25/2025)</p>
USDA Forest Service	USFS-R2, USFS-R4 Sensitive Species
USDOI FWS	Not listed
USDOI BLM	Not listed
IUCN	Not listed

Sources: WYNDD 2025; USDA Forest Service Regions 2 and 4 Sensitive Species Lists updated December 2024; NatureServe 2019

Table 3. Status summary based on best available scientific information. Updated 3/25/2025 by Trevor Bloom.

Criteria	Rationale
Distribution on the Bridger-Teton National Forest	As of March 2025, there are six <i>Botrychium paradoxum</i> populations known to occur on the Bridger-Teton National Forest discovered in 2023 and 2024 (Legler 2025). The species is likely present in more locations across the forest which contains suitable habitat and has yet to be surveyed.
Distribution outside the Bridger-Teton National Forest	Occurs from the British Columbia to Saskatchewan, and south to California, Utah, and Wyoming. In Wyoming, known from the Big Horn and Wind River Ranges (Big Horn, Johnson, Sheridan and Sublette counties). Known from 11 occurrences in Wyoming.
Abundance on the Bridger-Teton National Forest	The plant is rare on the Bridger-Teton National Forest. There are only six populations with a total of 55 individuals. It has been understudied and is likely present across a range of suitable habitat found on the forest.
Population Trend on the Bridger-Teton National Forest	Unknown.
Habitat Trend on the Bridger-Teton National Forest	Open, moist meadows (Wagner and Wagner 1993, Farrar 2011) or in spruce, lodgepole pine, and wet western red cedar forests (Montana Natural Heritage Program 2012). Wyoming populations are at willow thicket margins, stream banks and wetland margins in open valley bottoms and headwaters, and in small, mossy openings in <i>Pinus contorta</i> woodland.
Life history and demographic characteristics of the species	Puzzling moonwort is a perennial fern relative, 3-12 cm tall with a single leaf divided into two similar segments and is unique among the moonwort species in having both leaf segments bearing sporangia. Both leaf segments are normally spore-bearing (fertile) and glaucous green, succulent, and 0.5-4 cm long. The fertile segments may be pinnately branched or have sessile clusters of grape-like sporangia. Vegetative (sterile) segments are absent (Lellinger 1985; Wagner and Wagner 1993, Farrar and Popovich 2012).

Summary and Recommendations

Botrychium paradoxum is listed as S2, a WYNDD Species of Conservation Concern, and a Sensitive Species for USFS Region 2 and Region 4, all suggesting the rarity and imperiled nature of this species. It is only known from six populations on the Bridger-Teton discovered in 2023 and 2024 by Rocky Mountain Herbarium Curator Ben Legler. Therefore, it is likely present in other locations across the forest yet to be discovered.

One of the challenges with locating and counting populations of *Botrychium* is that the plants spend much of their life cycle below ground, dependent on mycorrhizal interactions. On a given year, a portion of an existing population will produce above ground reproductive parts – essential for detection and identification by survey. Plants may be detectable for only a few weeks in from late July through August, influenced by seasonal hydrology and snowpack. For these reasons, species occurrences and populations sizes are generally sparse across its entire distribution. The lack of information regarding the dispersal and colonizing ability, mycorrhizal relationships, adaptability to changing environmental conditions, reproductive potential, or genetic variability of these species makes it difficult to predict their long-term vulnerability (Beatty et al. 2003)

Climate related effects and drying of wetlands could reduce habitat and viability for rare species. Warming temperatures and reduced snowpack may result in the loss of high-elevation riparian and wetland habitats, resulting in drier, less productive systems. Disturbances and land management activities may actually create and maintain suitable habitat for this species or may negatively impact existing populations, depending on the disturbance intensity and frequency (Beatty et al. 2003).

It is likely that more populations occur on the forest but that their detection remains confounded by the species' life history traits and the lack of survey effort by trained botanists. The singular known population is exposed to several potential threats and little is understood regarding its response to varying types and intensity of disturbance. It is therefore recommended that *Botrychium paradoxum* be included as a SCC.

References

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- Farrar, D. R. and S. J. Popovich. 2012. Ophioglossaceae. Pages 24-35 Colorado Flora: Eastern Slope, fourth edition. W.A. Weber and R.C. Wittmann. University Press of Colorado, Boulder, CO.
- Legler, Ben. 2024. Surveys for *Botrychium* spp. (Moonworts) on the Bridger-Teton National Forest, Wyoming. 2023 Survey Results. Report prepared for the USDA Forest Service Region 4 and Wyoming Natural Diversity Database by the Rocky Mountain Herbarium.
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Kootenai National Forest. Montana Natural Heritage Program, Helena, MT. 82 pp. plus appendices

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