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Lolo National Forest Evaluations and Rationale for Identifying Species of Conservation Concern

Plants

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Summary

Species of conservation concern are native species known to occur in the plan area that are not recognized under the Endangered Species Act, but for which there is substantial concern for the species' long-term persistence within the plan area. The 2012 planning rule requires the regional forester to identify species of conservation concern (SCC) for the Lolo National Forest's revised land management plan (36 CFR 219.6 (b)(5)), and provide rationale for why species were or were not identified as SCC (Forest Service Handbook 1909.12 Section 21.22a). This document demonstrates how these requirements are being met.

An outline of the process to identify species of conservation concern is included in Forest Service Handbook (FSH 1909.12 Section 12.52 and FSH 1909.12 Section 21.22a), and more specific direction for the Lolo National Forest is found on the Northern Region's SCC webpage. A brief summary of the process follows in the paragraph below.

Using Forest Service and Montana Natural Heritage Program data, a master list was compiled of species with observation records in the plan area that met a conservation category specified in the Northern Region's SCC identification process. Each species was evaluated to determine whether the best available scientific information indicated substantial concern about the species' capability to persist over the long-term in the plan area. Substantial concern was generally demonstrated by some combination of significant threats to the species or its habitats, declines in population or habitat abundance and distribution, or other unique factors about the species' ecology, life history, or distribution that may affect resilience to environmental perturbation and thereby persistence within the plan area. The information may come from a variety of sources, including Federal and State agencies, literature, local information on occurrence and population status, subbasin analyses, broad-scale assessments, and information available from local species experts and other organizations.

The species evaluations in this document build upon the evaluations of potential SCC provided in the Lolo National Forest's draft assessment that was issued in June of 2023. There, 180 plant species were considered for potential SCC status, of which 81 warranted in-depth evaluations based on the species of conservation concern identification process. Here, following public review of the draft assessment, a total of 211 plant species are considered in this document, of which 86 warranted an in-depth evaluation. This includes 18 bryophytes, 7 lichens, and 61 vascular plants. Based on the best available scientific information, 10 plant species are identified as potential species of conservation concern:

- Arctic Sweet Coltsfoot (*Petasites frigidus* var. *frigidus*)
- Hiker's Gentian (*Gentianopsis simplex*)
- Hollyleaf Clover (*Trifolium gymnocarpon*)
- Howell's Gumweed (*Grindelia howellii*)
- Idaho Barren Strawberry (*Waldsteinia idahoensis*)
- Lackschewitz' Fleabane (*Erigeron lackschewitzii*)
- Mission Mountain Kittentails (*Synthyris canbyi*)
- Oregon Bluebells (*Mertensia bella*)
- Sandweed (*Athysanus pusillus*)
- Scalepod (*Idahoa scapigera*)

The regional forester's rationale for these determinations are provided in the remaining sections of this document. The list of species of conservation concern is subject to modification during the planning process, based on best available scientific information.

1. Introduction

Land management plans approved under the 2012 planning rule must provide the ecological conditions necessary for long-term persistence of species of conservation concern (SCC), within the authority of the Forest Service and the inherent capability of the land. The 2012 Planning Rule (36 CFR 219) defines SCC as "a species, other than a federally recognized threatened, endangered, proposed or candidate species, that is known to occur in the plan area and for which the regional forester has determined that the best available scientific information indicates substantial concern about the species' capability to persist over the long-term in the plan area" (36 CFR 219.9). The regional forester is responsible for identifying SCC, typically during the planning process.

Outlined direction for identifying SCC is included in the Forest Service handbook (FSH) for land management planning (i.e., the planning directives) at FSH 1909.12, chapter 10, section 12.52 and at chapter 20, section 21.22a. More specific direction for applying the process to the Lolo National Forest is found on the Northern Region's SCC page. A summary is provided below.

The first step in the process of identifying SCC for development of the Lolo National Forest's revised land management plan was to evaluate and identify potential SCC (PSCC). That step was completed during the Lolo National Forest's assessment phase, and serves as the precursor to this document, which represents the regional forester's rationale for the species identified and not identified as SCC. Updates in this document stem primarily from public comment to the Lolo's draft assessment. The same criteria are used for identifying PSCC and SCC, but the regional forester may update the SCC list and supporting documentation at any point during or after the planning process, based on the best available scientific information.

To begin determining which species to consider for SCC status, spatial observation records were obtained from the Montana Natural Heritage Program for all species documented to occur within the plan area. The Montana Natural Heritage Program, which is part of the international NatureServe network, manages statewide occurrence records and other information about species and their habitats. The Forest Service, other agencies, and the public all contribute observation records to the Montana Natural Heritage Program repository, making the database the most comprehensive, reliable, and up-to-date source of documented species occurrences in Montana.

Species observed within the plan area were considered for SCC evaluation if they met any of the following conservation categories.

1. NatureServe global (G) or infraspecific taxon (T) ranks of 1 or 2.
2. NatureServe G3 for plants and vertebrates. Invertebrate species with a G3 rank were not routinely evaluated due to a general lack of reliable characteristics for field identification and scientific information on the distribution, abundance, habitat use, trends, relevant threats, and life history characteristics for the individual species. Species with a higher ranking (e.g., G4, G5) were not routinely evaluated because they are reasonably secure at the global level; concern at the plan level is identified in category 9. This approach is consistent with FSH 1909.12 chapter 10, section 12.52d.
3. Montana Natural Heritage Program state (S) ranks of 1 or 2. Rankings are assigned by Montana Natural Heritage Program but are also reflected in the Montana Species of Concern list by Montana Fish Wildlife and Parks and Montana Natural Heritage Program. Species with a higher ranking (e.g., S3, S4, S5) were generally not considered because they indicate relatively secure conservation status

at the statewide level; concern at the plan level is identified in category 9. This approach is consistent with FSH 1909.12 chapter 10, section 12.52d.

4. Delisted (removed) from the Endangered Species Act list within the last five years or delisted and still monitored by the regulatory agency.
5. State of Montana, or federally recognized Tribes, threatened or endangered designations.
6. Positive "90-day findings" made by the US Fish and Wildlife Service in response to federal listing petitions.
7. Regional forester's sensitive species for the plan area and any adjoining national forest.
8. SCC or potential SCC on any adjoining national forest.
9. Local conservation concern due to potentially significant threats to populations or habitats, declining trends in populations or habitat, restricted ranges or habitats, or low population numbers.

Species identified as occupying the plan area, and fitting at least one of the identified conservation categories, were then evaluated to determine if the species met the necessary criteria for identification as a SCC (FSH 1909.12, chapter 10, section12.52c).

The criteria for identifying SCC include:

1. The species is native and documented as established or becoming established in the plan area. Species were not considered as established in the plan area if:
    a. Documented occurrences within the plan area were limited to accidental or transient observations, or the plan area was well outside the current established range of the species.
    b. Documented occurrences within the plan area were limited to historical records with no subsequent observations within the last forty years. This approach is consistent with the best available scientific information provided by NatureServe on when past observations are sufficient to conclude a species remains established in a location.
    c. Suspected occurrences within the plan area were too imprecise or vague to determine whether the observation occurred within the plan area. Imprecise records most commonly originate from historical documentation that provided only broad reference to location.
2. The best available scientific information must indicate substantial concern about the species' capability to persist over the long term in the plan area.
    a. In general, substantial concern was best demonstrated by a decreasing population (abundance or distribution), decreasing habitat availability or suitability, or significant threats. Other potential factors considered included geographic distribution, reproductive potential, dispersal capabilities, and other demographic and life history characteristics that may influence long-term persistence in the plan area.
    b. Rarity alone was not typically considered a substantial concern unless there were other prominent circumstances leading to concern for long-term persistence of the species within the plan area.
3. If there was insufficient scientific information available to conclude that there is substantial concern about a species' capability to persist in the plan area over the long-term, or if the species was secure in the plan area, the species was not identified as a SCC. Rationale for not identifying a species as a SCC included:

a. The species was deemed secure within the plan area and the best available scientific information concerning trends in populations, habitats, and threats did not suggest substantial concern about continued long-term persistence within the plan area.

b. Available scientific information was insufficient to conclude if there was a substantial concern about the species' likelihood to persist in the plan area. Insufficient scientific information included having limited inventory data resulting from low survey effort, lack of effective detection methods, or, in the case of purported population declines, lack of reasonably consistent monitoring methods among trend monitoring periods.

2. Alpine

2.1 Cliff Toothwort (*Cardamine rupicola*)

Conservation Categories

G3/S3 (Montana Natural Heritage Program, mtnhp.org, 02/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is endemic to Montana, limited to parts of six counties in the northwestern portion of the state. In the plan area, the species is known from two population from the same ridgeline in the eastern extent of plan area. However, species-specific surveys that consider the phenology, as well as the habitat associations of the species are lacking, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022). Where present, the species tends to be locally common (Montana Natural Heritage Program, mtnhp.org, 01/2023); however, due to the habitat requirements of the species, populations within the know range of the species are highly disjunct.

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

Sparsely vegetated, stony limestone soils or talus slopes in the subalpine and alpine zones (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but suitable habitat is largely limited to established wilderness areas and due to the elevation, such habitats are not generally subject to traditional disturbances such as fires, beetles or blow downs, suggesting habitat conditions are likely stable.

Relevant life history traits and other information

None

Relevant threats to populations occupying the plan area

The species is a local endemic, and range size is among the most consistent predictors of extinction risk (Chichorro et al. 2019). Moreover, populations that are geographically isolated, as populations of this species appear to be, are at greater risk for localized extinction (Dias 1996, Ovaskainen and Hanski 2004), particularly from stochastic events (Smith and Almeida 2020).

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no additional known unique threats to the species within the plan area. The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020).

Given the elevational distribution of the species, climate change may be the greatest threat as it may reduce the availability of suitable habitat conditions (Engler et al. 2011), as well as alter interactions with other species that shift elevational distribution (Alexander et al. 2015, Gómez et al. 2015, Iseli et al. 2023). Although the effects of climate change may take time to manifest (Nomoto and Alexander 2021, Alexander et al. 2018), such changes are likely to present novel challenges for the species because climate change often has more significant impacts on rare species with a limited distribution (Thuiller et al. 2005). Moreover, climate change has the potential to increase interest in high mountain recreation (Pröbstl-Haider et al. 2021), which may increase risk from trampling as well invasive species (Pickering 2022).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area.

Best available scientific information

Alexander, J.M., Chalmandrier, L., Lenoir, J., Burgess, T.I., Essl, F., Haider, S., Kueffer, C., McDougall, K., Milbau, A., Nunez, M.A., Pauchard, A., Rabitsch, W., Rew, L.J., Sanders, N.J., and Pellissier, L. 2018. Lags in the response of mountain plant communities to climate change. Global Change Biology 24 (2): 563-579 pp.

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2.2 Kerry's Paintbrush (*Castilleja kerryana*)

Conservation Categories

G3/S3 (Montana Natural Heritage Program, mtnhp.org, 02/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is believed to be endemic to Montana, where it is found in two drainages in the Scapegoat Wilderness (Egger 2013), including one population that overlaps with the plan area (Montana Natural Heritage Program, mtnhp.org, 01/2023). However, species-specific surveys that consider the phenology, as well as the habitat associations of the species are lacking, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

Occupies open slopes and ridges of the subalpine zone, on rocky, gravelly, well-drained limestone substrates (Egger 2013).

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but suitable habitat is largely limited to established wilderness areas and due to the elevation, such habitats are not generally subject to traditional disturbances such as fires, beetles or blow downs, suggesting habitat conditions are likely stable.

Relevant life history traits and other information

Only recently identified as a new species in 2013 (Egger 2013).

Relevant threats to populations occupying the plan area

The species is a local endemic, and range size is among the most consistent predictors of extinction risk (Chichorro et al. 2019). Moreover, populations that are geographically isolated, as populations of this species appear to be, are at greater risk for localized extinction (Dias 1996, Ovaskainen and Hanski 2004), particularly from stochastic events (Smith and Almeida 2020).

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no additional known unique threats to the species within the plan area. The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020).

Given the elevational distribution of the species, climate change may be the greatest threat as it may reduce the availability of suitable habitat conditions (Engler et al. 2011), as well as alter interactions with other species that shift elevational distribution (Alexander et al. 2015, Gómez et al. 2015, Iseli et al. 2023). Although the effects of climate change may take time to manifest (Nomoto and Alexander 2021, Alexander et al. 2018), such changes are likely to present novel challenges for the species because climate change often has more significant impacts on rare species with a limited distribution (Thuiller et al. 2005). Moreover, climate change has the potential to increase interest in high mountain recreation (Pröbstl-Haider et al. 2021), which may increase risk from trampling as well invasive species (Pickering 2022).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area.

Best available scientific information

Alexander, J.M., Chalmandrier, L., Lenoir, J., Burgess, T.I., Essl, F., Haider, S., Kueffer, C., McDougall, K., Milbau, A., Nunez, M.A., Pauchard, A., Rabitsch, W., Rew, L.J., Sanders, N.J., and Pellissier, L. 2018. Lags in the response of mountain plant communities to climate change. Global Change Biology 24 (2): 563-579 pp.

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2.3 Lyall Phacelia (*Phacelia lyallii*)

Conservation Categories

G3G4/S3S4 (Montana Natural Heritage Program, mtnhp.org, 02/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species occurs in British Columbia, Alberta, Idaho, and Montana. In Montana, the species widely distributed across the mountains in the western portion of the state and is known from roughly 90 observations (Montana Natural Heritage Program, mtnhp.org, 02/2023). The species is known from a single location within the plan area, but species-specific surveys that consider the phenology, as well as the habitat associations of the species are lacking, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species occupies a variety of open subalpine and alpine habitats, where it is often associated with rock outcrops or talus slopes (Lackschewitz 1991).

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but suitable habitat is largely limited to established wilderness areas and due to the elevation, such habitats are not generally subject to traditional disturbances such as fires, beetles or blow downs, suggesting habitat conditions are likely stable.

Relevant life history traits and other information

None

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area.

The species has a somewhat narrow ecological tolerance and does not tolerate human disturbance (Pipp 2017). The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020).

Given the elevational distribution of the species, climate change may be the greatest threat as it may reduce the availability of suitable habitat conditions (Engler et al. 2011), as well as alter interactions with

other species that shift elevational distribution (Alexander et al. 2015, Gómez et al. 2015, Iseli et al. 2023). Although the effects of climate change may take time to manifest (Nomoto and Alexander 2021, Alexander et al. 2018), such changes are likely to present novel challenges for the species because climate change often has more significant impacts on rare species with a limited distribution (Thuiller et al. 2005). Moreover, climate change has the potential to increase interest in high mountain recreation (Pröbstl-Haider et al. 2021), which may increase risk from trampling as well invasive species (Pickering 2022).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area.

Best available scientific information

Alexander, J.M., Chalmandrier, L., Lenoir, J., Burgess, T.I., Essl, F., Haider, S., Kueffer, C., McDougall, K., Milbau, A., Nunez, M.A., Pauchard, A., Rabitsch, W., Rew, L.J., Sanders, N.J., and Pellissier, L. 2018. Lags in the response of mountain plant communities to climate change. Global Change Biology 24 (2): 563-579 pp.

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Engler, R., Randin, C.F., Thuiller, W., Dullinger, S., Zimmermann, N.E., Araújo, M.B., Pearman, P.B., Le Lay, G., Piedallu, C., Albert, C.H., Choler, P., Coldea, G., De Lamo, X., Dirnböck, T., Gégout, J.-C., Gómez-García, D., Grytnes, J.-A., Heegaard, E., Høistad, F., Nogués-Bravo, D., Normand, S., Puşcaş, M., Sebastià, M.-T., Stanisci, A., Theurillat, J.-P., Trivedi, M.R., Vittoz, P., and Guisan, A. 2011. 21st century climate change threatens mountain flora unequally across Europe. Global Change Biology 17 (7): 2330-2341 pp.

Gómez, J.M., González-Megías, A., Lorite, J., Abdelaziz, M., and Perfectti, F. 2015. The silent extinction: climate change and the potential hybridization-mediated extinction of endemic high-mountain plants. Biodiversity and Conservation 24 (8): 1843-1857 pp.

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Iseli, E., Chisholm, C., Lenoir, J., Haider, S., Seipel, T., Barros, A., Hargreaves, A.L., Kardol, P., Lembrechts, J.J., McDougall, K., Rashid, I., Rumpf, S.B., Arévalo, J.R., Cavieres, L.A., Daehler, C.C., Dar, P.A., Endress, B.A., Jakobs, G., Jiménez, A., Küffer, C., Mihoc, M., Milbau, A., Morgan, J.W., Naylor, B.J., Pauchard, A., Ratier Backes, A., Reshi, Z.A., Rew, L.J., Righetti, D., Shannon, J.M., Valencia, G., Walsh, N., Wright, G.T., and Alexander, J.M. 2023. Rapid upwards

spread of non-native plants in mountains across continents. Nature Ecology & Evolution: 1-12 pp.

Lackschewitz, K. 1991. Vascular plants of west-central Montana-identification guidebook. Fort Collins, CO. U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 1 p.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

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Nomoto, H.A., and Alexander, J.M. 2021. Drivers of local extinction risk in alpine plants under warming climate. Ecol Lett 24 (6): 1157-1166 pp. 10.1111/ele.13727

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Pipp, A.K. 2017. Coefficient of Conservatism Rankings for the Flora of Montana: Part III. Helena, MT. Montana Natural Heritage Program. 107 p.

Pröbstl-Haider, U., Hödl, C., Ginner, K., and Borgwardt, F. 2021. Climate change: Impacts on outdoor activities in the summer and shoulder seasons. Journal of Outdoor Recreation and Tourism 34 10.1016/j.jort.2020.100344

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

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Thuiller, W., Lavorel, S., and Araújo, M.B. 2005. Niche properties and geographical extent as predictors of species sensitivity to climate change. Global Ecology and Biogeography 14 (4): 347-357 pp. 10.1111/j.1466-822X.2005.00162.x

2.4 Northwestern Groundsel (*Senecio conterminus*)

Conservation Categories

G3G4/S4 (Montana Natural Heritage Program, mtnhp.org, 02/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species occurs in western Canada and Montana, where it is known from roughly ten locations, including a single location within the plan area (Montana Natural Heritage Program, mtnhp.org, 01/2023). Species-specific surveys that consider the phenology, as well as the habitat associations of the species are lacking, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species occupies stony soil of fellfields, moraine, rock outcrops in the alpine zone.

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but suitable habitat is largely limited to established wilderness areas and due to the elevation, such habitats are not generally subject to traditional disturbances such as fires, beetles or blow downs, suggesting habitat conditions are likely stable.

Relevant life history traits and other information

None

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area.

The species has a somewhat narrow ecological tolerance and does not tolerate human disturbance (Pipp 2017). The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020).

Given the elevational distribution of the species, climate change may be the greatest threat as it may reduce the availability of suitable habitat conditions (Engler et al. 2011), as well as alter interactions with other species that shift elevational distribution (Alexander et al. 2015, Gómez et al. 2015, Iseli et al. 2023). Although the effects of climate change may take time to manifest (Nomoto and Alexander 2021,

Alexander et al. 2018), such changes are likely to present novel challenges for the species because climate change often has more significant impacts on rare species with a limited distribution (Thuiller et al. 2005). Moreover, climate change has the potential to increase interest in high mountain recreation (Pröbstl-Haider et al. 2021), which may increase risk from trampling as well invasive species (Pickering 2022).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is apparently secure within the state, and suitable habitat is available and widely distributed in the plan area.

Best available scientific information

Alexander, J.M., Chalmandrier, L., Lenoir, J., Burgess, T.I., Essl, F., Haider, S., Kueffer, C., McDougall, K., Milbau, A., Nunez, M.A., Pauchard, A., Rabitsch, W., Rew, L.J., Sanders, N.J., and Pellissier, L. 2018. Lags in the response of mountain plant communities to climate change. Global Change Biology 24 (2): 563-579 pp.

Alexander, J.M., Diez, J.M., and Levine, J.M. 2015. Novel competitors shape species' responses to climate change. Nature 525 (7570): 515-518 pp.

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

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Engler, R., Randin, C.F., Thuiller, W., Dullinger, S., Zimmermann, N.E., Araújo, M.B., Pearman, P.B., Le Lay, G., Piedallu, C., Albert, C.H., Choler, P., Coldea, G., De Lamo, X., Dirnböck, T., Gégout, J.-C., Gómez-García, D., Grytnes, J.-A., Heegaard, E., Høistad, F., Nogués-Bravo, D., Normand, S., Puşcaş, M., Sebastià, M.-T., Stanisci, A., Theurillat, J.-P., Trivedi, M.R., Vittoz, P., and Guisan, A. 2011. 21st century climate change threatens mountain flora unequally across Europe. Global Change Biology 17 (7): 2330-2341 pp.

Gómez, J.M., González-Megías, A., Lorite, J., Abdelaziz, M., and Perfectti, F. 2015. The silent extinction: climate change and the potential hybridization-mediated extinction of endemic high-mountain plants. Biodiversity and Conservation 24 (8): 1843-1857 pp.

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Iseli, E., Chisholm, C., Lenoir, J., Haider, S., Seipel, T., Barros, A., Hargreaves, A.L., Kardol, P., Lembrechts, J.J., McDougall, K., Rashid, I., Rumpf, S.B., Arévalo, J.R., Cavieres, L.A., Daehler, C.C., Dar, P.A., Endress, B.A., Jakobs, G., Jiménez, A., Küffer, C., Mihoc, M., Milbau, A., Morgan, J.W., Naylor, B.J., Pauchard, A., Ratier Backes, A., Reshi, Z.A., Rew, L.J., Righetti, D., Shannon, J.M., Valencia, G., Walsh, N., Wright, G.T., and Alexander, J.M. 2023. Rapid upwards

spread of non-native plants in mountains across continents. Nature Ecology & Evolution: 1-12 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Nomoto, H.A., and Alexander, J.M. 2021. Drivers of local extinction risk in alpine plants under warming climate. Ecol Lett 24 (6): 1157-1166 pp. 10.1111/ele.13727

Pickering, C.M. 2022. Mountain bike riding and hiking can contribute to the dispersal of weed seeds. Journal of Environmental Management 319: 1-10 pp.

Pipp, A.K. 2017. Coefficient of Conservatism Rankings for the Flora of Montana: Part III. Helena, MT. Montana Natural Heritage Program. 107 p.

Pröbstl-Haider, U., Hödl, C., Ginner, K., and Borgwardt, F. 2021. Climate change: Impacts on outdoor activities in the summer and shoulder seasons. Journal of Outdoor Recreation and Tourism 34 10.1016/j.jort.2020.100344

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

Thuiller, W., Lavorel, S., and Araújo, M.B. 2005. Niche properties and geographical extent as predictors of species sensitivity to climate change. Global Ecology and Biogeography 14 (4): 347-357 pp. 10.1111/j.1466-822X.2005.00162.x

2.5 Yellow Beardtongue (*Penstemon flavescens*)

Conservation Categories

G3/S3 (Montana Natural Heritage Program, mtnhp.org, 02/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is a regional endemic found only in northern Idaho and adjacent Montana, where it is limited to the western portion of the state, primarily in the Bitterroot Mountains. In the plan area, the species is known from five locations in the Bitterroot Mountains, but only two observations have been confirmed in the last 30 years (Montana Natural Heritage Program, mtnhp.org, 01/2023). Species-specific surveys that consider the phenology, as well as the habitat associations of the species are lacking, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area. The species is rhizomatous, so where found, it is often common.

Habitat description

The species occupies sparsely forested hillsides and wet alpine meadows.

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but modeled suitable habitat is widely available in the western extent of the plan area (Montana Natural Heritage Program 2020), including numerous locations of moderate suitability.

Relevant life history traits and other information

None

Relevant threats to populations occupying the plan area

The species is a local endemic, and range size is among the most consistent predictors of extinction risk (Chichorro et al. 2019). Moreover, populations that are geographically isolated, as populations of this species appear to be, are at greater risk for localized extinction (Dias 1996, Ovaskainen and Hanski 2004), particularly from stochastic events (Smith and Almeida 2020).

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no other known unique threats to the species within the plan area. The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020).

Given the elevational distribution of the species, climate change may be the greatest threat as it may reduce the availability of suitable habitat conditions (Engler et al. 2011), as well as alter interactions with other species that shift elevational distribution (Alexander et al. 2015, Gómez et al. 2015, Iseli et al. 2023). Although the effects of climate change may take time to manifest (Nomoto and Alexander 2021, Alexander et al. 2018), such changes are likely to present novel challenges for the species because climate change often has more significant impacts on rare species with a limited distribution (Thuiller et al. 2005). Moreover, climate change has the potential to increase interest in high mountain recreation (Pröbstl-Haider et al. 2021), which may increase risk from trampling as well invasive species (Pickering 2022).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is globally vulnerable but tends to be common where found and habitat is available and widely distributed in the western extent of the plan area (Montana Natural Heritage Program 2020).

Best available scientific information

Alexander, J.M., Chalmandrier, L., Lenoir, J., Burgess, T.I., Essl, F., Haider, S., Kueffer, C., McDougall, K., Milbau, A., Nunez, M.A., Pauchard, A., Rabitsch, W., Rew, L.J., Sanders, N.J., and Pellissier, L. 2018. Lags in the response of mountain plant communities to climate change. Global Change Biology 24 (2): 563-579 pp.

Alexander, J.M., Diez, J.M., and Levine, J.M. 2015. Novel competitors shape species' responses to climate change. Nature 525 (7570): 515-518 pp.

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Engler, R., Randin, C.F., Thuiller, W., Dullinger, S., Zimmermann, N.E., Araújo, M.B., Pearman, P.B., Le Lay, G., Piedallu, C., Albert, C.H., Choler, P., Coldea, G., De Lamo, X., Dirnböck, T., Gégout, J.-C., Gómez-García, D., Grytnes, J.-A., Heegaard, E., Høistad, F., Nogués-Bravo, D., Normand, S., Puşcaş, M., Sebastià, M.-T., Stanisci, A., Theurillat, J.-P., Trivedi, M.R., Vittoz, P., and Guisan, A. 2011. 21st century climate change threatens mountain flora unequally across Europe. Global Change Biology 17 (7): 2330-2341 pp.

Gómez, J.M., González-Megías, A., Lorite, J., Abdelaziz, M., and Perfectti, F. 2015. The silent extinction: climate change and the potential hybridization-mediated extinction of endemic high-mountain plants. Biodiversity and Conservation 24 (8): 1843-1857 pp.

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Iseli, E., Chisholm, C., Lenoir, J., Haider, S., Seipel, T., Barros, A., Hargreaves, A.L., Kardol, P., Lembrechts, J.J., McDougall, K., Rashid, I., Rumpf, S.B., Arévalo, J.R., Cavieres, L.A., Daehler, C.C., Dar, P.A., Endress, B.A., Jakobs, G., Jiménez, A., Küffer, C., Mihoc, M., Milbau, A., Morgan, J.W., Naylor, B.J., Pauchard, A., Ratier Backes, A., Reshi, Z.A., Rew, L.J., Righetti, D., Shannon, J.M., Valencia, G., Walsh, N., Wright, G.T., and Alexander, J.M. 2023. Rapid upwards spread of non-native plants in mountains across continents. Nature Ecology & Evolution: 1-12 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

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Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Smith, K.G., and Almeida, R.J. 2020. When are extinctions simply bad luck? Rarefaction as a framework for disentangling selective and stochastic extinctions. Journal of Applied Ecology 57 (1): 101-110 pp. https://doi.org/10.1111/1365-2664.13510

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

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3. Moist Meadow

3.1 Hiker's Gentian (*Gentianopsis simplex*)

Conservation Categories

G3/S3 (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is native to the western United States. In Montana, the species is primarily distributed in the southwestern portion of the state (Montana Natural Heritage Program, mtnhp.org, 01/2023). In the plan area the species is known from a single small region, as the plan area may represent the extreme northeastern distribution of the species; however species-specific surveys that consider the phenology, as well as the habitat associations of the species, are lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

Found in montane and subalpine zones, the species occupies wet meadows and riparian habitats.

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but modelled suitable habitat is limited to the southwestern extent (Montana Natural Heritage Program 2020).

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

The population within the plan area is at the edge of the species range, which may create challenges for persistence when populations are small, or habitat limited (Burgess et al. 2020). The species is known from a single region and modelled habitat within the plan area is limited to the southwestern extent. Small, isolated populations are at greater risk for localized extinction (Dias 1996, Ovaskainen and Hanski 2004), particularly from stochastic events (Smith and Almeida 2020).

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no other known unique threats to the species within the plan area. The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation,

and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

Yes

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

Yes

Rational for determination

The species is known from a single region in the southwestern extent of the plan area, which also includes the only alternative suitable habitat (Montana Natural Heritage Program 2020). Species with a limited distribution within the plan area may be more likely to experience localized extirpation (Smith and Almeida 2020).

Best available scientific information

Burgess, M.D., Eaton, M.A., and Gregory, R.D. 2020. A review of spatial patterns across species ranges to aid the targeting of conservation interventions. Biology Conservation 251

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Dias, P.C. 1996. Sources and sinks in population biology. Trends in Ecology & Evolution 11 (8): 326-330 pp. https://doi.org/10.1016/0169-5347(96)10037-9

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Montana Natural Heritage Program. 2020. Gentianopsis simplex (Hiker's Gentian) predicted suitable habitat modeling. Helena, MT. Montana Natural Heritage Program. 17 p.

Ovaskainen, O., and Hanski, I. 2004. Chapter 4: Metapopulation dynamics in highly fragmented landscapes. Chapter 4. In Hanski, Ilkka and Gaggiotti, Oscar E., eds., Ecology, genetics and evolution of metapopulations. Burlington, MA: Elsevier Science. 73-103 pp. https://doi.org/10.1016/B978-012323448-3/50006-4

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Smith, K.G., and Almeida, R.J. 2020. When are extinctions simply bad luck? Rarefaction as a framework for disentangling selective and stochastic extinctions. Journal of Applied Ecology 57 (1): 101-110 pp. https://doi.org/10.1111/1365-2664.13510

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

3.2 Oregon Bluebells (*Mertensia bella*)

Conservation Categories

G4/S2S3, Regional Forester Sensitive Species (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going within the plan area.

The species has a limited distribution in Oregon and Idaho and known from one location in the southwest portion of Montana, and three other locations on the extreme western extent of the plan area (Montana Natural Heritage Program, mtnhp.org, 01/2023). Species-specific surveys that consider the phenology, as well as the habitat associations of the species are largely lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species occurs in montane to subalpine habitat, and generally occurs in forest opening, including clearlcuts and roadcuts, generally in areas with high soil moisture (Lichthardt 1992).

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but suitable habitat is available in the western extent of the plan area, where the species is most likely to occur.

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

The species is a regional endemic, and range size is among the most consistent predictors of extinction risk (Chichorro et al. 2019). Moreover, populations that are geographically isolated, as populations of this species appear to be, are at greater risk for localized extinction (Dias 1996, Ovaskainen and Hanski 2004), particularly from stochastic events (Smith and Almeida 2020).

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no other known unique threats to the species within the plan area. The species has a narrow ecological tolerance and may tolerate limited human disturbance (Pipp 2017). The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

Yes

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

Yes

Rational for determination

The species is known from one small area in the plan area and alternative locations with suitable habitat that overlap the known range of the species are limited, suggesting the population within the plan area is likely small. Small populations are more likely to face localized extirpation, particularly when isolated from other source populations (Dias 1996, Ovaskainen and Hanski 2004, Smith and Almeida 2020).

Best available scientific information

Chichorro, F., Juslén, A., and Cardoso, P. 2019. A review of the relation between species traits and extinction risk. Biological Conservation 237: 220-229 pp. https://doi.org/10.1016/j.biocon.2019.07.001

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Dias, P.C. 1996. Sources and sinks in population biology. Trends in Ecology & Evolution 11 (8): 326-330 pp. https://doi.org/10.1016/0169-5347(96)10037-9

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lichthardt, J. 1992. Report on the conservation status of Mertensia bella (oregon bluebells) in Idaho. Boise, Idaho. Idaho Department of Fish and Game. 15 p.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Ovaskainen, O., and Hanski, I. 2004. Chapter 4: Metapopulation dynamics in highly fragmented landscapes. Chapter 4. In Hanski, Ilkka and Gaggiotti, Oscar E., eds., Ecology, genetics and evolution of metapopulations. Burlington, MA: Elsevier Science. 73-103 pp. https://doi.org/10.1016/B978-012323448-3/50006-4

Pipp, A.K. 2017. Coefficient of Conservatism Rankings for the Flora of Montana: Part III. Helena, MT. Montana Natural Heritage Program. 107 p.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Smith, K.G., and Almeida, R.J. 2020. When are extinctions simply bad luck? Rarefaction as a framework for disentangling selective and stochastic extinctions. Journal of Applied Ecology 57 (1): 101-110 pp. https://doi.org/10.1111/1365-2664.13510

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

3.3 Pale Larkspur (*Delphinium glaucum*)

Conservation Categories

G5/S1 (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is broadly distributed across much of the western United States and Canada. In Montana, the species is known from fewer than 20 locations, primarily in the southwest portion of the state (Montana Natural Heritage Program, mtnhp.org, 01/2023). The species is known from three locations in the extreme western portion of the plan area, but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are largely lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species occupies open conifer forests and wet meadow in the upper montane and lower subalpine region.

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but the habitat types the species is generally associated with are widely distributed.

Relevant life history traits and other information

There is considerable uncertainty about the rarity of the species in the state due to discrepancies in the number of herbarium specimens identified as representing the species (Montana Natural Heritage Program, mtnhp.org, 01/2023) an issue that is not uncommon in *Delphinium* (Marr et al. 2011).

The species is frequently visited by bumble bees (Pengelly and Cartar 2011), making it a potentially important species for pollinator populations (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The species has a somewhat narrow ecological tolerance but does tolerate human disturbance that replicates natural disturbance (Pipp 2017), including logging (Pengelly and Cartar 2011). The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation;

invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area, potentially due to issues of identification (Montana Natural Heritage Program, mtnhp.org, 01/2023). The species is globally secure and the habitat the species occupies is widely distributed in the plan area.

Best available scientific information

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Marr, K.L., Hebda, R.J., and MacKenzie, W.H. 2011. Alpine plant range extensions for northern British Columbia, including two species new to the province. The Canadian Field-Naturalist 125 (3): 227-234 pp.

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Pengelly, C.J., and Cartar, R.V. 2011. Effect of boreal forest logging on nectar production of four understory herbs. Forest Ecology and Management 261 (11): 2068-2074 pp. 10.1016/j.foreco.2011.02.032

Pipp, A.K. 2017. Coefficient of Conservatism Rankings for the Flora of Montana: Part III. Helena, MT. Montana Natural Heritage Program. 107 p.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

3.4 Straightbeak Buttercup (*Ranunculus orthorhynchus*)

Conservation Categories

G5/S1S2 (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is broadly distributed from Alaska to California and east to Montana and Wyoming. In Montana, the species is known from roughly a dozen observations. In the plan area, there is only a single observation in the last forty years (Montana Natural Heritage Program, mtnhp.org, 01/2023), but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

This species occurs primarily occurs in moist montane meadows (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but montane meadows are well distributed within the plan area.

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is globally secure.

Best available scientific information

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

4. Mesic Forest

4.1 Brown-Eyed Wolf Lichen (*Letharia columbiana*)

Conservation Categories

G3G5/S2 (Montana Natural Heritage Program, mtnhp.org, 02/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going. Surveys of suitable habitat within the plan area are lacking (Jovan et al. 2021), which may substantially affect the known distribution and abundance of lichen species (Hutchinson et al. 2002).

The species occurs from British Columbia and Alberta south to Wyoming. In Montana, there are more than 100 documented observations of the species in the western portion of the state, including roughly ten within the plan area (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

Occurs in subalpine forests, but occasionally in low-elevation forests.

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but the forest types that the species occupies are common and widely dispersed.

Relevant life history traits and other information

As a group, lichen generally have limited dispersal capability which may extenuate the effects of fragmentation (Bartemucci et al. 2022).

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area.

World-wide, the primary threats to lichen species include habitat degradation, fragmentation, and loss; pollution; and climate change (Lesica et al. 1991, Conti and Cecchetti 2001, Bergamini et al. 2005, Ellis et al. 2007, Geiser and Neitlich 2007, Scheidegger and Werth 2009, Cameron, Goudie, et al. 2013, Cameron, Neily, et al. 2013, McMurray et al. 2015, Ellis 2019, Allen et al. 2019).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. Suitable habitat is readily available and widely distributed throughout the plan area.

Best available scientific information

Allen, J.L., McMullin, R.T., Tripp, E.A., and Lendemer, J.C. 2019. Lichen conservation in North America: a review of current practices and research in Canada and the United States. Biodiversity and Conservation 28 (12): 3103-3138 pp.

Bartemucci, P., Lilles, E., and Gauslaa, Y. 2022. Silvicultural strategies for lichen conservation: Smaller gaps and shorter distances to edges promote recolonization. Ecosphere 13 (1): 1-20 pp.

Bergamini, A., Scheidegger, C., Stofer, S., Palmira, C., Davey, S., Dietrich, M., Dubs, F., Farkas, E., Groner, U., Kärkkäinen, K., Keller, C., Lökös, L., Lommi, S., Máguas, C., Mitchell, R., Pinho, P., Rico, V.J., Aragón, G., Truscott, A.-M., Wolseley, P., and Watt, A. 2005. Performance of macrolichens and lichen genera as indicators of lichen species richness and composition. Conservation Biology 19 (4): 1051-1062 pp.

Cameron, D.R., Goudie, I., and Richardson, D. 2013. Habitat loss exceeds habitat regeneration for an IUCN flagship lichen epiphyte: Erioderma pedicellatum. Canadian Journal of Forest Research 43 (11): 1075-1080 pp.

Cameron, R.P., Neily, T., and Clapp, H. 2013. Forest harvesting impacts on mortality of an endangered lichen at the landscape and stand scales. Canadian Journal of Forest Research 43 (5): 507-511 pp.

Conti, M.E., and Cecchetti, G. 2001. Biological monitoring: lichens as bioindicators of air pollution assessment—a review. Environmental pollution 114 (3): 471-492 pp.

Ellis, C. 2019. Climate Change, Bioclimatic Models and the Risk to Lichen Diversity. Diversity 11 (4) 10.3390/d11040054

Ellis, C.J., Coppins, B.J., Dawson, T.P., and Seaward, M.R.D. 2007. Response of British lichens to climate change scenarios: Trends and uncertainties in the projected impact for contrasting biogeographic groups. Biological Conservation 140 (3): 217-235 pp.

Geiser, L.H., and Neitlich, P.N. 2007. Air pollution and climate gradients in western Oregon and Washington indicated by epiphytic macrolichens. Environmental Pollution 145 (1): 203-218 pp.

Hutchinson, J., McCune, B., and Berryman, S. 2002. Concentration of rare epiphytic lichens along large streams in a mountainous watershed in Oregon, U.S.A. The Bryologist 105 (3): 439-450 pp. 10.1639/0007-2745(2002)105[0439:Corela]2.0.Co;2

Jovan, S., Haldeman, M., Will-Wolf, S., Dillman, K., Geiser, L., Thompson, J., Stone, D., and Hollinger, J. 2021. National atlas of epiphytic lichens in forested habitats of the United States. Portland, OR. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 96 p.

Lesica, P., McCune, B., Cooper, S.V., and Shic Hong, W. 1991. Differences in lichen and bryophyte communities between old-growth and managed second-growth forests in the Swan Valley, Montana. Canadian Journal of Botany 69: 1745-1755 pp.

McMurray, J.A., Roberts, D.W., and Geiser, L.H. 2015. Epiphytic lichen indication of nitrogen deposition and climate in the northern rocky mountains, USA. Ecological Indicators 49: 154-161 pp. 10.1016/j.ecolind.2014.10.015

Scheidegger, C., and Werth, S. 2009. Conservation strategies for lichens: insights from population biology. Fungal Biology Reviews 23 (3): 55-66 pp. 10.1016/j.fbr.2009.10.003

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

4.2 Bryophytes of Mesic Forests

Conservation Categories

Douglas' Neckera Moss (*Neckera douglasii*) – G4G5/S1

Giant Golden Moss (*Homalothecium megaptilum*) – G4/S1

Glaucous Dogtooth Moss (*Cynodontium glaucescens*) – G3G/SNR

Lyall's Polytrichum Moss (*Meiotrichum lyallii*) – G3G5/S1

Umbrella Moss (*Leucolepis acanthoneuron*) – G4G5/S1

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the representative species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates (Thompson 2004) are not known to be on-going.

Basic data on the distribution and abundance of bryophytes species is often limited (Cornwell et al. 2019) largely due to the challenges of sampling bryophytes (Frego 2007). In Montana, which has a relatively high diversity of species (508 species), the lack of systematic surveys, including within the plan area, may explain why nearly 10% of species are known from a single location (Elliott and Pipp 2019).

Population trend in the plan area

There are no known specific population trends for the representative species in Montana or the plan area.

Habitat description

Species maybe present in a variety of mesic forest types within the plan area where microclimatic conditions and appropriate substrates are available (Lesica et al. 1991, Rambo and Muir 1998, Mills and Macdonald 2005, Dynesius et al. 2008, Schmalholz and Hylander 2011, Schmalholz et al. 2011). In general, mesic forest associated species prefer cool, moist microsites and are located on litter, rock, soil, tree bases, down logs, and in some cases tree branches (Elliott and Pipp 2019).

Habitat trend in the plan area

Historic forest management has in some cases degraded habitat conditions that may support forest dependent bryophytes by altering microclimate and the availability of the woody debris (Lesica et al. 1991, Rambo and Muir 1998). Bryophytes communities are resilient to forest disturbance, but the effects are disturbance and species specific, and are affected by the availability of source populations in the surrounding landscape (Schmalholz and Hylander 2011, Schmalholz et al. 2011, Rudolphi and Gustafsson 2011, Paquette et al. 2016, Boudreault et al. 2018, Jagodziński et al. 2018). Forested habitats remain abundant within the plan area, and the availability of suitable substrates within managed forests is likely increasing with the implementation of conservation measures for soil and down-woody debris (Fenton and Frego 2005, Dynesius et al. 2008), as well as riparian area management (Hylander et al. 2002, Roper et al. 2019, Roper et al. 2018).

Relevant life history traits and other information

Bryophytes differ in the timing and expression of life cycles, which may affect sensitivity to certain stressors, but all species are dependent on the availability and function of suitable habitat conditions that support the species' life cycle.

Relevant threats to populations occupying the plan area

Beyond threats documented across the specific ranges of the species considered here (NatureServe, natureserve.org, 01/2023), there are no known unique threats within the plan area.

In general, bryophytes are affected by habitat destruction and fragmentation, air pollution, changes in water distribution and availability, and changing temperatures (Hylander et al. 2002, Söderström 2006, Root and McCune 2010, Oishi and Morimoto 2013, He et al. 2016, Monteiro and Vieira 2017, Vanneste et al. 2017). Bryophytes are sensitive to changes in microhabitat conditions that affect either substrate availability or microclimate conditions (Lesica et al. 1991, Rambo and Muir 1998, Mills and Macdonald 2005, Dynesius et al. 2008, Schmalholz and Hylander 2011, Schmalholz et al. 2011).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the life-histories as well as the distribution and abundance of the populations to substantiate the risk to the species within the plan area. Suitable habitat is abundant and widely distributed within the plan area and likely either stabilizing or improving due to improved management.

Best available scientific information

Boudreault, C., Paquette, M., Fenton, N.J., Pothier, D., and Bergeron, Y. 2018. Changes in bryophytes assemblages along a chronosequence in eastern boreal forest of Quebec. Canadian Journal of Forest Research 48 (7): 821-834 pp. 10.1139/cjfr-2017-0352

Cornwell, W.K., Pearse, W.D., Dalrymple, R.L., and Zanne, A.E. 2019. What we (don't) know about global plant diversity. Ecography 42 (11): 1819-1831 pp.

Dynesius, M., Åström, M., and Nilsson, C. 2008. Microclimatic buffering by logging residues and forest edges reduces clear-cutting impacts on forest bryophytes. Applied Vegetation Science 11 (3): 345-354 pp.

Elliott, J.C., and Pipp, A.K. 2019. History, Biogeography, and Species of Montana Mosses (1880–2018). Evansia 36(2) (2): 39-58 pp. https://doi.org/10.1639/0747-9859-36.2.39

Fenton, N.J., and Frego, K.A. 2005. Bryophyte (moss and liverwort) conservation under remnant canopy in managed forests. Biological Conservation 122 (3): 417-430 pp.

Frego, K.A. 2007. Bryophytes as potential indicators of forest integrity. Forest Ecology and Management 242 (1): 65-75 pp.

He, X., He, K.S., and Hyvönen, J. 2016. Will bryophytes survive in a warming world? Perspectives in Plant Ecology, Evolution and Systematics 19: 49-60 pp.

Hylander, K., Jonsson, B.G., and Nilsson, C. 2002. Evaluating Buffer Strips Along Boreal Streams Using Bryophytes as Indicators. Ecological Applications 12 (3): 797-806 pp. 10.1890/1051-0761(2002)012[0797:Ebsabs]2.0.Co;2

Jagodziński, A.M., Wierzcholska, S., Dyderski, M.K., Horodecki, P., Rusińska, A., Gdula, A.K., and Kasprowicz, M. 2018. Tree species effects on bryophyte guilds on a reclaimed post-mining site. Ecological Engineering 110: 117-127 pp.

Lesica, P., McCune, B., Cooper, S.V., and Shic Hong, W. 1991. Differences in lichen and bryophyte communities between old-growth and managed second-growth forests in the Swan Valley, Montana. Canadian Journal of Botany 69: 1745-1755 pp.

Mills, S.E., and Macdonald, S.E. 2005. Factors influencing bryophyte assemblage at different scales in the western Canadian boreal forest. The Bryologist 108(1) (1): 86-100 pp. 10.1639/0007-2745(2005)108[86:Fibaad]2.0.Co;2

Monteiro, J., and Vieira, C. 2017. Determinants of stream bryophyte community structure: bringing ecology into conservation. Freshwater Biology 62 (4): 695-710 pp. 10.1111/fwb.12895

Oishi, Y., and Morimoto, Y. 2013. Identifying indicator species for bryophyte conservation in fragmented forests. Landscape and Ecological Engineering 12 (1): 107-114 pp. 10.1007/s11355-013-0220-0

Paquette, M., Boudreault, C., Fenton, N., Pothier, D., and Bergeron, Y. 2016. Bryophyte species assemblages in fire and clear-cut origin boreal forests. Forest Ecology and Management 359: 99-108 pp. 10.1016/j.foreco.2015.09.031

Rambo, T.R., and Muir, P.S. 1998. Bryophyte species associations with coarse woody debris and stand ages in Oregon. The Bryologist 101 (3): 366-376 pp.

Root, H.T., and McCune, B. 2010. Forest floor lichen and bryophyte communities in thinned Pseudotsuga menziesii - Tsuga heterophylla forests. The Bryologist 113(3) (3): 619-630 pp. 10.1639/0007-2745-113.3.619

Roper, B.B., Capurso, J.M., Paroz, Y., and Young, M.K. 2018. Conservation of aquatic biodiversity in the context of multiple-use management on National Forest System lands. Fisheries 43 (9): 396-405 pp.

Roper, B.B., Saunders, W.C., and Ojala, J.V. 2019. Did changes in western federal land management policies improve salmonid habitat in streams on public lands within the Interior Columbia River Basin? Environmental Monitoring and Assessment 191 (9): 574 p.

Rudolphi, J., and Gustafsson, L. 2011. Forests regenerating after clear-cutting function as habitat for bryophyte and lichen species of conservation concern. PLoS One 6 (4): 1-9 pp.

Schmalholz, M., and Hylander, K. 2011. Microtopography creates small-scale refugia for boreal forest floor bryophytes during clear-cut logging. Ecography 34 (4): 637-648 pp. 10.1111/j.1600-0587.2010.06652.x

Schmalholz, M., Hylander, K., and Frego, K. 2011. Bryophyte species richness and composition in young forests regenerated after clear-cut logging versus after wildfire and spruce budworm outbreak. Biodiversity and Conservation 20 (12): 2575-2596 pp. 10.1007/s10531-011-0092-2

Söderström, L. 2006. Conservation Biology of Bryophytes. Lindbergia 31 (1/2): 24-32 pp. http://www.jstor.org/stable/20150204

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

Vanneste, T., Michelsen, O., Graae, B.J., Kyrkjeeide, M.O., Holien, H., Hassel, K., Lindmo, S., Kapás, R.E., and De Frenne, P. 2017. Impact of climate change on alpine vegetation of mountain summits in Norway. Ecological Research 32 (4): 579-593 pp. 10.1007/s11284-017-1472-1

4.3 Budding Tube Lichen (*Hypogymnia enteromorpha*)

Conservation Categories

G5/S2 (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going. Surveys of suitable habitat within the plan area are lacking (Jovan et al. 2021), which may substantially affect the known distribution and abundance of lichen species (Hutchinson et al. 2002).

The species occurs from Alaska to California along the coast and separately in the interior mountain ranges of Idaho and Montana. In Montana, there fewer than 10 documented observations of the species in the western portion of the state, including two within the plan area (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

Occupies open or partially shaded forest habitats where coniferous bark substates are available.

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but the forest types that the species occupies are common and widely dispersed.

Relevant life history traits and other information

As a group, lichen generally have limited dispersal capability which may extenuate the effects of fragmentation (Bartemucci et al. 2022).

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area.

World-wide, the primary threats to lichen species include habitat degradation, fragmentation, and loss; pollution; and climate change (Lesica et al. 1991, Conti and Cecchetti 2001, Bergamini et al. 2005, Ellis et al. 2007, Geiser and Neitlich 2007, Scheidegger and Werth 2009, Cameron, Goudie, et al. 2013, Cameron, Neily, et al. 2013, McMurray et al. 2015, Ellis 2019, Allen et al. 2019).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. Suitable habitat is readily available and widely distributed throughout the plan area.

Best available scientific information

Allen, J.L., McMullin, R.T., Tripp, E.A., and Lendemer, J.C. 2019. Lichen conservation in North America: a review of current practices and research in Canada and the United States. Biodiversity and Conservation 28 (12): 3103-3138 pp.

Bartemucci, P., Lilles, E., and Gauslaa, Y. 2022. Silvicultural strategies for lichen conservation: Smaller gaps and shorter distances to edges promote recolonization. Ecosphere 13 (1): 1-20 pp.

Bergamini, A., Scheidegger, C., Stofer, S., Palmira, C., Davey, S., Dietrich, M., Dubs, F., Farkas, E., Groner, U., Kärkkäinen, K., Keller, C., Lökös, L., Lommi, S., Máguas, C., Mitchell, R., Pinho, P., Rico, V.J., Aragón, G., Truscott, A.-M., Wolseley, P., and Watt, A. 2005. Performance of macrolichens and lichen genera as indicators of lichen species richness and composition. Conservation Biology 19 (4): 1051-1062 pp.

Cameron, D.R., Goudie, I., and Richardson, D. 2013. Habitat loss exceeds habitat regeneration for an IUCN flagship lichen epiphyte: Erioderma pedicellatum. Canadian Journal of Forest Research 43 (11): 1075-1080 pp.

Cameron, R.P., Neily, T., and Clapp, H. 2013. Forest harvesting impacts on mortality of an endangered lichen at the landscape and stand scales. Canadian Journal of Forest Research 43 (5): 507-511 pp.

Conti, M.E., and Cecchetti, G. 2001. Biological monitoring: lichens as bioindicators of air pollution assessment—a review. Environmental pollution 114 (3): 471-492 pp.

Ellis, C. 2019. Climate Change, Bioclimatic Models and the Risk to Lichen Diversity. Diversity 11 (4) 10.3390/d11040054

Ellis, C.J., Coppins, B.J., Dawson, T.P., and Seaward, M.R.D. 2007. Response of British lichens to climate change scenarios: Trends and uncertainties in the projected impact for contrasting biogeographic groups. Biological Conservation 140 (3): 217-235 pp.

Geiser, L.H., and Neitlich, P.N. 2007. Air pollution and climate gradients in western Oregon and Washington indicated by epiphytic macrolichens. Environmental Pollution 145 (1): 203-218 pp.

Hutchinson, J., McCune, B., and Berryman, S. 2002. Concentration of rare epiphytic lichens along large streams in a mountainous watershed in Oregon, U.S.A. The Bryologist 105 (3): 439-450 pp. 10.1639/0007-2745(2002)105[0439:Corela]2.0.Co;2

Jovan, S., Haldeman, M., Will-Wolf, S., Dillman, K., Geiser, L., Thompson, J., Stone, D., and Hollinger, J. 2021. National atlas of epiphytic lichens in forested habitats of the United States. Portland, OR. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 96 p.

Lesica, P., McCune, B., Cooper, S.V., and Shic Hong, W. 1991. Differences in lichen and bryophyte communities between old-growth and managed second-growth forests in the Swan Valley, Montana. Canadian Journal of Botany 69: 1745-1755 pp.

McMurray, J.A., Roberts, D.W., and Geiser, L.H. 2015. Epiphytic lichen indication of nitrogen deposition and climate in the northern rocky mountains, USA. Ecological Indicators 49: 154-161 pp. 10.1016/j.ecolind.2014.10.015

Scheidegger, C., and Werth, S. 2009. Conservation strategies for lichens: insights from population biology. Fungal Biology Reviews 23 (3): 55-66 pp. 10.1016/j.fbr.2009.10.003

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

4.4 Cascade Reedgrass (*Calamagrostis tweedyi*)

Conservation Categories

G3/S3 (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is found in the Pacific Northwest and represented by geographically separated population centers, two in Washington, one in southern Idaho, one in Ravalli County Montana, and the population center found within the plan area (Rust 2017). The species is restricted to the western extent of the plan area, but is widely dispersed, with roughly twenty populations (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species occurs in montane and subalpine moist meadows and coniferous forests from 900–2000 m in elevation (Montana Natural Heritage Program, mtnhp.org, 01/2023) and is often associated with northwest- to northeast-facing slopes (Rust 2017). Wildfire plays a substantial role in the distribution and life history of the species, with the species occurring more regularly in areas with recent burn history (Rust 2017, Moseley 1988). Although presumably a fire dependent species, the species appears resilient to changes in forest succession (Rust 2017), persisting even under closed canopy (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but modeled suitable habitat, including substantial areas of optimal habitat, is common within the plan area and widely available (Montana Natural Heritage Program 2020).

Relevant life history traits and other information

The species may have limited dispersal capability due to either limited seed viability or seedling establishment (Rust 2017).

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. However, populations that are geographically isolated, as populations of this species appear to be, are at greater risk for localized

extinction (Dias 1996, Ovaskainen and Hanski 2004), particularly from stochastic events (Smith and Almeida 2020).

The species has a moderate ecological tolerance, and is capable of persisting, but not necessarily thriving, in locations with human disturbance (Pipp 2017). The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020). The species appears highly adaptable to a variety of local habitat conditions (Rust 2017) but may ultimately be limited in distribution and abundance by the presence of fire on the landscape (Moseley 1988).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

Yes

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

The species is found in many locations within the western extent of the plan area (Montana Natural Heritage Program, mtnhp.org, 01/2023), and when found the species tends to be locally abundant (Rust 2017). Suitable habitat is readily available and widely distributed across the plan area (Montana Natural Heritage Program 2020).

Best available scientific information

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Dias, P.C. 1996. Sources and sinks in population biology. Trends in Ecology & Evolution 11 (8): 326-330 pp. https://doi.org/10.1016/0169-5347(96)10037-9

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Montana Natural Heritage Program. 2020. Calamagrostis tweedyi (Cascade reedgrass) Predicted Suitable Habitat Modeling. Helena, MT. Montana Natural Heritage Program. 17 p.

Moseley, R.K. 1988. Field investigation of calamagrostis tweedyi, a Region 4 sensitive species, on the Payette National Forest. December. Boise, ID. Idaho Department of Fish and Game, Natural Heritage Section, Nongame Wildlife/Endangered Species Program, Bureau of Wildlife. Boise, ID

Ovaskainen, O., and Hanski, I. 2004. Chapter 4: Metapopulation dynamics in highly fragmented landscapes. Chapter 4. In Hanski, Ilkka and Gaggiotti, Oscar E., eds., Ecology, genetics and evolution of metapopulations. Burlington, MA: Elsevier Science. 73-103 pp. https://doi.org/10.1016/B978-012323448-3/50006-4

Pipp, A.K. 2017. Coefficient of Conservatism Rankings for the Flora of Montana: Part III. Helena, MT. Montana Natural Heritage Program. 107 p.

Rust, S.K. 2017. Notes on the Ecology of Tweedy's Reedgrass. Sage Notes, 39 (4): 1,4,5 pp.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Smith, K.G., and Almeida, R.J. 2020. When are extinctions simply bad luck? Rarefaction as a framework for disentangling selective and stochastic extinctions. Journal of Applied Ecology 57 (1): 101-110 pp. https://doi.org/10.1111/1365-2664.13510

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

4.5 Clustered Lady's-slipper (*Cypripedium fasciculatum*)

Conservation Categories

G4/S3, Regional Forester Sensitive Species, Species of Conservation Concern on neighboring Forest (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable abundance estimates for the species (Thompson 2004) are not known to be on-going. At occupied sites in Montana the species often occurs in dense populations (Lichthardt 2003), and since 2000, documented occupancy at multiple sites within the plan area have exceeded 50 individuals with at least one exceeding 200, but most observations were few than 50 individuals (Montana Natural Heritage Program, mtnhp.org, 01/2023).

The species is native to much of the western United States, where populations are often highly disjunct (Kaye and Cramer 2005, Lichthardt 2003, Kaye et al. 2016). In Montana, the species is largely limited to the northwestern portion of the state, with dozens of known locations within the western extent of the plan area (Montana Natural Heritage Program, mtnhp.org, 01/2023). Due to a lack of surveys prior to the early 1990s, the species was largely unknown in the state (Lichthardt 2003). Species-specific surveys that consider the phenology, as well as the habitat associations of the species, are limited within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022), including this species (Ingegno 2017). Many of the known sites within the plan area were initially discovered during pre-timber harvest surveys, and some populations may be more extensive than currently known (Lichthardt 2003).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area, but the species has been regularly documented since the early 1990s, including multiple interannual observations at the same site (Montana Natural Heritage Program, mtnhp.org, 01/2023). Population viability analysis suggests that populations exceeding fifty individuals have roughly a 10% extinction probability, with a near zero probability of extinction for populations exceeding one hundred individuals (Kaye et al. 2016, Kaye et al. 2019). Thresholds that are surpassed at several sites within the plan area (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Habitat description

The species is found in Douglas fir or grand fir, ninebark habitats (Lichthardt 2003)(Montana Natural Heritage Program, mtnhp.org, 01/2023), where it tends to occupy north facing slopes with >60% canopy cover (Kaye and Cramer 2005) as the species is sensitive to solar radiation (Vance and Lake 2002). In addition to requiring shaded environments, the mycorrhizal fungi and pollinator associates for the species rely on local habitat conditions that include a rich organic layer (Seevers and Lang 1998), although the such conditions may be common (Lichthardt 2003).

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but Douglas fir and grand fir forests are common and suitable habitat is widely available in much of the western extent of the plan area (Montana Natural Heritage Program 2020).

Relevant life history traits and other information

The species has a slow life history strategy (Lichthardt 2003), living to at least 30 years (Harrod 1994) and foregoing vegetative regrowth if defoliated by disturbance (Kaye and Cramer 2005), although the effects likely vary by disturbance intensity (Lichthardt 2003, Seevers and Lang 1998). The species propagates locally through rhizomatous shoots, but relies on sexual reproduction for long distance dispersal (Kaye and Cramer 2005). As a non-reward pollinator dependent on *Diapriid* wasps, the species can produce few fruits, with limited dispersal and low seedling establishment (Kaye and Cramer 2005, Lichthardt 2003, Lipow et al. 2002).

All orchids, including this species (Shefferson et al. 2005), are dependent at some point in their life cycle on mycorrhizae, or fungal symbionts, that help acquire nutrients (Kaye and Cramer 2005). The distribution and abundance of orchid species is closely tied to the spatial distribution and abundance of mycorrhizal fungi associates, which are not evenly distributed even in suitable macrohabitats (Shefferson et al. 2005, McCormick and Jacquemyn 2013). Many occurrences of the species in Montana are associated with locations where the fungi *Armillaria* spp. or *Phaeolus* spp. have killed Douglas-fir (Lichthardt 2003).

Despite distant and disjunct populations, there is little evidence of genetic drift or population bottlenecks in the species (Kaye and Cramer 2005).

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020), including orchids (Fay 2018).

In general, the species has a narrow ecological tolerance and does not tolerate human disturbance (Pipp 2017), particularly activities that disturb soil and litter or canopy closure, including high intensity fire and timber harvest (Kaye and Cramer 2005, Harrod 1994, Lichthardt 2003). The species relationship with fire is complex, as abundances may reduce dramatically immediately following fire, but if suitable habitat is available the species can quickly repopulation and may even exceed previous population abundance (Lichthardt 2003).

The documented loss of the species in some low elevation sites within its known range, may suggest sensitivity to climate change (Kaye et al. 2016, Smallwood and Trapnell 2022), possibly due to limited phenological plasticity, as demonstrated in other orchids (Willis et al. 2008). However, climate change may ultimately increase the availability of suitable habitat for the species (Smallwood and Trapnell 2022).

Although not know to be affecting orchid populations within the plan area, orchids are sometimes threatened by exploitation from collectors, which in some cases has occurred for centuries (Case et al. 1998).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

Yes

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

The species is apparently secure globally, and suitable habitat is readily available and widely distributed in the plan area (Montana Natural Heritage Program 2020). There are no population trends for the species, but the species is regularly detected within the plan area, and several populations exceed 50 individuals with most population designated as healthy in previous assessments (Lichthardt 2003), suggesting limited risk to persistence (Kaye et al. 2016, Kaye et al. 2019).

Best available scientific information

Case, M.A., Mlodozeniec, H.T., Wallace, L.E., and Weldy, T.W. 1998. Conservation genetics and taxonomic status of the rare Kentucky lady's slipper: Cypripedium kentuckiense (Orchidaceae). American Journal of Botany 85 (12): 1779-1786 pp. https://doi.org/10.2307/2446512

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Fay, M.F. 2018. Orchid conservation: how can we meet the challenges in the twenty-first century? Botanical Studies 59 (1): 16 p.

Harrod, R.J. 1994. The Rhizome morphology and sensitivity to ground disturbance of Cypripedium fasciculatum Report. Vol. 1994. Leavenworth, WA. U.S. Department of Agriculture, Forest Service, Wenatchee National Forest. 1-5 pp.

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Ingegno, A.S. 2017. Predicting habitat distribution for five rare plant species within the blackfoot swan landscape restoration project. Master of Science in Geography Master's thesis, University of Montana, Missoula, MT. 85 p.

Kaye, T.N., Bahm, M.A., Thorpe, A.S., Gray, E., and Pfingsten, I. 2016. Elevation, population size, and time since observation predict extinction in a rare orchid (Cypripedium fasciculatum). Institute for Applied Ecology. and U.S. Department of the Interior, Bureau of Land Management., Medford District. Corvallis, OR

Kaye, T.N., Bahm, M.A., Thorpe, A.S., Gray, E.C., Pfingsten, I., and Waddell, C. 2019. Population extinctions driven by climate change, population size, and time since observation may make rare species databases inaccurate. PLoS One 14(10) (10): 1-13 pp.

Kaye, T.N., and Cramer, J.R. 2005. Conservation assessment for Cypripedium fasciculatum and Cypripedium montanum. Vallejo, CA. U.S. Department of Agriculture, Forest Service, Region 5. 55 p.

Lichthardt, J. 2003. Conservation strategy for clustered lady's-slipper orchid (Cypripedium fasciculatum) in U.S. Forest Service Region 1. Boise, ID. Idaho Department of Fish and Game, Natural Resources Policy Bureau. 27 p.

Lipow, S.R., Bernhardt, P., and Vance, N. 2002. Comparative rates of pollination and fruit set in widely separated populations of a rare orchid (Cypripedium fasciculatum). International Journal of Plant Sciences 163(5) (5): 775-782 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

McCormick, M.K., and Jacquemyn, H. 2013. What constrains the distribution of orchid populations? New Phytologist 202 (2): 392-400 pp. 10.1111/nph.12639

Montana Natural Heritage Program. 2020. Cypripedium fasciculatum (Clustered Lady's-slipper) Predicted Suitable Habitat Modeling. Helena, MT. Montana Natural Heritage Program. 17 p.

Pipp, A.K. 2017. Coefficient of Conservatism Rankings for the Flora of Montana: Part III. Montana Natural Heritage Program, Helena, Montana. 107 p.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Seevers, J., and Lang, F. 1998. Conservation assessment for Cypripedium fasciculatum kellogg ex S. Watson. U. S. Department of Agriculture, Forest Service and U.S. Department of the Interior, Bureau of Land Management, eds. Portland, OR. U. S. Department of Agriculture, Forest Service Region 6. 33 p.

Shefferson, R., P., Weiss, M., Kull, T., and Taylor, D.L. 2005. High specificity generally characterizes mycorrhizal association in rare lady's slipper orchids, genus *Cypripedium*. Molecular Ecology 14 (2): 613-626 pp. 10.1111/j.1365-294X.2005.02424.x

Smallwood, P.A., and Trapnell, D.W. 2022. Species distribution modeling reveals recent shifts in suitable habitat for six North American Cypripedium spp. (Orchidaceae). Diversity 14 (9): 1-12 pp. 10.3390/d14090694

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

Vance, N., and Lake, L. 2002. Response of clustered ladyslipper (Cypripedium fasciculatum) to partial overstory removal and prescribed fire in north central Idaho. Grangeville, ID. U.S. Department of Agriculture, Forest Service, Nez Perce National Forest. 6 p.

Willis, C.G., Ruhfel, B., Primack, R.B., Miller-Rushing, A.J., and Davis, C.C. 2008. Phylogenetic patterns of species loss in Thoreau's woods are driven by climate change. Proceedings of the National Academy of Sciences 105 (44): 17029-17033 pp.

4.6 Cusick's Aster (*Symphyotrichum cusickii*)

Conservation Categories

G4/S1S3 (Montana Natural Heritage Program, mtnhp.org, 02/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species occurs across the Pacific Northwest. In Montana, the species is known from three disparate observations, including a single observation within the plan area (Montana Natural Heritage Program, mtnhp.org, 02/2023), but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are limited within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species generally occupies open forestlands.

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but open woodlands are common and well distributed across the plan area.

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area.

The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is apparently secure globally, and forestland habitats are readily available and widely distributed in the plan area.

Best available scientific information

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

4.7 Mingan Island Moonwort (*Botrychium minganense*)

Conservation Categories

G5/S4, Species of Conservation Concern on neighboring Forest (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going within the plan area.

The species occurs throughout much of North America. In Montana the species is known from 300 observations, most predominately in the northwestern portion of the state (Montana Natural Heritage Program, mtnhp.org, 02/2023). The species is known from two locations in the plan area, but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022). New occurrences of moonwort populations are often discovered following systematic surveys in suitable habitat (Vanderhorst 1997).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species occupies a variety of mesic habitats across a variety of elevations. In Montana the species is regularly found along stream riparian areas and in association with old growth stands of western red cedar (Achuff 1992)(Montana Natural Heritage Program, mtnhp.org, 02/2023).

Habitat trend in the plan area

There are no specific habitat trends for the plan Area, but mesic habitats that may support the species occur widely within the plan area. The ecological conditions within and around some habitats that may support the species are likely either stable or improving due to advances in riparian and aquatic ecosystem management (Roper et al. 2019, Roper et al. 2018).

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016,

Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020). Activities including grazing, offroad recreation, timber harvest and road maintenance may affect the species (Ahlenslager and Potash 2007).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. Mesic habitats, particularly small streams, that could support the species are readily available and widely distributed in the plan area.

Best available scientific information

Achuff, P. 1992. Status review of Botrychium minganense: USDA Forest Service- Region 1 Lolo National Forest. Helena, Montana. Montana Natural Heritage Program. 29 p.

Ahlenslager, K., and Potash, L. 2007. Conservation assessment for 13 species of moonworts (*Botrychium* swartz subgenus *Botrychium*). Oregon/Washington. 3-49 pp.

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Roper, B.B., Capurso, J.M., Paroz, Y., and Young, M.K. 2018. Conservation of aquatic biodiversity in the context of multiple-use management on National Forest System lands. Fisheries 43 (9): 396-405 pp.

Roper, B.B., Saunders, W.C., and Ojala, J.V. 2019. Did changes in western federal land management policies improve salmonid habitat in streams on public lands within the Interior Columbia River Basin? Environmental Monitoring and Assessment 191 (9): 574 p.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

Vanderhorst, J. 1997. Status Revew Of Clarkia Rhomboidea In Montana Montana Natural Heritage Program. Helena, MT. Montana Natural Heritage Program State Library. Helena, MT. 19 pp. plus appendices. p.

4.8 Mountain Moonwort (*Botrychium montanum*)

Conservation Categories

G3G4/S3S4, Species of Conservation Concern on a neighboring Forest (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species occurs in the Pacific Northwest with occupancy most regularly documented in Oregon, Washington, and Montana (Montana Natural Heritage Program, mtnhp.org, 01/2023). In Montana the species is primarily distributed in the northwestern portion of the state. The species is known from a single location in the plan area, but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022). New occurrences of moonwort populations are often discovered following systematic surveys in suitable habitat (Vanderhorst 1997).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species is commonly associated with maritime habitats, most notably within wet mature to old growth red cedar and western hemlock habitats or other mesic habitat types that form thick canopy cover, low understory cover and heavy litter layers. (Montana Natural Heritage Program, mtnhp.org, 01/2023; (Vanderhorst 1997). This species also appears more capable of occupying dryer microclimates than other moonwort species (Vanderhorst 1997).

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but modeled habitat suitability is lower within the plan area that other parts of Montana; however, moderately suitable habitat is widely dispersed and available (Montana Natural Heritage Program 2020).

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016,

Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020). Activities including grazing and timber harvest may affect the species (Ahlenslager and Potash 2007). In particular, the species appears sensitive to management actions or natural disturbances that remove a substantial portion of the overstory, but the species can occupy secondary forest habitats (Ahlenslager and Potash 2007, Vanderhorst 1997).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. Suitable habitat is available and widely distributed in the plan area (Montana Natural Heritage Program 2020).

Best available scientific information

Ahlenslager, K., and Potash, L. 2007. Conservation assessment for 13 species of moonworts (*Botrychium* swartz subgenus *Botrychium*). Oregon/Washington. 3-49 pp.

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Montana Natural Heritage Program. 2020. Botrychium montanum (Mountain Moonwort) Predicted Suitable Habitat Modeling. Burkholder, Braden ed. Helena, MT. Montana Natural Heritage Program. 17 p.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

Vanderhorst, J. 1997. Status review of *clarkia rhomboidea* in Montana. January 1997. Helena, MT. Montana Natural Heritage Program. 56 p.

4.9 Pendent Foxtail Lichen (*Nodobryoria oregana*)

Conservation Categories

G3/SNR (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going. Surveys of suitable habitat within the plan area are lacking (Jovan et al. 2021), which may substantially affect the known distribution and abundance of lichen species (Hutchinson et al. 2002).

The species occurs from British Columbia and Alberta south to California and Wyoming. In Montana, there are roughly 30 documented observations of the species in the western portion of the state, including roughly four within the plan area (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

Occurs in forested habitat.

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but the forest types that the species occupies are common and widely dispersed.

Relevant life history traits and other information

As a group, lichen generally have limited dispersal capability which may extenuate the effects of fragmentation (Bartemucci et al. 2022).

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area.

World-wide, the primary threats to lichen species include habitat degradation, fragmentation, and loss; pollution; and climate change (Lesica et al. 1991, Conti and Cecchetti 2001, Bergamini et al. 2005, Ellis et al. 2007, Geiser and Neitlich 2007, Scheidegger and Werth 2009, Cameron, Goudie, et al. 2013, Cameron, Neily, et al. 2013, McMurray et al. 2015, Ellis 2019, Allen et al. 2019).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. Suitable habitat is readily available and widely distributed throughout the plan area.

Best available scientific information

Allen, J.L., McMullin, R.T., Tripp, E.A., and Lendemer, J.C. 2019. Lichen conservation in North America: a review of current practices and research in Canada and the United States. Biodiversity and Conservation 28 (12): 3103-3138 pp.

Bartemucci, P., Lilles, E., and Gauslaa, Y. 2022. Silvicultural strategies for lichen conservation: Smaller gaps and shorter distances to edges promote recolonization. Ecosphere 13 (1): 1-20 pp.

Bergamini, A., Scheidegger, C., Stofer, S., Palmira, C., Davey, S., Dietrich, M., Dubs, F., Farkas, E., Groner, U., Kärkkäinen, K., Keller, C., Lökös, L., Lommi, S., Máguas, C., Mitchell, R., Pinho, P., Rico, V.J., Aragón, G., Truscott, A.-M., Wolseley, P., and Watt, A. 2005. Performance of macrolichens and lichen genera as indicators of lichen species richness and composition. Conservation Biology 19 (4): 1051-1062 pp.

Cameron, D.R., Goudie, I., and Richardson, D. 2013. Habitat loss exceeds habitat regeneration for an IUCN flagship lichen epiphyte: Erioderma pedicellatum. Canadian Journal of Forest Research 43 (11): 1075-1080 pp.

Cameron, R.P., Neily, T., and Clapp, H. 2013. Forest harvesting impacts on mortality of an endangered lichen at the landscape and stand scales. Canadian Journal of Forest Research 43 (5): 507-511 pp.

Conti, M.E., and Cecchetti, G. 2001. Biological monitoring: lichens as bioindicators of air pollution assessment—a review. Environmental pollution 114 (3): 471-492 pp.

Ellis, C. 2019. Climate Change, Bioclimatic Models and the Risk to Lichen Diversity. Diversity 11 (4) 10.3390/d11040054

Ellis, C.J., Coppins, B.J., Dawson, T.P., and Seaward, M.R.D. 2007. Response of British lichens to climate change scenarios: Trends and uncertainties in the projected impact for contrasting biogeographic groups. Biological Conservation 140 (3): 217-235 pp.

Geiser, L.H., and Neitlich, P.N. 2007. Air pollution and climate gradients in western Oregon and Washington indicated by epiphytic macrolichens. Environmental Pollution 145 (1): 203-218 pp.

Hutchinson, J., McCune, B., and Berryman, S. 2002. Concentration of rare epiphytic lichens along large streams in a mountainous watershed in Oregon, U.S.A. The Bryologist 105 (3): 439-450 pp. 10.1639/0007-2745(2002)105[0439:Corela]2.0.Co;2

Jovan, S., Haldeman, M., Will-Wolf, S., Dillman, K., Geiser, L., Thompson, J., Stone, D., and Hollinger, J. 2021. National atlas of epiphytic lichens in forested habitats of the United States. Portland, OR. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 96 p.

Lesica, P., McCune, B., Cooper, S.V., and Shic Hong, W. 1991. Differences in lichen and bryophyte communities between old-growth and managed second-growth forests in the Swan Valley, Montana. Canadian Journal of Botany 69: 1745-1755 pp.

McMurray, J.A., Roberts, D.W., and Geiser, L.H. 2015. Epiphytic lichen indication of nitrogen deposition and climate in the northern rocky mountains, USA. Ecological Indicators 49: 154-161 pp. 10.1016/j.ecolind.2014.10.015

Scheidegger, C., and Werth, S. 2009. Conservation strategies for lichens: insights from population biology. Fungal Biology Reviews 23 (3): 55-66 pp. 10.1016/j.fbr.2009.10.003

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

4.10 Simple Horsehair Lichen (*Bryoria simplicior*)

Conservation Categories

G5/S2 (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going. Surveys of suitable habitat within the plan area are lacking (Jovan et al. 2021), which may substantially affect the known distribution and abundance of lichen species (Hutchinson et al. 2002).

Present in Northern Europe and Asia, in North America the species occurs across the boreal region south to Wyoming. In Montana, there are roughly twenty documented observations of the species in the western portion of the state, including five within the plan area (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species occupies forested habitat.

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but forest habitats are abundant and well distributed within the plan area.

Relevant life history traits and other information

As a group, lichen generally have limited dispersal capability which may extenuate the effects of fragmentation (Bartemucci et al. 2022).

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area.

World-wide, the primary threats to lichen species include habitat degradation, fragmentation, and loss; pollution; and climate change (Lesica et al. 1991, Conti and Cecchetti 2001, Bergamini et al. 2005, Ellis et al. 2007, Geiser and Neitlich 2007, Scheidegger and Werth 2009, Cameron, Goudie, et al. 2013, Cameron, Neily, et al. 2013, McMurray et al. 2015, Ellis 2019, Allen et al. 2019).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. Suitable habitat is readily available and widely distributed throughout the plan area.

Best available scientific information

Allen, J.L., McMullin, R.T., Tripp, E.A., and Lendemer, J.C. 2019. Lichen conservation in North America: a review of current practices and research in Canada and the United States. Biodiversity and Conservation 28 (12): 3103-3138 pp.

Bartemucci, P., Lilles, E., and Gauslaa, Y. 2022. Silvicultural strategies for lichen conservation: Smaller gaps and shorter distances to edges promote recolonization. Ecosphere 13 (1): 1-20 pp.

Bergamini, A., Scheidegger, C., Stofer, S., Palmira, C., Davey, S., Dietrich, M., Dubs, F., Farkas, E., Groner, U., Kärkkäinen, K., Keller, C., Lökös, L., Lommi, S., Máguas, C., Mitchell, R., Pinho, P., Rico, V.J., Aragón, G., Truscott, A.-M., Wolseley, P., and Watt, A. 2005. Performance of macrolichens and lichen genera as indicators of lichen species richness and composition. Conservation Biology 19 (4): 1051-1062 pp.

Cameron, D.R., Goudie, I., and Richardson, D. 2013. Habitat loss exceeds habitat regeneration for an IUCN flagship lichen epiphyte: Erioderma pedicellatum. Canadian Journal of Forest Research 43 (11): 1075-1080 pp.

Cameron, R.P., Neily, T., and Clapp, H. 2013. Forest harvesting impacts on mortality of an endangered lichen at the landscape and stand scales. Canadian Journal of Forest Research 43 (5): 507-511 pp.

Conti, M.E., and Cecchetti, G. 2001. Biological monitoring: lichens as bioindicators of air pollution assessment—a review. Environmental pollution 114 (3): 471-492 pp.

Ellis, C. 2019. Climate Change, Bioclimatic Models and the Risk to Lichen Diversity. Diversity 11 (4) 10.3390/d11040054

Ellis, C.J., Coppins, B.J., Dawson, T.P., and Seaward, M.R.D. 2007. Response of British lichens to climate change scenarios: Trends and uncertainties in the projected impact for contrasting biogeographic groups. Biological Conservation 140 (3): 217-235 pp.

Geiser, L.H., and Neitlich, P.N. 2007. Air pollution and climate gradients in western Oregon and Washington indicated by epiphytic macrolichens. Environmental Pollution 145 (1): 203-218 pp.

Hutchinson, J., McCune, B., and Berryman, S. 2002. Concentration of rare epiphytic lichens along large streams in a mountainous watershed in Oregon, U.S.A. The Bryologist 105 (3): 439-450 pp. 10.1639/0007-2745(2002)105[0439:Corela]2.0.Co;2

Jovan, S., Haldeman, M., Will-Wolf, S., Dillman, K., Geiser, L., Thompson, J., Stone, D., and Hollinger, J. 2021. National atlas of epiphytic lichens in forested habitats of the United States. Portland, OR. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 96 p.

Lesica, P., McCune, B., Cooper, S.V., and Shic Hong, W. 1991. Differences in lichen and bryophyte communities between old-growth and managed second-growth forests in the Swan Valley, Montana. Canadian Journal of Botany 69: 1745-1755 pp.

McMurray, J.A., Roberts, D.W., and Geiser, L.H. 2015. Epiphytic lichen indication of nitrogen deposition and climate in the northern rocky mountains, USA. Ecological Indicators 49: 154-161 pp. 10.1016/j.ecolind.2014.10.015

Scheidegger, C., and Werth, S. 2009. Conservation strategies for lichens: insights from population biology. Fungal Biology Reviews 23 (3): 55-66 pp. 10.1016/j.fbr.2009.10.003

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

4.11 Small-winged Sedge (*Carex stenoptila*)

Conservation Categories

G3/S2S3 (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is known from Colorado, Idaho, Montana, Utah, and Wyoming. In Montana, the species is known from roughly twelve extremely disjunct locations (Montana Natural Heritage Program, mtnhp.org, 01/2023). The species is known from a single sample within the plan area, but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

Found in montane and subalpine open forest, often associated with rocky and moist soil along streams (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but modeled suitable habitat, particularly moderate habitat, is widely distributed throughout the plan area (Montana Natural Heritage Program 2020).

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. Suitable habitat is readily available and widely distributed (Montana Natural Heritage Program 2020).

Best available scientific information

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Montana Natural Heritage Program. 2020. Carex stenoptila (Small-winged Sedge) Predicted Suitable Habitat Modeling. Helena, MT. Montana Natural Heritage Program. 17 p.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

4.12 Textured Lungwort Lichen (*Lobaria scrobiculata*)

Conservation Categories

G5/S1 (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going. Surveys of suitable habitat within the plan area are lacking (Jovan et al. 2021), which may substantially affect the known distribution and abundance of lichen species (e.g., (Hutchinson et al. 2002).

The species primarily occurs in the boreal regions of the northern hemisphere and in New Zealand in the southern hemisphere. In the United States, the species range stretches south to North Carolina, Michigan, Minnesota, Manitoba, Idaho, Oregon, and Washington. In Montana, the species has two documented occurrences, including one within the plan area (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species grows in moist, somewhat open habitats, on tree bark, soil, mosses, and rocks (Jordan 1973, Schei et al. 2012). Although something of a generalist, the species may be more commonly associated with deciduous trees (Cameron 2002).

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but the species occupies a variety of moist forest types and substrates (Jordan 1973, Schei et al. 2012), which are common and well distributed across the plan area.

Relevant life history traits and other information

As a group, lichen generally have limited dispersal capability which may extenuate the effects of fragmentation (Bartemucci et al. 2022).

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area.

World-wide, the primary threats to lichen species include habitat degradation, fragmentation, and loss; pollution; and climate change (Lesica et al. 1991, Conti and Cecchetti 2001, Bergamini et al. 2005, Ellis et al. 2007, Geiser and Neitlich 2007, Scheidegger and Werth 2009, Cameron, Goudie, et al. 2013, Cameron, Neily, et al. 2013, McMurray et al. 2015, Ellis 2019, Allen et al. 2019).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. Suitable habitat is readily available and widely distributed throughout the plan area.

Best available scientific information

Allen, J.L., McMullin, R.T., Tripp, E.A., and Lendemer, J.C. 2019. Lichen conservation in North America: a review of current practices and research in Canada and the United States. Biodiversity and Conservation 28 (12): 3103-3138 pp.

Bartemucci, P., Lilles, E., and Gauslaa, Y. 2022. Silvicultural strategies for lichen conservation: Smaller gaps and shorter distances to edges promote recolonization. Ecosphere 13 (1): 1-20 pp.

Bergamini, A., Scheidegger, C., Stofer, S., Palmira, C., Davey, S., Dietrich, M., Dubs, F., Farkas, E., Groner, U., Kärkkäinen, K., Keller, C., Lökös, L., Lommi, S., Máguas, C., Mitchell, R., Pinho, P., Rico, V.J., Aragón, G., Truscott, A.-M., Wolseley, P., and Watt, A. 2005. Performance of macrolichens and lichen genera as indicators of lichen species richness and composition. Conservation Biology 19 (4): 1051-1062 pp.

Cameron, D.R., Goudie, I., and Richardson, D. 2013. Habitat loss exceeds habitat regeneration for an IUCN flagship lichen epiphyte: Erioderma pedicellatum. Canadian Journal of Forest Research 43 (11): 1075-1080 pp.

Cameron, R.P. 2002. Habitat Associations of Epiphytic Lichens in Managed and Unmanaged Forest Stands in Nova Scotia. Northeastern Naturalist 9 (1): 27-46 pp.

Cameron, R.P., Neily, T., and Clapp, H. 2013. Forest harvesting impacts on mortality of an endangered lichen at the landscape and stand scales. Canadian Journal of Forest Research 43 (5): 507-511 pp.

Conti, M.E., and Cecchetti, G. 2001. Biological monitoring: lichens as bioindicators of air pollution assessment—a review. Environmental pollution 114 (3): 471-492 pp.

Ellis, C. 2019. Climate Change, Bioclimatic Models and the Risk to Lichen Diversity. Diversity 11 (4) 10.3390/d11040054

Ellis, C.J., Coppins, B.J., Dawson, T.P., and Seaward, M.R.D. 2007. Response of British lichens to climate change scenarios: Trends and uncertainties in the projected impact for contrasting biogeographic groups. Biological Conservation 140 (3): 217-235 pp.

Geiser, L.H., and Neitlich, P.N. 2007. Air pollution and climate gradients in western Oregon and Washington indicated by epiphytic macrolichens. Environmental Pollution 145 (1): 203-218 pp.

Hutchinson, J., McCune, B., and Berryman, S. 2002. Concentration of rare epiphytic lichens along large streams in a mountainous watershed in Oregon, U.S.A. The Bryologist 105 (3): 439-450 pp. 10.1639/0007-2745(2002)105[0439:Corela]2.0.Co;2

Jordan, W.P. 1973. The genus lobaria in North America north of Mexico. The Bryologist 76 (2): 225-251 pp.

Jovan, S., Haldeman, M., Will-Wolf, S., Dillman, K., Geiser, L., Thompson, J., Stone, D., and Hollinger, J. 2021. National atlas of epiphytic lichens in forested habitats of the United States. Portland, OR. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 96 p.

Lesica, P., McCune, B., Cooper, S.V., and Shic Hong, W. 1991. Differences in lichen and bryophyte communities between old-growth and managed second-growth forests in the Swan Valley, Montana. Canadian Journal of Botany 69: 1745-1755 pp.

McMurray, J.A., Roberts, D.W., and Geiser, L.H. 2015. Epiphytic lichen indication of nitrogen deposition and climate in the northern rocky mountains, USA. Ecological Indicators 49: 154-161 pp. 10.1016/j.ecolind.2014.10.015

Schei, F.H., Blom, H.H., Gjerde, I., Grytnes, J.-A., Heegaard, E., and Saetersdal, M. 2012. Fine-scale distribution and abundance of epiphytic lichens: environmental filtering or local dispersal dynamics? Journal of Vegetation Science 23 (3): 459-470 pp. 10.1111/j.1654-1103.2011.01368.x

Scheidegger, C., and Werth, S. 2009. Conservation strategies for lichens: insights from population biology. Fungal Biology Reviews 23 (3): 55-66 pp. 10.1016/j.fbr.2009.10.003

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

5. Dry Forest

5.1 Diamond Clarkia (*Clarkia rhomboidea*)

Conservation Categories

G5/S3 (Montana Natural Heritage Program, mtnhp.org, 02/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is broadly distributed across much of the western United States and British Columbia. In Montana, the species is limited to the extreme western portion of the state (Montana Natural Heritage Program, mtnhp.org, 01/2023). The species is known from fewer than ten locations within the plan area, but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are limited within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

Found in open, dry montane forest, in Montana, the species is often associated with open Douglas fir and ponderosa pine forest types (Vanderhorst 1997).

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but Douglas fir and ponderosa pine forest are common, and modeled suitable habitat, including significant areas of optimal habitat, is readily available and widely dispersed within the western extent of the plan area (Program 2021).

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020). The most pervasive threat to the species is likely invasive species (Vanderhorst 1997).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is globally secure, and habitat is readily available and widely distributed in the plan area (Montana Natural Heritage Program 2021).

Best available scientific information

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Montana Natural Heritage Program. 2021. Clarkia rhomboidea (Diamond Clarkia) Predicted Suitable Habitat Modeling. Helena, MT. Montana Natural Heritage Program. 17 p.

Program, M.N.H. 2021. Clarkia rhomboidea (Diamond Clarkia)
Predicted Suitable Habitat Modeling (website).

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

Vanderhorst, J. 1997. Status review of *clarkia rhomboidea* in Montana. January 1997. Helena, MT. Montana Natural Heritage Program. 56 p.

5.2 Elegant Mariposa Lily (*Calochortus elegans*)

Conservation Categories

G3G4/S3S4 (Montana Natural Heritage Program, mtnhp.org, 02/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species has a disjunct distribution with populations in Northern California and Southern Oregon, Northeastern Oregon and Southeastern Washington, Idaho, and Western Montana. The species is known from roughly ten locations in the western portion of the plan area (Montana Natural Heritage Program, mtnhp.org, 01/2023), but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are limited within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

Associated with rocky soils, usually found on the margins of coniferous forests or on grassy slopes in open woodlands (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but suitable habitat types are common within the plan area.

Relevant life history traits and other information

Species was first discovered in Idaho by Merriweather Lewis and represented the first known specimen of the genus (Schneider 2015). The bulb is edible and historically of value to indigenous peoples (Endress et al. 2022).

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area.

Best available scientific information

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Schneider, A. 2015. Who's in that Name? Meriwether Lewis. Bulletin of the Native Plant Society of Oregon 47(10) (10): 1-10 pp.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

5.3 Hollyleaf Clover (*Trifolium gymnocarpon*)

Conservation Categories

G5/S2, Regional Forester Sensitive Species (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is distributed throughout much of the Great Basin area of the western United States, with populations in Montana limited to the western extent, and only one population in known to occur within the plan area (Montana Natural Heritage Program, mtnhp.org, 01/2023). Species-specific surveys that consider the phenology, as well as the habitat associations of the species are largely lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species occupies open coniferous forests.

Habitat trend in the plan area

There are no specific habitat trends for the plan area, modelled suitable habitat conditions are very limited within the plan area (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. However, the species has known from a single population in the plan area, and suitable habitat is very limited. Populations that are geographically isolated, as populations of this species appear to be within the plan area, are at greater risk for localized extinction (Dias 1996, Ovaskainen and Hanski 2004), particularly from stochastic events (Smith and Almeida 2020).

The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

Yes

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

Yes

Rational for determination

The species is known from a single location within the plan area and alternative suitable habitat within the plan area is limited, which suggests the population within the plan area is likely small. Small populations are more likely to face localized extirpation, particularly when isolated from other source populations (Dias 1996, Ovaskainen and Hanski 2004, Smith and Almeida 2020).

Best available scientific information

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Dias, P.C. 1996. Sources and sinks in population biology. Trends in Ecology & Evolution 11 (8): 326-330 pp. https://doi.org/10.1016/0169-5347(96)10037-9

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Ovaskainen, O., and Hanski, I. 2004. Chapter 4: Metapopulation dynamics in highly fragmented landscapes. Chapter 4. In Hanski, Ilkka and Gaggiotti, Oscar E., eds., Ecology, genetics and evolution of metapopulations. Burlington, MA: Elsevier Science. 73-103 pp. https://doi.org/10.1016/B978-012323448-3/50006-4

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Smith, K.G., and Almeida, R.J. 2020. When are extinctions simply bad luck? Rarefaction as a framework for disentangling selective and stochastic extinctions. Journal of Applied Ecology 57 (1): 101-110 pp. https://doi.org/10.1111/1365-2664.13510

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

5.4 Idaho Barren Strawberry (*Waldsteinia idahoensis*)

Conservation Categories

G3/S2S3 (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is an endemic that is found primarily in Idaho, with the population in Montana limited to one location within the plan area (Montana Natural Heritage Program, mtnhp.org, 01/2023). Species-specific surveys that consider the phenology, as well as the habitat associations of the species are largely lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species occupies open coniferous forests.

Habitat trend in the plan area

There are no specific habitat trends for the plan area, modelled suitable habitat conditions are very limited within the plan area (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. However, the species has known from a single population in the plan area, and suitable habitat is very limited. Populations that are geographically isolated, as populations of this species appear to be within the plan area, are at greater risk for localized extinction (Dias 1996, Ovaskainen and Hanski 2004), particularly from stochastic events (Smith and Almeida 2020).

The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

Yes

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

Yes

Rational for determination

The species is known from a single location within the plan area and alternative suitable habitat within the plan area is limited, which suggests the population within the plan area is likely small. Small populations are more likely to face localized extirpation, particularly when isolated from other source populations (Dias 1996, Ovaskainen and Hanski 2004, Smith and Almeida 2020).

Best available scientific information

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Dias, P.C. 1996. Sources and sinks in population biology. Trends in Ecology & Evolution 11 (8): 326-330 pp. https://doi.org/10.1016/0169-5347(96)10037-9

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Ovaskainen, O., and Hanski, I. 2004. Chapter 4: Metapopulation dynamics in highly fragmented landscapes. Chapter 4. In Hanski, Ilkka and Gaggiotti, Oscar E., eds., Ecology, genetics and evolution of metapopulations. Burlington, MA: Elsevier Science. 73-103 pp. https://doi.org/10.1016/B978-012323448-3/50006-4

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Smith, K.G., and Almeida, R.J. 2020. When are extinctions simply bad luck? Rarefaction as a framework for disentangling selective and stochastic extinctions. Journal of Applied Ecology 57 (1): 101-110 pp. https://doi.org/10.1111/1365-2664.13510

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

5.5 North Idaho Monkeyflower (*Mimulus clivicola*)

Conservation Categories

G4/S2 (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species has a limited distribution in northeastern Oregon, central Idaho, and northwest Montana, where it was first discovered in 2010 (Odegard 2012) and all known observations are within the plan area (Montana Natural Heritage Program, mtnhp.org, 01/2023). Species-specific surveys that consider the phenology, as well as the habitat associations of the species are largely lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022), including this species (Lorain et al. 1993).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area, however, where the species occurs, populations tend to be less than 200 individuals (Lorain et al. 1993).

Habitat description

The species has a narrow ecological niche, with most populations found on steep southern aspects where individuals are found growing in open pockets of moist, exposed mineral soil, with spring moisture being among the most important predictors of occurrence (Lorain et al. 1993).

Habitat trend in the plan area

There are no specific habitat trends for the plan area.

Relevant life history traits and other information

An annual that shows erratic population fluctuations in association with interannual weather conditions, particular spring moisture (Lorain et al. 1993).

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The species is a regional endemic, and range size is among the most consistent predictors of extinction risk (Chichorro et al. 2019). Moreover, populations that are geographically isolated, as populations of this species appear to be, are at greater risk for localized extinction (Dias 1996, Ovaskainen and Hanski 2004), particularly from stochastic events (Smith and Almeida 2020).

The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is apparently globally secure, and habitat is available and widely distributed in the western extent of the plan area.

Best available scientific information

Chichorro, F., Juslén, A., and Cardoso, P. 2019. A review of the relation between species traits and extinction risk. Biological Conservation 237: 220-229 pp. https://doi.org/10.1016/j.biocon.2019.07.001

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Dias, P.C. 1996. Sources and sinks in population biology. Trends in Ecology & Evolution 11 (8): 326-330 pp. https://doi.org/10.1016/0169-5347(96)10037-9

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lorain, C.C., Shelly, J.S., Atwood, D., and Longrie, D. 1993. Conservation assessment for Mimulus clivicola (bank monkeyflower). Idaho Department of Fish and Game, Conservation Data Center, ed.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Odegard, C. 2012. Mimulus Clivicola (Noteworthy Collection) Montana. Madroño 59 (3): 166 p. 10.3120/0024-9637-59.3.166

Ovaskainen, O., and Hanski, I. 2004. Chapter 4: Metapopulation dynamics in highly fragmented landscapes. Chapter 4. In Hanski, Ilkka and Gaggiotti, Oscar E., eds., Ecology, genetics and evolution of metapopulations. Burlington, MA: Elsevier Science. 73-103 pp. https://doi.org/10.1016/B978-012323448-3/50006-4

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Smith, K.G., and Almeida, R.J. 2020. When are extinctions simply bad luck? Rarefaction as a framework for disentangling selective and stochastic extinctions. Journal of Applied Ecology 57 (1): 101-110 pp. https://doi.org/10.1111/1365-2664.13510

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

6. Grassland and Shrubland

6.1 Divaricate Navarretia (*Navarretia divaricata*)

Conservation Categories

G5/S1S2 (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is broadly distributed across the Pacific Northwest, south through California. In Montana, the species is known from a single occurrence in the plan area (Montana Natural Heritage Program, mtnhp.org, 01/2023), but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are limited within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

This species occurs in open meadows and fields, the single known location in Montana is at the base of a rock outcrop in an open conifer forest (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but fields and open conifer forests are common.

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is globally secure, and habitat is readily available and widely distributed in the plan area.

Best available scientific information

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

6.2 Howell's Gumweed (*Grindelia howellii*)

Conservation Categories

G3/S2S3, Regional Forester Sensitive Species, Species of Conservation Concern on neighboring Forest (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area. The species is regionally endemic to western Montana and Idaho with two disjunct populations, one in each state; however, there are questions about the *Grindelia* taxonomy that may increase the known range in Idaho (Bartoli and Tortosa 2012, Williams and White 2017). In Montana, the species is known primarily from Missoula and Powell counties, where there are over 100 documented occurrences, but most occurrences represent few individuals (Montana Natural Heritage Program, mtnhp.org, 01/2023). There are two sub-populations that represent most of the known individuals and the core population area for the species. In the plan area the species is known from a few dozen location in the eastern extent of the plan area, each representing few individuals (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Species-specific surveys that consider the phenology, as well as the habitat associations of the species may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

However, targeted surveys dating to the early 1980s have not substantially increased the known extent of the species within the plan area, and recent intensive sampling based on modelled habitat suitability suggests the species is likely extremely rare within its known extent (Ingegno 2017).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the Plan Area. The species is consistently identified within the plan area, but the rarity and ephemeral nature of populations makes trends difficult to ascertain. Moreover, several sub-populations within the plan area have experienced population declines.

Habitat description

The species is found at relatively low elevations where it occupies open, grassy hills and valley bottoms surrounded by mixed conifer forest communities (Lorain 1991, Ingegno 2017). The species is often documented in disturbed sites along roadways and in recent timber harvests (Shelly 1986, Lorain 1991)(Montana Natural Heritage Program, mtnhp.org, 01/2023).

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but dry meadows and disturbed habitats are common, and suitable habitat is abundant with the plan area but restricted to the eastern extent (Ingegno 2017, Montana Natural Heritage Program 2022). Ultimately, habitat occupancy may be limited by the extent of the species' range within the plan area rather than the availability of presumably suitable habitat conditions.

Relevant life history traits and other information

The species expresses a fast life history strategy, being relatively short-lived and highly fecund (Ingegno 2017). Seeds are easily dispersed by animals, giving the species a reasonable ability to colonize new habitats (Ingegno 2017).

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. However, the species is a regional endemic, and range size is among the most consistent predictors of extinction risk (Chichorro et al. 2019). Moreover, populations that are geographically isolated, as populations of this species appear to be, are at greater risk for localized extinction (Dias 1996, Ovaskainen and Hanski 2004), particularly from stochastic events (Smith and Almeida 2020).

The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020). Competition with other early serial plant species, particularly non-native invasives, may substantially limit the abundance of the species, with populations further inhibited by chemical applications to control invasives (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

Yes

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

Yes

Rational for determination

The species has an extremely limited range and a highly limited distribution within the plan area. Systematic surveys for the species have failed to increase the number of known populations (Ingegno 2017) and recent events have resulted in the loss of known populations. Small populations are more likely to face localized extirpation, particularly when isolated from other source populations (Dias 1996, Ovaskainen and Hanski 2004, Smith and Almeida 2020). Although suitable habitat is available, habitat degradation and competition from invasive species represent a substantial threat in the plan area that may limit the ability of the species to replace lost populations.

Best available scientific information

Bartoli, A., and Tortosa, R.D. 2012. Revision of the North American Species of Grindelia (Asteraceae). Annals of the Missouri Botanical Garden 98 (4): 447-513 pp. 10.3417/2008125

Chichorro, F., Juslén, A., and Cardoso, P. 2019. A review of the relation between species traits and extinction risk. Biological Conservation 237: 220-229 pp. https://doi.org/10.1016/j.biocon.2019.07.001

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Dias, P.C. 1996. Sources and sinks in population biology. Trends in Ecology & Evolution 11 (8): 326-330 pp. https://doi.org/10.1016/0169-5347(96)10037-9

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Ingegno, A.S. 2017. Predicting habitat distribution for five rare plant species within the blackfoot swan landscape restoration project. Master of Science in Geography Master's thesis, University of Montana, Missoula, MT. 85 p.

Lorain, C.C. 1991. Species management guide for Grindelia howellii (Howell's gumweed), on the St. Joe National Forest. Boise, ID. Idaho Department of Fish and Game. 22 p.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Montana Natural Heritage Program. 2022. Grindelia howellii (Howell’s Gumweed) Predicted Suitable Habitat Modeling. Burkholder, Braden, ed. Helena, MT. 17p. Montana Natural Heritage Program. Helena, MT. 17 p.

Ovaskainen, O., and Hanski, I. 2004. Chapter 4: Metapopulation dynamics in highly fragmented landscapes. Chapter 4. In Hanski, Ilkka and Gaggiotti, Oscar E., eds., Ecology, genetics and evolution of metapopulations. Burlington, MA: Elsevier Science. 73-103 pp. https://doi.org/10.1016/B978-012323448-3/50006-4

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Shelly, J.S. 1986. Report on the conservation status of Grindelia howellii, a candidate threatened species. Helena, MT. Montana Natural Heritage Program. 143 p. 10.5962/bhl.title.25417

Smith, K.G., and Almeida, R.J. 2020. When are extinctions simply bad luck? Rarefaction as a framework for disentangling selective and stochastic extinctions. Journal of Applied Ecology 57 (1): 101-110 pp. https://doi.org/10.1111/1365-2664.13510

Williams, E.W., and White, A. 2017. Howell's gumweed (Grindelia howellii) genetic diversity and conservation lab report, NFGEL project #333. Placerville, CA. U.S. Department of Agriculture, Forest Service, National Forest Genetics Laboratory. 19 p.

6.3 Linear-leaf Fleabane (*Erigeron linearis*)

Conservation Categories

G5/S2 (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is native to the western United States and British Columbia. In Montana, the species is primarily distributed in the southwestern portion of the state (Montana Natural Heritage Program, mtnhp.org, 01/2023). In the plan area the species is known from two locations, but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are limited within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species occupies dry, rocky slopes and is generally associated with sagebrush, bitterbrush and juniper overstories (Heidel and Cooper 1998).

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but modeled suitable habitat, including considerable coverage of moderate habitat, is well distributed across the plan area (Montana Natural Heritage Program 2021).

Relevant life history traits and other information

The species has high value for pollinators (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020). Given the form of the species, and association with open, rocky slopes, the species is likely tolerant to some disturbance, but may be facing increased competition from non-native invasives (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is globally secure, and habitat is readily available and widely distributed in the plan area (Montana Natural Heritage Program 2021).

Best available scientific information

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heidel, B.L., and Cooper, S.V. 1998. Botanical survey of the Scratchgravel Hills, Lewis and Clark County, Montana. Helena, MT. Bureau of Land Management, Montana Natural Heritage Program. 58 p.

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Montana Natural Heritage Program. 2021. Erigeron linearis (Linear-leaf Fleabane) Predicted Suitable Habitat Modeling. Burkholder, Braden, ed. Helena, MT. 17p. Montana Natural Heritage Program. Helena, MT. 17 p.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

6.4 Many-ribbed Sedge (Carex multicostata)

Conservation Categories

G5/S2S3 (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is broadly distributed across the western United States. In Montana, the species is known from roughly 20 records in the western half of the state (Montana Natural Heritage Program, mtnhp.org, 01/2023). The species is known from two locations within the plan area, but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

This species occurs in dry fields and open conifer forest.

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but fields and open conifer forests are common.

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is globally secure, and habitat is readily available and widely distributed across the plan area.

Best available scientific information

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

6.5 Scribner's Panic Grass (*Dichanthelium oligosanthes* var. *scribnerianum*)

Conservation Categories

G5T5/S1S2 (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is broadly distributed across much of North America. In Montana, the species is known from roughly 10 records with only three in the western half of the state (Montana Natural Heritage Program, mtnhp.org, 01/2023). The species is known from a single location within the plan area, but the species is cryptic where it grows (Linex 2019) and species-specific surveys that consider the phenology, as well as the habitat associations of the species, are lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

This species is found in open grasslands and dry forests but is also present in disturbed settings.

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but the species is quite adaptable to human disturbance and modeled suitable habitat, including optimal habitat, is widely distributed in the western extent of the plan area (Montana Natural Heritage Program 2020).

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is globally secure, capable of occupying disturbed landscapes, and natural habitat is readily available and widely distributed in the plan area (Montana Natural Heritage Program 2020).

Best available scientific information

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Linex, R. 2019. Scribner's dichanthelium. Ranch & Rural Living Magazine, March, 100: 5-6 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Montana Natural Heritage Program. 2020. Dichanthelium oligosanthes var. scribnerianum (Scribner’s Panic Grass) predicted suitable habitat modeling. Helena, MT. Montana Natural Heritage Program. 17 p.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

6.6 Slender Hareleaf (*Lagophylla ramosissima*)

Conservation Categories

G5/S1 (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species occurs throughout most of the western United States. In Montana, the species is known from twelve observations in the northwestern portion of the state, many of which are in the northwestern extent of the plan area (Montana Natural Heritage Program, mtnhp.org, 01/2023). Species-specific surveys that consider the phenology, as well as the habitat associations of the species are largely lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species is found in many habitat types within its known range, within Montana the species is associated with open and disturbed grasslands (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but the habitat types the species occupies are widely distributed.

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is globally secure.

Best available scientific information

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

6.7 Tapertip Onion (*Allium acuminatum*)

Conservation Categories

G5/S2S3, Regional Forester Sensitive Species (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going within the plan area.

The species is a common forb native to the western United States and British Columbia (Johnson et al. 2013). In Montana, the species is known from roughly ten locations, including three within the western extent of the plan area (Montana Natural Heritage Program, mtnhp.org, 01/2023); however, species-specific surveys that consider the phenology, as well as the habitat associations of the species, are lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area, although the species is considered secure and is common in many western states (Johnson et al. 2013).

Habitat description

The species is generally found in on sagebrush plains, rich meadows, rocky foothills, and mountain slopes (Montana Natural Heritage Program, mtnhp.org, 01/2023)(Johnson et al. 2013).

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but modeled suitable habitat, including many areas of optimal habitat, is widely available and well distributed throughout the western half of the plan area (Montana Natural Heritage Program 2020).

Relevant life history traits and other information

The species early flowering phenology may be important for supporting native bee populations, and the plant is an important resource for young sage grouse (Johnson et al. 2013).. The species is also a culturally important food resource in some areas of Western North America species (Endress et al. 2022). Like other allium, the species exhibits summer dormancy when faced with seasonal stress (Phillips et al. 2011).

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016,

Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020). In Montana many known populations occur along roadways, and therefore may be vulnerable to road management and construction (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is secure globally, and suitable habitat is readily available and widely distributed in the plan area (Montana Natural Heritage Program 2020).

Best available scientific information

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Johnson, R.C., Hellier, B.C., and Vance-Borland, K.W. 2013. Genecology and seed zones for tapertip onion in the US Great Basin. Botany 91 (10): 686-694 pp. 10.1139/cjb-2013-0046

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Montana Natural Heritage Program. 2020. Allium acuminatum (tapertip onion) predicted suitable habitat modeling. Helena, Montana. Montana Natural Heritage Program. 17 p.

Phillips, N.C., Drost, D.T., Varga, W.A., and Shultz, L.M. 2011. Demography, reproduction, and dormancy along altitudinal gradients in three intermountain Allium species with contrasting abundance and distribution. Flora - Morphology, Distribution, Functional Ecology of Plants 206 (2): 164-171 pp. 10.1016/j.flora.2010.05.002

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

6.8 Western Pearl-flower (*Heterocodon rariflorum*)

Conservation Categories

G5/S2 (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going.

The current range of the species is within the Pacific Northwest, including British Columbia, having been extirpated from Wyoming and Colorado (Nature Serve 01/2023). In Montana, the species is known from fewer than 100 locations from the northwestern portion of the state (Montana Natural Heritage Program, mtnhp.org, 01/2023). The species is known from several disparate locations in the western and northern eastern extent of the plan area, but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022, Ingegno 2017).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

Associated with wetlands and other riparian areas, the species is also often found in wet meadows (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but modeled suitable habitat is abundant and well dispersed, particularly in the western extent of the plan area (Ingegno 2017, Montana Natural Heritage Program 2020). The ecological conditions within and around some habitats that may support the species are likely either stable or improving due to advances in riparian and aquatic ecosystem management (Roper et al. 2019, Roper et al. 2018).

Relevant life history traits and other information

The only species within the genera, the species has large, gravity dispersed seeds which limit the effective dispersal range (Ingegno 2017).

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The species has a somewhat narrow ecological tolerance and does not tolerate human disturbance (Pipp 2017). The primary threats to the species across its distribution are likely those common to most plant species including habitat loss,

degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is globally secure and suitable habitat is available and widely distributed in the plan area (Ingegno 2017, Program 2020).

Best available scientific information

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Ingegno, A.S. 2017. Predicting habitat distribution for five rare plant species within the blackfoot swan landscape restoration project. Master of Science in Geography Master's thesis, University of Montana, Missoula, MT. 85 p.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Montana Natural Heritage Program. 2020. Heterocodon rariflorum (Western Pearl-flower) Predicted Suitable Habitat Modeling. Helena, MT. Montana Natural Heritage Program. 17 p.

Pipp, A.K. 2017. Coefficient of Conservatism Rankings for the Flora of Montana: Part III. Helena, MT. Montana Natural Heritage Program. 107 p.

Program, M.N.H. 2020. Heterocodon rariflorum (Western Pearl-flower) Predicted Suitable Habitat Modeling (website).

Roper, B.B., Capurso, J.M., Paroz, Y., and Young, M.K. 2018. Conservation of aquatic biodiversity in the context of multiple-use management on National Forest System lands. Fisheries 43 (9): 396-405 pp.

Roper, B.B., Saunders, W.C., and Ojala, J.V. 2019. Did changes in western federal land management policies improve salmonid habitat in streams on public lands within the Interior Columbia River Basin? Environmental Monitoring and Assessment 191 (9): 574 p.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

7. Talus, Scree, and Rock

7.1 Bryophytes of Talus, Scree and Rock Areas

Conservation Categories

Britton's Dry Rock Moss (*Grimmia brittoniae*) – G5/S1

Lime-Seep Eucladium Moss (*Eucladium verticillatum*) – G4/S1

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the representative species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates (Thompson 2004) are not known to be on-going.

Basic data on the distribution and abundance of bryophytes species is often limited (Cornwell et al. 2019) largely due to the challenges of sampling bryophytes (Frego 2007). In Montana, which has a relatively high diversity of species (508 species), the lack of systematic surveys, including within the plan area, may explain why nearly 10% of species are known from a single location (Elliott and Pipp 2019).

Population trend in the plan area

There are no known specific population trends for the representative species in Montana or the plan area.

Habitat description

Overhang and outcrops of vernally moist rock faces, often associated with seeps or springs that leave leached minerals (Greven and Spribille 1999, Elliott and Pipp 2019).

Habitat trend in the plan area

There is no specific trend information, but in moist rock faces are not disturbed within the plan area outside of large landscape level perturbations, thus habitat trends are likely stabile. Habitat suitability modeling suggests that moderate to optimal habitat is widely distributed for at some representative species with the plan area (Montana Natural Heritage Program 2022).

Relevant life history traits and other information

Bryophytes differ in the timing and expression of life cycles, which may affect sensitivity to certain stressors, but all species are dependent on the availability and function of suitable habitat conditions that support the species' life cycle.

Relevant threats to populations occupying the plan area

Beyond threats documented across the specific ranges of the species considered here (NatureServe, natureserve.org, 01/2023), there are no known unique threats within the plan area.

In general, bryophytes are affected by habitat destruction and fragmentation, air pollution, changes in water distribution and availability, and changing temperatures (Hylander et al. 2002, Söderström 2006, Root and McCune 2010, Oishi and Morimoto 2013, He et al. 2016, Monteiro and Vieira 2017, Vanneste et al. 2017). Bryophytes are sensitive to changes in microhabitat conditions that affect either substrate availability or microclimate conditions (Lesica et al. 1991, Rambo and Muir 1998, Mills and Macdonald 2005, Dynesius et al. 2008, Schmalholz and Hylander 2011, Schmalholz et al. 2011).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the life-histories as well as the distribution and abundance of the populations to substantiate the risk to the species within the plan area. Suitable habitat is abundant and widely distributed within the plan area and likely either stabilizing or improving due to improved management.

Best available scientific information

Cornwell, W.K., Pearse, W.D., Dalrymple, R.L., and Zanne, A.E. 2019. What we (don't) know about global plant diversity. Ecography 42 (11): 1819-1831 pp.

Dynesius, M., Åström, M., and Nilsson, C. 2008. Microclimatic buffering by logging residues and forest edges reduces clear-cutting impacts on forest bryophytes. Applied Vegetation Science 11 (3): 345-354 pp.

Elliott, J.C., and Pipp, A.K. 2019. History, Biogeography, and Species of Montana Mosses (1880–2018). Evansia 36(2) (2): 39-58 pp. https://doi.org/10.1639/0747-9859-36.2.39

Frego, K.A. 2007. Bryophytes as potential indicators of forest integrity. Forest Ecology and Management 242 (1): 65-75 pp.

Greven, H., and Spribille, T. 1999. Grimmia brittoniae, a rare moss endemic to northwestern Montana. The Bryologist 102(1) (1): 116-118 pp.

He, X., He, K.S., and Hyvönen, J. 2016. Will bryophytes survive in a warming world? Perspectives in Plant Ecology, Evolution and Systematics 19: 49-60 pp.

Hylander, K., Jonsson, B.G., and Nilsson, C. 2002. Evaluating Buffer Strips Along Boreal Streams Using Bryophytes as Indicators. Ecological Applications 12 (3): 797-806 pp. 10.1890/1051-0761(2002)012[0797:Ebsabs]2.0.Co;2

Lesica, P., McCune, B., Cooper, S.V., and Shic Hong, W. 1991. Differences in lichen and bryophyte communities between old-growth and managed second-growth forests in the Swan Valley, Montana. Canadian Journal of Botany 69: 1745-1755 pp.

Mills, S.E., and Macdonald, S.E. 2005. Factors influencing bryophyte assemblage at different scales in the western Canadian boreal forest. The Bryologist 108(1) (1): 86-100 pp. 10.1639/0007-2745(2005)108[86:Fibaad]2.0.Co;2

Montana Natural Heritage Program. 2022. Grimmia brittoniae (Britton's Dry Rock Moss) Predicted Suitable Habitat Modeling. Burkholder, Braden, ed. Helena, MT. 17p. Montana Natural Heritage Program. Helena, MT. 17 p.

Monteiro, J., and Vieira, C. 2017. Determinants of stream bryophyte community structure: bringing ecology into conservation. Freshwater Biology 62 (4): 695-710 pp. 10.1111/fwb.12895

Oishi, Y., and Morimoto, Y. 2013. Identifying indicator species for bryophyte conservation in fragmented forests. Landscape and Ecological Engineering 12 (1): 107-114 pp. 10.1007/s11355-013-0220-0

Rambo, T.R., and Muir, P.S. 1998. Bryophyte species associations with coarse woody debris and stand ages in Oregon. The Bryologist 101 (3): 366-376 pp.

Root, H.T., and McCune, B. 2010. Forest floor lichen and bryophyte communities in thinned Pseudotsuga menziesii - Tsuga heterophylla forests. The Bryologist 113(3) (3): 619-630 pp. 10.1639/0007-2745-113.3.619

Schmalholz, M., and Hylander, K. 2011. Microtopography creates small-scale refugia for boreal forest floor bryophytes during clear-cut logging. Ecography 34 (4): 637-648 pp. 10.1111/j.1600-0587.2010.06652.x

Schmalholz, M., Hylander, K., and Frego, K. 2011. Bryophyte species richness and composition in young forests regenerated after clear-cut logging versus after wildfire and spruce budworm outbreak. Biodiversity and Conservation 20 (12): 2575-2596 pp. 10.1007/s10531-011-0092-2

Söderström, L. 2006. Conservation Biology of Bryophytes. Lindbergia 31 (1/2): 24-32 pp. http://www.jstor.org/stable/20150204

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

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7.2 Lackschewitz' Fleabane (*Erigeron lackschewitzii*)

Conservation Categories

G3/S3 (Montana Natural Heritage Program, mtnhp.org, 10/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is endemic to Montana and southern Alberta. In Montana the species is found along and around the continental divide from the Canadian border south to near the border with Idaho. The species is documented in two locations in the very northeastern extent of the plan area (Montana Natural Heritage Program, mtnhp.org, 10/2023), but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are limited within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species is generally associated with calcareous soil and talus slopes along subalpine and alpine ridges (Montana Natural Heritage Program, mtnhp.org, 10/2023).

Habitat trend in the plan area

There are no specific habitat trends for the plan area. Modeled suitable habitat is very limited to locations in the northeastern extent of the plan area (Montana Natural Heritage Program 2021). In general, modelled suitable habitat appears split, with no modelled habitat occurring between the northern and southern range extent of the species (Montana Natural Heritage Program 2021).

Relevant life history traits and other information

None

Relevant threats to populations occupying the plan area

The species is a local endemic, and range size is among the most consistent predictors of extinction risk (Chichorro et al. 2019). Moreover, the species range is limited to a very small portion of the plan area with little redundancy in modelled suitable habitat within the plan area (Montana Natural Heritage Program 2021), further increasing risk for localized extinction (Dias 1996, Ovaskainen and Hanski 2004), particularly from stochastic events (Smith and Almeida 2020).

Beyond threats documented across the species range (NatureServe, natureserve.org, 10/2023), there are no additional known unique threats to the species within the plan area. The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation,

and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020).

Given the elevational distribution of the species, climate change may be the greatest threat as it may reduce the availability of suitable habitat conditions (Engler et al. 2011), as well as alter interactions with other species that shift elevational distribution (Alexander et al. 2015, Gómez et al. 2015, Iseli et al. 2023). Although the effects of climate change may take time to manifest (Nomoto and Alexander 2021, Alexander et al. 2018), such changes are likely to present novel challenges for the species because climate change often has more significant impacts on rare species with a limited distribution (Thuiller et al. 2005). Moreover, climate change has the potential to increase interest in high mountain recreation (Pröbstl-Haider et al. 2021), which may increase risk from trampling as well invasive species (Pickering 2022).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

Yes

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

Yes

Rational for determination

The species is a Montana endemic with a range that only slightly overlaps the plan area. There are only two known locations of the species within the plan area and alternative suitable habitat within the plan area is limited as the plan area, which suggests the population within the plan area is likely small with few areas of redundancy. Small populations are more likely to face localized extirpation, particularly when isolated from other source populations as (Dias 1996, Ovaskainen and Hanski 2004, Smith and Almeida 2020) as is likely the case for this species given the disjunct distribution of suitable habitat within the plan area (Montana Natural Heritage Program 2021).

Best available scientific information

Alexander, J.M., Chalmandrier, L., Lenoir, J., Burgess, T.I., Essl, F., Haider, S., Kueffer, C., McDougall, K., Milbau, A., Nunez, M.A., Pauchard, A., Rabitsch, W., Rew, L.J., Sanders, N.J., and Pellissier, L. 2018. Lags in the response of mountain plant communities to climate change. Global Change Biology 24 (2): 563-579 pp.

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Dias, P.C. 1996. Sources and sinks in population biology. Trends in Ecology & Evolution 11 (8): 326-330 pp. https://doi.org/10.1016/0169-5347(96)10037-9

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Engler, R., Randin, C.F., Thuiller, W., Dullinger, S., Zimmermann, N.E., Araújo, M.B., Pearman, P.B., Le Lay, G., Piedallu, C., Albert, C.H., Choler, P., Coldea, G., De Lamo, X., Dirnböck, T., Gégout, J.-C., Gómez-García, D., Grytnes, J.-A., Heegaard, E., Høistad, F., Nogués-Bravo, D., Normand, S., Puşcaş, M., Sebastià, M.-T., Stanisci, A., Theurillat, J.-P., Trivedi, M.R., Vittoz, P., and Guisan, A. 2011. 21st century climate change threatens mountain flora unequally across Europe. Global Change Biology 17 (7): 2330-2341 pp.

Gómez, J.M., González-Megías, A., Lorite, J., Abdelaziz, M., and Perfectti, F. 2015. The silent extinction: climate change and the potential hybridization-mediated extinction of endemic high-mountain plants. Biodiversity and Conservation 24 (8): 1843-1857 pp.

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Iseli, E., Chisholm, C., Lenoir, J., Haider, S., Seipel, T., Barros, A., Hargreaves, A.L., Kardol, P., Lembrechts, J.J., McDougall, K., Rashid, I., Rumpf, S.B., Arévalo, J.R., Cavieres, L.A., Daehler, C.C., Dar, P.A., Endress, B.A., Jakobs, G., Jiménez, A., Küffer, C., Mihoc, M., Milbau, A., Morgan, J.W., Naylor, B.J., Pauchard, A., Ratier Backes, A., Reshi, Z.A., Rew, L.J., Righetti, D., Shannon, J.M., Valencia, G., Walsh, N., Wright, G.T., and Alexander, J.M. 2023. Rapid upwards spread of non-native plants in mountains across continents. Nature Ecology & Evolution: 1-12 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

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Nomoto, H.A., and Alexander, J.M. 2021. Drivers of local extinction risk in alpine plants under warming climate. Ecol Lett 24 (6): 1157-1166 pp. 10.1111/ele.13727

Ovaskainen, O., and Hanski, I. 2004. Chapter 4: Metapopulation dynamics in highly fragmented landscapes. Chapter 4. In Hanski, Ilkka and Gaggiotti, Oscar E., eds., Ecology, genetics and evolution of metapopulations. Burlington, MA: Elsevier Science. 73-103 pp. https://doi.org/10.1016/B978-012323448-3/50006-4

Pickering, C.M. 2022. Mountain bike riding and hiking can contribute to the dispersal of weed seeds. Journal of Environmental Management 319: 1-10 pp.

Pröbstl-Haider, U., Hödl, C., Ginner, K., and Borgwardt, F. 2021. Climate change: Impacts on outdoor activities in the summer and shoulder seasons. Journal of Outdoor Recreation and Tourism 34 10.1016/j.jort.2020.100344

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Smith, K.G., and Almeida, R.J. 2020. When are extinctions simply bad luck? Rarefaction as a framework for disentangling selective and stochastic extinctions. Journal of Applied Ecology 57 (1): 101-110 pp. https://doi.org/10.1111/1365-2664.13510

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

Thuiller, W., Lavorel, S., and Araújo, M.B. 2005. Niche properties and geographical extent as predictors of species sensitivity to climate change. Global Ecology and Biogeography 14 (4): 347-357 pp. 10.1111/j.1466-822X.2005.00162.x

7.3 Mission Mountain Kittentails (*Synthyris canbyi*)

Conservation Categories

G2G3/S2S3 (Montana Natural Heritage Program, mtnhp.org, 10/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is endemic to Montana. The species is documented from a single location in the very northern extent of the plan area (Montana Natural Heritage Program, mtnhp.org, 10/2023), but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are limited within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species is generally associated with calcareous soil and talus slopes along subalpine and alpine ridges (Montana Natural Heritage Program, mtnhp.org, 10/2023).

Habitat trend in the plan area

There are no specific habitat trends for the plan area. Modeled suitable habitat is limited to locations in the northern extent of the plan area with the majority of habitat being of low suitability (Montana National Heritage Program 2018).

Relevant life history traits and other information

None

Relevant threats to populations occupying the plan area

The species is a local endemic, and range size is among the most consistent predictors of extinction risk (Chichorro et al. 2019). Moreover, the species range is limited to a very small portion of the plan area with little redundancy in modeled suitable habitat within the plan area (Montana National Heritage Program 2018), further increasing risk for localized extinction (Dias 1996, Ovaskainen and Hanski 2004), particularly from stochastic events (Smith and Almeida 2020).

Beyond threats documented across the species range (NatureServe, natureserve.org, 10/2023), there are no additional known unique threats to the species within the plan area. The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation,

and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020).

Given the elevational distribution of the species, climate change may be the greatest threat as it may reduce the availability of suitable habitat conditions (Engler et al. 2011), as well as alter interactions with other species that shift elevational distribution (Alexander et al. 2015, Gómez et al. 2015, Iseli et al. 2023). Although the effects of climate change may take time to manifest (Nomoto and Alexander 2021, Alexander et al. 2018), such changes are likely to present novel challenges for the species because climate change often has more significant impacts on rare species with a limited distribution (Thuiller et al. 2005). Moreover, climate change has the potential to increase interest in high mountain recreation (Pröbstl-Haider et al. 2021), which may increase risk from trampling as well invasive species (Pickering 2022).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

Yes

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

Yes

Rational for determination

The species is a very localized endemic with a range that only slightly overlaps the plan area. There is only a single known location of the species within the plan area and alternative suitable habitat within the plan area is limited, which suggests the population within the plan area is likely small with few areas of redundancy. Small populations are more likely to face localized extirpation, particularly when isolated from other source populations as (Dias 1996, Ovaskainen and Hanski 2004, Smith and Almeida 2020) as is likely the case for this species given the disjunct distribution of suitable habitat within the plan area (Montana National Heritage Program 2018).

Best available scientific information

Alexander, J.M., Chalmandrier, L., Lenoir, J., Burgess, T.I., Essl, F., Haider, S., Kueffer, C., McDougall, K., Milbau, A., Nunez, M.A., Pauchard, A., Rabitsch, W., Rew, L.J., Sanders, N.J., and Pellissier, L. 2018. Lags in the response of mountain plant communities to climate change. Global Change Biology 24 (2): 563-579 pp.

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Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Dias, P.C. 1996. Sources and sinks in population biology. Trends in Ecology & Evolution 11 (8): 326-330 pp. https://doi.org/10.1016/0169-5347(96)10037-9

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Engler, R., Randin, C.F., Thuiller, W., Dullinger, S., Zimmermann, N.E., Araújo, M.B., Pearman, P.B., Le Lay, G., Piedallu, C., Albert, C.H., Choler, P., Coldea, G., De Lamo, X., Dirnböck, T., Gégout, J.-C., Gómez-García, D., Grytnes, J.-A., Heegaard, E., Høistad, F., Nogués-Bravo, D., Normand, S., Puşcaş, M., Sebastià, M.-T., Stanisci, A., Theurillat, J.-P., Trivedi, M.R., Vittoz, P., and Guisan, A. 2011. 21st century climate change threatens mountain flora unequally across Europe. Global Change Biology 17 (7): 2330-2341 pp.

Gómez, J.M., González-Megías, A., Lorite, J., Abdelaziz, M., and Perfectti, F. 2015. The silent extinction: climate change and the potential hybridization-mediated extinction of endemic high-mountain plants. Biodiversity and Conservation 24 (8): 1843-1857 pp.

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Iseli, E., Chisholm, C., Lenoir, J., Haider, S., Seipel, T., Barros, A., Hargreaves, A.L., Kardol, P., Lembrechts, J.J., McDougall, K., Rashid, I., Rumpf, S.B., Arévalo, J.R., Cavieres, L.A., Daehler, C.C., Dar, P.A., Endress, B.A., Jakobs, G., Jiménez, A., Küffer, C., Mihoc, M., Milbau, A., Morgan, J.W., Naylor, B.J., Pauchard, A., Ratier Backes, A., Reshi, Z.A., Rew, L.J., Righetti, D., Shannon, J.M., Valencia, G., Walsh, N., Wright, G.T., and Alexander, J.M. 2023. Rapid upwards spread of non-native plants in mountains across continents. Nature Ecology & Evolution: 1-12 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Montana National Heritage Program. 2018. Mission Mountain kittentails (Synthyris canbyi) predicted suitable habitat models. Helena, MT. Montana Natural Heritage Program. 14 p.

Nomoto, H.A., and Alexander, J.M. 2021. Drivers of local extinction risk in alpine plants under warming climate. Ecol Lett 24 (6): 1157-1166 pp. 10.1111/ele.13727

Ovaskainen, O., and Hanski, I. 2004. Chapter 4: Metapopulation dynamics in highly fragmented landscapes. Chapter 4. In Hanski, Ilkka and Gaggiotti, Oscar E., eds., Ecology, genetics and evolution of metapopulations. Burlington, MA: Elsevier Science. 73-103 pp. https://doi.org/10.1016/B978-012323448-3/50006-4

Pickering, C.M. 2022. Mountain bike riding and hiking can contribute to the dispersal of weed seeds. Journal of Environmental Management 319: 1-10 pp.

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Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Smith, K.G., and Almeida, R.J. 2020. When are extinctions simply bad luck? Rarefaction as a framework for disentangling selective and stochastic extinctions. Journal of Applied Ecology 57 (1): 101-110 pp. https://doi.org/10.1111/1365-2664.13510

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Thuiller, W., Lavorel, S., and Araújo, M.B. 2005. Niche properties and geographical extent as predictors of species sensitivity to climate change. Global Ecology and Biogeography 14 (4): 347-357 pp. 10.1111/j.1466-822X.2005.00162.x

7.4 Musk-root (*Adoxa moschatellina*)

Conservation Categories

G5/S3, Species of Conservation Concern on neighboring Forest (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species has a circumpolar distribution, primarily occurring in arctic, boreal, and north temperate habitats. In Montana, the species is known from roughly several extremely disjunct locations, (Montana Natural Heritage Program, mtnhp.org, 01/2023), but the species is known from Wyoming and is considered secure in Alberta (Alberta Biodiversity Monitoring Institute(ABMI) 2019). The species is documented in four locations in the southeastern extent of the plan area, but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are limited within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022). Indeed, the species is likely under-recorded, as it generally occurs in small, isolated populations and is cryptic both in appearance and life cycle (Jefferson and Kirby 2018).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species is can be found in moist forests, often in association with moist soils and shaded forest margins (Alberta Biodiversity Monitoring Institute(ABMI) 2019, Jefferson and Kirby 2018), but the species is often found along cliff edges and scree slopes (Jefferson and Kirby 2018), and in Montana rockslides with underlying cool air flow (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but modeled suitable habitat is abundant in the southeastern extent of the plan area, including considerable areas of optimal habitat (Montana Natural Heritage Program 2017).

Relevant life history traits and other information

One of only two species of the genera *Adoxa*, little is known about the ecology of the species (Jefferson and Kirby 2018).

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area.

The species has a narrow ecological tolerance and does not tolerate human disturbance (Pipp 2017). The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020). The species may be intolerant of human land use practices that alter local habitat conditions (Alberta Biodiversity Monitoring Institute(ABMI) 2019), including grazing and recreation (Montana Natural Heritage Program, mtnhp.org, 01/2023); however, the species is commonly associated with old trails and lanes in Europe (Jefferson and Kirby 2018).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is secure globally, and suitable habitat is readily available and widely distributed in the plan area (Montana Natural Heritage Program 2017).

Best available scientific information

Alberta Biodiversity Monitoring Institute(ABMI). 2019. Moschatel (Adoxa moschatellina) ABMI Species Profile Series. ABMI Species Profile Series. Alberta Biodiversity Monitoring Institute. Alberta. 6 p.

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Jefferson, R., and Kirby, K. 2018. A scent of musk –the 'life and times' of Moschatel, the Good Friday flower. British Wildlife 30(2) (2): 79-85 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

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Pipp, A.K. 2017. Coefficient of Conservatism Rankings for the Flora of Montana: Part III. Helena, MT. Montana Natural Heritage Program. 107 p.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

7.5 Sand Springbeauty (*Claytonia arenicola*)

Conservation Categories

G4/S2S3 (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going within the plan area.

The species is native to Washington, Oregon, Idaho, and Montana. In Montana, the species is known from roughly twenty locations, all of which are in the western extent of the plan area (Montana Natural Heritage Program, mtnhp.org, 01/2023). Species-specific surveys that consider the phenology, as well as the habitat associations of the species, are largely lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022). Where found in the plan area, the species is abundant, described as numbering in the thousands (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

Found on mossy cover talus and rock ledges, generally on cool north or northeast facing slopes with minimal tree or shrub cover (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but the availability and distribution of rocky habitat is likely stable.

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is apparently globally secure.

Best available scientific information

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

7.6 Sandweed (*Athysanus pusillus*)

Conservation Categories

G5/S1S2 (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is a broadly distributed across the western United States and British Columbia. In Montana, the species is limited to the extreme western edge of the state, where it is known from fewer than 30 records (Montana Natural Heritage Program, mtnhp.org, 01/2023). The species is known from a single location within the plan area, but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species occupies moist soils near slopes and cliffs, in the lower montane zone.

Habitat trend in the plan area

There are no specific habitat trend, but modeled suitable habitat is limited in area and suitability (Montana Natural Heritage Program 2020).

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

The population within the plan area is at the edge of the species range, which may create challenges for persistence when populations are small, or habitat limited (Burgess et al. 2020). The species is known from a single location and modelled habitat within the plan area is of lower suitability and disjunct from more suitable habitat within the range of the species, suggesting that populations within the plan area are both small and isolated. Small, isolated populations are at greater risk for localized extinction (Dias 1996, Ovaskainen and Hanski 2004), particularly from stochastic events (Smith and Almeida 2020).

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no other known unique threats to the species within the plan area. The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020). Invasive species such as knapweeds and

cheatgrass that quickly establish following disturbance, may present a particular risk to the species within the plan area (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

Yes

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

Yes

Rational for determination

The species is known from a single location within the plan area and alternative suitable habitat within the plan area is limited, which suggests that the population within the plan area is likely small. Small populations are more likely to face localized extirpation, particularly when isolated from other source populations (Dias 1996, Ovaskainen and Hanski 2004, Smith and Almeida 2020), as indicated by the distribution of modelled habitat suitability across western Montana (Montana Natural Heritage Program 2020). Additional stressors from invasive competitors may further limit the resilience of the known populations of the species within the plan area.

Best available scientific information

Burgess, M.D., Eaton, M.A., and Gregory, R.D. 2020. A review of spatial patterns across species ranges to aid the targeting of conservation interventions. Biology Conservation 251

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Dias, P.C. 1996. Sources and sinks in population biology. Trends in Ecology & Evolution 11 (8): 326-330 pp. https://doi.org/10.1016/0169-5347(96)10037-9

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Montana Natural Heritage Program. 2020. Athysanus pusillus (sandweed) predicted suitable habitat modeling. Helena, Montana. Montana Natural Heritage Program. 17 p.

Ovaskainen, O., and Hanski, I. 2004. Chapter 4: Metapopulation dynamics in highly fragmented landscapes. Chapter 4. In Hanski, Ilkka and Gaggiotti, Oscar E., eds., Ecology, genetics and evolution of metapopulations. Burlington, MA: Elsevier Science. 73-103 pp. https://doi.org/10.1016/B978-012323448-3/50006-4

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Smith, K.G., and Almeida, R.J. 2020. When are extinctions simply bad luck? Rarefaction as a framework for disentangling selective and stochastic extinctions. Journal of Applied Ecology 57 (1): 101-110 pp. https://doi.org/10.1111/1365-2664.13510

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

7.7 Scalepod (*Idahoa scapigera*)

Conservation Categories

G5/S1S2 (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is a broadly distributed across the western United States and British Columbia. In Montana, the species is limited to the extreme western extent of the state, where it is known from roughly 30 records (Montana Natural Heritage Program, mtnhp.org, 01/2023). The species is known from two locations within the plan area, but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species occupies moist soils near slopes and cliffs, in the lower montane zone.

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but modeled suitable habitat is is limited in area and suitability (Montana Natural Heritage Program 2020).

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

The population within the plan area is at the edge of the species range, which may create challenges for persistence when populations are small, or habitat limited (Burgess et al. 2020). The species is known from a single location and modelled habitat within the plan area is of lower suitability and disjunct from more suitable habitat within the range of the species, suggesting that populations within the plan area are both small and isolated. Small, isolated populations are at greater risk for localized extinction (Dias 1996, Ovaskainen and Hanski 2004), particularly from stochastic events (Smith and Almeida 2020).

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no other known unique threats to the species within the plan area. The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020). Invasive species such as knapweeds and

cheatgrass that quickly establish following disturbance, may present a particular risk to the species within the plan area (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

Yes

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

Yes

Rational for determination

The species is known from a single location within the plan area and alternative suitable habitat within the plan area is limited, which suggests that the population within the plan area is likely small. Small populations are more likely to face localized extirpation, particularly when isolated from other source populations (Dias 1996, Ovaskainen and Hanski 2004, Smith and Almeida 2020), as indicated by the distribution of modelled habitat suitability across western Montana (Montana Natural Heritage Program 2020).

Best available scientific information

Burgess, M.D., Eaton, M.A., and Gregory, R.D. 2020. A review of spatial patterns across species ranges to aid the targeting of conservation interventions. Biology Conservation 251

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Dias, P.C. 1996. Sources and sinks in population biology. Trends in Ecology & Evolution 11 (8): 326-330 pp. https://doi.org/10.1016/0169-5347(96)10037-9

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Montana Natural Heritage Program. 2020. Idahoa scapigera (scalepod) predicted suitable habitat modeling. Helena, Montana. Montana Natural Heritage Program. 17 p.

Ovaskainen, O., and Hanski, I. 2004. Chapter 4: Metapopulation dynamics in highly fragmented landscapes. Chapter 4. In Hanski, Ilkka and Gaggiotti, Oscar E., eds., Ecology, genetics and evolution of metapopulations. Burlington, MA: Elsevier Science. 73-103 pp. https://doi.org/10.1016/B978-012323448-3/50006-4

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Smith, K.G., and Almeida, R.J. 2020. When are extinctions simply bad luck? Rarefaction as a framework for disentangling selective and stochastic extinctions. Journal of Applied Ecology 57 (1): 101-110 pp. https://doi.org/10.1111/1365-2664.13510

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

7.8 Short-flowered Monkeyflower (*Mimulus breviflorus*)

Conservation Categories

G4/S1S2 (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is broadly distributed across the Pacific Northwest from British Columbia to California and east to Wyoming and Montana. In Montana, the species is known from fewer than fifteen records in the western half of the state (Montana Natural Heritage Program, mtnhp.org, 01/2023). The species is known from a single location within the plan area, but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species occupies areas of rock talus or outcrops in coniferous forest or grasslands.

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but modeled suitable habitat, including substantial areas of moderate suitability, is widely available throughout much of the plan area (Montana Natural Heritage Program 2021).

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is apparently globally secure, and habitat is readily available and widely distributed in the plan area (Montana Natural Heritage Program 2021).

Best available scientific information

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Montana Natural Heritage Program. 2021. Mimulus breviflorus (short-flowered monkeyflower) predicted suitable habitat modeling. Helena, Montana. Montana Natural Heritage Program. 17 p.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

7.9 Stalk-leaved Monkeyflower (*Mimulus ampliatus*)

Conservation Categories

G3/S3, Species of Conservation Concern on a neighboring Forest (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is a regional endemic found in eastern Washington, northern Idaho, and northwestern Montana, where it is known from fewer than 40 records (Montana Natural Heritage Program, mtnhp.org, 01/2023). The species is known from a single location within the plan area, but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species is found across a broad elevational gradient, where it occupies moist soils near slopes and cliffs, or along riparian areas.

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but modeled suitable habitat, including substantial areas of moderate suitability, is widely available (Montana Natural Heritage Program 2020).

Relevant life history traits and other information

The species is believed to be the rarest member of a clade of closely related monkey flowers, only recently verified as a unique species (Whittall et al. 2006).

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is considered vulnerable, but habitat is readily available and widely distributed in the plan area (Montana Natural Heritage Program 2020).

Best available scientific information

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Montana Natural Heritage Program. 2020. Mimulus ampliatus (stalk-leaved monkeyflower) predicted suitable habitat modeling. Helena, Montana. Montana Natural Heritage Program. 17 p.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

Whittall, J.B., Carlson, M.L., Beardsley, P.M., Meinke, R.J., and Liston, A. 2006. The Mimulus moschatus Alliance (Phrymaceae): Molecular and morphological phylogenetics and their conservation implications. Systematic Botany 31(2) (2): 380-397 pp. 10.1600/036364406777585810

8. Aquatic

8.1 Beck Water-marigold (*Bidens beckii*)

Conservation Categories

G5/S2, Regional Forester Sensitive Species (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is known from many northern states and most southern provinces of Canada. In Montana, the species is primarily limited to the northwestern portion of the state, including at least six moderate to large populations (Montana Natural Heritage Program, mtnhp.org, 01/2023). All known locations within the plan area are limited to the eastern extent, where several large waterbodies having known populations. Species-specific surveys that consider the phenology, as well as the habitat associations of the species are lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species occupies large low-elevation, slow-moving rivers, lakes, and wetlands (Montana Natural Heritage Program, mtnhp.org, 01/2023), where it is associated with nutrient-poor substrates (Johnson and Ostrofsky 2004).

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but the habitat types the species occupies are widely distributed. The ecological conditions within and around some habitats that may support the species are likely either stable or improving due to advances in riparian and aquatic ecosystem management (Roper et al. 2019, Roper et al. 2018).

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The species has a narrow ecological tolerance and does not tolerate human disturbance (Pipp 2017). The primary threats to the species across its

distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020). Changes in water quality and disturbance from recreation may have localized effects on populations (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is globally secure, and habitat is readily available and widely distributed in the plan area.

Best available scientific information

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Johnson, R.K., and Ostrofsky, M.L. 2004. Effects of sediment nutrients and depth on small-scale spatial heterogeneity of submersed macrophyte communities in Lake Pleasant, Pennsylvania. Canadian Journal of Fisheries and Aquatic Sciences 61 (8): 1493-1502 pp. 10.1139/f04-081

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Pipp, A.K. 2017. Coefficient of Conservatism Rankings for the Flora of Montana: Part III. Helena, MT. Montana Natural Heritage Program. 107 p.

Roper, B.B., Capurso, J.M., Paroz, Y., and Young, M.K. 2018. Conservation of aquatic biodiversity in the context of multiple-use management on National Forest System lands. Fisheries 43 (9): 396-405 pp.

Roper, B.B., Saunders, W.C., and Ojala, J.V. 2019. Did changes in western federal land management policies improve salmonid habitat in streams on public lands within the Interior Columbia River Basin? Environmental Monitoring and Assessment 191 (9): 574 p.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

8.2 Blunt-leaved Pondweed (*Potamogeton obtusifolius*)

Conservation Categories

G5/S3, Species of Conservation Concern on neighboring Forest (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going within the plan area.

The species is broadly distributed over much of the northern portion of North America. In Montana, the species is known from roughly 30 locations primarily form the northwestern portion of the state (Montana Natural Heritage Program, mtnhp.org, 01/2023). The species is known from a single location in the plan area, but species-specific surveys that consider the phenology, as well as the habitat associations of the species are largely lacking (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species is associated with the shallows of lakes, ponds, and sloughs (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Habitat trend in the plan area

The habitat types the species occupies are abundant and well distributed within the plan area, with substantial areas of modeled suitable habitat, including optimal habitat, in many areas (Montana Natural Heritage Program 2017). The ecological conditions within and around some habitats that may support the species are likely either stable or improving due to advances in riparian and aquatic ecosystem management (Roper et al. 2019, Roper et al. 2018).

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The species has a somewhat narrow ecological tolerance and does not tolerate human disturbance (Pipp 2017). The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The habitat that supports the species is well distributed in the plan area (Montana Natural Heritage Program 2017), habitat conditions are stable or improving (Roper et al. 2018, Roper et al. 2019), and the species is globally secure.

Best available scientific information

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Montana Natural Heritage Program. 2017. Blunt-leaved pondweed (*Potamogeton obtusifolius*) predicted suitable habitat modeling. Helena, MT. Montana Natural Heritage Program. 14 p.

Pipp, A.K. 2017. Coefficient of Conservatism Rankings for the Flora of Montana: Part III. Helena, MT. Montana Natural Heritage Program. 107 p.

Roper, B.B., Capurso, J.M., Paroz, Y., and Young, M.K. 2018. Conservation of aquatic biodiversity in the context of multiple-use management on National Forest System lands. Fisheries 43 (9): 396-405 pp.

Roper, B.B., Saunders, W.C., and Ojala, J.V. 2019. Did changes in western federal land management policies improve salmonid habitat in streams on public lands within the Interior Columbia River Basin? Environmental Monitoring and Assessment 191 (9): 574 p.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

8.3 Flatleaf Bladderwort (*Utricularia intermedia*)

Conservation Categories

G5/S2 (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is broadly distributed across much of temperate and boreal North America. In Montana, the species is known from roughly 20 records in the western half of the state (Montana Natural Heritage Program, mtnhp.org, 01/2023). The species is known from a single location within the plan area, but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

This species is associated with fens and bogs and bog pools, or with floating moss mats in larger waterbodies.

Habitat trend in the plan area

No specific habitat trends are known within the plan area, but modeled suitable habitat are readily available and widely distributed across the plan area (Montana Natural Heritage Program 2017). The ecological conditions within and around some habitats that may support the species are likely either stable or improving due to advances in riparian and aquatic ecosystem management (Roper et al. 2019, Roper et al. 2018).

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The species has a narrow ecological tolerance and does not tolerate human disturbance (Pipp 2017). The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020). Bogs and fens are vulnerable to changes in

climate and nutrient availability (Berendse et al. 2001, Antala et al. 2022, Salimi et al. 2021) and more generally activities that affect hydrological regimes (Chadde et al. 1998).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is globally secure, and habitat is readily available and widely distributed in the plan area (Montana Natural Heritage Program 2017).

Best available scientific information

Antala, M., Juszczak, R., van der Tol, C., and Rastogi, A. 2022. Impact of climate change-induced alterations in peatland vegetation phenology and composition on carbon balance. Sci Total Environ 827: 154294 p.

Berendse, F., Van Breemen, N., Rydin, H., Buttler, A., Heijmans, M., Hoosbeek, M.R., Lee, J.A., Mitchell, E., Saarinen, T., Vasander, H., and Wallén, B. 2001. Raised atmospheric CO2 levels and increased N deposition cause shifts in plant species composition and production in Sphagnum bogs. Global Change Biology 7 (5): 591-598 pp. 10.1046/j.1365-2486.2001.00433.x

Chadde, S.W., Shelly, J.S., Bursik, R.J., Moseley, R.K., Evenden, A.G., Mantas, M., Rabe, F., and Heidel, B. 1998. Peatlands on National Forests of the northern Rocky Mountains: Ecology and conservation. Ogden, UT. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 75 p. https://www.fs.fed.us/rm/pubs/rmrs_gtr011.pdf

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Montana Natural Heritage Program. 2017. Flatleaf bladderwort (Utricularia intermedia) predicted suitable habitat modeling. Helena, Montana. Montana Natural Heritage Program. 14 p.

Pipp, A.K. 2017. Coefficient of Conservatism Rankings for the Flora of Montana: Part III. Helena, MT. Montana Natural Heritage Program. 107 p.

Roper, B.B., Capurso, J.M., Paroz, Y., and Young, M.K. 2018. Conservation of aquatic biodiversity in the context of multiple-use management on National Forest System lands. Fisheries 43 (9): 396-405 pp.

Roper, B.B., Saunders, W.C., and Ojala, J.V. 2019. Did changes in western federal land management policies improve salmonid habitat in streams on public lands within the Interior Columbia River Basin? Environmental Monitoring and Assessment 191 (9): 574 p.

Salimi, S., Almuktar, S.A.A.A.N., and Scholz, M. 2021. Impact of climate change on wetland ecosystems: A critical review of experimental wetlands. Journal of Environmental Management 286: 1-15 pp.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

8.4 Lesser Bladderwort (*Utricularia minor*)

Conservation Categories

G5/S3 (Montana Natural Heritage Program, mtnhp.org, 08/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is broadly distributed across much of temperate and boreal North America. In Montana, the species is known from roughly 40 records in the western half of the state (Montana Natural Heritage Program, mtnhp.org, 08/2023). The species is known from two locations within the plan area, but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

This species is associated with fens and bogs and bog pools, or with floating moss mats in larger waterbodies.

Habitat trend in the plan area

No specific habitat trends are known within the plan area, but the ecological conditions within and around some habitats that may support the species are likely either stable or improving due to advances in riparian and aquatic ecosystem management (Roper et al. 2019, Roper et al. 2018).

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 08/2023), there are no known unique threats to the species within the plan area. The species has a narrow ecological tolerance and does not tolerate human disturbance (Pipp 2017). The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020). Bogs and fens are vulnerable to changes in climate and nutrient availability (Berendse et al. 2001, Antala et al. 2022, Salimi et al. 2021) and more generally activities that affect hydrological regimes (Chadde et al. 1998).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is globally secure, and habitat is likely habitat is readily available and well distributed in the plan area(Montana Natural Heritage Program 2017).

Best available scientific information

Antala, M., Juszczak, R., van der Tol, C., and Rastogi, A. 2022. Impact of climate change-induced alterations in peatland vegetation phenology and composition on carbon balance. Sci Total Environ 827: 154294 p.

Berendse, F., Van Breemen, N., Rydin, H., Buttler, A., Heijmans, M., Hoosbeek, M.R., Lee, J.A., Mitchell, E., Saarinen, T., Vasander, H., and Wallén, B. 2001. Raised atmospheric CO2 levels and increased N deposition cause shifts in plant species composition and production in Sphagnum bogs. Global Change Biology 7 (5): 591-598 pp. 10.1046/j.1365-2486.2001.00433.x

Chadde, S.W., Shelly, J.S., Bursik, R.J., Moseley, R.K., Evenden, A.G., Mantas, M., Rabe, F., and Heidel, B. 1998. Peatlands on National Forests of the northern Rocky Mountains: Ecology and conservation. Ogden, UT. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 75 p. https://www.fs.fed.us/rm/pubs/rmrs_gtr011.pdf

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Montana Natural Heritage Program. 2017. Flatleaf bladderwort (Utricularia intermedia) predicted suitable habitat modeling. Helena, Montana. Montana Natural Heritage Program. 14 p.

Pipp, A.K. 2017. Coefficient of Conservatism Rankings for the Flora of Montana: Part III. Helena, MT. Montana Natural Heritage Program. 107 p.

Roper, B.B., Capurso, J.M., Paroz, Y., and Young, M.K. 2018. Conservation of aquatic biodiversity in the context of multiple-use management on National Forest System lands. Fisheries 43 (9): 396-405 pp.

Roper, B.B., Saunders, W.C., and Ojala, J.V. 2019. Did changes in western federal land management policies improve salmonid habitat in streams on public lands within the Interior Columbia River Basin? Environmental Monitoring and Assessment 191 (9): 574 p.

Salimi, S., Almuktar, S.A.A.A.N., and Scholz, M. 2021. Impact of climate change on wetland ecosystems: A critical review of experimental wetlands. Journal of Environmental Management 286: 1-15 pp.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

8.5 Northern Bladderwort (*Utricularia ochroleuca*)

Conservation Categories

G4G5/S1 (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is a broadly distributed across much of the northern portion of North America. In Montana, the species known from fewer than 10 records from the western portion of the state (Montana Natural Heritage Program, mtnhp.org, 01/2023). The species is known from a single location within the plan area, but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species occupies acidic, shallow waters.

Habitat trend in the plan area

There are no specific habitat trends for the plan area. The ecological conditions within and around some habitats that may support the species are likely either stable or improving due to advances in riparian and aquatic ecosystem management (Roper et al. 2018, Roper et al. 2019).

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The species has a somewhat narrow ecological tolerance and does not tolerate human disturbance (Pipp 2017). The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is apparently globally secure.

Best available scientific information

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Pipp, A.K. 2017. Coefficient of Conservatism Rankings for the Flora of Montana: Part III. Helena, MT. Montana Natural Heritage Program. 107 p.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

8.6 Water Bulrush (*Schoenoplectus subterminalis*)

Conservation Categories

G5/S3, Regional Forester Sensitive Species (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going.

Widely distributed across much of North America, in Montana, the species is known from fewer than twenty locations in the northwestern portion of the state. The species is known from a single location within the plan area (Montana Natural Heritage Program, mtnhp.org, 01/2023). Species-specific surveys that consider the phenology, as well as the habitat associations of the species, are lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species has an aquatic habit with submergent or floating stems. It can occupy a variety of waterbody types but is generally found in boggy areas.

Habitat trend in the plan area

No specific habitat trends are known within the plan area, but modeled suitable habitat, including optimal habitat, is readily available, particularly in the eastern extent of the plan area (Montana Natural Heritage Program 2020). The ecological conditions within and around some habitats that may support the species are likely either stable or improving due to advances in riparian and aquatic ecosystem management (Roper et al. 2019, Roper et al. 2018).

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The species has a narrow ecological tolerance and does not tolerate human disturbance (Pipp 2017). The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020). Bogs and fens are vulnerable to changes in

climate and nutrient availability (Berendse et al. 2001, Antala et al. 2022, Salimi et al. 2021) and more generally activities that affect hydrological regimes (Chadde et al. 1998).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is globally secure, and habitat is available and widely distributed in the eastern extent of the plan area (Montana Natural Heritage Program 2020).

Best available scientific information

Antala, M., Juszczak, R., van der Tol, C., and Rastogi, A. 2022. Impact of climate change-induced alterations in peatland vegetation phenology and composition on carbon balance. Sci Total Environ 827: 154294 p.

Berendse, F., Van Breemen, N., Rydin, H., Buttler, A., Heijmans, M., Hoosbeek, M.R., Lee, J.A., Mitchell, E., Saarinen, T., Vasander, H., and Wallén, B. 2001. Raised atmospheric CO2 levels and increased N deposition cause shifts in plant species composition and production in Sphagnum bogs. Global Change Biology 7 (5): 591-598 pp. 10.1046/j.1365-2486.2001.00433.x

Chadde, S.W., Shelly, J.S., Bursik, R.J., Moseley, R.K., Evenden, A.G., Mantas, M., Rabe, F., and Heidel, B. 1998. Peatlands on National Forests of the northern Rocky Mountains: Ecology and conservation. Ogden, UT. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 75 p. https://www.fs.fed.us/rm/pubs/rmrs_gtr011.pdf

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Montana Natural Heritage Program. 2020. Schoenoplectus subterminalis (water bulrush) predicted suitable habitat modeling. Helena, Montana. Montana Natural Heritage Program. 17 p.

Pipp, A.K. 2017. Coefficient of Conservatism Rankings for the Flora of Montana: Part III. Helena, MT. Montana Natural Heritage Program. 107 p.

Roper, B.B., Capurso, J.M., Paroz, Y., and Young, M.K. 2018. Conservation of aquatic biodiversity in the context of multiple-use management on National Forest System lands. Fisheries 43 (9): 396-405 pp.

Roper, B.B., Saunders, W.C., and Ojala, J.V. 2019. Did changes in western federal land management policies improve salmonid habitat in streams on public lands within the Interior Columbia River Basin? Environmental Monitoring and Assessment 191 (9): 574 p.

Salimi, S., Almuktar, S.A.A.A.N., and Scholz, M. 2021. Impact of climate change on wetland ecosystems: A critical review of experimental wetlands. Journal of Environmental Management 286: 1-15 pp.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

8.7 Watershield (*Brasenia schreberi*)

Conservation Categories

G5/S1S2 (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going within the plan area.

The species is widely distributed in tropical and temperate regions throughout the world. In Montana the species is limited to the northwest portion of the state. In the plan area the species is known from a single population, where the species is abundant, with stem counts in the thousands (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area, but the known population in the plan area has persisted since first documented in the 1930s (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Habitat description

The species is associated with shallow lakes and ponds, and slow-moving rivers (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Habitat trend in the plan area

No specific habitat trends are known within the plan area , but modeled suitable habitat is well distributed with the eastern extent of the plan area (Montana Natural Heritage Program 2020). The ecological conditions within and around some habitats that may support the species are likely either stable or improving due to advances in riparian and aquatic ecosystem management (Roper et al. 2019, Roper et al. 2018).

Relevant life history traits and other information

This is the only known species of *Brasenia*. Often considered a nuisance species in shallow lakes and ponds.

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The species has a narrow ecological tolerance and does not tolerate human disturbance (Pipp 2017). The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020). Changes in water quality and disturbance

from recreation may have localized effects on populations (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. Suitable habitat is available and widely distributed in the eastern extent of the the plan area (Montana Natural Heritage Program 2020).

Best available scientific information

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Montana Natural Heritage Program. 2020. Brasenia schreberi (watershield) predicted suitable habitat modeling. Helena, Montana. Montana Natural Heritage Program. 17 p.

Pipp, A.K. 2017. Coefficient of Conservatism Rankings for the Flora of Montana: Part III. Helena, MT. Montana Natural Heritage Program. 107 p.

Roper, B.B., Capurso, J.M., Paroz, Y., and Young, M.K. 2018. Conservation of aquatic biodiversity in the context of multiple-use management on National Forest System lands. Fisheries 43 (9): 396-405 pp.

Roper, B.B., Saunders, W.C., and Ojala, J.V. 2019. Did changes in western federal land management policies improve salmonid habitat in streams on public lands within the Interior Columbia River Basin? Environmental Monitoring and Assessment 191 (9): 574 p.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

9. Riparian

9.1 Bryophytes of Riparian Areas

Conservation Categories

Unnamed fountain moss (*Dichelyma uncinatum*) – G3G5/SNR

Unnamed fountain moss (*Fontinalis neomexicana*) – G3G5/SNR

Unnamed orthotrichum moss (*Orthotrichum affine*) – G3G5/SNR

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the representative species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates (Thompson 2004) are not known to be on-going.

Basic data on the distribution and abundance of bryophytes species is often limited (Cornwell et al. 2019) largely due to the challenges of sampling bryophytes (Frego 2007). In Montana, which has a relatively high diversity of species (508 species), the lack of systematic surveys, including in the plan area, may explain why nearly 10% of species are known from a single location (Elliott and Pipp 2019).

Population trend in the plan area

There are no known specific population trends for the representative species in Montana or the plan area.

Habitat description

Species maybe present in a variety of riparian areas within the plan area where microclimatic conditions and appropriate substrates are available (Lesica et al. 1991, Rambo and Muir 1998, Mills and Macdonald 2005, Dynesius et al. 2008, Schmalholz and Hylander 2011, Schmalholz et al. 2011). In general, the associated species prefer cool, moist microsites and are located on litter, rock, soil, tree bases, down logs, and in some cases tree branches (Elliott and Pipp 2019).

Habitat trend in the plan area

Historic forest management has in some cases degraded habitat conditions that may support the representative species by altering microclimate and the availability of the woody debris (Lesica et al. 1991, Rambo and Muir 1998). Bryophytes communities are resilient to some disturbance, but the effects are disturbance and species specific, and are affected by the availability of source populations in the surrounding landscape (Schmalholz and Hylander 2011, Schmalholz et al. 2011, Rudolphi and Gustafsson 2011, Paquette et al. 2016, Boudreault et al. 2018, Jagodziński et al. 2018). Forested habitats remain abundant within the plan area, and the availability of suitable substrates within managed forests is likely increasing with the implementation of conservation measures for soil and down-woody debris (Fenton and Frego 2005, Dynesius et al. 2008), as well as riparian area management (Hylander et al. 2002, Roper et al. 2019, Roper et al. 2018).

Relevant life history traits and other information

Bryophytes differ in the timing and expression of life cycles, which may affect sensitivity to certain stressors, but all species are dependent on the availability and function of suitable habitat conditions that support the species' life cycle.

Relevant threats to populations occupying the plan area

Beyond threats documented across the specific ranges of the species considered here (NatureServe, natureserve.org, 01/2023), there are no known unique threats within the plan area.

In general, bryophytes are affected by habitat destruction and fragmentation, air pollution, changes in water distribution and availability, and changing temperatures (Hylander et al. 2002, Söderström 2006, Root and McCune 2010, Oishi and Morimoto 2013, He et al. 2016, Monteiro and Vieira 2017, Vanneste et al. 2017). Bryophytes are sensitive to changes in microhabitat conditions that affect either substrate availability or microclimate conditions (Lesica et al. 1991, Rambo and Muir 1998, Mills and Macdonald 2005, Dynesius et al. 2008, Schmalholz and Hylander 2011, Schmalholz et al. 2011).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the life-histories as well as the distribution and abundance of the populations to substantiate the risk to the species within the plan area. Suitable habitat is abundant and widely distributed within the plan area and likely either stabilizing or improving due to improved management.

Best available scientific information

Boudreault, C., Paquette, M., Fenton, N.J., Pothier, D., and Bergeron, Y. 2018. Changes in bryophytes assemblages along a chronosequence in eastern boreal forest of Quebec. Canadian Journal of Forest Research 48 (7): 821-834 pp. 10.1139/cjfr-2017-0352

Cornwell, W.K., Pearse, W.D., Dalrymple, R.L., and Zanne, A.E. 2019. What we (don't) know about global plant diversity. Ecography 42 (11): 1819-1831 pp.

Dynesius, M., Åström, M., and Nilsson, C. 2008. Microclimatic buffering by logging residues and forest edges reduces clear-cutting impacts on forest bryophytes. Applied Vegetation Science 11 (3): 345-354 pp.

Elliott, J.C., and Pipp, A.K. 2019. History, Biogeography, and Species of Montana Mosses (1880–2018). Evansia 36(2) (2): 39-58 pp. https://doi.org/10.1639/0747-9859-36.2.39

Fenton, N.J., and Frego, K.A. 2005. Bryophyte (moss and liverwort) conservation under remnant canopy in managed forests. Biological Conservation 122 (3): 417-430 pp.

Frego, K.A. 2007. Bryophytes as potential indicators of forest integrity. Forest Ecology and Management 242 (1): 65-75 pp.

He, X., He, K.S., and Hyvönen, J. 2016. Will bryophytes survive in a warming world? Perspectives in Plant Ecology, Evolution and Systematics 19: 49-60 pp.

Hylander, K., Jonsson, B.G., and Nilsson, C. 2002. Evaluating Buffer Strips Along Boreal Streams Using Bryophytes as Indicators. Ecological Applications 12 (3): 797-806 pp. 10.1890/1051-0761(2002)012[0797:Ebsabs]2.0.Co;2

Jagodziński, A.M., Wierzcholska, S., Dyderski, M.K., Horodecki, P., Rusińska, A., Gdula, A.K., and Kasprowicz, M. 2018. Tree species effects on bryophyte guilds on a reclaimed post-mining site. Ecological Engineering 110: 117-127 pp.

Lesica, P., McCune, B., Cooper, S.V., and Shic Hong, W. 1991. Differences in lichen and bryophyte communities between old-growth and managed second-growth forests in the Swan Valley, Montana. Canadian Journal of Botany 69: 1745-1755 pp.

Mills, S.E., and Macdonald, S.E. 2005. Factors influencing bryophyte assemblage at different scales in the western Canadian boreal forest. The Bryologist 108(1) (1): 86-100 pp. 10.1639/0007-2745(2005)108[86:Fibaad]2.0.Co;2

Monteiro, J., and Vieira, C. 2017. Determinants of stream bryophyte community structure: bringing ecology into conservation. Freshwater Biology 62 (4): 695-710 pp. 10.1111/fwb.12895

Oishi, Y., and Morimoto, Y. 2013. Identifying indicator species for bryophyte conservation in fragmented forests. Landscape and Ecological Engineering 12 (1): 107-114 pp. 10.1007/s11355-013-0220-0

Paquette, M., Boudreault, C., Fenton, N., Pothier, D., and Bergeron, Y. 2016. Bryophyte species assemblages in fire and clear-cut origin boreal forests. Forest Ecology and Management 359: 99-108 pp. 10.1016/j.foreco.2015.09.031

Rambo, T.R., and Muir, P.S. 1998. Bryophyte species associations with coarse woody debris and stand ages in Oregon. The Bryologist 101 (3): 366-376 pp.

Root, H.T., and McCune, B. 2010. Forest floor lichen and bryophyte communities in thinned Pseudotsuga menziesii - Tsuga heterophylla forests. The Bryologist 113(3) (3): 619-630 pp. 10.1639/0007-2745-113.3.619

Roper, B.B., Capurso, J.M., Paroz, Y., and Young, M.K. 2018. Conservation of aquatic biodiversity in the context of multiple-use management on National Forest System lands. Fisheries 43 (9): 396-405 pp.

Roper, B.B., Saunders, W.C., and Ojala, J.V. 2019. Did changes in western federal land management policies improve salmonid habitat in streams on public lands within the Interior Columbia River Basin? Environmental Monitoring and Assessment 191 (9): 574 p.

Rudolphi, J., and Gustafsson, L. 2011. Forests regenerating after clear-cutting function as habitat for bryophyte and lichen species of conservation concern. PLoS One 6 (4): 1-9 pp.

Schmalholz, M., and Hylander, K. 2011. Microtopography creates small-scale refugia for boreal forest floor bryophytes during clear-cut logging. Ecography 34 (4): 637-648 pp. 10.1111/j.1600-0587.2010.06652.x

Schmalholz, M., Hylander, K., and Frego, K. 2011. Bryophyte species richness and composition in young forests regenerated after clear-cut logging versus after wildfire and spruce budworm outbreak. Biodiversity and Conservation 20 (12): 2575-2596 pp. 10.1007/s10531-011-0092-2

Söderström, L. 2006. Conservation Biology of Bryophytes. Lindbergia 31 (1/2): 24-32 pp. http://www.jstor.org/stable/20150204

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

Vanneste, T., Michelsen, O., Graae, B.J., Kyrkjeeide, M.O., Holien, H., Hassel, K., Lindmo, S., Kapás, R.E., and De Frenne, P. 2017. Impact of climate change on alpine vegetation of mountain summits in Norway. Ecological Research 32 (4): 579-593 pp. 10.1007/s11284-017-1472-1

9.2 Coville's Rush (*Juncus covillei*)

Conservation Categories

G5/S2S3, Regional Forester Sensitive Species (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable abundance estimates for the species (Thompson 2004) are not known to be on-going.

The current range of the species is within the Pacific Northwest. In Montana, the species is known from fewer than twenty locations from the western portion of the state (Montana Natural Heritage Program, mtnhp.org, 01/2023). The species is known from two disparate locations in the plan area, but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species is associated with large riverine systems, where it is limited to moist gravel or sandy soils (Montana Natural Heritage Program, mtnhp.org, 01/2023) and often associated with tussocks for bryophytes (Levine 2000).

Habitat trend in the plan area

There are no specific habitat trends for the plan area. The large rivers that support the species are limited within the plan area, but modeled suitable habitat is available (Montana Natural Heritage Program 2020). The ecological conditions within and around some habitats that may support the species are likely either stable or improving due to advances in riparian and aquatic ecosystem management (Roper et al. 2019, Roper et al. 2018).

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The species has a somewhat narrow ecological tolerance and does not tolerate human disturbance (Pipp 2017). The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan rea. The habitat that supports the species is limited within the plan area (Montana Natural Heritage Program 2020), but habitat conditions are stable or improving (Roper et al. 2018, Roper et al. 2019), and the species is globally secure.

Best available scientific information

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Levine, J.M. 2000. Complex Interactions in a Streamside Plant Community. Ecology 81(12) (12): 3431-3444 pp. 10.1890/0012-9658(2000)081[3431:Ciiasp]2.0.Co;2

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Montana Natural Heritage Program. 2020. Juncus covillei (coville's rush) predicted suitable habitat modeling. Helena, Montana. Montana Natural Heritage Program. 17 p.

Pipp, A.K. 2017. Coefficient of Conservatism Rankings for the Flora of Montana: Part III. Helena, MT. Montana Natural Heritage Program. 107 p.

Roper, B.B., Capurso, J.M., Paroz, Y., and Young, M.K. 2018. Conservation of aquatic biodiversity in the context of multiple-use management on National Forest System lands. Fisheries 43 (9): 396-405 pp.

Roper, B.B., Saunders, W.C., and Ojala, J.V. 2019. Did changes in western federal land management policies improve salmonid habitat in streams on public lands within the Interior Columbia River Basin? Environmental Monitoring and Assessment 191 (9): 574 p.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

9.3 Foxtail Muhly (*Muhlenbergia andina*)

Conservation Categories

G4/S2S3 (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is broadly distributed across the western United States and western Canada. In Montana, the species is known from roughly fifteen records in the western half of the state (Montana Natural Heritage Program, mtnhp.org, 01/2023). The species is known from a single location within the plan area, but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

This species occupies moist meadows, marshes, and riparian areas.

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but moist meadows and riparian areas are common and well distributed. The ecological conditions within and around some habitats that may support the species are likely either stable or improving due to advances in riparian and aquatic ecosystem management (Roper et al. 2019, Roper et al. 2018).

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is globally secure, and habitat is readily available and widely distributed.

Best available scientific information

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Roper, B.B., Capurso, J.M., Paroz, Y., and Young, M.K. 2018. Conservation of aquatic biodiversity in the context of multiple-use management on National Forest System lands. Fisheries 43 (9): 396-405 pp.

Roper, B.B., Saunders, W.C., and Ojala, J.V. 2019. Did changes in western federal land management policies improve salmonid habitat in streams on public lands within the Interior Columbia River Basin? Environmental Monitoring and Assessment 191 (9): 574 p.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

9.4 Gray Lungwort Lichen (*Lobaria hallii*)

Conservation Categories

G4/S2 (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going. Surveys of suitable habitat within the plan area are lacking (Jovan et al. 2021), which may substantially affect the known distribution and abundance of lichen species (Hutchinson et al. 2002).

Present in Northern Europe and Asia, in North America the species occurs from Alaska to northern California and east to western Montana (Lesher et al. 2003). In Montana, there are roughly twelve documented observations of the species in the northwestern portion of the state, including one within the plan area (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species occupies a diversity of habitats including wetlands, swales and riparian areas, orchards, meadows, low elevation forests, and rocky balds (Lesher et al. 2003). The species uses a variety of substrates, although is more commonly found on hardwoods, and will occupy a wide range of successional stages, from young to mature stands, and disturbed forests (Lesher et al. 2003). In Montana, the species is largely restricted to the low elevation, moist forests (McCune 1982).

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but the habitats that the species occupies are common and widely dispersed.

Relevant life history traits and other information

As a group, lichen generally have limited dispersal capability which may extenuate the effects of fragmentation (Bartemucci et al. 2022).

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area.

World-wide, the primary threats to lichen species include habitat degradation, fragmentation, and loss; pollution; and climate change (Lesica et al. 1991, Conti and Cecchetti 2001, Bergamini et al. 2005, Ellis et al. 2007, Geiser and Neitlich 2007, Scheidegger and Werth 2009, Cameron, Goudie, et al. 2013, Cameron, Neily, et al. 2013, McMurray et al. 2015, Ellis 2019, Allen et al. 2019).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. Suitable habitat is readily available and widely distributed throughout the plan area.

Best available scientific information

Allen, J.L., McMullin, R.T., Tripp, E.A., and Lendemer, J.C. 2019. Lichen conservation in North America: a review of current practices and research in Canada and the United States. Biodiversity and Conservation 28 (12): 3103-3138 pp.

Bartemucci, P., Lilles, E., and Gauslaa, Y. 2022. Silvicultural strategies for lichen conservation: Smaller gaps and shorter distances to edges promote recolonization. Ecosphere 13 (1): 1-20 pp.

Bergamini, A., Scheidegger, C., Stofer, S., Palmira, C., Davey, S., Dietrich, M., Dubs, F., Farkas, E., Groner, U., Kärkkäinen, K., Keller, C., Lökös, L., Lommi, S., Máguas, C., Mitchell, R., Pinho, P., Rico, V.J., Aragón, G., Truscott, A.-M., Wolseley, P., and Watt, A. 2005. Performance of macrolichens and lichen genera as indicators of lichen species richness and composition. Conservation Biology 19 (4): 1051-1062 pp.

Cameron, D.R., Goudie, I., and Richardson, D. 2013. Habitat loss exceeds habitat regeneration for an IUCN flagship lichen epiphyte: Erioderma pedicellatum. Canadian Journal of Forest Research 43 (11): 1075-1080 pp.

Cameron, R.P., Neily, T., and Clapp, H. 2013. Forest harvesting impacts on mortality of an endangered lichen at the landscape and stand scales. Canadian Journal of Forest Research 43 (5): 507-511 pp.

Conti, M.E., and Cecchetti, G. 2001. Biological monitoring: lichens as bioindicators of air pollution assessment—a review. Environmental pollution 114 (3): 471-492 pp.

Ellis, C. 2019. Climate Change, Bioclimatic Models and the Risk to Lichen Diversity. Diversity 11 (4) 10.3390/d11040054

Ellis, C.J., Coppins, B.J., Dawson, T.P., and Seaward, M.R.D. 2007. Response of British lichens to climate change scenarios: Trends and uncertainties in the projected impact for contrasting biogeographic groups. Biological Conservation 140 (3): 217-235 pp.

Geiser, L.H., and Neitlich, P.N. 2007. Air pollution and climate gradients in western Oregon and Washington indicated by epiphytic macrolichens. Environmental Pollution 145 (1): 203-218 pp.

Hutchinson, J., McCune, B., and Berryman, S. 2002. Concentration of rare epiphytic lichens along large streams in a mountainous watershed in Oregon, U.S.A. The Bryologist 105 (3): 439-450 pp. 10.1639/0007-2745(2002)105[0439:Corela]2.0.Co;2

Jovan, S., Haldeman, M., Will-Wolf, S., Dillman, K., Geiser, L., Thompson, J., Stone, D., and Hollinger, J. 2021. National atlas of epiphytic lichens in forested habitats of the United States. Portland, OR. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 96 p.

Lesher, R.D., Derr, C.C., and Geiser, L.H. 2003. Natural history and management considerations for northwest forest plan survey and manage lichens. Based on Informatio as of the year 2000. Portland, OR. U.S. Department of Agricuture, Forest Service, Pacific Northwest Region Natural Resources. 218 p. http://web.or.blm.gov/ForPlan/MR-Lichen/index.htm

Lesica, P., McCune, B., Cooper, S.V., and Shic Hong, W. 1991. Differences in lichen and bryophyte communities between old-growth and managed second-growth forests in the Swan Valley, Montana. Canadian Journal of Botany 69: 1745-1755 pp.

McCune, B. 1982. Lichens of the Swan Valley, Montana. The Bryologist 85 (1): 13-21 pp.

McMurray, J.A., Roberts, D.W., and Geiser, L.H. 2015. Epiphytic lichen indication of nitrogen deposition and climate in the northern rocky mountains, USA. Ecological Indicators 49: 154-161 pp. 10.1016/j.ecolind.2014.10.015

Scheidegger, C., and Werth, S. 2009. Conservation strategies for lichens: insights from population biology. Fungal Biology Reviews 23 (3): 55-66 pp. 10.1016/j.fbr.2009.10.003

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

9.5 Pustulate Tarpaper Lichen (*Collema curtisporum*)

Conservation Categories

G3/S1 (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going. Surveys of suitable habitat within the plan area are lacking (Jovan et al. 2021), which may substantially affect the known distribution and abundance of lichen species (Hutchinson et al. 2002).

The species has a disjunct distribution, occurring in Northern Europe as well as the Pacific Northwest of North America (Hutchinson et al. 2002). In Montana, the species has fewer than twenty confirmed observations, all from the northwestern portion of the state, including a single observation within the plan area (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

Generally associated with moist forests, in Europe the species is found in aspen communities (Hedenås and Hedström 2007); however, in North America the species is found in primarily flood plain forests where it is usually found growing on black cottonwood tree bark (McCune et al. 2002, McCune 1982).

Habitat trend in the plan area

There are no specific habitat trends within the plan area, but the distribution of large rivers with suitable flood plains that support black cottonwood gallery forests (Hutchinson et al. 2002) is relatively limited. The ecological conditions within and around some habitats that may support the species are likely either stable or improving due to advances in riparian and aquatic ecosystem management within the plan area (Roper et al. 2019, Roper et al. 2018).

Relevant life history traits and other information

As a group, lichen generally have limited dispersal capability which may extenuate the effects of fragmentation (Bartemucci et al. 2022).

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area.

World-wide, the primary threats to lichen species include habitat degradation, fragmentation, and loss; pollution; and climate change (Lesica et al. 1991, Conti and Cecchetti 2001, Bergamini et al. 2005, Ellis

et al. 2007, Geiser and Neitlich 2007, Scheidegger and Werth 2009, Cameron, Goudie, et al. 2013, Cameron, Neily, et al. 2013, McMurray et al. 2015, Ellis 2019, Allen et al. 2019).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. Suitable habitat is readily available and widely distributed throughout the plan area.

Best available scientific information

Allen, J.L., McMullin, R.T., Tripp, E.A., and Lendemer, J.C. 2019. Lichen conservation in North America: a review of current practices and research in Canada and the United States. Biodiversity and Conservation 28 (12): 3103-3138 pp.

Bartemucci, P., Lilles, E., and Gauslaa, Y. 2022. Silvicultural strategies for lichen conservation: Smaller gaps and shorter distances to edges promote recolonization. Ecosphere 13 (1): 1-20 pp.

Bergamini, A., Scheidegger, C., Stofer, S., Palmira, C., Davey, S., Dietrich, M., Dubs, F., Farkas, E., Groner, U., Kärkkäinen, K., Keller, C., Lökös, L., Lommi, S., Máguas, C., Mitchell, R., Pinho, P., Rico, V.J., Aragón, G., Truscott, A.-M., Wolseley, P., and Watt, A. 2005. Performance of macrolichens and lichen genera as indicators of lichen species richness and composition. Conservation Biology 19 (4): 1051-1062 pp.

Cameron, D.R., Goudie, I., and Richardson, D. 2013. Habitat loss exceeds habitat regeneration for an IUCN flagship lichen epiphyte: Erioderma pedicellatum. Canadian Journal of Forest Research 43 (11): 1075-1080 pp.

Cameron, R.P., Neily, T., and Clapp, H. 2013. Forest harvesting impacts on mortality of an endangered lichen at the landscape and stand scales. Canadian Journal of Forest Research 43 (5): 507-511 pp.

Conti, M.E., and Cecchetti, G. 2001. Biological monitoring: lichens as bioindicators of air pollution assessment—a review. Environmental pollution 114 (3): 471-492 pp.

Ellis, C. 2019. Climate Change, Bioclimatic Models and the Risk to Lichen Diversity. Diversity 11 (4) 10.3390/d11040054

Ellis, C.J., Coppins, B.J., Dawson, T.P., and Seaward, M.R.D. 2007. Response of British lichens to climate change scenarios: Trends and uncertainties in the projected impact for contrasting biogeographic groups. Biological Conservation 140 (3): 217-235 pp.

Geiser, L.H., and Neitlich, P.N. 2007. Air pollution and climate gradients in western Oregon and Washington indicated by epiphytic macrolichens. Environmental Pollution 145 (1): 203-218 pp.

Hedenås, H., and Hedström, P. 2007. Conservation of epiphytic lichens: significance of remnant aspen (Populus tremula) trees in clear-cuts. Biological conservation 135 (3): 388-395 pp.

Hutchinson, J., McCune, B., and Berryman, S. 2002. Concentration of rare epiphytic lichens along large streams in a mountainous watershed in Oregon, U.S.A. The Bryologist 105 (3): 439-450 pp. 10.1639/0007-2745(2002)105[0439:Corela]2.0.Co;2

Jovan, S., Haldeman, M., Will-Wolf, S., Dillman, K., Geiser, L., Thompson, J., Stone, D., and Hollinger, J. 2021. National atlas of epiphytic lichens in forested habitats of the United States. Portland, OR. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 96 p.

Lesica, P., McCune, B., Cooper, S.V., and Shic Hong, W. 1991. Differences in lichen and bryophyte communities between old-growth and managed second-growth forests in the Swan Valley, Montana. Canadian Journal of Botany 69: 1745-1755 pp.

McCune, B. 1982. Lichens of the Swan Valley, Montana. The Bryologist 85 (1): 13-21 pp.

McCune, B., Hutchinson, J., and Berryman, S. 2002. Concentration of rare epiphytic lichens along large streams in a mountainous watershed in Oregon, U.S.A. The Bryologist 105 (3): 439-450 pp. 10.1639/0007-2745(2002)105[0439:Corela]2.0.Co;2

McMurray, J.A., Roberts, D.W., and Geiser, L.H. 2015. Epiphytic lichen indication of nitrogen deposition and climate in the northern rocky mountains, USA. Ecological Indicators 49: 154-161 pp. 10.1016/j.ecolind.2014.10.015

Roper, B.B., Capurso, J.M., Paroz, Y., and Young, M.K. 2018. Conservation of aquatic biodiversity in the context of multiple-use management on National Forest System lands. Fisheries 43 (9): 396-405 pp.

Roper, B.B., Saunders, W.C., and Ojala, J.V. 2019. Did changes in western federal land management policies improve salmonid habitat in streams on public lands within the Interior Columbia River Basin? Environmental Monitoring and Assessment 191 (9): 574 p.

Scheidegger, C., and Werth, S. 2009. Conservation strategies for lichens: insights from population biology. Fungal Biology Reviews 23 (3): 55-66 pp. 10.1016/j.fbr.2009.10.003

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

10. Wetland and Fen

10.1 Arctic Sweet Coltsfoot (*Petasites frigidus* var. *frigidus*)

Conservation Categories

G5/S2 (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is broadly distributed across much of the north temperate and boreal areas of North America. In Montana, the species is known from roughly fifteen observations in the northwestern portion of the state (Montana Natural Heritage Program, mtnhp.org, 01/2023). The species is known from one location within the plan area, but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

This species is associated with wet meadows, fens, and riparian areas in the valleys and foothills.

Habitat trend in the plan area

No specific habitat trends are known within the plan area. Modeled suitable habitat exists, but is limited to the northeastern extent of the plan area (Montana Natural Heritage Program 2022). The ecological conditions within and around some habitats that may support the species are likely either stable or improving due to advances in riparian and aquatic ecosystem management (Roper et al. 2019, Roper et al. 2018).

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

The population within the plan area is at the edge of the species range, which may create challenges for persistence when populations are small, or habitat limited (Burgess et al. 2020). The species is known from two locations and modelled habitat within the plan area is limited to the northeastern extent of the plan area. Small, isolated populations are at greater risk for localized extinction (Dias 1996, Ovaskainen and Hanski 2004), particularly from stochastic events (Smith and Almeida 2020).

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The species has a very narrow ecological tolerance and does not tolerate human disturbance (Pipp 2017). The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020). Bogs and fens are vulnerable to changes in climate and nutrient availability (Berendse et al. 2001, Antala et al. 2022, Salimi et al. 2021) and more generally activities that affect hydrological regimes (Chadde et al. 1998).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

Yes

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

Yes

Rational for determination

The species is known from two locations in the northeastern extent of the plan area, which also includes the only alternative suitable habitat area (Montana Natural Heritage Program 2022). Populations with a limited distribution within the plan area may be more likely to experience localized extirpation (Smith and Almeida 2020).

Best available scientific information

Antala, M., Juszczak, R., van der Tol, C., and Rastogi, A. 2022. Impact of climate change-induced alterations in peatland vegetation phenology and composition on carbon balance. Sci Total Environ 827: 154294 p.

Berendse, F., Van Breemen, N., Rydin, H., Buttler, A., Heijmans, M., Hoosbeek, M.R., Lee, J.A., Mitchell, E., Saarinen, T., Vasander, H., and Wallén, B. 2001. Raised atmospheric CO2 levels and increased N deposition cause shifts in plant species composition and production in Sphagnum bogs. Global Change Biology 7 (5): 591-598 pp. 10.1046/j.1365-2486.2001.00433.x

Burgess, M.D., Eaton, M.A., and Gregory, R.D. 2020. A review of spatial patterns across species ranges to aid the targeting of conservation interventions. Biology Conservation 251

Chadde, S.W., Shelly, J.S., Bursik, R.J., Moseley, R.K., Evenden, A.G., Mantas, M., Rabe, F., and Heidel, B. 1998. Peatlands on National Forests of the northern Rocky Mountains: Ecology and conservation. Ogden, UT. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 75 p. https://www.fs.fed.us/rm/pubs/rmrs_gtr011.pdf

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Dias, P.C. 1996. Sources and sinks in population biology. Trends in Ecology & Evolution 11 (8): 326-330 pp. https://doi.org/10.1016/0169-5347(96)10037-9

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Montana Natural Heritage Program. 2022. Petasites frigidus var. Frigidus (arctic sweet coltsfoot) predicted suitable habitat modeling. Helena, Montana. Montana Natural Heritage Program. 17 p.

Ovaskainen, O., and Hanski, I. 2004. Chapter 4: Metapopulation dynamics in highly fragmented landscapes. Chapter 4. In Hanski, Ilkka and Gaggiotti, Oscar E., eds., Ecology, genetics and evolution of metapopulations. Burlington, MA: Elsevier Science. 73-103 pp. https://doi.org/10.1016/B978-012323448-3/50006-4

Pipp, A.K. 2017. Coefficient of Conservatism Rankings for the Flora of Montana: Part III. Helena, MT. Montana Natural Heritage Program. 107 p.

Roper, B.B., Capurso, J.M., Paroz, Y., and Young, M.K. 2018. Conservation of aquatic biodiversity in the context of multiple-use management on National Forest System lands. Fisheries 43 (9): 396-405 pp.

Roper, B.B., Saunders, W.C., and Ojala, J.V. 2019. Did changes in western federal land management policies improve salmonid habitat in streams on public lands within the Interior Columbia River Basin? Environmental Monitoring and Assessment 191 (9): 574 p.

Salimi, S., Almuktar, S.A.A.A.N., and Scholz, M. 2021. Impact of climate change on wetland ecosystems: A critical review of experimental wetlands. Journal of Environmental Management 286: 1-15 pp.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Smith, K.G., and Almeida, R.J. 2020. When are extinctions simply bad luck? Rarefaction as a framework for disentangling selective and stochastic extinctions. Journal of Applied Ecology 57 (1): 101-110 pp. https://doi.org/10.1111/1365-2664.13510

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

10.2 Big-leaf Sedge (*Carex amplifolia*)

Conservation Categories

G4/S3, Regional Forester Sensitive Species (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is broadly distributed across the western United States and British Columbia. In Montana, the species is known from fewer than 10 records in the western half of the state (Montana Natural Heritage Program, mtnhp.org, 01/2023). The species is known from a single location within the plan area, but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

Swamps, bogs, and other wetlands in cedar forests and along streams in other coniferous forests (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Habitat trend in the plan area

No specific habitat trends are known within the plan area, but suitable wetland habitats are common within the plan area. The ecological conditions within and around some habitats that may support the species are likely either stable or improving due to advances in riparian and aquatic ecosystem management (Roper et al. 2019, Roper et al. 2018).

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The species has a moderate ecological tolerance, and is capable of persisting, but not necessarily thriving in locations with human disturbance (Pipp 2017). The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020). Bogs and fens are vulnerable to changes in climate and nutrient availability (Berendse et al. 2001,

Antala et al. 2022, Salimi et al. 2021) and more generally activities that affect hydrological regimes (Chadde et al. 1998).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is globally apparently secure, and habitat is readily available and widely distributed in the plan area.

Best available scientific information

Antala, M., Juszczak, R., van der Tol, C., and Rastogi, A. 2022. Impact of climate change-induced alterations in peatland vegetation phenology and composition on carbon balance. Sci Total Environ 827: 154294 p.

Berendse, F., Van Breemen, N., Rydin, H., Buttler, A., Heijmans, M., Hoosbeek, M.R., Lee, J.A., Mitchell, E., Saarinen, T., Vasander, H., and Wallén, B. 2001. Raised atmospheric CO2 levels and increased N deposition cause shifts in plant species composition and production in Sphagnum bogs. Global Change Biology 7 (5): 591-598 pp. 10.1046/j.1365-2486.2001.00433.x

Chadde, S.W., Shelly, J.S., Bursik, R.J., Moseley, R.K., Evenden, A.G., Mantas, M., Rabe, F., and Heidel, B. 1998. Peatlands on National Forests of the northern Rocky Mountains: Ecology and conservation. Ogden, UT. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 75 p. https://www.fs.fed.us/rm/pubs/rmrs_gtr011.pdf

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Pipp, A.K. 2017. Coefficient of Conservatism Rankings for the Flora of Montana: Part III. Helena, MT. Montana Natural Heritage Program. 107 p.

Roper, B.B., Capurso, J.M., Paroz, Y., and Young, M.K. 2018. Conservation of aquatic biodiversity in the context of multiple-use management on National Forest System lands. Fisheries 43 (9): 396-405 pp.

Roper, B.B., Saunders, W.C., and Ojala, J.V. 2019. Did changes in western federal land management policies improve salmonid habitat in streams on public lands within the Interior Columbia River Basin? Environmental Monitoring and Assessment 191 (9): 574 p.

Salimi, S., Almuktar, S.A.A.A.N., and Scholz, M. 2021. Impact of climate change on wetland ecosystems: A critical review of experimental wetlands. Journal of Environmental Management 286: 1-15 pp.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

10.3 Bryophytes of Wetlands and Fens

Conservation Categories

Limprichtia Moss (*Scorpidium revolvens*) – G5/S1

Meesia Moss (*Meesia triquetra*) – G5/S2

Messia Moss (*Messia uliginosa*) – G5/S1S2

Mendocino Peatmoss (*Sphagnum mendocinum*) – G4G5/S1

Narrowleaf Peatmoss (*Sphagnum angustifolium*) – G5/S2

Streamside Peatmoss (Sphagnum riparium) – G5/S1

Unnamed peatmoss (*Sphagnum centrale*) – G5/S1

Unnamed moss (*Scorpidium scorpioides*) – G5/S2

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the representative species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates (Thompson 2004) are not known to be on-going.

Basic data on the distribution and abundance of bryophytes species is often limited (Cornwell et al. 2019) largely due to the challenges of sampling bryophytes (Frego 2007). In Montana, which has a relatively high diversity of species (508 species), the lack of systematic surveys, including within the plan area, may explain why nearly 10% of species are known from a single location (Elliott and Pipp 2019).

Population trend in the plan area

There are no known specific population trends for the representative species in Montana or the plan area.

Habitat description

Species are associated with waterbodies or wet meadows and the surrounding uplands. Species very in the degree of habitat specialization, with some species occupying a broad array of waterbody types and others being waterbody type specialists. Fens and bogs support many of the representative species.

Habitat trend in the plan area

Waterbodies represent a minor portion of the total area, but are widely distributed throughout the plan area, and are largely stable in distribution and abundance. The ecological conditions within and around some habitats that may support the species are likely either stable or improving due to advances in riparian and aquatic ecosystem management (Roper et al. 2019, Roper et al. 2018). Moreover, habitat suitability modeling for one of the representative species, *Meesia triquetra*, suggests that moderate habitat is widely distributed (Montana Natural Heritage Program 2017).

Relevant life history traits and other information

Bryophytes differ in the timing and expression of life cycles, which may affect sensitivity to certain stressors, but all species are dependent on the availability and function of suitable habitat conditions that support the species' life cycle.

Relevant threats to populations occupying the plan area

Beyond threats documented across the specific ranges of the species considered here (NatureServe, natureserve.org, 01/2023), there are no known unique threats within the plan area.

In general, bryophytes are affected by habitat destruction and fragmentation, air pollution, changes in water distribution and availability, and changing temperatures (Hylander et al. 2002, Söderström 2006, Root and McCune 2010, Oishi and Morimoto 2013, He et al. 2016, Monteiro and Vieira 2017, Vanneste et al. 2017). Bryophytes are sensitive to changes in microhabitat conditions that affect either substrate availability or microclimate conditions (Lesica et al. 1991, Rambo and Muir 1998, Mills and Macdonald 2005, Dynesius et al. 2008, Schmalholz and Hylander 2011, Schmalholz et al. 2011).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the life-histories as well as the distribution and abundance of the populations to substantiate the risk to the species within the plan area. Suitable habitat is abundant and widely distributed within the plan area and likely either stabilizing or improving due to improved management.

Best available scientific information

Cornwell, W.K., Pearse, W.D., Dalrymple, R.L., and Zanne, A.E. 2019. What we (don't) know about global plant diversity. Ecography 42 (11): 1819-1831 pp.

Dynesius, M., Åström, M., and Nilsson, C. 2008. Microclimatic buffering by logging residues and forest edges reduces clear-cutting impacts on forest bryophytes. Applied Vegetation Science 11 (3): 345-354 pp.

Elliott, J.C., and Pipp, A.K. 2019. History, Biogeography, and Species of Montana Mosses (1880–2018). Evansia 36(2) (2): 39-58 pp. https://doi.org/10.1639/0747-9859-36.2.39

Frego, K.A. 2007. Bryophytes as potential indicators of forest integrity. Forest Ecology and Management 242 (1): 65-75 pp.

He, X., He, K.S., and Hyvönen, J. 2016. Will bryophytes survive in a warming world? Perspectives in Plant Ecology, Evolution and Systematics 19: 49-60 pp.

Hylander, K., Jonsson, B.G., and Nilsson, C. 2002. Evaluating Buffer Strips Along Boreal Streams Using Bryophytes as Indicators. Ecological Applications 12 (3): 797-806 pp. 10.1890/1051-0761(2002)012[0797:Ebsabs]2.0.Co;2

Lesica, P., McCune, B., Cooper, S.V., and Shic Hong, W. 1991. Differences in lichen and bryophyte communities between old-growth and managed second-growth forests in the Swan Valley, Montana. Canadian Journal of Botany 69: 1745-1755 pp.

Mills, S.E., and Macdonald, S.E. 2005. Factors influencing bryophyte assemblage at different scales in the western Canadian boreal forest. The Bryologist 108(1) (1): 86-100 pp. 10.1639/0007-2745(2005)108[86:Fibaad]2.0.Co;2

Montana Natural Heritage Program. 2017. Meesia Moss (Meesia triquetra) Predicted Suitable Habitat Modeling. Burkholder, Braden, ed. 25 October 2017. Helena, MT. 11p. Montana Natural Heritage Program. Helena MT. 11 p.

Monteiro, J., and Vieira, C. 2017. Determinants of stream bryophyte community structure: bringing ecology into conservation. Freshwater Biology 62 (4): 695-710 pp. 10.1111/fwb.12895

Oishi, Y., and Morimoto, Y. 2013. Identifying indicator species for bryophyte conservation in fragmented forests. Landscape and Ecological Engineering 12 (1): 107-114 pp. 10.1007/s11355-013-0220-0

Rambo, T.R., and Muir, P.S. 1998. Bryophyte species associations with coarse woody debris and stand ages in Oregon. The Bryologist 101 (3): 366-376 pp.

Root, H.T., and McCune, B. 2010. Forest floor lichen and bryophyte communities in thinned Pseudotsuga menziesii - Tsuga heterophylla forests. The Bryologist 113(3) (3): 619-630 pp. 10.1639/0007-2745-113.3.619

Roper, B.B., Capurso, J.M., Paroz, Y., and Young, M.K. 2018. Conservation of aquatic biodiversity in the context of multiple-use management on National Forest System lands. Fisheries 43 (9): 396-405 pp.

Roper, B.B., Saunders, W.C., and Ojala, J.V. 2019. Did changes in western federal land management policies improve salmonid habitat in streams on public lands within the Interior Columbia River Basin? Environmental Monitoring and Assessment 191 (9): 574 p.

Schmalholz, M., and Hylander, K. 2011. Microtopography creates small-scale refugia for boreal forest floor bryophytes during clear-cut logging. Ecography 34 (4): 637-648 pp. 10.1111/j.1600-0587.2010.06652.x

Schmalholz, M., Hylander, K., and Frego, K. 2011. Bryophyte species richness and composition in young forests regenerated after clear-cut logging versus after wildfire and spruce budworm outbreak. Biodiversity and Conservation 20 (12): 2575-2596 pp. 10.1007/s10531-011-0092-2

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Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

Vanneste, T., Michelsen, O., Graae, B.J., Kyrkjeeide, M.O., Holien, H., Hassel, K., Lindmo, S., Kapás, R.E., and De Frenne, P. 2017. Impact of climate change on alpine vegetation of mountain summits in Norway. Ecological Research 32 (4): 579-593 pp. 10.1007/s11284-017-1472-1

10.4 Crested Shieldfern (*Dryopteris cristata*)

Conservation Categories

G5/S3, Species of Conservation Concern on neighboring Forest (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going.

In North America, the species is primarily distributed in the eastern United States and much of Canada with some population in Washington, Idaho, and Montana, where it a primarily occurs in the northwestern portion of the state (Montana Natural Heritage Program, mtnhp.org, 01/2023). The species is known from seven locations, five of which are in the northeastern extent of the plan area, but species-specific surveys that consider the phenology, as well as the habitat associations of the species may substantially affect the known distribution and abundance of plant species (Ingegno 2017, Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

Often associated with fens and swamps, but also known from wet woodlands and meadows (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but modeled suitable habitat, including optimal habitat, is abundant and well dispersed, especially in the eastern extent of the plan area (Ingegno 2017, Montana Natural Heritage Program 2020). The ecological conditions within and around some habitats that may support the species are likely either stable or improving due to advances in riparian and aquatic ecosystem management (Roper et al. 2019, Roper et al. 2018).

Relevant life history traits and other information

The species is highly fecund, and produces spores that are highly tolerant of harsh environmental conditions (Peck et al. 1990).

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020). Bogs and fens are vulnerable to changes in

climate and nutrient availability (Berendse et al. 2001, Antala et al. 2022, Salimi et al. 2021) and more generally activities that affect hydrological regimes (Chadde et al. 1998). In addition, many presumably suitable sites have experienced invasion by canary reed grass (Ingegno 2017).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is globally secure, highly fecund, and the habitat the species occupies is readily available and widely distributed in the plan area (Ingegno 2017, Montana Natural Heritage Program 2020).

Best available scientific information

Antala, M., Juszczak, R., van der Tol, C., and Rastogi, A. 2022. Impact of climate change-induced alterations in peatland vegetation phenology and composition on carbon balance. Sci Total Environ 827: 154294 p.

Berendse, F., Van Breemen, N., Rydin, H., Buttler, A., Heijmans, M., Hoosbeek, M.R., Lee, J.A., Mitchell, E., Saarinen, T., Vasander, H., and Wallén, B. 2001. Raised atmospheric CO2 levels and increased N deposition cause shifts in plant species composition and production in Sphagnum bogs. Global Change Biology 7 (5): 591-598 pp. 10.1046/j.1365-2486.2001.00433.x

Chadde, S.W., Shelly, J.S., Bursik, R.J., Moseley, R.K., Evenden, A.G., Mantas, M., Rabe, F., and Heidel, B. 1998. Peatlands on National Forests of the northern Rocky Mountains: Ecology and conservation. Ogden, UT. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 75 p. https://www.fs.fed.us/rm/pubs/rmrs_gtr011.pdf

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Ingegno, A.S. 2017. Predicting habitat distribution for five rare plant species within the blackfoot swan landscape restoration project. Master of Science in Geography Master's thesis, University of Montana, Missoula, MT. 85 p.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Montana Natural Heritage Program. 2020. Dryopteris cristata (Crested Shieldfern) predicted suitable habitat modeling. Helena, MT. Montana Natural Heritage Program. 17 p.

Peck, J.H., Peck, C.J., and Farrar, D.R. 1990. Influences of life history attributes on formation of local and distant fern populations. American Fern Journal 80 (4): 126-142 pp. 10.2307/1547200

Roper, B.B., Capurso, J.M., Paroz, Y., and Young, M.K. 2018. Conservation of aquatic biodiversity in the context of multiple-use management on National Forest System lands. Fisheries 43 (9): 396-405 pp.

Roper, B.B., Saunders, W.C., and Ojala, J.V. 2019. Did changes in western federal land management policies improve salmonid habitat in streams on public lands within the Interior Columbia River Basin? Environmental Monitoring and Assessment 191 (9): 574 p.

Salimi, S., Almuktar, S.A.A.A.N., and Scholz, M. 2021. Impact of climate change on wetland ecosystems: A critical review of experimental wetlands. Journal of Environmental Management 286: 1-15 pp.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

10.5 English Sundew (*Drosera anglica*)

Conservation Categories

G5/S3, Species of Conservation Concern on neighboring Forest (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the Plan Area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is a circumboreal species, occurring in northern Europe, Asia, and North America. In Montana, the species is known from fewer than 30 locations, primarily in the northwestern portion of the state, with most of the populations described as large and healthy (Montana Natural Heritage Program, mtnhp.org, 01/2023). The species is known from three locations in widely disparate sites in the plan area, but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species occupies bogs and fens where it is often found on sphagnum mats, but also in grassy or sedgy seepages, or on open flats of organic material (Wolf et al. 2006, Rice 2019).

Habitat trend in the plan area

No specific habitat trends are known within the plan area, but the habitat types the species is generally associated, while rare, are widely distributed. The ecological conditions within and around some habitats that may support the species are likely either stable or improving due to advances in riparian and aquatic ecosystem management (Roper et al. 2019, Roper et al. 2018).

Relevant life history traits and other information

The species is frequently visited by bumble bees (Pengelly and Cartar 2011), making it a potentially important species supporting pollinator populations (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area.

The species has a narrow ecological tolerance and does not tolerate human disturbance (Pipp 2017). The primary threats to the species across its distribution are likely those common to most plant species

including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020). Bogs and fens are vulnerable to changes in climate and nutrient availability (Berendse et al. 2001, Antala et al. 2022, Salimi et al. 2021) and more generally activities that affect hydrological regimes (Chadde et al. 1998, Wolf et al. 2006). In addition, the species association with moss mats, makes the species vulnerable to actions that disrupt mat continuity, including trampling by people or livestock (Wolf et al. 2006).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area, potentially due to issues of identification (Montana Natural Heritage Program, mtnhp.org, 01/2023). The species is globally secure and the habitat the species occupies is rare, but widely distributed.

Best available scientific information

Antala, M., Juszczak, R., van der Tol, C., and Rastogi, A. 2022. Impact of climate change-induced alterations in peatland vegetation phenology and composition on carbon balance. Sci Total Environ 827: 154294 p.

Berendse, F., Van Breemen, N., Rydin, H., Buttler, A., Heijmans, M., Hoosbeek, M.R., Lee, J.A., Mitchell, E., Saarinen, T., Vasander, H., and Wallén, B. 2001. Raised atmospheric CO2 levels and increased N deposition cause shifts in plant species composition and production in Sphagnum bogs. Global Change Biology 7 (5): 591-598 pp. 10.1046/j.1365-2486.2001.00433.x

Chadde, S.W., Shelly, J.S., Bursik, R.J., Moseley, R.K., Evenden, A.G., Mantas, M., Rabe, F., and Heidel, B. 1998. Peatlands on National Forests of the northern Rocky Mountains: Ecology and conservation. Ogden, UT. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 75 p. https://www.fs.fed.us/rm/pubs/rmrs_gtr011.pdf

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Pengelly, C.J., and Cartar, R.V. 2011. Effect of boreal forest logging on nectar production of four understory herbs. Forest Ecology and Management 261 (11): 2068-2074 pp. 10.1016/j.foreco.2011.02.032

Pipp, A.K. 2017. Coefficient of Conservatism Rankings for the Flora of Montana: Part III. Helena, MT. Montana Natural Heritage Program. 107 p.

Rice, B.A. 2019. The genus Drosera L. (Droseraceae) in the western USA. Phytologia 101: 25-37 pp.

Roper, B.B., Capurso, J.M., Paroz, Y., and Young, M.K. 2018. Conservation of aquatic biodiversity in the context of multiple-use management on National Forest System lands. Fisheries 43 (9): 396-405 pp.

Roper, B.B., Saunders, W.C., and Ojala, J.V. 2019. Did changes in western federal land management policies improve salmonid habitat in streams on public lands within the Interior Columbia River Basin? Environmental Monitoring and Assessment 191 (9): 574 p.

Salimi, S., Almuktar, S.A.A.A.N., and Scholz, M. 2021. Impact of climate change on wetland ecosystems: A critical review of experimental wetlands. Journal of Environmental Management 286: 1-15 pp.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

Wolf, E.C., Gage, E., and Cooper, D.J. 2006. Drosera anglica Huds. (English sundew): A technical conservation assessment. Fort Collins, CO. Colorado State University, Department of Forest, Rangeland and Watershed Stewardship. 51 p.

10.6 Giant Helleborine (*Epipactis gigantea*)

Conservation Categories

G4/S2S3, Regional Forester Sensitive Species (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is native to much of the western United States and British Columbia. In Montana, the species is documented in locations in the south and southwest part of the state, but the primary distribution is in the northwest (Montana Natural Heritage Program, mtnhp.org, 01/2023). In the plan area the species is known from a single location, but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species occupies a variety of life zones ranging from desert to montane (Rocchio et al. 2006). In Montana, the species is commonly associated with saturated, calcareous soil, usually in proximity to warm seeps and springs that prevent the soil from freezing.

Habitat trend in the plan area

There are no specific habitat trends for the plan area.

Relevant life history traits and other information

The species has a fast life history strategy, growing rapidly and setting numerous seeds, but once established primarily propagates locally through asexual reproduction (Rocchio et al. 2006). All orchids, including this species (Rocchio et al. 2006), are dependent at some point in their life cycle on mycorrhizae, or fundal symbionts, that help acquire nutrients. The distribution and abundance of orchid species is closely tied to the spatial distribution and abundance of mycorrhizal fungi associates, which are not evenly distributed even in suitable macrohabitats (Shefferson et al. 2005, McCormick and Jacquemyn 2013).

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the Plan Area.

In general, the species has a narrow ecological tolerance and does not tolerate human disturbance (Pipp 2017); however, the species is known to persist even in areas with significant human disturbance

(Hornbeck et al. 2003). The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020), including orchids (Fay 2018). Although not know to be affecting orchid populations within the plan area, orchids are sometimes threatened by exploitation by collectors, which in some cases has occurred for centuries (Case et al. 1998).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is apparently globally secure, and habitat is readily available and widely distributed in the plan area (Montana Natural Heritage Program 2020).

Best available scientific information

Case, M.A., Mlodozeniec, H.T., Wallace, L.E., and Weldy, T.W. 1998. Conservation genetics and taxonomic status of the rare Kentucky lady's slipper: Cypripedium kentuckiense (Orchidaceae). American Journal of Botany 85 (12): 1779-1786 pp. https://doi.org/10.2307/2446512

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Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Fay, M.F. 2018. Orchid conservation: how can we meet the challenges in the twenty-first century? Botanical Studies 59 (1): 16 p.

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Hornbeck, J.H., Reyher, D., Sieg, C.H., and Crook, R.W. 2003. Conservation assessment for southern maidenhair fern and stream orchid in the Black Hills National Forest, South Dakota and Wyoming. Custer, SD. United States Department of Agriculture, Forest Service, Rocky Mountain Region, Black Hills National Forest. 45 p.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

McCormick, M.K., and Jacquemyn, H. 2013. What constrains the distribution of orchid populations? New Phytologist 202 (2): 392-400 pp. 10.1111/nph.12639

Montana Natural Heritage Program. 2020. Epipactis gigantea (Giant Helleborine) predicted suitable habitat modeling. Helena, MT. Montana Natural Heritage Program. 17 p.

Pipp, A.K. 2017. Coefficient of Conservatism Rankings for the Flora of Montana: Part III. Montana Natural Heritage Program, Helena, Montana. 107 p.

Rocchio, J., March, M., and Anderson, D.G. 2006. Epipactis gigantea Dougl. ex Hook. (stream orchid): A technical conservation assessment. Fort Collins, CO. U.S. Department of Agriculture, Forest Service, Rocky Mountain Region. 50 p.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Shefferson, R., P., Weiss, M., Kull, T., and Taylor, D.L. 2005. High specificity generally characterizes mycorrhizal association in rare lady's slipper orchids, genus *Cypripedium*. Molecular Ecology 14 (2): 613-626 pp. 10.1111/j.1365-294X.2005.02424.x

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

10.7 Glaucus Beaked Sedge (*Carex rostrata*)

Conservation Categories

G5/S2S3 (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is broadly distributed across much of temperate and boreal North America. In Montana, the species is known from roughly 20 records in the western half of the state (Montana Natural Heritage Program, mtnhp.org, 01/2023). The species is known from a single location within the plan area, but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

This species occurs in shallow water, including fens, bogs and bog pools, or on floating moss mats in larger lakes and streams.

Habitat trend in the plan area

No specific habitat trends are known within the plan area, but potential habitat is readily available and widely distributed. The ecological conditions within and around some habitats that may support the species are likely either stable or improving due to advances in riparian and aquatic ecosystem management (Roper et al. 2019, Roper et al. 2018).

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The species has a narrow ecological tolerance and does not tolerate human disturbance (Pipp 2017). The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020). Bogs and fens are vulnerable to changes in climate and nutrient availability (Berendse et al. 2001, Antala et al. 2022, Salimi et al. 2021) and more generally activities that affect hydrological regimes (Chadde et al. 1998).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is globally secure, and habitat is available and widely distributed.

Best available scientific information

Antala, M., Juszczak, R., van der Tol, C., and Rastogi, A. 2022. Impact of climate change-induced alterations in peatland vegetation phenology and composition on carbon balance. Sci Total Environ 827: 154294 p.

Berendse, F., Van Breemen, N., Rydin, H., Buttler, A., Heijmans, M., Hoosbeek, M.R., Lee, J.A., Mitchell, E., Saarinen, T., Vasander, H., and Wallén, B. 2001. Raised atmospheric CO2 levels and increased N deposition cause shifts in plant species composition and production in Sphagnum bogs. Global Change Biology 7 (5): 591-598 pp. 10.1046/j.1365-2486.2001.00433.x

Chadde, S.W., Shelly, J.S., Bursik, R.J., Moseley, R.K., Evenden, A.G., Mantas, M., Rabe, F., and Heidel, B. 1998. Peatlands on National Forests of the northern Rocky Mountains: Ecology and conservation. Ogden, UT. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 75 p. https://www.fs.fed.us/rm/pubs/rmrs_gtr011.pdf

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Pipp, A.K. 2017. Coefficient of Conservatism Rankings for the Flora of Montana: Part III. Helena, MT. Montana Natural Heritage Program. 107 p.

Roper, B.B., Capurso, J.M., Paroz, Y., and Young, M.K. 2018. Conservation of aquatic biodiversity in the context of multiple-use management on National Forest System lands. Fisheries 43 (9): 396-405 pp.

Roper, B.B., Saunders, W.C., and Ojala, J.V. 2019. Did changes in western federal land management policies improve salmonid habitat in streams on public lands within the Interior Columbia River Basin? Environmental Monitoring and Assessment 191 (9): 574 p.

Salimi, S., Almuktar, S.A.A.A.N., and Scholz, M. 2021. Impact of climate change on wetland ecosystems: A critical review of experimental wetlands. Journal of Environmental Management 286: 1-15 pp.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

10.8 Lanceleaf Moonwort (*Botrychium lanceolatum*)

Conservation Categories

G5/S3, Species of Conservation Concern on neighboring Forest (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species occurs throughout much of North America. In Montana the species is known from roughly 90 observations, most predominately in the northwestern portion of the state (Montana Natural Heritage Program, mtnhp.org, 02/2023). The species is known from a single location in the plan area, but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022). New occurrences of moonwort populations are often discovered following systematic surveys in suitable habitat.

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species occupies a variety of mesic habitats (Ahlenslager and Potash 2007).

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but modeled suitable habitat is widely available and broadly distributed within the plan area (Montana Natural Heritage Program 2020). The ecological conditions within and around some habitats that may support the species are likely either stable or improving due to advances in riparian and aquatic ecosystem management (Roper et al. 2019, Roper et al. 2018).

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020). Activities including grazing, offroad recreation, timber harvest and road maintenance may affect the species (Ahlenslager and Potash 2007).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. Suitable habitat is readily available and widely distributed in the plan area (Montana Natural Heritage Program 2020).

Best available scientific information

Ahlenslager, K., and Potash, L. 2007. Conservation assessment for 13 species of moonworts (*Botrychium* swartz subgenus *Botrychium*). Oregon/Washington. 3-49 pp.

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Montana Natural Heritage Program. 2020. Botrychium lanceolatum (lanceleaf moonwort) predicted suitable habitat modeling. Helena, Montana. Montana Natural Heritage Program. 17 p.

Roper, B.B., Capurso, J.M., Paroz, Y., and Young, M.K. 2018. Conservation of aquatic biodiversity in the context of multiple-use management on National Forest System lands. Fisheries 43 (9): 396-405 pp.

Roper, B.B., Saunders, W.C., and Ojala, J.V. 2019. Did changes in western federal land management policies improve salmonid habitat in streams on public lands within the Interior Columbia River Basin? Environmental Monitoring and Assessment 191 (9): 574 p.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

10.9 Meadow Horsetail (*Equisetum pratense*)

Conservation Categories

G5/S2 (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is native to much of the northern United States and most of Canada. In Montana, the species is documented in locations across much of the western part of the state, but the primary distribution is in the northwest (Montana Natural Heritage Program, mtnhp.org, 01/2023). In the plan area the species is known from two locations documented more than 30 years ago but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species occupies moist meadows and forests as well as associated riparian areas from valley bottoms to montane habitats, but requires unvegetated soil for establishment (Dodds 2022).

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but potential habitat is common within the plan area.

Relevant life history traits and other information

The species propagates by spores as well as vegetatively from rhizomes, often resulting in large colonies (Dodds 2022).

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. In general, the species has a moderate ecological tolerance and is capable of tolerating disturbance (Pipp 2017), especially once established (Dodds 2022). The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is globally secure, and habitat is available and widely distributed in the plan area.

Best available scientific information

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Dodds, J.S. 2022. Equisetum pratense Rare Plant Profile. Trenton, NJ. New Jersey Department of Environmental Protection, State Parks, Forests & Historic Sites, State Forest Fire Service & Forestry, Office of Natural Lands Management, New Jersey Natural Heritage Program. Trenton, NJ. 15 p.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Pipp, A.K. 2017. Coefficient of Conservatism Rankings for the Flora of Montana: Part III. Helena, MT. Montana Natural Heritage Program. 107 p.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

10.10 Nevada Clubrush (*Amphiscirpus nevadensis*)

Conservation Categories

G4/S2 (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is a broadly distributed across the western United States and western Canada. In Montana, the species known from fewer than 20 records scattered throughout the state (Montana Natural Heritage Program, mtnhp.org, 01/2023). The species is known from a single location within the plan area, but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species occupies the shoreline of saline or alkaline wetlands and fens.

Habitat trend in the plan area

There are no specific habitat trends for the plan area. The ecological conditions within and around some habitats that may support the species are likely either stable or improving due to advances in riparian and aquatic ecosystem management (Roper et al. 2019, Roper et al. 2018).

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The species has a somewhat narrow ecological tolerance and does not tolerate human disturbance (Pipp 2017). The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020). Bogs and fens are vulnerable to changes in climate and nutrient availability (Berendse et al. 2001, Antala et al. 2022, Salimi et al. 2021) and more generally activities that affect hydrological regimes (Chadde et al. 1998).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is apparently globally secure.

Best available scientific information

Antala, M., Juszczak, R., van der Tol, C., and Rastogi, A. 2022. Impact of climate change-induced alterations in peatland vegetation phenology and composition on carbon balance. Sci Total Environ 827: 154294 p.

Berendse, F., Van Breemen, N., Rydin, H., Buttler, A., Heijmans, M., Hoosbeek, M.R., Lee, J.A., Mitchell, E., Saarinen, T., Vasander, H., and Wallén, B. 2001. Raised atmospheric CO2 levels and increased N deposition cause shifts in plant species composition and production in Sphagnum bogs. Global Change Biology 7 (5): 591-598 pp. 10.1046/j.1365-2486.2001.00433.x

Chadde, S.W., Shelly, J.S., Bursik, R.J., Moseley, R.K., Evenden, A.G., Mantas, M., Rabe, F., and Heidel, B. 1998. Peatlands on National Forests of the northern Rocky Mountains: Ecology and conservation. Ogden, UT. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 75 p. https://www.fs.fed.us/rm/pubs/rmrs_gtr011.pdf

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Pipp, A.K. 2017. Coefficient of Conservatism Rankings for the Flora of Montana: Part III. Helena, MT. Montana Natural Heritage Program. 107 p.

Roper, B.B., Capurso, J.M., Paroz, Y., and Young, M.K. 2018. Conservation of aquatic biodiversity in the context of multiple-use management on National Forest System lands. Fisheries 43 (9): 396-405 pp.

Roper, B.B., Saunders, W.C., and Ojala, J.V. 2019. Did changes in western federal land management policies improve salmonid habitat in streams on public lands within the Interior Columbia River Basin? Environmental Monitoring and Assessment 191 (9): 574 p.

Salimi, S., Almuktar, S.A.A.A.N., and Scholz, M. 2021. Impact of climate change on wetland ecosystems: A critical review of experimental wetlands. Journal of Environmental Management 286: 1-15 pp.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

10.11 Pale-yellow Jewel-weed (*Impatiens aurella*)

Conservation Categories

G4/S3 (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species has a limited distribution in the Pacific Northwest with populations in British Columbia, Washington, Idaho and Montana (NatureServe, natureserve.org, 08/2023). In Montana, the species known from roughly 20 records scattered in the western third of the state (Montana Natural Heritage Program, mtnhp.org, 08/2023). The species is known from a two locations in the western half of the plan area, but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species occupies a variety of wetland habitats and even lakeshores, where it is often found along the edge of cattails or similar vegetation (Symonds 2015). In Montana, habitat is often associated with riverine wetland systems (Montana Natural Heritage Program 2020).

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but modeled suitable habitat is available and widely dispersed across the plan area (Montana Natural Heritage Program 2020). The ecological conditions within and around some habitats that may support the species are likely either stable or improving due to advances in riparian and aquatic ecosystem management (Roper et al. 2019, Roper et al. 2018).

Relevant life history traits and other information

Annual that produces closed, self-pollenating flowers in the early spring and showy, insect and hummingbird pollenated flowers later in the summer (Symonds 2015).

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 08/2023), there are no known unique threats to the species within the plan area. The species has a some ecological tolerance and may tolerate even persist following human disturbance (Pipp 2017). The primary threats to the species across its distribution are likely those common to most plant species including habitat loss,

degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is apparently globally secure.

Best available scientific information

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Montana Natural Heritage Program. 2020. Impatiens aurella (pale-yellow jewel-weed) predicted suitable habitat modeling. Helena, MT. Montana Natural Heritage Program. 17 p.

Pipp, A.K. 2017. Coefficient of Conservatism Rankings for the Flora of Montana: Part III. Helena, MT. Montana Natural Heritage Program. 107 p.

Roper, B.B., Capurso, J.M., Paroz, Y., and Young, M.K. 2018. Conservation of aquatic biodiversity in the context of multiple-use management on National Forest System lands. Fisheries 43 (9): 396-405 pp.

Roper, B.B., Saunders, W.C., and Ojala, J.V. 2019. Did changes in western federal land management policies improve salmonid habitat in streams on public lands within the Interior Columbia River Basin? Environmental Monitoring and Assessment 191 (9): 574 p.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Symonds, J. 2015. Impatiens aurella plant species at risk fact sheet. Pages 2. in B.C. Ministry of Forests, Lands and Natural Resource Operations, ed.; Penticton, B.C.; B.C. Ministry of Forests, Lands and Natural Resource Operations.

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

10.12 Pod Grass (*Scheuchzeria palustris*)

Conservation Categories

G4G5/S1 (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going.

A circumboreal species documented in many northern states and all of Canada. In Montana, the species is known from fewer than twenty locations in the northwestern portion of the state, including three locations in the eastern extent of the plan area (Montana Natural Heritage Program, mtnhp.org, 01/2023). Species-specific surveys that consider the phenology, as well as the habitat associations of the species are lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species is generally associated with bogs and fens, where it is often associated with sphagnum moss.

Habitat trend in the plan area

No specific habitat trends are known within the plan area, but modeled suitable habitat, albeit low suitability habitat, is readily available, particularly in the eastern extent of the plan area (Montana Natural Heritage Program 2020). The ecological conditions within and around some habitats that may support the species are likely either stable or improving due to advances in riparian and aquatic ecosystem management (Roper et al. 2019, Roper et al. 2018).

Relevant life history traits and other information

The species is the only member of the *Scheuchzeris* genus.

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The species has a narrow ecological tolerance and does not tolerate human disturbance (Pipp 2017). The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020). Bogs and fens are vulnerable to changes in climate and nutrient availability (Berendse et al. 2001, Antala et al. 2022, Salimi et al. 2021) and more generally activities that affect hydrological regimes (Chadde et al. 1998).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is globally secure, and habitat is available and widely distributed in the eastern extent of the plan area (Montana Natural Heritage Program 2020).

Best available scientific information

Antala, M., Juszczak, R., van der Tol, C., and Rastogi, A. 2022. Impact of climate change-induced alterations in peatland vegetation phenology and composition on carbon balance. Sci Total Environ 827: 154294 p.

Berendse, F., Van Breemen, N., Rydin, H., Buttler, A., Heijmans, M., Hoosbeek, M.R., Lee, J.A., Mitchell, E., Saarinen, T., Vasander, H., and Wallén, B. 2001. Raised atmospheric CO2 levels and increased N deposition cause shifts in plant species composition and production in Sphagnum bogs. Global Change Biology 7 (5): 591-598 pp. 10.1046/j.1365-2486.2001.00433.x

Chadde, S.W., Shelly, J.S., Bursik, R.J., Moseley, R.K., Evenden, A.G., Mantas, M., Rabe, F., and Heidel, B. 1998. Peatlands on National Forests of the northern Rocky Mountains: Ecology and conservation. Ogden, UT. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 75 p. https://www.fs.fed.us/rm/pubs/rmrs_gtr011.pdf

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Montana Natural Heritage Program. 2020. Scheuchzeria palustris (pod grass) predicted suitable habitat modeling. Helena, Montana. Montana Natural Heritage Program. 17 p.

Pipp, A.K. 2017. Coefficient of Conservatism Rankings for the Flora of Montana: Part III. Helena, MT. Montana Natural Heritage Program. 107 p.

Roper, B.B., Capurso, J.M., Paroz, Y., and Young, M.K. 2018. Conservation of aquatic biodiversity in the context of multiple-use management on National Forest System lands. Fisheries 43 (9): 396-405 pp.

Roper, B.B., Saunders, W.C., and Ojala, J.V. 2019. Did changes in western federal land management policies improve salmonid habitat in streams on public lands within the Interior Columbia River Basin? Environmental Monitoring and Assessment 191 (9): 574 p.

Salimi, S., Almuktar, S.A.A.A.N., and Scholz, M. 2021. Impact of climate change on wetland ecosystems: A critical review of experimental wetlands. Journal of Environmental Management 286: 1-15 pp.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

10.13 Pointed Broom Sedge (*Carex scoparia*)

Conservation Categories

G5/S1S2 (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the Plan Area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going within the Plan Area.

The species is broadly distributed across much of temperate North America. In Montana, the species is known from fewer than 20 records scattered across the state (Montana Natural Heritage Program, mtnhp.org, 01/2023). The species is known from three locations within the plan area, but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

Most common along ponds, lakes, and rivers, but sometimes in wet meadows, marshes, and bogs.

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but modeled suitable habitat, including areas of optimal habitat, is widely available (Montana Natural Heritage Program 2019). The ecological conditions within and around some habitats that may support the species are likely either stable or improving due to advances in riparian and aquatic ecosystem management (Roper et al. 2019, Roper et al. 2018).

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The species has a somewhat narrow ecological tolerance and does not tolerate human disturbance (Pipp 2017). The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020). Bogs and fens are vulnerable to changes in climate and nutrient availability (Berendse et al. 2001, Antala et al. 2022, Salimi et al. 2021) and more generally activities that affect hydrological regimes (Chadde et al. 1998).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is globally secure, and suitable habitat is readily available and widely distributed in the plan area (Montana Natural Heritage Program 2019).

Best available scientific information

Antala, M., Juszczak, R., van der Tol, C., and Rastogi, A. 2022. Impact of climate change-induced alterations in peatland vegetation phenology and composition on carbon balance. Sci Total Environ 827: 154294 p.

Berendse, F., Van Breemen, N., Rydin, H., Buttler, A., Heijmans, M., Hoosbeek, M.R., Lee, J.A., Mitchell, E., Saarinen, T., Vasander, H., and Wallén, B. 2001. Raised atmospheric CO2 levels and increased N deposition cause shifts in plant species composition and production in Sphagnum bogs. Global Change Biology 7 (5): 591-598 pp. 10.1046/j.1365-2486.2001.00433.x

Chadde, S.W., Shelly, J.S., Bursik, R.J., Moseley, R.K., Evenden, A.G., Mantas, M., Rabe, F., and Heidel, B. 1998. Peatlands on National Forests of the northern Rocky Mountains: Ecology and conservation. Ogden, UT. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 75 p. https://www.fs.fed.us/rm/pubs/rmrs_gtr011.pdf

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Montana Natural Heritage Program. 2019. Pointed Broom Sedge (Carex scoparia) Predicted Suitable Habitat Modeling. Helena, MT. Montana Natural Heritage Program. 11 p.

Pipp, A.K. 2017. Coefficient of Conservatism Rankings for the Flora of Montana: Part III. Helena, MT. Montana Natural Heritage Program. 107 p.

Roper, B.B., Capurso, J.M., Paroz, Y., and Young, M.K. 2018. Conservation of aquatic biodiversity in the context of multiple-use management on National Forest System lands. Fisheries 43 (9): 396-405 pp.

Roper, B.B., Saunders, W.C., and Ojala, J.V. 2019. Did changes in western federal land management policies improve salmonid habitat in streams on public lands within the Interior Columbia River Basin? Environmental Monitoring and Assessment 191 (9): 574 p.

Salimi, S., Almuktar, S.A.A.A.N., and Scholz, M. 2021. Impact of climate change on wetland ecosystems: A critical review of experimental wetlands. Journal of Environmental Management 286: 1-15 pp.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

10.14 Slender Cottongrass (*Eriophorum gracile*)

Conservation Categories

G5/S3, Species of Conservation Concern on a neighboring Forest (Montana Natural Heritage Program, mtnhp.org, 02/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is broadly distributed across much of temperate and boreal North America. In Montana, the species is known from roughly 65 records in the western portion of the state (Montana Natural Heritage Program, mtnhp.org, 01/2023). The species is known from a single location within the plan area, but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

Found in wet, organic soils of fens across mid- to lower elevations.

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but modeled suitable habitat, including areas of optimal habitat, is widely distributed (Montana Natural Heritage Program 2020). The ecological conditions within and around some habitats that may support the species are likely either stable or improving due to advances in riparian and aquatic ecosystem management (Roper et al. 2019, Roper et al. 2018).

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The species has a very narrow ecological tolerance and does not tolerate human disturbance (Pipp 2017). The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020). Bogs and fens are vulnerable to changes in climate and nutrient availability (Berendse et al. 2001, Antala et al. 2022, Salimi et al. 2021) and more

generally activities that affect hydrological regimes (Chadde et al. 1998), which may affect the species (Decker et al. 2006).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is globally secure, and suitable habitat is widely distributed in the plan area (Montana Natural Heritage Program 2020).

Best available scientific information

Antala, M., Juszczak, R., van der Tol, C., and Rastogi, A. 2022. Impact of climate change-induced alterations in peatland vegetation phenology and composition on carbon balance. Sci Total Environ 827: 154294 p.

Berendse, F., Van Breemen, N., Rydin, H., Buttler, A., Heijmans, M., Hoosbeek, M.R., Lee, J.A., Mitchell, E., Saarinen, T., Vasander, H., and Wallén, B. 2001. Raised atmospheric CO2 levels and increased N deposition cause shifts in plant species composition and production in Sphagnum bogs. Global Change Biology 7 (5): 591-598 pp. 10.1046/j.1365-2486.2001.00433.x

Chadde, S.W., Shelly, J.S., Bursik, R.J., Moseley, R.K., Evenden, A.G., Mantas, M., Rabe, F., and Heidel, B. 1998. Peatlands on National Forests of the northern Rocky Mountains: Ecology and conservation. Ogden, UT. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 75 p. https://www.fs.fed.us/rm/pubs/rmrs_gtr011.pdf

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Decker, K., Culver, D.R., and Anderson, D.G. 2006. *Eriophorum gracile* W. D. J. Koch (slender cottongrass): a technical conservation assessment. Program, Colorado Natural Heritage, ed. Fort Collins, Co. Colorado Natural Heritage Program. 1-42 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

Montana Natural Heritage Program. 2020. Eriophorum gracile (slender cottongrass) predicted suitable habitat modeling. Helena, Montana. Montana Natural Heritage Program. 17 p.

Pipp, A.K. 2017. Coefficient of Conservatism Rankings for the Flora of Montana: Part III. Helena, MT. Montana Natural Heritage Program. 107 p.

Roper, B.B., Capurso, J.M., Paroz, Y., and Young, M.K. 2018. Conservation of aquatic biodiversity in the context of multiple-use management on National Forest System lands. Fisheries 43 (9): 396-405 pp.

Roper, B.B., Saunders, W.C., and Ojala, J.V. 2019. Did changes in western federal land management policies improve salmonid habitat in streams on public lands within the Interior Columbia River Basin? Environmental Monitoring and Assessment 191 (9): 574 p.

Salimi, S., Almuktar, S.A.A.A.N., and Scholz, M. 2021. Impact of climate change on wetland ecosystems: A critical review of experimental wetlands. Journal of Environmental Management 286: 1-15 pp.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

10.15 Small Yellow Lady's-slipper *(Cypripedium parviflorum)*

Conservation Categories

G5/S3S4, Regional Forester Sensitive Species (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is native to much of North America; however, the species is part of a larger species complex for which the taxonomy is in revision (Nature Serve 01/2023). In Montana, the species occurs in locations throughout the state, but the primary distribution is in the northwest (Montana Natural Heritage Program, mtnhp.org, 01/2023). In the plan area, the species is known from five plants in a single location documented nearly 30 years ago; however, species-specific surveys that consider the phenology, as well as the habitat associations of the species, are limited within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022), including this species (Ingegno 2017).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species occurs in moist deciduous and coniferous forest, thickets, meadows, prairies, sometimes tundra, and occasionally fens; often in calcareous soils.

Habitat trend in the plan area

There are no specific habitat trends for the plan area, but wet meadows and forests are common and modeled suitable habitat, including large areas of optimal habitat, is widely available throughout the plan area (Montana Natural Heritage Program 2020) .

Relevant life history traits and other information

The species has a slow life history strategy, likely living for decades and taking a decade or more to reach sexual maturity (Curtis 1943, Reddoch and Reddoch 1997). As a non-reward pollinator, the species can produce few fruits (Tremblay et al. 2005). All orchids, including this species (Shefferson et al. 2005), are dependent at some point in their life cycle on mycorrhizae, or fungal symbionts, that help acquire nutrients. The distribution and abundance of orchid species is closely tied to the spatial distribution and abundance of mycorrhizal fungi associates, which are not evenly distributed even in suitable macrohabitats (Shefferson et al. 2005, McCormick and Jacquemyn 2013).

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area.

In general, the species has a narrow ecological tolerance and does not tolerate human disturbance (Pipp 2017). The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020), including orchids (Fay 2018).

Although not know to be affecting orchid populations within the plan area, orchids are sometimes threatened by exploitation from collectors, which in some cases has occurred for centuries (Case et al. 1998).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is globally secure, and habitat is readily available and widely distributed in the plan area (Montana Natural Heritage Program 2020).

Best available scientific information

Case, M.A., Mlodozeniec, H.T., Wallace, L.E., and Weldy, T.W. 1998. Conservation genetics and taxonomic status of the rare Kentucky lady's slipper: Cypripedium kentuckiense (Orchidaceae). American Journal of Botany 85 (12): 1779-1786 pp. https://doi.org/10.2307/2446512

Corlett, R.T. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity 38 (1): 10-16 pp.

Curtis, J.T. 1943. Germination and Seedling Development in Five Species of Cypripedium L. American Journal of Botany 30 (3): 199-206 pp.

Endress, B.A., Averett, J.P., Steinmetz, S., and Quaempts, E.J. 2022. Forgotten forbs: Standard vegetation surveys underrepresent ecologically and culturally important forbs in a threatened grassland ecosystem. Conservation Science and Practice 4 (10): 1-14 pp. 10.1111/csp2.12813

Fay, M.F. 2018. Orchid conservation: how can we meet the challenges in the twenty-first century? Botanical Studies 59 (1): 16 p.

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. Plant Diversity 41 (2): 36-49 pp.

Ingegno, A.S. 2017. Predicting habitat distribution for five rare plant species within the blackfoot swan landscape restoration project. Master of Science in Geography Master's thesis, University of Montana, Missoula, MT. 85 p.

Lughadha, N.E., Bachman, S.P., Leão, T.C.C., Forest, F., Halley, J.M., Moat, J., Acedo, C., Bacon, K.L., Brewer, R.F.A., Gâteblé, G., Gonçalves, S.C., Govaerts, R., Hollingsworth, P.M., Krisai-Greilhuber, I., de Lirio, E.J., Moore, P.G.P., Negrão, R., Onana, J.M., Rajaovelona, L.R., Razanajatovo, H., Reich, P.B., L., R.S., Rivers, M.C., Cooper, A., Iganci, J., Lewis, G.P., Smidt, E.C., Antonelli, A., Mueller, G.M., and Walker, B.E. 2020. Extinction risk and threats to plants and fungi. Plants, People, Planet 2 (5): 389-408 pp. 10.1002/ppp3.10146

Maxwell, S.L., Fuller, R.A., Brooks, T.M., and Watson, J.E.M. 2016. Biodiversity: The ravages of guns, nets and bulldozers. Nature 536 (7615): 143-145 pp.

McCormick, M.K., and Jacquemyn, H. 2013. What constrains the distribution of orchid populations? New Phytologist 202 (2): 392-400 pp. 10.1111/nph.12639

Montana Natural Heritage Program. 2020. Cypripedium parviflorum (Small Yellow Lady's-slipper) Predicted Suitable Habitat Modeling. Helena, MT. Montana Natural Heritage Program. 17 p.

Pipp, A.K. 2017. Coefficient of Conservatism Rankings for the Flora of Montana: Part III. Montana Natural Heritage Program, Helena, Montana. 107 p.

Reddoch, J.M., and Reddoch, A.H. 1997. The orchids in the Ottawa District: floristics, phytogeography, population studies and historical review. Vol. 111 (1). Ottawa Canada: The Ottawa Field-Naturalists' Club. 192 p.

Schulze, K., Knights, K., Coad, L., Geldmann, J., Leverington, F., Eassom, A., Marr, M., Butchart, S.H.M., Hockings, M., and Burgess, N.D. 2018. An assessment of threats to terrestrial protected areas. Conservation Letters 11 (3): 1-10 pp. 10.1111/conl.12435

Shefferson, R., P., Weiss, M., Kull, T., and Taylor, D.L. 2005. High specificity generally characterizes mycorrhizal association in rare lady's slipper orchids, genus *Cypripedium*. Molecular Ecology 14 (2): 613-626 pp. 10.1111/j.1365-294X.2005.02424.x

Thompson, W.L. 2004. Sampling rare or elusive species: concepts, designs, and techniques for estimating population parameters. Washington D.C.: Island Press. 447 p.

Tremblay, R.L., Ackerman, J.D., Zimmerman, J.K., and Calvo, R.N. 2005. Variation in sexual reproduction in orchids and its evolutionary consequences: a spasmodic journey to diversification. Biological Journal of the Linnean Society 84 (1): 1-54 pp. https://doi.org/10.1111/j.1095-8312.2004.00400.x

10.16 Tufted Club-rush (*Trichophorum cespitosum*)

Conservation Categories

G5/S2, (Montana Natural Heritage Program, mtnhp.org, 02/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species is broadly distributed across much of temperate and boreal North America. In Montana, the species is known from roughly 50 records in the western half of the state (Montana Natural Heritage Program, mtnhp.org, 01/2023). The species is known from a single location within the plan area, but species-specific surveys that consider the phenology, as well as the habitat associations of the species are lacking, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species is associated with wet meadows and fens up to the alpine zone.

Habitat trend in the plan area

No specific habitat trends are known within the plan area, but modeled suitable habitat, including substantial areas of optimal habitat, are readily available and widely distributed across the plan area (Montana Natural Heritage Program 2020). The ecological conditions within and around some habitats that may support the species are likely either stable or improving due to advances in riparian and aquatic ecosystem management (Roper et al. 2019, Roper et al. 2018).

Relevant life history traits and other information

None

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area.

The species has a somewhat narrow ecological tolerance and does not tolerate human disturbance (Pipp 2017). The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016, Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020).

Given the elevational distribution of the species, climate change may be the greatest threat as it may reduce the availability of suitable habitat conditions (Engler et al. 2011), as well as alter interactions with other species that shift elevational distribution (Alexander et al. 2015, Gómez et al. 2015, Iseli et al. 2023). Although the effects of climate change may take time to manifest (Nomoto and Alexander 2021, Alexander et al. 2018), such changes are likely to present novel challenges for the species because climate change often has more significant impacts on rare species with a limited distribution (Thuiller et al. 2005). Moreover, climate change has the potential to increase interest in high mountain recreation (Pröbstl-Haider et al. 2021), which may increase risk from trampling as well invasive species (Pickering 2022).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. The species is globally secure, and habitat is readily available and widely distributed in the plan area.

Best available scientific information

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10.17 Wavy Moonwort (*Botrychium crenulatum*)

Conservation Categories

G4/S3, Species of Conservation Concern on a neighboring Forest (Montana Natural Heritage Program, mtnhp.org, 01/2023).

Is the species native and known to occupy the plan area?

Yes

Distribution and abundance in the plan area

There are no known population estimates for the species in Montana or the plan area, and surveys designed to provide reliable occupancy or abundance estimates for the species (Thompson 2004) are not known to be on-going.

The species occurs throughout much of western North America, as well as Minnesota and Ontario (Montana Natural Heritage Program, mtnhp.org, 02/2023). In Montana the species is primarily distributed in the northwestern portion of the state. The species is known from a single location in the plan area, but species-specific surveys that consider the phenology, as well as the habitat associations of the species, are lacking within the plan area, which may substantially affect the known distribution and abundance of plant species (Endress et al. 2022). New occurrences of moonwort populations are often discovered following systematic surveys in suitable habitat (Vanderhorst 1997).

Population trend in the plan area

There are no known specific population trends for the species in Montana or the plan area.

Habitat description

The species occurs at mid-elevations in a variety of wetlands and other mesic sites, including disturbed locations.

Habitat trend in the plan area

There are no specific habitat trends for the plan area, and modeled suitable habitat is available although suitability is lower than in other parts of Montana (Montana Natural Heritage Program 2020). The ecological conditions within and around some habitats that may support the species are likely either stable or improving due to advances in riparian and aquatic ecosystem management (Roper et al. 2019, Roper et al. 2018).

Relevant life history traits and other information

None.

Relevant threats to populations occupying the plan area

Beyond threats documented across the species range (NatureServe, natureserve.org, 01/2023), there are no known unique threats to the species within the plan area. The primary threats to the species across its distribution are likely those common to most plant species including habitat loss, degradation, and fragmentation; invasive species; pollution; and climate change (Corlett 2016, Maxwell et al. 2016,

Schulze et al. 2018, Heywood 2019, Lughadha et al. 2020). Activities including grazing, offroad recreation, timber harvest and road maintenance may affect the species (Ahlenslager and Potash 2007).

Is there sufficient scientific information available to determine if there is substantial concern for long-term persistence of the species in the plan area?

No

Is this species identified as a Species of Conservation Concern for the Revised Land Management plan and FEIS?

No

Rational for determination

There is insufficient information on the distribution and abundance of the species within the plan area. Suitable habitat is available (Montana Natural Heritage Program 2020).

Best available scientific information

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