

SPECIES FACT SHEET

Scientific Name: *Pristinicola hemphilli* Pilsbry, 1890

Common Name(s): Pristine pyrg; pristine springsnail

Phylum: Mollusca

Class: Gastropoda

Order: Neotaenioglossa

Family: Hydrobiidae (ITIS 2019, see Liu and Hershler 2019)

Synonyms: *Bythinella hemphilli* (Pilsbry 1890; Hershler and Liu 2017)

Conservation Status:

Global Status: G3 (last reviewed 19 February 2008)

National Status (United States): N3 (14 September 1999)

State Statuses: S3 (OR); S2S3 (WA)

(NatureServe 2019)

Federal Status (United States): Not listed (USFWS 2019)

IUCN Red List: Not evaluated (IUCN 2019)

Taxonomic Note:

This species was previously placed in the Lithoglyphidae family (Johnson et al. 2013) and currently belongs to the family Hydrobiidae (Liu and Hershler 2019).

Technical Description:

Adult: Currently, *P. hemphilli* belongs to the family Hydrobiidae, which generally consists of small aquatic snails with minute, somewhat fusiform shells that are higher than wide and whorled to the right (Jepsen et al. 2012; Blevins et al. 2018; ITIS 2019). Identification of *P. hemphilli* and other hydrobiids can be challenging due to their small size, as many are smaller than 4 mm (Frest and Johannes 1999). Species in the *Pristinicola* genus typically have “small to medium-sized, narrow-conic shells with wrinkled protoconch, smooth whorls, and simple aperture” (Hershler 1999).

The **shell is white** and the **animal is typically pale**, nearly pigmentless (Hershler 1999; Frest and Johannes 1999). The male penis lacks accessory lobes or glands (Hershler 1999). The female has a pouch-like seminal receptacle, coiled oviduct of tight loops, and large glandular oviduct, ventrally closed; its bursa copulatrix is large and posteriorly recurved (Hershler 1999).

According to Hershler et al. (1994), the **narrowly-conic shell can be between 1.7-3.1 mm in length**. There are **4.5-5.5 whorls** that end in a **blunt apex**. The protoconch is finely wrinkled, often eroded and is about 1.5 whorls. Teleoconch whorls have shallow sutures and are flat to moderately convex and rarely have an abapical shoulder or subsutural angulation. The sculpture of weak collabral growth lines on the teleoconch is often accompanied by numerous faint spiral striae. Ovate-elongate aperture is rounded or expanded below and rounded or slightly angled above. The fairly thick inner lip is complete and slightly reflected, adnate or very slightly separated from the body whorl. The slightly thickened outer lip can be straight or slightly curved, usually opisthocline, or sometimes orthocline. Tan-light brown periostracum is often covered by thick dark deposits. Umbilicus is usually absent or slightly rimate. Ovate operculum is red-brown, fairly thick and horny; the dorsal surface is unfrilled and nucleus eccentric. The fairly large attachment scar is raised and callus. Inner edge of the attachment scar margin is strongly thickened while a weaker scar runs along the outer edge. For a further detailed description of the morphology of *P. hemphilli*, refer to Hershler et al. 1994.

Immature: Egg capsules for this species are very small (Frest and Johannes 1999). However, the eggs and juvenile stages of *P. hemphilli* have not been formally described.

Life History:

Adults: *Pristinicola hemphilli* likely has an annual life cycle (Frest and Johannes 1999). This species of snail is semelparous (reproduces a single time before dying). *Pristinicola hemphilli* is completely aquatic and breathes using gills. Adults are found in cold, clear shallow waters with few macrophytes and are primarily periphyton grazers (Frest and Johannes 1999). Snails feed upon algae, yeast, bacteria, and diatoms from rocks and woody surfaces, although they have been known to feed upon other plant surfaces. This species prefers spring environments (i.e., a crenocole) and has been found in habitats with hard substrates (Frest and Johannes 1999). Plant matter transported by birds and mammals as well as mud passively moving downstream may help aid in downstream dispersal.

Immature: The small egg capsules of this species are laid individually in sheltered areas, typically on rock undersides (Frest and Johannes 1999).

Range, Distribution, and Abundance:

Type Locality: *Bythinella hemphilli* Pilsbry, 1890: 63-64. Near Kentucky Ferry, Snake River, Washington, however the precise location is unknown (Hershler 1999; Hershler and Liu 2017).

Range: *Pristinicola hemphilli* is found in the following ecoregions: Blue Mountains, Northern Basin Range (includes Owyhee Uplands), Columbia Basin, East Cascades, Klamath Mountains, and West Cascades and the Cascade Crest (ORBIC 2019). This species occurs in California, Idaho, Oregon, and Washington and is possibly extinct in Montana (Cordeiro 2011; ORBIC 2019). *Pristinicola hemphilli* has a scattered distribution in the Columbia Basin, including a few large tributaries and in the Willamette and the Blue Mountains and Deschutes River drainage (Frest and Johannes 1995). The easternmost presently known occurrences are in the Lower Salmon system in Idaho (Frest and Johannes 1997). The southernmost occurrences are known to occur in the Rogue, Umpqua, and Smith River basins in southern Oregon and Del Norte County in northern California. Extant sites are often on public lands, including National Forest, Bureau of Land Management, National Scenic Area, Bureau of Reclamation, and state and federal fish hatcheries (Frest and Johannes 1995).

Distribution: In Oregon, *P. hemphilli* has been detected in Baker, Clackamas, Grant, Harney, Hood River, Jackson, Jefferson, Josephine, Linn, Lane, Morrow, Multnomah, Sherman, Umatilla, Union, and Wasco Counties. In Washington, this species has been detected in Clark, Columbia, Cowlitz, Grant, King, Klickitat, Pierce, Skamania, Spokane, Thurston, and Whitman Counties.

BLM/Forest Service Land:

Documented: In Oregon, *P. hemphilli* has been documented on Northwest Oregon BLM District Land (in Multnomah, Clackamas, and Linn Counties) and the Wallowa-Whitman (in Baker and Union Counties), Mount Hood (in Clackamas, Hood River, Multnomah, and Wasco Counties), Malheur (in Grant and Harney Counties), Ochoco (in Jefferson County), Rogue River-Siskiyou (in Josephine County), Umatilla-OR (in Morrow, Umatilla, Union, and Grant Counties), and Willamette (in Lane County) National Forests. In Washington, it has been detected on the Umatilla National Forest (in Columbia County) and the Columbia River Gorge National Scenic Area (Clark, Klickitat, and Skamania Counties).

Suspected: In Oregon, due to the close proximity of records, *P. hemphilli* is suspected on Burns (near Harney County), Medford (near Jackson and Josephine Counties), and Prineville (near Sherman and Wasco Counties) BLM District Land. It is also suspected on the Deschutes National Forest due to the close proximity of records in Opal Springs, Jefferson County.

In Washington, *P. hemphilli* is suspected on Mount Baker-Snoqualmie (near Pierce and King County) National Forest and Gifford Pinchot National Forest, given close proximity of observations in unnamed spring complexes in Klickitat and Pierce Counties.

Abundance: Abundance estimates are not available for *P. hemphilli*. There is insufficient data regarding population trends and it has been assessed as Data Deficient by the IUCN Red List working group (Cordeiro 2011). *Pristinicola hemphilli* populations can contain hundreds of individuals, although numbers can vary significantly between years due to environmental factors (Cordeiro 2011; NatureServe 2019). Recent surveys observed five specimens at Sufferin Smith Spring, Wallowa-Whitman National Forest, La Grande District (Blevins et al. 2018) and three specimens on the Walla Walla Ranger District (Jepsen et al. 2012). This species was also detected at 20 sites during 2015 caddisfly surveys on the Columbia River Gorge National Scenic Area in Oregon, although abundance was not recorded (Fallon et al. 2016).

Habitat Associations:

Pristinicola hemphilli has been found in a variety habitats, from eastside dry forests to western wet forests. It has been documented in semi-arid sage scrub habitats at low-medium elevations (Frest and Johannes 1995). In the Cascades, this species is also found at sites with fairly dense Douglas fir (*Pseudotsuga menziesii*) forest types at low-medium elevation (Frest and Johannes 1995, 1997; Blevins et al. 2018).

In general, this species prefers seeps and small-medium springs and can occasionally be found in spring influenced creeks and larger springs (Frest and Johannes 1995; Johannes 2016). This species also prefers springs and seeps in pristine condition with coarse gravel or cobble substrate (Frest and Johannes 1999; Stagliano et al. 2007). These preferred seeps and small-medium springs are generally shallow and have a slow to moderate flow of very cold, clear water (Frest and Johannes 1995).

Plants commonly found in association with *P. hemphilli* include currant (*Ribes* sp.), watercress (*Nasturtium* sp.), duckweed (*Lemna* sp.), yellowcresses (*Rorippa*), monkeyflowers (*Mimulus*), and bryophytes (Frest and Johannes 1995; Blevins et al. 2018). Live specimens have also been detected at a small spring/temporary stream with wild ginger (*Asarum* sp.), snowberry (*Symphoricarpos* sp.), strawberry (*Fragaria* sp.), and Douglas fir (*P. menziesii*) (Jepsen et al. 2012).

Surveys targeting caddisflies detected *P. hemphilli* at many sites, including: small-mid-size stream with minimal disturbance; 1st and 2nd tributaries to creeks, large streams, and small falls and talus slope; large streams with moderate gradient below falls and at falls; splash zone on cobbles; headwaters; low gradient channel with intermittent surface water; small perennial streams; and high gradient 1st order perennial streams with talus and short falls (Fallon et al. 2016).

Threats:

Since this species of snail is normally associated with springs and seeps in pristine condition, it is vulnerable to activities that could disrupt this type of habitat. *Pristinicola hemphilli* colony size can be variable from year to year, making it difficult to assess population trends. *Pristinicola hemphilli* is globally ranked G3- rare, threatened or uncommon (ORBIC 2019). Johnson et al. (2013) assigned a conservation status of Vulnerable (V) to *P. hemphilli* populations defining it as a “species that is imminently likely to become threatened throughout all or a significant portion of its range”.

The primary threat to *P. hemphilli* is habitat loss (Cordeiro 2011; NatureServe 2019) and grazing (Frest and Johannes 1995). Any activity that has the possibility to alter springs and seeps or the terrestrial habitat surrounding the springs where this species occurs can be considered a threat to this species; this includes affects to water quantity (e.g., from groundwater withdrawal) and water quality (e.g., dissolved oxygen, temperature, sedimentation, pollution) (Johnson et al. 2013). Activities that have the potential to create disturbance can include urbanization and associated coastal modification and development, grazing, water diversion and ditching of springs and seeps, and highway construction and maintenance (Frest and Johannes 2000; Jordan and Black 2012). Other threats include roads and other transportation corridors, recreational activities, and agricultural and forestry pollutants (Cordeiro 2011).

Diversions and groundwater pumping for campground, hatchery stock, and domestic water supplies can induce hydrologic changes affecting flow of the small seeps and springs which *P. hemphilli* prefer, primarily affecting sites in the Columbia Gorge area (Frest and Johannes 1995). Additional damage has also been caused by urbanization, logging, road construction, and maintenance along WA 14 and I-84, and at sites in Baker County; flooding as a result of dam maintenance and construction at the Hells Canyon Dam and the John Day Dam is also an issue (Frest and Johannes 1995). At some sites in Grant County, Washington, excessive nutrient algae growth and loss of local populations has occurred due to nutrient-rich groundwater changing the water chemistry (Frest and Johannes 1997; Cordeiro 2011).

Some of the springs that support *P. hemphilli* populations are within forests; therefore, any management of the surrounding forests likely influences the immediate and long-term survival of this species. Research has shown that to reduce microclimate extremes and protect gastropods, partial cuts should be favored over clearcuts, aggregated (group) retention over dispersed retention or thinning, and larger group retention over smaller group retention (Jordan and Black 2012). In regard to fire, a number of studies have found negative and long-lasting responses, including population extirpation and reductions in gastropod abundance and species richness (Jordan and Black 2012 and references therein). If burning is to occur, smaller burns surrounded by unburned plots can help maintain gastropod community structure. Although there is limited information comparing gastropod response to differences in burn severity and frequency, it is generally accepted that a fire regime involving low-intensity burns at infrequent fire-return intervals (>5 years) may help retain gastropod communities (Jordan and Black 2012).

Conservation Considerations:

Research: Monitor and assess activities for impacts on *P. hemphilli* populations and its habitat. Monitor the effects of habitat changes on this species. Research on population size, distribution, and population trends is needed (Cordeiro 2011).

Phylogenetic relationships among freshwater snails are being investigated and will continue to evolve. Identifying immature freshwater snails can be difficult and COI DNA barcoding could be used for accurate species identification. *Pristiniocla hemphilli* has been sequenced for molecular analysis (COI: AF520940; Hershler and Liu 2012) and applying COI DNA barcoding to current

and future collections may help assess diversity and distribution of freshwater gastropods.

Inventory: Survey and map all *P. hemphilli* occurrences. Surveys could target spring sites on seepy hillsides with grand fir (*Abies grandis*) and Douglas fir (*P. menziesii*) in the overstory, currant (*Ribes* sp.) in the understory, and aquatic plants including watercress (*Nasturtium* sp.) and duckweed (*Lemna* sp.) (Blevins et al. 2018). Surveyors could search under rocks that are embedded in moss and other low-lying vegetation (Blevins et al. 2018). Future surveys could occur on BLM land in Hells Canyon and along the Wenaha and North Fork John Day Rivers (Jepsen et al. 2012).

Management: Protect all new and known sites from practices that would adversely affect any aspect of this species' life cycle, including timber harvest, cattle-grazing, road construction, building construction, and hydrologic modifications. Vegetative cover should be maintained, as well as water quality and the current hydrologic regime at sites known to contain this species of snail. Protect this species' habitat from further destruction and restore it when opportunities are presented. Minimize or eliminate conversion of habitat for other uses. Minimize grazing access at known sites to protect from potential habitat damage or impacts to water quality. Enforcing close monitoring and management of grazing would help land managers assess its effects on hydrologic patterns and the aquatic habitat. Activities that lower the flow rate or raise the water temperature such as diversions or pumping of groundwater should be restricted.

Version 2:

Prepared by: Katie Hietala-Henschell
The Xerces Society for Invertebrate Conservation
Date: August 2019

Reviewed by: Candace Fallon
The Xerces Society for Invertebrate Conservation
Date: September 2019

Version 1:

Prepared by: Heather Andrews
Umpqua National Forest
Date: 14 June 2010

Reviewed by: Rob Huff and Robin Vora

FS/BLM Conservation Planning Coordinator – Deschutes and Ochoco National Forests

Date: September 2010

Recommended citation:

Hietala-Henschell, K., H. Andrews, R. Huff, and R. Vora. 2019. Interagency Special Status/Sensitive Species Program (ISSSSP) Species Fact Sheet: *Pristinicola hemphilli*. USDA Forest Service Region 6 and USDI Bureau of Land Management Oregon State Office. 17 pp. Available at:

<https://www.fs.fed.us/r6/sfpnw/issssp/species-index/fauna-invertebrates.shtml>

ATTACHMENTS:

- (1) References
- (2) List of pertinent or knowledgeable contacts
- (3) Map of known records in Oregon and Washington
- (4) Photographs of this species
- (5) Survey protocol, including specifics for this species

ATTACHMENT 1: References

Blevins, E., T. Burke, E. Pelton, and L. Rost. 2018. Spring 2016 Wallowa-Whitman National Forest, La Grande District Terrestrial Mollusk Surveys. Version 1.2. Final Report to the Interagency Special Status/Sensitive Species Program (ISSSSP) from the Xerces Society for Invertebrate Conservation.

Cordeiro, J. 2011. *Pristinicola hemphilli*. The IUCN Red List of Threatened Species 2011: e.T189336A8717774. Available at:
<http://dx.doi.org/10.2305/IUCN.UK.2011-2.RLTS.T189336A8717774.en>

Fallon, C., E. Blevins, and R. Wisseman. 2016. Surveys to determine the status and distribution of three Columbia River Gorge endemic caddisfly and stonefly species: *Farula constricta*, *Neothremma andersoni*, and *Nanonemoura wahkeena*. Final Report from the Xerces Society and Aquatic Biology Associates, Inc. to the Interagency Special Status/Sensitive Species Program (ISSSSP) and the Columbia River Gorge National Scenic Area. Assistance Agreement L13AC00102, Modification 3. 101 pp.

Frest, T.J. and E.J. Johannes. 1995. Interior Columbia Basin mollusk species of special concern. Prepared for Interior Columbia Basin Ecosystem Management Project. Walla Wall, WA by Deixis Consulting. 286 pp.

Frest, T.J and E.J. Johannes. 1997. Land snail survey of the lower Salmon River Drainage, Idaho. Idaho Bureau of Land Management. Technical Bulletin No.97-18. 373 pp.

Frest, T.J. and E.J. Johannes. 1999. Field guide to survey and manage freshwater mollusk species. USFWS Regional Ecosystem Office, USDI BLM Oregon State Office, Portland, Oregon. 128 pp.

Hershler, R. 1999. A systematic review of the Hydrobiid snails (Gastropoda: Rissooidea) of the Great Basin, Western United States. Part II. Genera *Coligyryus*, *Eremopyrgus*, *Fluminicola*, *Pristinicola*, and *Tryonia*. The Veliger. 42(4):306-337.

Hershler, R., T.J. Frest, E.J. Johannes, P.A. Bowler, and F.G. Thompson. 1994. Two New Genera of Hydrobiid Snails (Prosobranchia: Rissooidea) from the Northwestern United States. The Veliger 37(3): 221-243. [ITIS] Integrated Taxonomic Information System. 2019. ITIS Report: *Pristinicola hemphilli* Pilsbry, 1907. TSN 568126. Accessed: 05 June 2019.

Hershler, R. and H.P. Liu. 2012. Molecular phylogeny of the western North American pebblesnails, Genus *Fluminicola* (Rissooidea: Lithoglyphidae), with description of a new species. Journal of Molluscan Studies. 78: 321-329.

Hershler, R. and H.P. Liu. 2017. Annotated checklist of freshwater truncatelloidean gastropods of the western United States, with an illustrated key to the genera. Technical Note 449. U.S. Department of the Interior, Bureau of Land Management, National Operations Center, Denver, CO.

[ITIS] Integrated Taxonomic Information System. 2019. ITIS Report: *Pristinicola hemphilli* Pilsbry, 1890. TSN 568126. Accessed: 05 August 2019. Available at: <http://www.itis.gov>.

[IUCN] International Union for Conservation of Nature. 2019. The IUCN Red List of Threatened Species. Version 2018-2. Available at: <http://www.iucnredlist.org> Downloaded on 05 June 2019.

Jepsen, S., A. Carleton, S. Foltz Jordan, and T. Burke. 2012. Spring 2012 Blue Mountains terrestrial mollusk surveys. Final report to the Interagency Special Status/Sensitive Species Program (ISSSSP). Assistance agreement L08AC13768, Modification 7. 88 pp.

Johannes, E.J. 2016. Springs and the minute snail that inhabit them in the Puget Sound region: Searching for the concealed. *The Dredgings*. 56(2):3-6.

Johnson, P.D., A.E. Bogan, K.M. Brown, N.M. Burkhead, J.R. Cordeiro, J.T. Garner, P.D. Hartfield, D.A. W. Lepitzki, G.L. Mackie, E. Pip, T.A. Tarpley, J.S. Tiemann, N.V. Whelan, and E.E. Strong. 2013. Conservation status of freshwater Gastropods of Canada and the United States. *Fisheries*. 38(6): 247-282.

Liu, H.P. and R. Hershler. 2019. A new species and range extensions for three other species of pebblesnails (Lithoglyphidae, Fluminicola) from the Upper Klamath basin, California-Oregon. *ZooKeys*. 812:47-67. Available at: <https://zookeys.pensoft.net/article/29205/>

NatureServe. 2019. *Pristinicola hemphilli* Pilsbry, 1890. Version 7.1 (2 February 2009) Data last updated March 2019. Accessed 21 June 2019. Available at: <http://explorer.natureserve.org/index.htm>

[ORBIC] Oregon Biodiversity Information Center. 2019. Rare, threatened and endangered species of Oregon. Institute for Natural Resources, Portland State University, Portland, Oregon. 136 pp.

Stagliano, D.M., G.M. Stephens, and W.R. Bosworth. 2007. Aquatic Invertebrate Species of Concern on USFS Northern Region Lands. In: USDA Forest Service (ed.). Montana Natural Heritage Program + Idaho Conservation Data Centre.

Turgeon, D.D., J.F. Quinn, Jr., A.E. Bogan, E.V. Coan, F.G. Hochberg, W.G. Lyons, P.M. Mikkelsen, R.J. Neves, C.F.E. Roper, G. Rosenberg, B. Roth, A. Scheltema, F.G. Thompson, M. Vecchione, and J.D. Williams. 1998. Common and scientific names of aquatic invertebrates from the United States and Canada: Mollusks. 2nd Edition. American Fisheries Society Special Publication 26, Bethesda, Maryland: 526 pp.

[USFWS] United States Fish and Wildlife Service. 2019. Environmental Conservation Online System (ECOS). Online database. Available at: <https://ecos.fws.gov/ecp0/reports/ad-hoc-species-report-input>

Map references:

[BLM] Bureau of Land Management. 2018. GeoBOB GIS export provided to Candace Fallon, the Xerces Society, by Chelsea Waddell, BLM Regional GeoBOB and ARIMS Data Coordinator, September 2018.

Hershler, R. and H.P. Liu. 2012. Molecular phylogeny of the western North American pebblesnails, Genus *Fluminicola* (Rissooidea: Lithoglyphidae), with description of a new species. *Journal of Molluscan Studies*. 78: 321-329.

Johannes, E.J. 2019. Personal collection provided to the Xerces Society, by Ed Johannes, Deixus Consultants, November 2019.

[ORBIC] Oregon Biodiversity Information Center. 2018. ORBIC invertebrate GIS export provided to Candace Fallon, the Xerces Society, by Lindsey Wise, Oregon State University ORBIC Biodiversity Data Manager, October 2018.

[USFS] United States Forest Service. 2018. NRM Wildlife Invertebrate Database. Database provided by Carol Hughes, USFS to Candace Fallon, the Xerces Society, September 2018.

[NMNH] National Museum of Natural History, Smithsonian Institution. 2019. Department of Zoology Collections. Database. Available at: <https://collections.nmnh.si.edu/search/iz/>

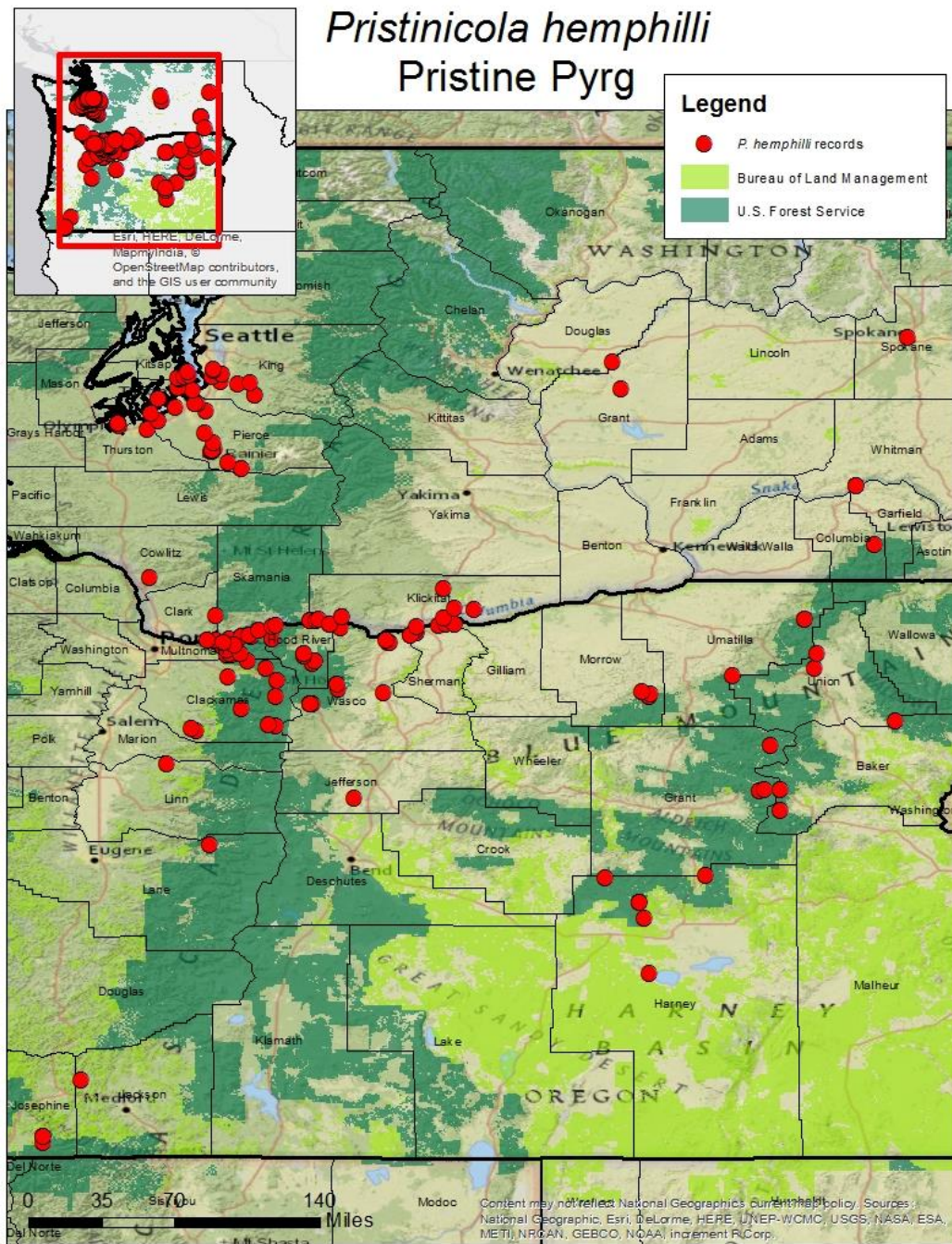
Xerces Society. 2019. ISSSSP Curation Database. Queried August 2019.

ATTACHMENT 2: List of pertinent, knowledgeable contacts

Ed Johannes, Deixis Consultants, Seattle-Tacoma, WA

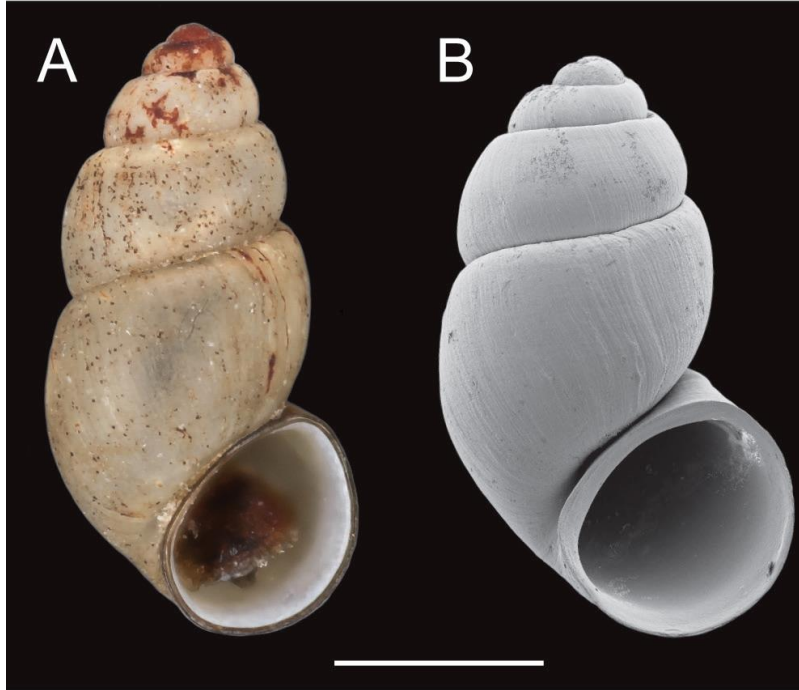
Robert Hershler, Research Zoologist Emeritus, Smithsonian National Museum of Natural History, Washington DC.

ATTACHMENT 3: Map of known *Pristinicola hemphilli* records in Oregon and Washington



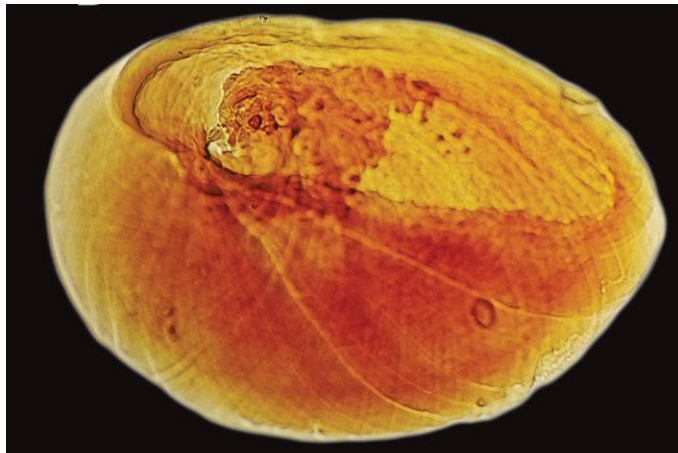
Known records of *Pristinicola hemphilli* in Oregon and Washington, relative to Forest Service and BLM land.

ATTACHMENT 4: Photographs of this species and its habitat



Photographs of *Pristinicola hemphilli* shell, scale bar, 1.0 mm. Image found in Hershler and Liu 2017 and photographed by Karolyn Darrow and Freya Goetz, Public Domain. Available at:

https://www.blm.gov/sites/blm.gov/files/documents/files/TN_449.pdf



Photograph of opercula (dorsal aspect), operculum reddish in color. Image found in Hershler and Liu 2017 and photographed by Freya Goetz, Public Domain. Available at:

https://www.blm.gov/sites/blm.gov/files/documents/files/TN_449.pdf



Photograph of *Pristinicola hemphilli* habitat, Sufferin Smith Spring, May 2016 on the Wallowa-Whitman National Forest, La Grande District. Image found in Blevins et al. 2018, used with permission.



Photograph of *Pristinicola hemphilli* habitat, North Fork Umatilla River, May 2012, on the Umatilla National Forest, Walla Walla Ranger District. Image found in Jepsen et al. 2012, used with permission.

ATTACHMENT 5: Aquatic Gastropod Survey Protocol, including specifics for this species

Taxonomic group:

Aquatic Gastropoda

How:

Please refer to the following documents for detailed mollusk survey methodology:

1. General collection and monitoring methods for aquatic mollusks:

See documents under the heading “Invertebrates – Mollusks” on the Interagency Sensitive and Special Status Species web page: <https://www.fs.fed.us/r6/sfpnw/issssp/inventories/identification.shtml>

2. Standard survey methodology that can be used by field personnel to determine presence/absence of aquatic mollusk species in a given waterbody, and to document species locations and habitats in a consistent format:

- Duncan, N. 2008. Survey Protocol for Aquatic Mollusk Species: Preliminary Inventory and Presence/Absence Sampling. Version 3.1. Portland, OR. Interagency Special Status/Sensitive Species Program. U.S. Department of Interior, Bureau of Land Management, Oregon/Washington and U.S. Department of Agriculture, Forest Service, Region 6. 52 pp. Available at: <https://www.fs.fed.us/r6/sfpnw/issssp/species-index/fauna-invertebrates.shtml>
- Inventory and Monitoring protocol page, with NRIS/GeoBOB field forms. Available at: <http://www.fs.fed.us/r6/sfpnw/issssp/species-index/fauna-invertebrates.shtml>
- ID services page, with current versions of field tags. Available at: <http://www.fs.fed.us/r6/sfpnw/issssp/inventories/identification.shtml>

Species-specific survey details, including:

Pristinicola hemphilli

How to survey: Aquatic snails may occur in a variety of habitat types, including springs, rivers and streams, and lakes and ponds. Seek out key habitat features known to be utilized by the target species (e.g., seeps, small-medium cold springs, spring influenced creeks, and larger springs). Record geographic coordinates and key habitat features for each site surveyed. Standardized abundance estimates for this species at new and known sites would assist future conservation efforts, since population size is important in evaluating the stability of a species at a given locality.

A variety of methods may be used to sample for aquatic snails, including hand and dip-net collection, kick-net collection, and the use of surber samplers, grab samples, dredges, and wire-basket benthos samplers. Duncan (2008) outlines methods appropriate for typical aquatic habitats. Sample procedures should limit impacts to sensitive habitats, particularly springs and streambeds. Surveyors should avoid use of chemicals such as bug repellent or sunblock, which may wash off into the water. Surveyors should also take steps to disinfect gear prior to sampling and reduce risk of transferring invasive species among sampling sites (Duncan 2008). More information on invasive species and prevention strategies can be found at:

<http://www.fs.usda.gov/detail/r6/forest-grasslandhealth/invasivespecies/?cid=stelprdb5302184>.

Where: Surveys for *P. hemphilli* could occur in seeps, small-medium springs, spring influenced creeks, or larger springs. Springs in the arid west can be identified from a distance by locating green vegetation bordering the spring source and run on hillsides; however, locating springs in dense forest or other vegetative cover is more difficult (Johannes 2016). Surveys could also target spring sites on seepy hillsides with grand fir (*A. grandis*) and Douglas fir (*P. menziesii*) in the overstory, currant (*Ribes* sp.) in the understory, and floating or emergent aquatic plants such as watercress (*Nasturtium* sp.) and duckweed (*Lemna* sp.) (Blevins et al. 2018). Surveyors could search under rocks that are embedded in moss and under other low-lying vegetation. Future surveys could occur on BLM land in Hells Canyon and along the Wenaha and North Fork John Day Rivers.

When: Sampling in springs can be conducted any time of year but is recommended early to mid-summer, except in grazed areas or areas that may experience late-season impacts. Surveys in flowing waters should be conducted after water levels and flows have decreased and survey conditions are safe. Surveys in lakes or other lentic habitats should not occur during the coldest months to improve detection of bottom-dwelling species. These and other recommendations are outlined further in Duncan 2008. In Oregon and Washington, *P. hemphilli* has been collected throughout the entire year.

References (Survey Protocol only):

Duncan, N. 2008. Survey Protocol for Aquatic Mollusk Species: Preliminary Inventory and Presence/Absence Sampling. Version 3.1. Portland, OR. Interagency Special Status/Sensitive Species Program. U.S. Department of Interior, Bureau of Land Management, Oregon/Washington and U.S. Department of Agriculture, Forest Service, Region 6. 52 pp. [Available at: <http://www.fs.fed.us/r6/sfpnw/issssp/species-index/fauna-invertebrates.shtml>].

Johannes, E.J. 2016. Springs and the minute snail that inhabit them in the Puget Sound region: Searching for the concealed. Deixis Consultants, SeaTac, Washington. 44(3): 34-37.

US Forest Service, Pacific Northwest Region. Invasive Aquatic Species. [Available at: <http://www.fs.usda.gov/detail/r6/forest-grasslandhealth/invasivespecies/?cid=stelprdb5302184>]