| **SPECIES: Scientific [common]** | ***Selaginella selaginoides* [Club spikemoss]** |
|---|---|
| **Forest:** | Bridger-Teton National Forest |
| **Forest Reviewer:** | R.Lehman |
| **Date of Review:** | 5/7/20; 01/13/21 |
| **Forest concurrence (or recommendation if new) for inclusion of species on list of potential SCC: (Enter Yes or No)** | No |

**FOREST REVIEW RESULTS:**

1. The Forest concurs or recommends the species for inclusion on the list of potential SCC:
   Yes___ No_X__

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_X__ No___

   If no, provide explanation and stop assessment.

2. Is the Species Known to Occur within the Planning Area? Yes_X__ 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 |
|---|---|---|---|---|
| 07/21/1925 | Unknown | U.S.A., Wyoming, Sublette County: Near the lower end of New Fork Lakes. 43.0823° N, 109.9642° W; NAD 83, uncertainty 1 mi | Mossy rocks in wet meadow. Associated plants *Parnassia parviflora* Elev. 7700 ft | E. B. & L. Payson #4403, EO #2 (WYNDD 2019, Heidel & Handley 2006) |
| 08/7/1925, 09/7/1936 | Unknown | U.S.A, Wyoming, Sublette County: Bridger Teton National Forest, Lower Green River Lake. 43.2977° N, 109.8405° W; NAD 83, uncertainty 0.5 mi. | Mossy banks in forest. Elev. 8000 ft. Possible issue with reported location, low Spike-moss not known to occur at reported location (WYNND 2019) | E. & L. Payson (1925) #4596; Marion Ownbey (1936) #1136, EO #3 (WYNDD 2019, Heidel & Handley 2006) |

| | | | | |
|---|---|---|---|---|
| 7/23/2018 | 100 individuals estimated, Locally common | U.S.A., Wyoming, Sublette County: West slope Wind River Range: E of Green River, ca 0.5 mi N of north shore of Lower Green River Lake. | Graminoid fen with marl pools, on hummocks below shrubs; 8000 ft; with *Carex simulata, Salix brachycarpa, Primula egalikensis*. Elev. 8000 ft. | Bonnie Heidel 4756, EO #8 (Rocky Mountain Herbarium 2020, WYNND 2019) |

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?

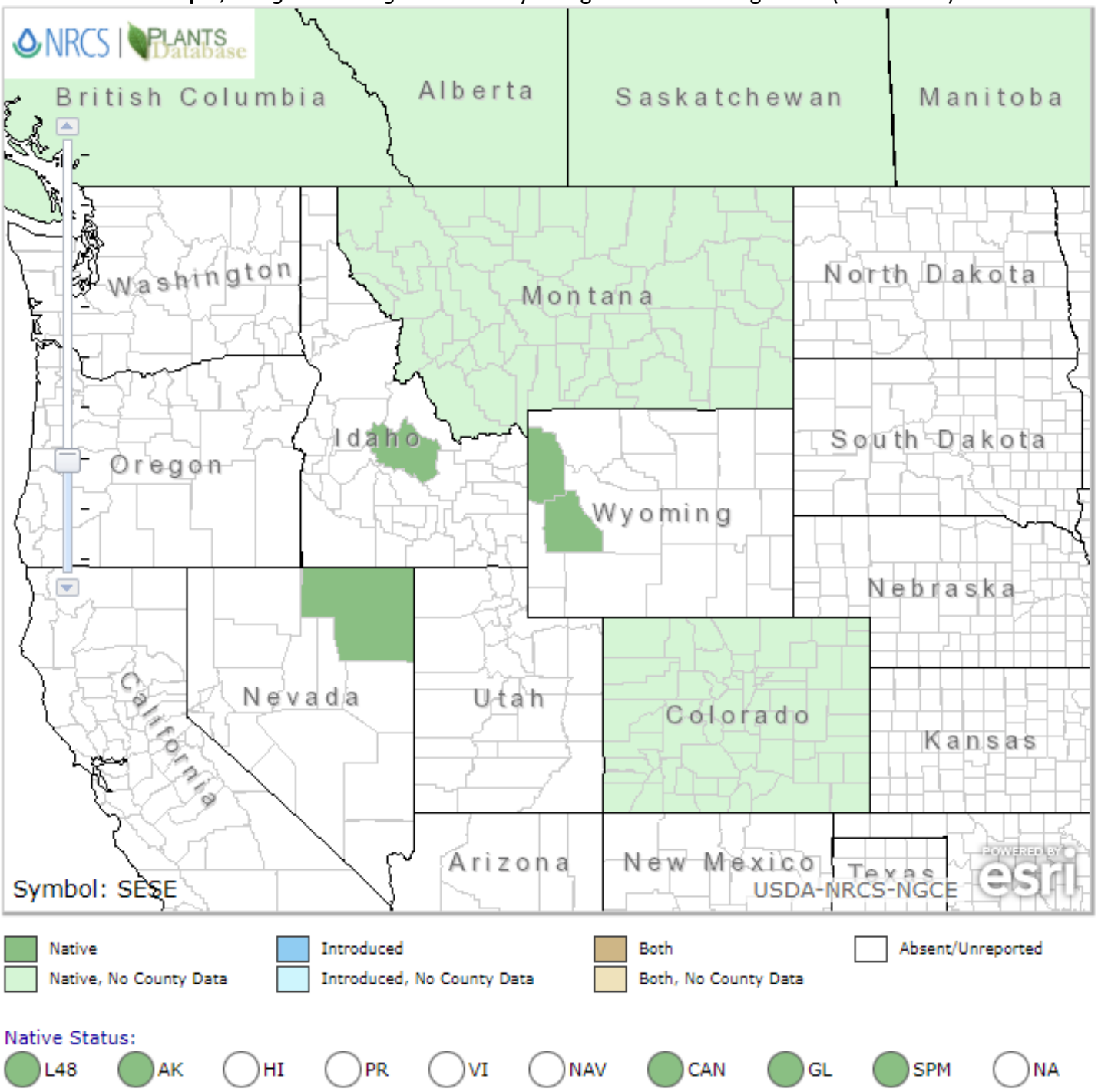
Yes___ No___

Provide explanation for determination

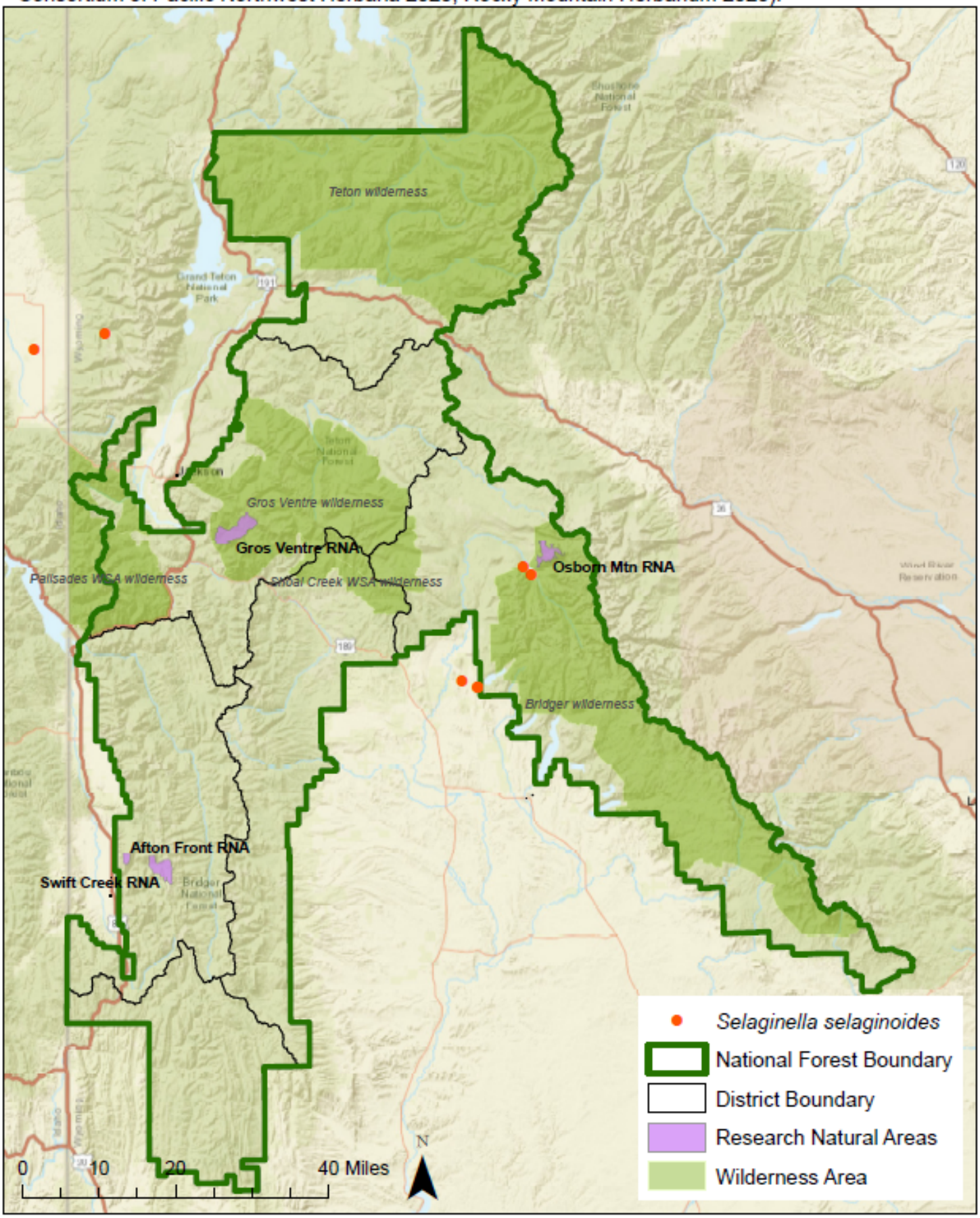
N/A–Occurrences have been documented since 1990.

If determination is no, stop assessment

**Map 1**, *Selaginella selaginoides* in Wyoming and surrounding states (NRCS 2020).



**Map 2**, *S. selaginoides* occurrences in Bridger-Teton National Forest vicinity (SEINet 2020; Consortium of Pacific Northwest Herbaria 2020; Rocky Mountain Herbarium 2020).



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

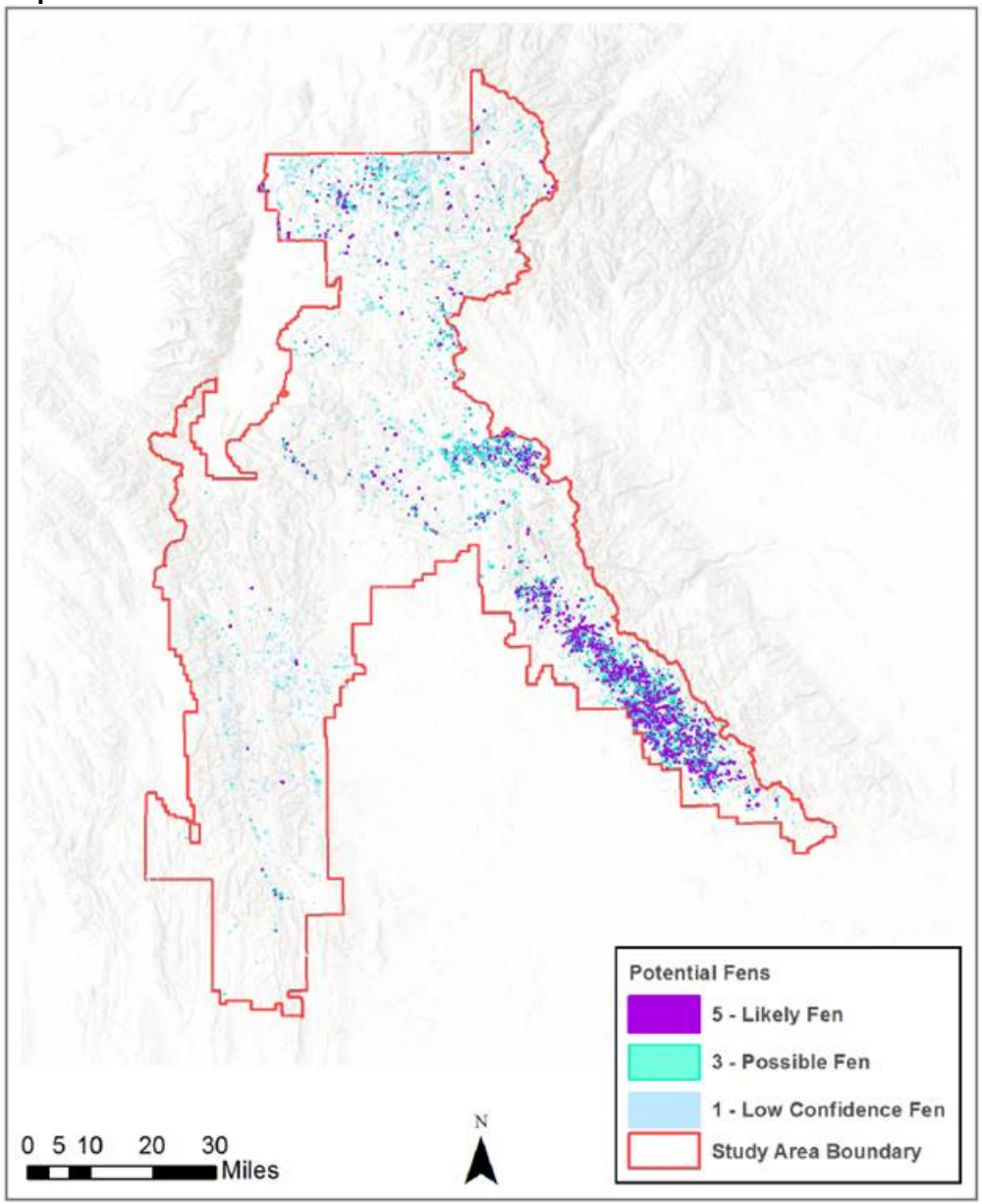
| Entity | Status/Rank (include definition) |
|---|---|
| **NatureServe Global Status** | **G5—Secure**<br><br>*Common; widespread and abundant.* |
| **NatureServe State Status** | **S1—Critically Imperiled**<br><br>*At very high risk of extirpation in the jurisdiction due to very restricted range, very few populations or occurrences, very steep declines, severe threats, or other factors.* |
| **WYNDD** | **Plant Species of Concern**<br><br>*Species vulnerable to extirpation at the global or state level due to:*<br>*a. their rarity (e.g., restricted distribution, small population size, low population density)*<br>*b. inherent vulnerability (e.g., specialized habitat requirements, restrictive life history)*<br>*c. threats (e.g., significant loss of habitat, sensitivity to disturbances)*<br>(Wyoming Natural Diversity Database - Species of Concern) |
| **USDA Forest Service** | Not Region 4 Sensitive |
| **USDOI FWS** | Not listed |
| **USDOI BLM** | Not listed |
| **IUCN** | Not listed |

Sources: WYNDD 2020; Heidel 2018; USDA Forest Service Regions 2 and 4 Sensitive Species Lists; NatureServe 2020

**Table 3.** Status summary based on best available scientific information.

| Criteria | Rationale |
|---|---|
| Distribution on the Bridger-Teton National Forest | *Selaginella selaginoides* is known from two records on the Bridger Teton National Forest. This population is located next to Mount A\Osborn in the eastern section of the forest (Table 1, Map 2). There is another population that occurs at the Forest boundary, south of the population described above (Map 2). |
| Distribution outside the Bridger-Teton National Forest | *Selaginella selaginoides* occurs from Canada, scattered on the upper Atlantic Coast, near the Great Lakes, and in some sections of the Western United States. In Wyoming, it is known from the upper Green River Basin, foothills of the Wind River Range (Sublette County), and Teton Range (Teton counties) (WYNDD 2020). |
| Abundance on the Bridger-Teton National Forest | Population size is not known, but there have been 6 occurrences in Wyoming, 3 of which are extant and 3 of which are historical (WYNDD 2020). Population sizes tend to be small and restricted to specialized, microhabitats (WYNDD 2020). Trends on the Bridger-Teton National forest cannot be assessed due to a lack of data. |
| Population Trend on the Bridger-Teton National Forest | Population trends are not known (WYNDD 2020). Trends on the Bridger-Teaton National Forest cannot be assessed due to a lack of data. |
| Habitat Trend on the Bridger-Teton National Forest | *Selaginella selaginoides* occupies moist, montane habitats in the western United States, which are wet places like, mossy stream banks, lakeshores, fens, and wet talus slopes at low- to mid-elevations, in neutral to alkaline soil (Heidel, & Handley. 2006). They occur on mossy banks and saturated moss-covered zones in wet meadows, at elevations of 7,700 – 8,000 ft. in Wyoming (WYNDD 2020). Wyoming populations are on cool, saturated moss-covered zones in wet meadows, stream banks, mossy coniferous forest, canyon bottom wetlands, seeps and ferns (WYNDD 2020).<br><br>Organic soil wetlands known as fens are an irreplaceable resource that the U.S. Forest Service has determined should be managed for conservation and restoration. Fens are defined as groundwater-fed wetlands with organic soils that typically support sedges and low stature shrubs. In the arid west, organic soil formation can take thousands of years. Long-term maintenance of fens requires maintenance of both the hydrology and the plant communities that enable fen formation. (Smith and Lemly 2018).<br><br>In total, 9,503 potential fens were mapped throughout the BTNF, of which 2,966 were most likely to be fens. |

**Map 3 Potential Fens on BTNF**




Map 3 shows the distribution of potential fens on the BTNF (Smith and Lemly 2018). A HIGH/LOW number of potential fens are located in the vicinity of the Selaginella selaginoides Range area and may serve as potential

| Criteria | Rationale |
|---|---|
| | habitat for the species. Fen distribution patters showed a strong elevation gradient, with 89% of potential fens falling between 8,000 and 11,000 feet, as well as hotspots for fens in the North Fork Silver Creek, Upper Boulder Creek, Upper Pole Creek, and Washakie Creek-East Fork River (Smith and Lemly 2019).<br><br>Based on the scarcity of occurrences, *Selaginella selaginoides* is likely sparse and isolated on the BTNF; however, the distribution of potential fen locations suggests that habitat may exist across the Forest, particularly at elevations of 8,000 and 11,000 feet and around the North Fork Silver Creek, Upper Boulder Creek, Upper Pole Creek, and Washakie Creek-East Fork River (Smith and Lemly 2019).<br><br>Mapping of potential fens based on digital aerial photography and topographic maps identified 9,503 potential fen locations on the BTNF, indicating a rich resource of fen wetlands that may provide potential habitat for fen obligates such as *Selaginella selaginoides*. The potential fen locations had an average size of 1.44 acres and covered a total of 13,708 acres or 0.4% of the total Forest land area (Smith and Lemly 2018). 89% of all potential fen locations and 94% of likely fen locations occurred between 8,000 to 11,000 ft in elevation. North Fork of Silver Creek, Upper Boulder Creek, Upper Pole Creek, and Washakie Creek-East Fork River contained particularly high numbers of likely fens (Smith and Lemly 2018). Most potential fens on the BTNF showed little sign of human disturbance, particularly at higher elevations (Smith and Lemly 2018), and fens and wetlands are generally protected on National Forests. Therefore, habitat conditions for the species are likely stable. |
| Threats to the Species and its Habitat on the Bridger-Teton National Forest | Potentially threatened by trampling and water development (WYNDD 2020). *Selaginella selaginoides* is a habitat specialist that requires cool, stable settings and groundwater near the surface during most or all of the growing season. The general threats to wetland habitat at low- to mid-elevation valley wetlands are habitat loss and degradation associated with water loss, inundation, or successional change. There is evidence to suggest that Wyoming populations may have been or could be impacted by water impoundment, campground development, subdivision development, and road construction. In addition, known populations are potentially affected by water diversions, beaver activity, grazing activities and range developments, crown fires in the surrounding watershed, timber harvest, and exotic species encroachment in the wetland habitat. Finally, the palynological record indicates that *S. selaginoides* is also susceptible to climate warming. As such, it may be a relict species with limited colonizing ability and restoration potential (Heidel and Handley 2006).<br><br>Riparian habitat and wetlands receive additional considerations and protections from disturbances through forest management direction and water regulations. These considerations and protections would avoid or |

| Criteria | Rationale |
|---|---|
| | minimize adverse effects to special status riparian and wetland plants, such as *Selaginella selaginoides*, where they occur.<br><br>Grazing can impact wetlands by altering water quality, trampling herbaceous vegetation, increasing bare ground, and facilitating noxious weed expansion in riparian areas. Rangelands form a major component of ecosystems in the Bridger-Teton National Forest, and there are open rangelands throughout the Forest. While adherence to rangeland management plans will limit the chance of overgrazing, there is potential for impacts to *Selaginella selaginoides* and its habitat to occur where there is overlap with grazing.<br><br>Riparian and wetland habitat may be threatened by climate change effects and disturbance or loss of wetland habitat. Changes in flow regimes, such as those from water diversions and dams, impact the amount, season, and timing of flows. This can substantially alter associated riparian and wetland species because of their dependence on fluvial geomorphic process, surface water, and groundwater. Floods are responsible for erosion, transport, and deposition of sediments, as well as the amounts and location of vegetation and debris. Many dominant riparian species, such as cottonwoods and willows, are pioneer species that depend on these events to provide bare, moist substrates necessary for seed germination and plant establishment (Halofsky et al. 2018).<br><br>Mid-elevation riparian and wetland communities are rated as having a moderate to high sensitivity to climate change, moderate adaptive capacity, and moderate to high vulnerability (Halofsky et al. 2018). Mid-elevation riparian plant species may have the ability to move upward in elevation, but where resilience has been compromised by human uses, these systems may not be able to easily adjust to changes in their environment. Invasive species that already dominate many mid-elevation sites are likely to expand their dominance. As riparian areas become drier, upland species will continue to expand into these sites (Halofsky et al. 2018).<br><br>The condition of wetlands in high elevation forests is generally excellent to good. Human stressors were observed in some fen wetlands while mapping fens on the BTNF, such as off-roading vehicle trails, foot trails, fences or impoundments, and those observations were captured in the “Notes” field of the GIS dataset accompanying this report. However most potential fens in BTNF showed little sign of human disturbance, particularly at higher elevations (Smith and Lemly 2018).<br><br>Rare plant populations that may be small, isolated, tied to snowpack abundance and distribution timing changes of spring thaw and fall frost cycles, and/or have limited dispersal capacity, are highly vulnerable to impacts from environmental change (Ellstrand and Diane 1993, Halofsky et al. 2018.<br><br>To analyze trends in occupied habitat, aerial imagery and a USFS GIS database of invasive plant populations, |

| Criteria | Rationale |
|---|---|
| | historical wildfires, trails, roads, Wilderness Areas, and Research Natural Areas was assessed at each contemporary occurrence on the Forest (USFS GIS 2019, Google Earth Pro 2020).<br><br>There are two historic element occurrences (#2 and #3) from 1925 and 1936, and the status of these are unknown.<br><br>• Element occurrence #8 discovered in 2018 is in the vicinity of element occurrence #3 near the Bridger Wilderness. This fen area is adjacent to Lower Green River Lake with trails and a parking area to access the lake nearby. Invasive Canada thistle (*Cirsium arvense*) is associated with the parking area and roads and may pose a threat if it become established in or near the wetland. This occurrence is not within a grazing allotment so livestock grazing is not likely.<br><br>Invasive plants have been identified as a major threat to the biological diversity and ecological integrity within and outside the BTNF. Invasive plants create many adverse environmental effects, including, but not limited to: displacement of native plants; reduction in functionality of habitat and forage for wildlife and livestock; threats to populations of threatened, endangered and sensitive species; alteration of physical and biological properties of soil, including productivity; changes to the intensity and frequency of fires; facilitation of further invasive species invasions; and loss of recreational opportunities (Halofsky et al. 2018). The presence of invasive plant species may be compounded by the presence of cattle which may create an environment more conducive to the establishment of invasive plant species (Halofsky et al. 2018). |
| Life history and demographic characteristics of the species | *Selaginella selaginoides* is a moss-like, glabrous, perennial herb with slender branched, prostrate, sterile stems and ascending fertile stems arising 3-10 cm above the ground. They have thin, narrowly shaped leaves that are 1-3 mm long, spirally arranged on the stem with bristles on the margin and not present on the tip. The upper leaves of fertile stems are large, with spore-bearing receptables at the base. The fruiting/flowering period is from late July to early September. Demographic studies of *Selaginella selaginoides* are lacking (Flora of North American 2020; Heidel, & Handley. 2006; WYNDD 2020). |
| Date: May 6, 2020<br>Reviewer: J. Remp | |

**Summary and Recommendations**

Species (Scientific and Common Name): *Selaginella selaginoides* (northern naiad)

*Selaginella selaginoides* is listed as S1 (critically imperiled) and G5 (secure) globally. It occurs across Canada, the upper Atlantic Coast, and with an isolated distribution in the Western United States. In Wyoming, it is known from the upper Green River Basin and foothills of the Wind River Range. There are six occurrences in Wyoming, with two historic and one contemporary record (1925, 1936, 2018) on the Bridger-Teton Forest. Plants in Wyoming grow in cool, moss-covered zones in wet meadows, stream banks, coniferous forest, canyon bottom wetlands, seeps and fens (WYNDD 2020). The distribution of potential fens suggests that additional populations may exist, particularly at elevations above 8,000 feet and around the North Fork Silver Creek, Upper Boulder Creek, Upper Pole Creek, and Washakie Creek-East Fork River (Smith and Lemly 2019).

The single contemporary occurrence, adjacent the outlet of Lower Green River Lake, has trails and a parking area nearby. Though it does not fall within an active grazing allotment, there have been reports of invasive Canada thistle (*Cirsium arvense*) associated with the parking area. In general, populations are affected by water diversions, beaver activity, grazing and range developments, crown fires in the surrounding watershed, timber harvest, and exotic species encroachment in the wetland habitat. The palynological record indicates that *S. selaginoides* is also susceptible to climate warming. As such, it may be a relict species with limited colonizing ability and restoration potential (Heidel and Handley 2006).

Despite the lack of trend data and scarcity of recent Wyoming observations, there is great potential for additional 'relict' populations on the Forest. Riparian habitat and wetlands receive considerations and protections from disturbance through forest management and water regulations. When applied, these considerations and protections will reduce or avoid adverse effects to *Selaginella selaginoides*. Thus it is not recommended at *Selaginella selaginoides* be included as a SCC.

Evaluator: Jessica Irwin & Rose Lehman Date: 5/7/20; 1/13/21

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