Plant Species Evaluation Form

*Howellia aquatilis* Gray

**WATER HOWELLIA**

**Family:** Campanulaceae  
**Family Symbol:** HOAQ  
**Calif. Endemic:** No

**Synonyms/Other Names:** *Howellia aquatilis* was originally described by Asa Gray (1879) from material collected in Oregon by the botanist brothers Thomas and Joseph Howell. There are no synonyms of this name (Tropicos 2018; The Plant List 2018).

E.L. Greene (1891) published another species under the genus *Howellia*, *H. limosa*. This species was moved to the related genus *Legenere* by McVaugh (1943) as *L. limosa* (Greene) McVaugh. It remains a rare wetland endemic in California and the only species of *Legenere* in North America. A second species of *Howellia*, endemic to Argentina and Chile, *Howellia valdiviana* (Phil.) E. Wimm was also placed in *Legenere* as *L. valdiviana* (Phil.) E. Wimm (Tropicos 2018; The Plant List 2018). *Howellia* remains a monotypic genus.

**Identification Issues:** *Howellia* belongs to the Lobelioideae subfamily of Campanulaceae. This group is characterized by a distinctive bilateral corolla having two small, narrow, separate, erect upper lobes and three expanded, semi-connate, spreading lower lobes and filaments and anthers fused into a tube. (Gardeners will be familiar with the flower form from horticulturally popular species of *Lobelia*.) In most of the species of this group, the ovary or pedicel twists during bud development such that this familiar floral form is an inverted flower (Gray 1879; Morin 2012).

The North American members of Lobelioideae are wetland specialists. *Howellia* and its closest relatives (the speciose *Downingia*, the monotypic *Porterella* and the two species of *Legenere*) are specialists of ephemeral wetland (vernal pool) habitats, with a center of diversity in the western U.S., and these may co-occur in wetlands, utilizing different inundation-depth microsites. All are able to germinate and begin growth underwater, and may be confused early in the season. However the other species in Lobelioideae are all emergent aquatics or mature as sprawlers on exposed substrate after draw-down (NatureServe 2018; Morin 2012). *Howellia aquatilis* is the only species specialized to a full season of inundation and is the most extreme of the group in exhibiting classic submersed-aquatic features of flaccid stems that float on the water surface, dimorphic leaves, with specialized (narrow, thin, linear to filiform) submersed leaves and dimorphic flowers with specialized submersed cleistogamous flowers that set seed underwater. Indeed, the vegetative growth of *Howellia* (leaves simple, alternate, or occasionally sub-opposite or whorled) was noted by Gray (1879) to most resemble other aquatics such as *Najas flexilis* or *Elodea*. *Howellia* can easily be distinguished from other submerged aquatic species by its distinctive lobelioid-type corolla and by its elongate, inferior fruits that retain the five acute calyx lobes at the tip. It can be distinguished from fellow Lobelioideae by the aquatic-
specialist traits mentioned above, and by its fruit which is both pedicelled, ellipsoid, and which dehisces by longitudinal slits or irregular tears (Morin 2012).

**Taxonomy:**
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Species In Genus: 1 sp. Etymology: Named in honor of Thomas (1842--1912) and Joseph (1830-1912) Howell, brothers and botanists in Pacific Northwest.

Species Description – Habit: Annual, aquatic, rooted, glabrous. Stem: submersed, ascending to erect, or floating; 10--60 cm. Leaf: alternate (sometimes +- opposite or whorled), cauline, linear, entire or minutely toothed, sessile. Inflorescence: flowers 1 in leaf or bract axils, scattered; pedicels stout, 1--4(8) mm; bract 1 per flower. Flower: inverted; sepals 1/6--2/5 ovary, narrowly triangular; corolla white, 0 in lower flowers or not, tube 2--2.7 mm, narrowly cylindric, split adaxially +- to base, +- 2-lipped, 2 adaxial lobes +- 1--1.3 mm, narrowly strap-shaped, spreading, 3 abaxial lobes +- 1--1.3 mm; stamens fused into tube, anthers 0.2--0.9 mm, 2 shorter anthers minutely appendaged; ovary inferior, 5--13 mm, ellipsoid, stigma head-like. Fruit: 5--13 mm, 1--2 mm diam, ellipsoid, 1-chambered, depressed-conic at top, open on sides by slits or irregular tears. Seed: 2--4 mm, cylindric, shiny, chestnut-brown.

**Status:**
Note: Federally recognized Endangered, Threatened, Proposed, or Candidate species under the Endangered Species Act are omitted as they do not meet the definition of a Species of Conservation Concern (FSH 1909.12 § 12.52).

<table>
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<th>State Listing</th>
<th>G-rank</th>
<th>S-rank</th>
<th>CRPR</th>
<th>R5 FSS</th>
<th>NFP SM</th>
<th>CA BLM</th>
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<td>CA: S2</td>
<td>2B.2</td>
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Expanded abbreviations and citations: State Listing=California Endangered Species Act Listing (CDFW 2018b), Nevada Division of Forestry Fully Protected Species (NAC 527) (NDF 2012), Oregon Department of Agriculture Listed Plants (ODA 2014); G-rank=Global Conservation Status (CDFW 2018a; NatureServe 2018); S-rank=Subnational (state or province-level) Conservation Status (CDFW 2018a; NatureServe 2018; NNHP 2017; ORBIC 2016); CRPR=California Rare Plant Rank (CNPS 2018); R5 FSS=USDA Forest Service Region 5 Regional Forester Sensitive Plant Species List (USDA 2013); NFP SM=Forest Service and Bureau of Land Management Northwest Forest Plan Survey and Manage Species (USDA 2001); CA BLM=California Bureau of Land Management Designated Sensitive Species (BLM 2010); SWAP=California State Wildlife Action Plan Status (CDFW 2015); NNHP=Nebraska Natural Heritage Program Status (NNHP 2017); NNPS=Nebraska Native Plant Society Status (NNHP 2017); ORBIC=Oregon Biological Information Center Status (ORBIC 2016); OCS=Oregon Conservation Strategy Species (ODFW 2016); IUCN=International Union for Conservation of Nature Red List Status (IUCN 2017).

*Howellia aquatilis* was added to the first edition of the CNPS Inventory at the equivalent of California Rare Plant Rank (CRPR) 1B (rare, threatened, or endangered in California), when known in California from a single collection near Howard Lake in 1928 (Powell 1974). In the second edition of the CNPS Inventory, *H. aquatilis* was converted to the equivalent of CRPR 1A (presumed extinct) (Smith et al. 1980), and remained a 1A taxon until the fifth edition because a 1979 resurvey conclusion of possible extirpation from the Howard Lake site due to cattle grazing
and trampling. In 1994, it was designated a Federally Threatened plant by U.S. Fish and Wildlife Service (Federal Register 1994; NRCS 2011). It was rediscovered in California in 1996 by D. Isle and D. Efseaff (Isle 1997) and was subsequently changed to the equivalency of CRPR 2B (rare and endangered in California, more common elsewhere) in the sixth edition of the CNPS Inventory, when at the time was known from five extant occurrences in the state (RPSAC and Tibor 2001).

*Howellia aquatilis* is now known from seven presumed extant occurrences in California, albeit with one occurrence (EO 7) being known only from a 1893 collection (CNDDB 2017), and has remained a CRPR 2B taxon (CNPS 2018). It is not a state listed species, and was placed on the Federal Register to be considered for de-listing from Federal Threatened status in 2018 (Huhndorf pers. comm. 2018).

**Distribution:** *Howellia aquatilis* is an endemic of the western U.S., currently known from relatively few, widely scattered populations in Washington, Idaho, western Montana, Oregon, and northwestern California (Morin 2012; NRCS 2009). Although similar habitat continues from the Montana populations across the border 100 km north and into British Columbia, no populations have been recorded in Canada (CPNWH 2018). This species is thought to have formerly had a wider range in the northwestern U.S. (NRCS 2009), based on late 19th century and early 20th century specimens from locations in Idaho, Washington, western Oregon, and Humboldt County, California that no longer have extant populations (CPNWH 2018).

In 2005, there were 214 extant occurrences of *H. aquatilis* rangewide, but the total area occupied was only 285 acres (Mincemoyer 2005). This pattern of clustered occurrences that are small in area, but distributed over a large range is a classic distribution pattern for aquatic plants (Santamaria 2002), and is explained by a combination of factors: extreme microhabitat specificity, high local extirpation rate due to high year-to-year variability in habitat quality, and a pattern frequent local dispersal punctuated by rarer long-distance dispersal events (Lesica 1988; Santamaria 2002).

The current range of *Howellia aquatilis* (196 out of the 214 occurrences that have been observed since 1990) is as follows: In Montana, it is restricted to wetlands in the Swan Valley, which comprise the largest complex of subpopulations (101) in its range (Mincemoyer 2005). In Idaho, Howellia occurs in a small pond near Moscow in the SW corner of the state, and no new populations have been located despite intensive surveying (Shelley and Moseley 1988; Bursik 1995). Two large complexes of populations have been discovered since the 1980’s in Washington: one in eastern Washington, in Spokane County, and one in western Washington in Pierce County (Mincemoyer 2005). Historic and current populations dot the corridor (and migrating waterfowl flyway) from the Puget Sound region southwards through the Columbia River floodplain, into Oregon’s Willamette Valley. Howellia was thought to be extirpated in Oregon until it was discovered in Benton County in 2002 (Mincemoyer 2005). In California, it was thought to be extirpated from the site of a historic Alice Eastwood collection near Howard Lake, Mendocino County until its rediscovery there in 1996 (Isle 1997; CNPS 2018). Surveys since 1996 have revealed a metapopulation complex of wetlands near the 1928 collection (EOs 1-6) in the High North Coast Ranges bioregion (Morin 2012). An 1893 collection at Dobbyn
Howellia aquatilis Gray

Creek in Humboldt County has since come to light, but no extant populations have been located in the vicinity (EO 7) (CNDDB 2017).
Howellia aquatilis Gray

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**Locations within California:**
Record numbers indicate sites that contain an individual, population, or groups of populations located within ¼ mile of each other, per the California Natural Diversity Database (CNDDB 2017) definition of Element Occurrences (EOs) in California. Official EO numbers for plants in California are determined solely by the CNDDB and are included within the Reference (Source) column for CNDDB data. Duplicate records from the same site are given the same record number and included in red. The Population Info column includes total number of individuals and total number and size of populations/sub-populations when provided. Elevations provided in meters from source have been converted to feet. If not provided in original source, Land Manager information was obtained using the California Protected Areas Database (CPAD 2016) and Quad information was obtained using 24K Quads, SDE Feature Class (CDFG 2013). All other information is directly from the Reference (Source) unless additional citation is given.

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<th>Rec. #</th>
<th>Locality</th>
<th>County</th>
<th>Quad</th>
<th>Reference (Source)</th>
<th>Date Last Observed</th>
<th>Population Info</th>
<th>Threats</th>
<th>Land Manager</th>
<th>Elev. (ft.)</th>
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<tr>
<td>1</td>
<td>0.5 MILE NW OF HOWARD LAKE, JUST SOUTH OF ROAD 23N37, 0.4 MILE FROM JUNCTION OF 23N38 ON 23N37, MENDOCINO NF.</td>
<td>Mendocino</td>
<td>Leech Lake Mtn. (3912381)</td>
<td>CNDDB, May 2017 (EO 1)</td>
<td>7/3/1997</td>
<td>50-100 PLANTS SEEN IN 1996. 100'S IN 1997 IN 2 MAIN PATCHES.</td>
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<td>small pond near Howard Lake (ENE of Covelo)</td>
<td>Mendocino</td>
<td>Buck Rock (3912288)</td>
<td>CCH, Jan 2017 (JEPS94619)</td>
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<td>GRASS LAKE.</td>
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<td>Leech Lake Mtn. (3912381)</td>
<td>CNDDB, May 2017 (EO 2)</td>
<td>7/18/1996</td>
<td>FEWER THAN 50 PLANTS IN 1996. DURING THE 1996 VISITS, DUCKS HAD HEAVILY BROWSED THE PLANTS WHICH KILLED SOME BY UPROOTING; HOWEVER, MORE STEMS EXIST.</td>
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<td>Mendocino National Forest--North Coast Ranges. Upper Middle Fork Eel River Watershed. Grass Lake</td>
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<td>Leech Lake Mtn. (3912381)</td>
<td>CCH, Jan 2017 (CHSC91586)</td>
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<td>Dewell Gardens; Mendocino Lake Mtn. (3912381)</td>
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<td>Mendocino National Forest North Coast Ranges Upper Middle Fork Eel River Watershed. Dewell Lake; 10S 0495964 E 4423312 N</td>
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<td>Leech Lake Mtn. (3912381)</td>
<td>CCH, Jan 2017 (CHSC107 489)</td>
<td>7/8/2009</td>
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<td>Leech Lake Mtn. (3912381)</td>
<td>CCH, Jan 2017 (CHSC914 10)</td>
<td>7/2/1996</td>
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<td>Bear Wallow Pond, FR 24N21C -- 0.26 mi W of Dewell L, Mendocino NF</td>
<td>Mendocino</td>
<td>Leech Lake Mtn. (3912381)</td>
<td>Calflora, May 2017 (wb1194-1737)</td>
<td>7/1/2013</td>
<td>1 individuals</td>
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<td>Mendocino NF</td>
<td>4334</td>
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### Howellia aquatilis Gray

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<th>Population Info</th>
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<th>Elev. (ft.)</th>
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<tbody>
<tr>
<td>4</td>
<td>W SIDE OF ALDER CREEK, ABOUT 1 MI W OF ANT RIDGE AT EDGE OF POND; 50 YARDS SW OF UNIMPROVED ROAD.</td>
<td>Mendocino</td>
<td>Leech Lake Mtn. (3912381)</td>
<td>CNDDB, May 2017 (EO 4)</td>
<td>6/17/1997</td>
<td>HUNDREDS OF PLANTS SEEN IN 1996, 1000'S IN 1997.</td>
<td>TYPHA FOUND AT ONE END OF POND-NO HOWELLIA FOUND THERE.</td>
<td>Mendocino NF</td>
<td>4000</td>
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<tr>
<td>5</td>
<td>ABOUT 0.7 MILE S OF BLANDS COVE, 0.2 MI W OF JUNCTION OF ROAD 24N21 WITH 24N52 TO TRAVELERS HOME TRAIL.</td>
<td>Mendocino</td>
<td>Leech Lake Mtn. (3912381)</td>
<td>CNDDB, May 2017 (EO 5)</td>
<td>8/1/2000</td>
<td>FEWER THAN 10 PLANTS IN 1996. MORE THAN 7 PLANTS OBSERVED IN 2000, INCLUDING 4 EMERGENT FLOWERS. PLANTS WERE AT LEAST 12 INCHES TALL AND WELL-BRANCHED.</td>
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<td>6</td>
<td>ABOUT 0.25 MILE NNW OF HOWARD LAKE.</td>
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<td>Buck Rock (3912288)</td>
<td>CNDDB, May 2017 (EO 6)</td>
<td>9/10/1998</td>
<td>UNKNOWN NUMBER OF PLANTS SEEN IN 1998 DURING SURVEYS FOR OPHIOGLOSSUM PUSILLUM. A 1996 ISLE COLLECTION FROM &quot;T23N R10W SEC 5 NE 1/4 OF NW 1/4 OF NE 1/4&quot; IS ALSO ATTRIBUTED TO THIS SITE. NEEDS FIELDWORK.</td>
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<td>6</td>
<td>Mendocino National Forest--North Coast Ranges. Upper Middle Fork Eel River Watershed</td>
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<td>Buck Rock (3912288)</td>
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<td>Near Howard Lake, Forest Reserve</td>
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<td>7</td>
<td>DOBBYN CREEK, HUMBOLDT COUNTY.</td>
<td>Humboldt</td>
<td>Alderpoin t (4012325)</td>
<td>CNDDDB, May 2017 (EO 7)</td>
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<td>ONLY SOURCE OF INFORMATION FOR THIS SITE IS AN 1893 BLANKINSHIP COLLECTION. NEEDS FIELDWORK.</td>
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Distribution on National Forest System (NFS) Lands:
(Please see Reference column of Locations table above for references pertaining to Record Numbers indicated on NFS lands.)

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<th>Non-CNDDDB Records</th>
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<th>Historic (not seen in past 20 yrs.)</th>
<th>Most Recent Obs.</th>
<th>EOs/Recs. (5 mile buffer)</th>
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Demographic and Population Trends: *Howellia aquatilis* is currently known from seven occurrences in California, six of which have been observed between 1996 and 2009. Of these, five have had some population estimate information: occurrence one (EO 1) was estimated between 50 and 100 plants in 1996 and “100s” in 1997. Occurrence two (EO 2) was estimated in 1996 only, at fewer than 50 plants. Occurrence three (EO 3) was confirmed extant in 1996 (25 plants), 2001 (30 plants), 2005, 2009, and 2013. Occurrence four (EO 4) appears to be the only large population, with “hundreds” of plants observed in 1996 and “thousands” in 1997. Occurrence five (EO 5) appears to be a small population with fewer than 10 plants observed in 1996 and 1997. Occurrence six (EO 6), observed in 1998, had no population size estimate made. Occurrence seven (EO 7) is based on an 1893 specimen by Blankinship, with no population...
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estimate recorded (population status unconfirmed). From these data, no trends can be discerned. It appears that all but EO 4 are likely very small populations.

Howellia is prone to large year to year fluctuations in population size, due to its requirement to germinate in the autumn in moist but not inundated soil, followed by inundation for the duration of the growing season. In addition, its seeds lack dormancy, its seedbank quality and quantity drops precipitously within a few months (Lesica 1992), which puts populations, especially small ones, at significant risk of local extirpation from natural variation in water levels due to drought or wet years (Lesica 1988, 1992). However, genetic studies suggest that founding of new populations or re-founding of extirpated ones is a reasonably frequent occurrence (Shierenbeck and Phipps 2010).

Life History: A detailed study of Howellia life history and reproduction (1988) provides the following information: Howellia aquatilis is an annual aquatic plant with flaccid stems, frequently branched from the base. It reproduces entirely from seed (Mincemoyer 2005). It produces self-fertilized cleistogamous flowers in its leaf axils underwater continually until reaching the water surface (usually mid-May until mid-July), at which point it produces chasmogamous flowers with white corollas in terminal racemes that are structured such that they self-fertilize upon opening. The chasmogamous phase of flowering is short (typically mid July through early August), as plants quickly wither and die once standing water has completely evaporated. No pollinators have been recorded for Howellia and its reproduction strategy is assumed to be almost entirely inbreeding. The seeds are thin-coated, 1-5 per capsule, maturing and dispersing onto the mud throughout the growing season. They germinate soon after the pond dries, only on exposed sediments as they require aerobic conditions. Seed number and viability drops quickly in the seed bank over the winter, so the majority of the seed bank is short-term, and recruitment for the following year is largely dependent on seed production in the current year, a significant vulnerability to population persistence (Lesica 1988; Mincemoyer 2005).

No information on disease is reported, but predation by ducks was recorded for occurrence two (EO 2) in 1996 (CNDDB 2017), which is also the most likely means of dispersal of seed (Schierenbeck and Phipps 2010).

Diversity: A phylogenetic analysis by Schulteis et al. (2001) of a subgroup of Campanulaceae that consists of four genera (Downingia, Porterella, Legenere, and the monotypic Howellia aquatilis) of annual amphibious species of vernal pools and similarly ephemeral wetland habitats of western USA confirmed the monophyly of this group, and Howellia’s distinctness from the related genera Downingia, Porterella, and Legenere. Three samples from Montana were used and no variation was detected between them in chloroplast trnK and nuclear 18S-26S ribosomal RNA spacer region sequences used for the analysis.

Lesica et al (1988) did the first population genetic study of Howellia aquatilis, using isozyme electrophoreses. They examined 18 gene loci in four populations: one each from eastern and western Washington and two from Montana. They found no variation either within or between populations, an unusual case of monomorphy for this type of genetic marker and concluded that this may have been due to recent establishment of these populations post-glaciation, and/or a largely self-pollinating reproduction strategy.

A more extensive study by Schierenbeck and Phipps (2010) used 119 AFLP DNA markers, included 92 individuals from six California populations as well as representatives from across the species range. This study did find moderate genetic variation within populations but little variation between populations, especially among the six clustered California populations,
indicating that these populations are older than the recent glaciation period. They considered the pattern of partitioning of genetic variation to be consistent with a pattern of frequent dispersal among both neighboring populations and long distance dispersal across the range of this species, probably mediated by waterfowl migrating between California and the northern locations in *Howellia*’s range. That is, most of the genetic variants found were shared among most populations, meaning that dispersal is frequent enough between populations that genetic variations arising in one population are soon shared with others through transport of propagules.

**Habitat:** *Howellia* is found in those small, vernal, freshwater wetlands: ponds, sloughs, glacial potholes and former river oxbows that have an annual cycle of filling with water and drying in late season. These sites are typically shallow, less than 1 meter in depth, and often do not have an outlet (Mincemoyer 2005; NRCS 2012). Microhabitats can include both shallow water and the edges of deep ponds that are partially surrounded by deciduous trees such as black cottonwood and aspen, or conifers such as Engelmann spruce, and lodgepole pine forests, which provide the deep organic surface horizons preferred by *Howellia* for germination and optimal growth. In wetland complexes, only a small subset of waterbodies will be occupied, suggesting additional habitat constraints (Lesica 1992). Dominant species in these ponds are *Carex* spp., *Equisetum* spp., and broad-leaved emergent, such as *Sium*, *Callitriche*, *Potamogeton*, and *Ranunculus* (Lesica 1988; NRCS 2012). *Howellia* sites are found at elevations as low as 3 meters in Washington to 1,372 meters in Montana (Mincemoyer 2005). In California, *Howellia* occupies montane habitat ranging from 1,100 to 1,500 meters (Morin 2012).

**Habitat Status or Trend:** *Howellia aquatilis* is considered Vulnerable (S3) in Montana, Critically Imperiled (S1) in Oregon and Idaho, and Imperiled (S2) in Washington and California (NatureServe 2018). The federal government manages lands that completely or partially encompass 70% of known *Howellia* sites, 45% are on USFS lands, followed by USFWS and DoD. State agencies in Montana and Washington manage another six populations. Eighteen percent (18%) of sites occur on private lands, including The Nature Conservancy and Plum Creek Timber Company (Mincemoyer 2005). In California, the USFS owns the land of six of its occurrences, the ownership of the seventh has not been determined. None of the California occurrences provide site/occurrence quality/viability or trend information (CNDDB 2017). A significant potential for overall habitat decline, that is general over the range of *Howellia*, is increased weather variability associated with global warming, causing pond drying/inundation patterns to become more volatile and smaller ponds to convert to upland (Burkett et al. 2000), posing an increased risk of local extinction.

**Capacity for the Species to Disperse:** The seed of *Howellia aquatilis* is oblong, 1-4 mm long (Morin 2012), and is dropped directly into mud from plants growing underwater or from decaying plants on dried pond bottom (Lesica 1988). The genetic architecture of *Howellia* populations suggests that dispersal primarily occurs via ingestion by, or attachment to, animals, especially migrating waterfowl (Schierenbeck and Phipps 2010), and that both short and long-distance dispersal are relatively frequent events. A study of seed dispersal via waterfowl guts (Mueller and van der Valk 2002) demonstrated that seed viability after passing through a duck gut varies by species, and was generally higher for smaller seeds and thicker-walled seeds. *Howellia* seed has not been tested, but falls into the size category with circa 14-48% viable seed passing through mallard guts, although it is thin-coated (Lesica 1988), with viability consequently lower.

The dispersal success of *Howellia* is probably limited more by its very restrictive ecological requirements (Lesica 1988, 1992); it grows and produces seed only when submerged in water.
**Howellia aquatilis**

However, unlike most aquatic plants, it is incapable of germinating underwater. Consequently, this species can only complete its life cycle in intermittently aquatic habitats. Furthermore, its optimum condition is ponds with moderately organic, relatively coarse-textured sediments <15 cm deep and water with low concentrations of dissolved solids. These requirements define a small subset of possible wetland habitats in its range, this narrow set of requirements thus exposes it to local extinction in periods of environmental flux, as has been observed in repeated population surveys (Lesica 1992).

**Threats:** Threats listed for *Howellia* populations are as follows:

1) Grazing and trampling (CNPS 2018; NRCS 2012). In California, resurveys of the site of the 1928 Eastwood collection found *Howellia* extirpated due to cattle grazing and trampling, and occurrence three (EO 3) lists “Cattle tracks around pond” as a potential threat (CNDDB 2017).

2) Invasive plants. *Howellia* does not thrive under conditions of dense vegetation, especially grasses (Lesica 1992). Populations in Montana are threatened by encroaching *Phalaris arundinacea* swards, and this species may also threaten *Howellia* elsewhere in its range (Lesica 1997). *Lythrum salicaria* and *Iris pseudacorus* are invading other *Howellia* sites (Mincemoyer 2005).

3) Timber harvest activities are listed by several sources (Lesica 1992, Shelley and Moseley 1988; Mincemoyer 2005; NRCS 2012), notably at sites in Montana owned by the Plum Tree Timber Company.

4) Hydrological alteration in general (CNPS 2018), and by changes in weather patterns specifically (Mincemoyer 2005).

5) Residential development (Lesica 1992; NRCS 2012) and other human activity, especially on the 67 occurrences on private land (Mincemoyer 2005).

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Formatting: Form is set up as 508 compliant. Please use the “styles” if further formatting is necessary.

Purpose: This is to maintain the best available science on a species that could be used by the Forest Service in a variety of functions. Specifically, there would be additional steps and evaluations to determine whether or not this species would be considered a Species of Conservation Concern under the 2012 Planning Rule or a Sensitive Species under the 1982 Planning Rule.

Additional Considerations at the Forest Level: Habitat amount and juxtaposition of both the species and habitat locations.