SPRING 2016 WALLOWA-WHITMAN NATIONAL FOREST, LA GRANDE DISTRICT TERRESTRIAL MOLLUSK SURVEYS

FINAL REPORT FROM THE XERCES SOCIETY TO THE INTERAGENCY SPECIAL STATUS / SENSITIVE SPECIES PROGRAM (ISSSSP)

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FIELD WORK, BACKGROUND RESEARCH, AND REPORT COMPLETED BY EMILIE BLEVINS, EMMA PELTON, AND LAURA ROST, XERCES SOCIETY FOR INVERTEBRATE CONSERVATION

IN COLLABORATION WITH LAURA NAVARRETE, WILDLIFE BIOLOGIST, US FOREST SERVICE, WALLOWA-WHITMAN NATIONAL FOREST, LA GRANDE RANGER DISTRICT

SPECIES IDENTIFICATIONS AND DESCRIPTIONS BY TOM BURKE, CERTIFIED WILDLIFE BIOLOGIST

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ABSTRACT

In order to aid management for sensitive and strategic mollusks on the La Grande Ranger District, Wallowa-Whitman National Forest (LGRD-WAW), staff at the Xerces Society were contracted to conduct surveys for four species of terrestrial mollusk in 2016: Blue mountainsnail (*Oreohelix strigosa delicata* – OR-SEN/WA-STR), humped coin (*Polygyrella polygyrella* – OR-STR/WA-SEN), shiny tightcoil (*Pristiloma wascoense* – SEN), and fir pinwheel (*Radiodiscus abietum* – SEN). Of these, only *Radiodiscus abietum* has been listed as previously reported from the Forest (Huff 2009), although no historic record could be found; all other target species were considered suspected. Although surveys targeted these species, at least one specimen of each mollusk species encountered was collected in order to provide a more complete picture of the mollusk fauna of the La Grande Ranger District.

Working with district Wildlife Biologist Laura Navarrete, Xerces staff completed surveys over eight days between May 8 and 18, 2016. Nearly 42 person-hours was spent actively surveying 42 sites, averaging about 1 person-hour of active survey time per site. In total 28 mollusk species were identified from 31 sites during these surveys, including 21 native snails, 1 native slug, and 6 exotic slugs. Although terrestrial mollusks were targeted, five aquatic snails were collected from freshwater habitats encountered during surveys including from streams, springs and ponds. Two of the four target species (*Radiodiscus abietum* and *Pristiloma wascoense*) and an additional three special status species (thinlip tightcoil: *Pristiloma idahoense* – WA-SEN; Umatilla megomphix: *Megomphix lutarius* – STR; pristine springsnail: *Pristinicola hemphilli* – OR-STR/WA-SEN) were collected. Both *P. wascoense* and *M. lutarius* were previously only suspected to occur on the Wallowa-Whitman National Forest. The range of *P. idahoense* has been reported to include the Blue Mountains of Umatilla County, Oregon (Baker 1932; Burke 2013), but this species was not considered suspected nor was it previously detected on the Wallowa-Whitman National Forest. A subspecies of mountainsnail (of the species *Oreohelix strigosa*), thought to be as-yet undescribed, was also collected from one site. In addition, a species of aquatic snail (*Planorbella oregonensis*) whose only extant population was thought to occur at Borax Lake in southeastern Oregon was collected at one site on the LGRD. Notably, *M. lutarius* has been reported only from Walla Walla County in Washington (Baker 1932) and from Umatilla County in Oregon (Baker 1932; California Academy of Sciences; Jepsen et al. 2012), including the Umatilla National Forest in Oregon (Jepsen et al. 2012).

We achieved all major goals of this project, including:

- Survey for *Oreohelix strigosa delicata*, *Polygyrella polygyrella*, *Pristiloma wascoense*, and *Radiodiscus abietum* in suitable habitat on the La Grande Ranger District, Wallowa Whitman National Forest near historic records,
- Produce a report detailing survey methods and findings,
- Provide data to the Forest Service's Natural Resource Information System (NRIS), including datasheets and a geodatabase of areas surveyed and points where target or other special status mollusk species were detected.

Tom Burke (Certified Wildlife Biologist) identified all specimens to species or subspecies as possible and documented notable diagnostic characteristics and observations. This final report documents the results of these surveys, as well as diagnostic information noted by Tom Burke during the identification process, including information regarding observations, species, and the habitat in which they were collected.

Based on our findings (discussed in detail below) we recommend conducting additional terrestrial mollusk surveys on the WAW to supplement the information gathered during these surveys. In particular we recommend conducting surveys in the fall targeting *Polygyrella polygyrella*, which has been collected elsewhere recently between late June and late September. Fall surveys may also result in the collection of other species not encountered in the spring (Jepsen et al. 2011, 2012). We also recommend conducting further surveys in typical

Oreohelix strigosa delicata habitat, especially talus slopes, to supplement the single collection of a possibly unique subspecies found during these surveys. Further surveys at the single *Megomphix lutarius* site could also provide valuable information regarding abundance and habitat requirements, particularly valuable given its rarity. Similarly, further sampling at Flat Rock Spring is recommended for the rare aquatic species *Planorbella oregonensis*, of which little is known, and surveys at ponded habitat may reveal additional populations on the WAW.

INTRODUCTION

Terrestrial and aquatic gastropods are important members of northwestern forestland communities. Many species are rare, have limited distribution, or are sensitive to habitat modification. As of July 2015, 99 species and subspecies of terrestrial and aquatic gastropods are included on the Region 6 Regional Forester Special Status Species List (USFS 2015), and of these, 14 have been detected or are suspected to occur on the Wallowa-Whitman National Forest. This project was intended to document the occurrence of four sensitive or strategic species on the La Grande Ranger District (LGRD) of the Wallowa-Whitman National Forest (WAW): Blue mountainsnail (*Oreohelix strigosa delicata* – OR-SEN/WA-STR), humped coin (*Polygyrella polygyrella* – OR-STR/WA-SEN), shiny tightcoil (*Pristiloma wascoense* – SEN), and fir pinwheel (*Radiodiscus abietum* – SEN). The western portion of the LGRD-WAW borders the Umatilla National Forest in Oregon, and recent terrestrial mollusk surveys have been conducted by Xerces Society staff on both the Umatilla National Forest and Vale District BLM lands (Jepsen et al. 2011, 2012). As a result of these and other surveys, the four target species and other sensitive or strategic mollusks have been collected from multiple sites in Oregon and Washington (Figure 1; Tables 1-4).

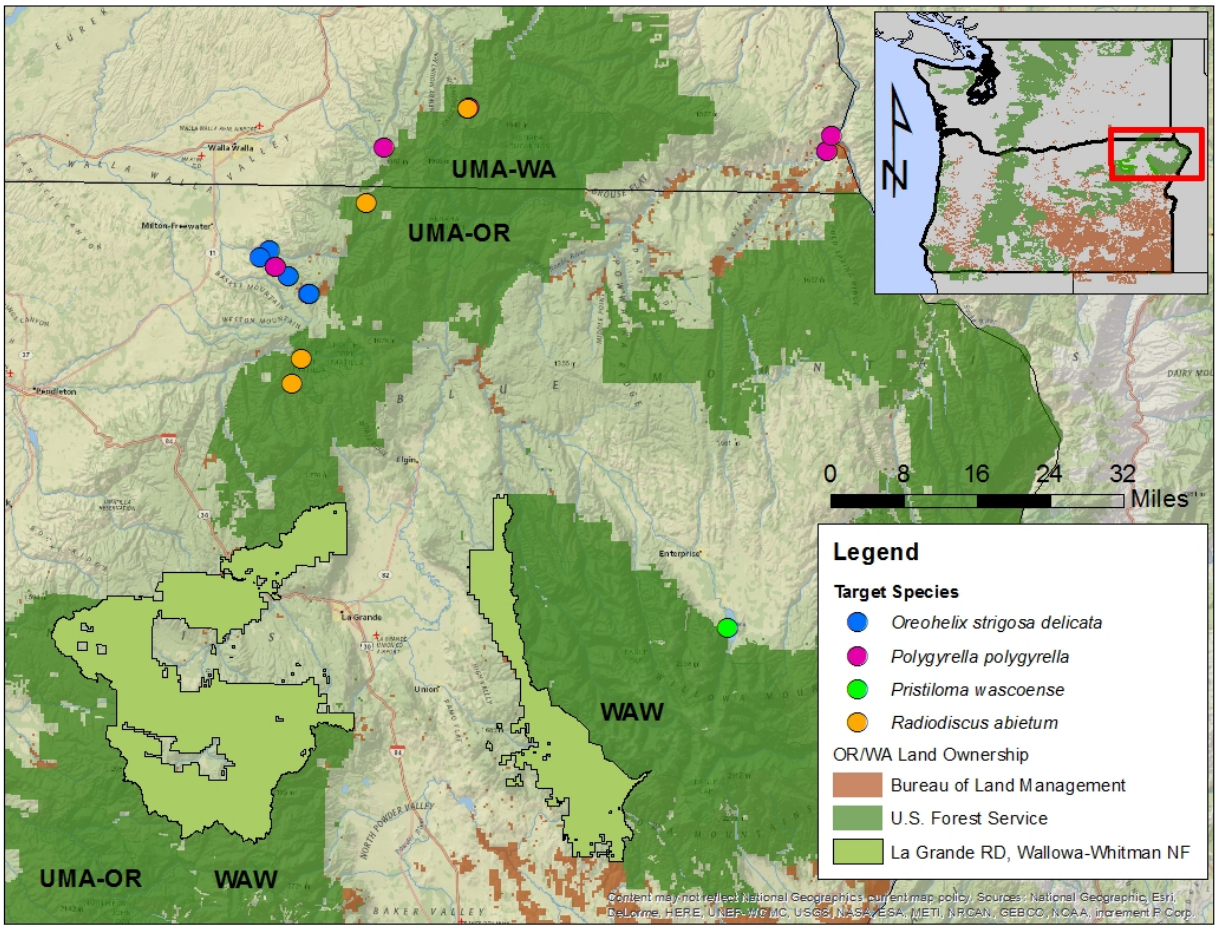

Figure 1. Past occurrence records in the vicinity of the LGRD-WAW 2016 surveys for four target terrestrial mollusk species and subspecies in the Blue Mountains ecoregion of Oregon and Washington, including the Umatilla National Forest (UMA-WA and UMA-OR) and Wallowa-Whitman National Forest (WAW). Idaho records are not shown.

OREOHELIX STRIGOSA DELICATA

The Blue mountainsnail (*Oreohelix strigosa delicata*) is a narrow-range subspecies considered a FS sensitive species in Oregon and strategic species in Washington (Figure 2). The subspecies is ranked S1 (Critically Imperiled) in Oregon and Washington (ORBIC 2016; WNHP 2016). It is a terrestrial pulmonate snail originally collected from a site 2-4 miles along the South Fork Walla Walla River canyon, north of Milton, Oregon (Pilsbry 1939; Table 1). Numerous *O. strigosa* subspecies have been described (and several remain undescribed), and shell morphology can be quite variable even within subspecies; Burke (2013) provides a key to six subspecies of *O. strigosa*. *Oreohelix strigosa delicata* is the only subspecies reported from northeastern Oregon, though other species of *Oreohelix* have been reported from the area (Burke 2013). Frest and Johannes (1995a) discuss an undescribed subspecies of *O. strigosa* reported in Pilsbry (1939) from Cottonwood Canyon, Umatilla County, Oregon. It has not yet been documented from a national forest in the region, though it has been collected from BLM lands in the Vale District.

Figure 2. *Oreohelix strigosa delicata*. Photo credit Tom Burke, used with permission and republished from Appendix III of Jepsen et al. 2012.

Oreohelix strigosa is a snail of riparian habitat and open forest, typically found in rock talus, shrubby areas, or under forest litter (Burke 2013). The Walla Walla canyon, where the subspecies was collected, is described by Frest and Johannes (1995a) as “a moderately steep basalt creek canyon with short basalt cliffs and small-scale talus piles in some areas. Fairly open *Pinus ponderosa* (ponderosa pine) and *Pseudotsuga menziesii* (Douglas-fir) forest, with some deciduous understory and common grasses.” They also suggest that the species is “a mesophile or weakly xerophilic species” (Frest and Johannes 1995a). Duncan et al. (2003) reports that live specimens of *Oreohelix* snails “are most easily found during or shortly after rains, or in aestivation among talus.” Refugia sites for aestivation are also “assumed to be located under more stable rock schist and woody debris” (Fallon and Jordan 2015). Species of *Oreohelix* generally live “near the surface, with a single stone, a bit of bark, or a few leaves for cover. This genus browses plant and rock surfaces for detritus, microscopic fungi, plants and animals, and the snails may be found under the litter where they apparently find food within the duff layer and may occasionally feed on live plant tissues (Fallon and Jordan 2015).

Recent collections of the *delicata* subspecies include those of Jepsen et al. (2012) northwest of the LGRD in talus and seep habitats with blackberry, horsetail, maple, and Pacific ninebark. *Cryptomastix hendersoni* was also collected at the site. Depending on the site, the number of animals collected has ranged from 3-50 specimens, though true abundance estimates are not available. Small groups of *Oreohelix* may occur patchily within the species’ range (Fallon and Jordan 2015).

Table 1**.** Past collection localities for *Oreohelix strigosa delicata* in Oregon and Washington.

State	County	Location	Date	Reference
Oregon	Umatilla	Walla Walla River Canyon, 6 mi SE of Milton	5-Jun-1941	Santa Barbara Museum of Natural History (SBMNH)
Oregon	Umatilla	Walla Walla Canyon, above Milton, 2-3 miles up the north fork	11-Aug-1931 9-Jul-1946	Academy of Natural Sciences, Drexel University (ANSP), Harvard Museum of Comparative Zoology (MCZ), National Museum of Natural History (NMNH) Pilsbry 1939
Oregon	Umatilla	South Fork Walla Walla, BLM-Vale-OR	14-May-2012	Jepsen et al. 2012
Oregon, Washington		Blue Mountains range, indefinite locality		Frest and Johannes 1995a

POLYGYRELLA POLYGYRELLA

The humped coin (*Polygyrella polygyrella*) is a regionally endemic species classified by FS as strategic in Oregon and a sensitive species in Washington (Figure 3). The species is ranked S1 (Critically Imperiled) in Oregon and Washington (ORBIC 2016; WNHP 2016). It is a terrestrial pulmonate snail originally collected from the Coeur d'Alene Mountains in Idaho (Huff and Foltz 2010; Table 2). It has been documented from the Umatilla National Forest in Washington.

Figure 3. *Polygyrella polygyrella*. Photo credit Sarina Jepsen and Tom Burke, used with permission and republished from Jepsen et al. 2011.

Polygyrella polygyrella is a species often found in "mesic or damp forest habitats, in litter and under rocks, logs, and other woody debris" (Burke 2013). Associated forest species include Douglas-fir (*Pseudotsuga menziesii*) and spruce (*Picea*); habitat often includes rock outcrops consisting of basalt, schist, or limestone (Frest and Johannes 1995a). In general, it is found in

> partly open forest with a rich understory, including diverse forbs, mosses, and deciduous shrubs...the best colonies occur in forested taluses. Moist valley, ravine, gorge, or talus sites are preferred, i.e. low on a slope and near permanent or persistent water, but not normally subject to regular or catastrophic flooding...This species is a mesophile, but can tolerate moderately xerophilic conditions in rock taluses (Frest and Johannes 1995a).

Recent collections of this species include those of Jepsen et al. (2011) in open forested habitat (4 live specimens observed). *Anguispira kochi, Microphysula ingersolli, Radiodiscus abietum*, and species of *Cryptomastix* were collected at the same site. Frest and Johannes (1995a) also report *Radiodiscus abietum* as an associated species. As many as 35 live specimens have also been reported from a single site (Hendricks 2005).

Table 2**.** Past collection localities for *Polygyrella polygyrella* in Oregon and Washington. UMA = Umatilla

State	County	Location	Date	Reference
Oregon	Umatilla	east of Milton, 2 to 3 miles up the NF Walla Walla River	11-Aug-1931	ANSP
Washington	Walla Walla	15 miles east of Walla Walla		Huff and Foltz 2010
Washington	Columbia	Touchet River 2-1, UMA NF	26-Sep-2010	Jepsen et al. 2011
Washington	Columbia	Tributary of NF Touchet River, FS Rd 64 20.5 mi S of US 12, UMA NF	20-Jun-2009	Leonard 2009 Richart 2009
Washington	Columbia	Touchet River; North Fork, UMA NF	20-Jun-2009	Leonard 2009 Richart 2009
Washington	Asotin	Talus on S. side of Rogersburg Rd. SW of town site at RM 2.1.	19-Aug-1989 2-Sep-1990	Deixis collection 2009
Washington	Asotin	Talus N. of Heller Bar on W. side of Snake River Rd and Snake River at RM 168.3.	1-Sep-1990	Deixis collection 2009

PRISTILOMA WASCOENSE

Pristiloma wascoense is ranked as S2 (Imperiled) in Oregon and S3? (Vulnerable, uncertain) in Washington (ORBIC 2016; WNHP 2016). It is a terrestrial pulmonate snail originally collected from Wasco County in Oregon (Hemphill 1911). It has been documented from the Okanogan-Wenatchee, Mt. Baker-Snoqualmie, Gifford Pinchot, Mt Hood, Willamette, and Deschutes National Forests of Oregon and Washington (Table 3).

The species has been reported from ponderosa pine and Douglas-fir forested habitat at high elevations, as well as from moist, shaded talus habitat with deciduous trees; moist microsites associated with talus or riparian habitat may be typical for members of the genus (Jordan 2010). Burke (2013) notes the species may often be found in the vicinity of deciduous trees such as aspen. Associated mollusks include *Anguispira kochi, Cryptomastix mullani, Euconulus fulvus, Punctum randolphi,* and *Discus whitneyi*, among others (Frest and Johannes 1995a; Jordan 2010). Photos of this species can be found in Burke (2013).

Table 3**.** Past collection localities for *Pristiloma wascoense* in Oregon and Washington. OKW: Okanogan-Wenatchee, MTH = Mt Hood, GIP = Gifford Pinchot, MBS = Mount Baker-Snoqualmie, WIL = Willamette

State	County	Location	Date	Reference
Oregon	Clackamas	near Oregon City	pre-1914	California Academy of Sciences (CAS)
Oregon	Clackamas	MTH NF	14-Nov-1999	Burke 2009
Oregon	Deschutes	Slough Campground, Deschutes NF	28-Jul-1999	Burke 2009
Oregon	Hood River	Neal Creek, MTH NF	19-Jul-2002	Oregon State Arthropod Collection
Oregon	Marion	WIL NF	17-May-2012	Cascade Crossing Project Survey (NRIS)
Oregon	Marion	WIL NF	17-May-2012	Cascade Crossing Project Survey (NRIS)
Oregon	Marion	near Salem	1911	Pilsbry 1946
Oregon	Wallowa	Wallowa Valley 1-3 miles above Wallowa Lake	8-Sept-1941	Pilsbry 1946
Oregon	Wasco	MTH NF, Barlow RD	24-Apr-2010	Oregon State Arthropod Collection
Oregon	Wasco	Pen Creek, MTH NF	10-Apr-2003	Oregon State Arthropod Collection
Oregon	Wasco	Neal Creek, MTH NF	1911	Frest and Johannes 1995a
Washington	Chelan	OKW NF, Cle Elum RD	26-Apr-2000	Burke 2009
Washington	Chelan	OKW NF, Leavenworth RD	13-Nov-1998	Burke 2009
Washington	Chelan	Falls Creek, OKW NF, Chelan RD	25-Oct-2000	Burke 2009

State	County	Location	Date	Reference
Washington	Chelan	Swakane Canyon, OKW NF	28-May-1998	Burke 2009
Washington	Kittitas	Gooseberry Flat, Taneum Cr. Watershed, OKW NF	23-Jul-1995	Burke 2009
Washington	Kittitas	Manastash/Taneum Sheep Allotment, OKW NF	26-Apr-2000	Burke 2009
Washington	Pend Oreille	above Pass Creek Pass (C33) and west of Stagger Inn Campground (C32), Kaniksu NF	14-Aug-2010 and 18-Aug-2010	Lucid et al. 2016
Washington	Pierce	2.6 km up Glacier Basin Trail above White River CG, Mt. Rainier Nat. Park	30-Jun-1973	Branson 1980
Washington	Pierce	Tipsoo Lake, just west of Chinook Pass, Mt Rainier Nat. Park	24-Jun-1973	Branson 1980
Washington	Skamania	Fourmile Creek, Tributary of Cispus River, GIP NF	4-May-1995	Burke 2009
Washington	Yakima	Northwest of Chinook Pass, MBS NF	22-Sep-2000	Frest and Johannes 2001

RADIODISCUS ABIETUM

The fir pinwheel (*Radiodiscus abietum*) is a FS sensitive species in Oregon and Washington (Figure 4; Table 4). It is ranked as S1 (Critically Imperiled) in Oregon and S3 (Vulnerable) in Washington (ORBIC 2016; WNHP 2016). It is a terrestrial pulmonate snail originally collected from near the mouth of the East Fork Weiser River in Idaho, where it was found estivating under rocks “near end of driest summer in history of region” (Baker 1930). It has been documented from the Colville, Wallowa-Whitman, and Umatilla National Forests of Oregon and Washington (Huff 2009), though no historic record of the Wallowa-Whitman site has been found. Recent collections on the Umatilla NF include from rocky areas with associated springs, creeks, and riparian areas (Jepsen et al. 2011, 2012). Frest and Johannes (1995b) describe it as “a mesophile species, apparently feeding on partly decayed leaves and organic debris in soil.” They also note that it is most commonly found in remnant moist forest patches at moderate elevations but is never abundant (Frest and Johannes 1995b). Associated mollusk species include *Polygyrella polygyrella*, *Anguispira kochi*, *Microphysula ingersolli*, and those in the genera *Cryptomastix*, *Prophysaon*, *Arion*, and *Ariolimax* (Jepsen et al. 2011, 2012).

Figure 4. *Radiodiscus abietum*. Photo credit John Slapcinsky, Florida Museum of Natural History; used under Creative Commons License, CC BY-NC-SA 3.0.

Table 4**.** Past collection localities for *Radiodiscus abietum* in Oregon and Washington. UMA = Umatilla, COL = Colville

State	County	Location	Date	Reference
Oregon	Umatilla	above Weston	17-Jul-1935	ANSP
Oregon	Umatilla	Thomas Creek 4-3, near confluence of Thomas Creek and SF Umatilla, UMA NF	28-Sep-2010	Jepsen et al. 2011
Oregon	Umatilla	North Fork Umatilla 1, UMA NF	15-May-2012	Jepsen et al. 2012
Oregon	Umatilla	Tiger Saddle 3-2, between Tiger Saddle Rd and Tiger Creek, UMA NF	27-Sep-2010	Jepsen et al. 2011
Washington	Stevens	Sixmile Creek	13-Nov-1979	Burke 2017
Washington	Pend Oreille	above Marshall Lake	1-July-1983	Burke 2017
Washington	Pend Oreille	east of the Pend Oreille River, COL NF	multiple, between 16-May-1979 and 2-Jun-2005	Burke 2017
Washington	Pend Oreille	west of Petit Lake (C29), Kaniksu NF	15-Aug-2010	Lucid et al. 2016
Washington	Pend Oreille	near Gypsy Creek (C35), COL NF	15-Aug-2010 and 29-Aug-2010	Lucid et al. 2016
Washington	Pend Oreille	near Stagger Inn Campground (C32; C48), Kaniksu NF	18-Aug-2010 and 26-Aug-2010	Lucid et al. 2016

State	County	Location	Date	Reference
Washington	Pend Oreille	northeast of Orwig Hump (C31T), Kaniksu NF	1-Jun-2010 and 15-Jun-2013	Lucid et al. 2016
Washington	Pend Oreille	Salmo-Priest Wilderness (C53), COL NF	12-Aug-2010	Lucid et al. 2016
Washington	Pend Oreille	near Harvey Creek (C8), COL NF	16-Aug-2010	Lucid et al. 2016
Washington	Pend Oreille	north of Mill Pond (C11), COL NF	14-Aug-2010	Lucid et al. 2016
Washington	Pend Oreille	near Sullivan Creek #1 Campground (C10), COL NF	30-Aug-2010	Lucid et al. 2016
Washington	Pend Oreille	north of Pass Creek (C17; C18), COL NF	29-Aug-2010 and 31-Aug-2010	Lucid et al. 2016
Washington	Pend Oreille	west of Johns Creek (C9), COL NF	30-Aug-2010	Lucid et al. 2016
Washington	Columbia	Touchet River 2-1, UMA NF	26-Sep-2010	Jepsen et al. 2011
Washington	Spokane	base of Mt. Spokane	22-Jun-1957	Field Museum of Natural History (FMNH)

METHODS

SITE SELECTION AND SURVEY PERIOD

Prior to selecting sites, we reviewed the type of habitat in which each target species has been reported, including information reported in species fact sheets (Huff 2009; Huff and Foltz 2010; Jordan 2010; Fallon and Jordan 2015) or profiles (Frest and Johannes 1995a), survey reports (Jepsen et al. 2011; Jepsen et al. 2012), and survey protocols (Duncan et al. 2003). Tom Burke provided taxonomic and survey expertise and recommendations not only for the four target species for this project but also mollusks generally.

Targeted habitat included:

- basalt or other rock outcrops or talus in open forest, including the bottom or lateral borders of talus slopes and along drip lines of larger boulders or rock outcrops, generally where vegetation is also present, and including adjacent habitat within 10m
- springs, seeps, and seasonally damp areas including riparian habitat, especially where herbaceous vegetation is present (watercress, monkeyflower, etc.)
- areas with damp wood debris or litter
- open forest with forbs, mosses, deciduous shrubs or trees (including aspen and cottonwood), especially with a diverse understory.

Because snail density and diversity is often positively correlated with amount of calcium in soil and litter (reviewed in Graveland and Van der Wal 1996), and because Frest and Johannes (1995a) note that limestone habitat may be

associated with a target species, we also targeted moonwort (*Botrychium* sp.) habitat documented on the WAW. Alverson and Zika (2008), discussing the high moonwort species diversity in the Wallowas comment that:

> We suspect that the presence of calcareous substrates promotes moonwort species richness in these meadows. Where moonworts occur, the substrate is typically composed, at least in part, of alluvially transported calcareous boulders that originated on the limestone outcrops of the high ridges…it appears that the presence of limestone and other calcareous materials appears to be correlated with moonwort species diversity.

We consulted with District Biologist Laura Navarrete to determine the type, availability, and location of habitat on the La Grande Ranger District (Figure 5). Based on her knowledge of the survey area we were able to prioritize specific areas based on likelihood of occupancy, elevation and accessibility (limited by snowpack), and Forest Service interest. This approach enabled us to spend significantly more time surveying and less time searching for or navigating to sites.

Terrestrial mollusk surveys may take place following spring melt-out before the summer dry period or during fall-winter rains, though surveys should be completed before the first heavy freeze (Frest and Johannes 1995a; Duncan et al. 2003). However, Jepsen et al. (2011, 2012) found that spring surveys in the region were more effective compared with fall surveys, in part due to dry conditions. On average, the area receives more rainfall in the spring months as compared to the fall (PRISM 2017). Therefore, we planned surveys for the month of May with assistance from District Biologist Laura Navarrete in order to coincide with spring melt-out, although snow remained and continued to melt during the survey period (Figure 6) limiting access to some sites. Because seasonal and climatic conditions generally affect the activity of terrestrial mollusks and thus the likelihood of encounter, the timing of our surveys may also have influenced the particular species documented on the LGRD.

Figure 5. Riparian areas with deciduous trees and shrubs provide habitat for multiple species (including two target and four non-target species, see Results) of terrestrial mollusk on the Forest.

Figure 6. Persistent snow on May 9, 2016 at 5,466 feet elevation on the eastern portion of the La Grande Ranger District. Road access was limited at this elevation but terrestrial mollusks were active and easily collected.

SAMPLING METHODOLOGY

Xerces Society staff have developed a terrestrial gastropod survey protocol (Appendix I) based in part on recommendations and protocols discussed by Frest and Johannes (1995a: general collection and monitoring methods), Duncan et al. (2003: pre-disturbance surveys), and Hendricks and Maxell (2005: inventory information). Data sheets and identification service information should also be consulted and can be accessed from the ISSSSP website (http://www.fs.fed.us/r6/sfpnw/issssp/inventories). Surveys for certain species of terrestrial mollusk may require additional species-specific considerations (see Species Fact Sheets published on the ISSSSP website), particularly if they inhabit specialized habitat. Surveys must also be adapted to the particular survey location, especially the timing of surveys at various elevations or landscape positions. We searched in appropriate habitat by first examining the ground surface for live mollusks or shells. We turned over rocks and logs and searched the litter layer, especially any damp surfaces. Where water was present we also searched along the edges and just within waterbodies.

The total time spent at each site varied, but for these surveys we planned to have at least two observers (though often three were present) survey for a minimum of 10 minutes (i.e., 20-30 person-minutes). If mollusks were encountered within the first 10 minutes, the survey period generally extended to a total of 20 minutes. Surveys lasted longer at sites with a variety of habitats or microhabitats and when species diversity was evidently greater. At each site, we recorded information about the habitat, soil moisture, plant community, and locality. A Garmin Rino GPS unit was used to obtain geographic coordinates for each site surveyed. All shells and live specimens were collected by hand and temporarily stored in small plastic containers or vials. Slugs were immediately placed in water to avoid desiccation and begin the process of preservation. Specimen processing followed the protocol in Appendix I, and all mollusks were submitted to Tom Burke for specimen identification.

DATA ENTRY AND SPECIES IDENTIFICATION

All data for this project were entered into an Excel spreadsheet and transferred to the Forest Service's Natural Resource Information System (NRIS) DX Wildlife data workbook. Related spatial data (survey sites and species

detections) were added to a personal geodatabase. All specimens collected for this project were identified by mollusk expert Tom Burke.

RESULTS

SURVEY RESULTS

We surveyed a total of 42 sites for a total of nearly 42 person-hours, spending an average of 21 minutes surveying each site (Figure 7). We collected at least 28 species of mollusk from 31 sites. Although several specimens were represented only by juvenile individuals, or by crushed snails or shell fragments, Tom Burke was able to identify most specimens to species based on the available material and species' diagnostic characteristics. Of the surveyed sites, FS sensitive or strategic species (including non-target species) were collected from 13. Appendix II contains a summary table of mollusk species by survey site, and site descriptions and photos are included in Appendix III.

Of all sites where terrestrial mollusks were encountered, *Euconulus fulvus* was collected from half, while *Pristiloma wascoense* and *Anguispira kochi* were collected from about a third. Other frequently encountered species include *Zonitoides arboreas* (6 sites) and the nonnative slug *Arion circumscriptus* (5 sites). When mollusks were encountered, sites averaged about three species.

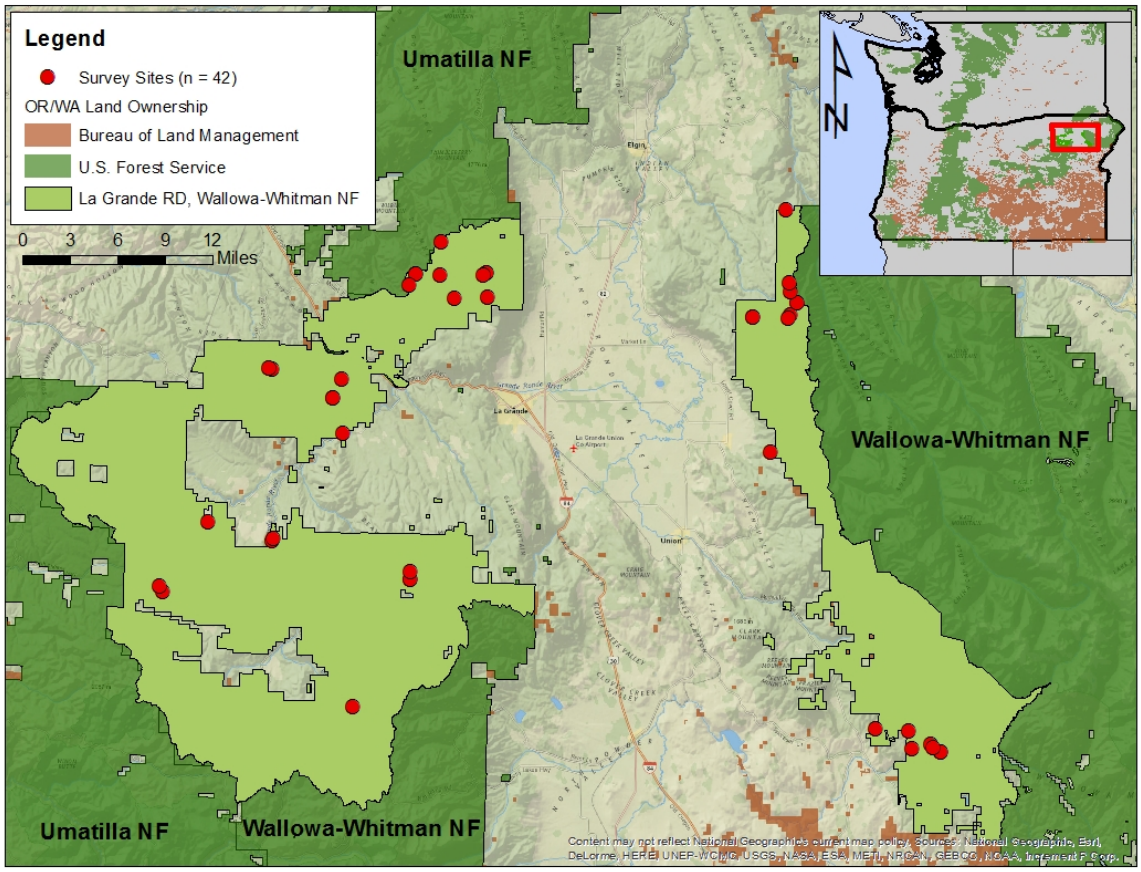

Figure 7. Map of terrestrial mollusk sites in the Wallowa-Whitman National Forest, La Grande Ranger District surveyed in May 2016.

OREOHELIX STRIGOSA DELICATA

No species identified as *Oreohelix strigosa delicata* were collected during these surveys. One live specimen of *Oreohelix strigosa* was collected from a talus slope at the Mill/Bridge Creek site, which was later discovered to occur on private land adjacent to the Forest boundary. The snail was collected near the downslope end of the talus near shrubs and trees (currant, grand fir), mosses, and ferns. Other species collected at the same site include *Radiodiscus abietum*, *Euconulus fulvus,* and *Zonitoides arboreas*. Tom Burke provides the following information regarding this specimen:

> While [the specimen from Mill/Bridge Creek] is obviously an *Oreohelix*, it is a unique specimen. It is an adult shell but is quite small. Although, there are species of that size, this one was collected outside of the range of any of those. *O. strigosa*, however, can vary in size within a population, and *O. strigosa delicata* with 5 to 5½ whorls, can range in size from 12 to 20 mm wide. The specimen in question was collected about 38 miles southeast across the Blue Mountains and Grande Ronde Valley from the known location for *O. strigosa delicata*. With 5¼ whorls, this shell is about <u>14 mm wide</u> by 8.7 mm high with a <u>low to moderately elevated spire</u>. The thickening and concentration of growth striae at the aperture of the shell indicates that it has reached its adult size and will grow little if any larger. Farther back from the aperture, the shell may be considered <u>fairly thin</u>. The markings approaching the aperture consist of a wide sub-peripheral band, then a very narrow white peripheral band and a dark supraperipheral band that is one and a half times the width of the lower band. Difficult to see on this shell are very faint, fairly wide supernumerary bands, one above and 2 or three below the other bands. The periostracum is weathered and badly pitted, but it appears to have been a rich honey-brown color. The whitish to horn-colored shell nacre is exposed over most of the shell. The aperture is obliquely obovate extending out and down from the penultimate whorl, the palatal insertion intersecting at about 90° or at a slight descent.
>
> <u>Growth wrinkles are coarse</u>, but spiral striae are not apparent; the weathering and eroding of the shell prevents good observation of any other sculpturing, such as granulose texture reported for *O. s. delicata*. The protoconch appears to be about 1¾ whorls but is so eroded that no sculpturing can be seen on it. Because of the weathering and pitting of this shell, it is difficult to determine whether or not it is *Oreohelix strigosa delicata*, but it appears to have some of that subspecies characteristics (marked above as underlined phrases). Other specimens from that population need to be examined in order to make that determination.

The specimen, therefore, is identified in this collection as unique and is listed as *Oreohelix strigosa* (n. ssp.?).

Although one of the specimens from Site 15 (a talus slope across from Spool Cart Campground) was originally identified as an *Oreohelix strigosa*, it was later determined that that specimen is actually that of *Anguispira kochi*, a species whose shell can be difficult to separate from specimens of *Oreohelix*, particularly if weathered; however, the species are easily separated when the snail's body can be examined and the pedal furrows of *Anguispira* are visible (Table 5). The above and following information on species identification is provided by Tom Burke:

> Table below displays lists of comparisons between the shells of these species. [The *Anguispira*] specimen…had a lower spire and more rounded aperture than the other *Anguispira kochi* that were found with it, and with the weathered condition of the shell, it appeared to be *Oreohelix strigosa*. On reexamination, its similarity to *Anguispira* became apparent and after various measurements and study, its lower band being on the periphery, and the angular insertion of the umbilicus of *Oreohelix strigosa* made it apparent that this was *Anguispira* when compared to other shells of both of those species.

Table 5. Comparison of *Oreohelix strigosa* and *Anguispira kochi* shell characteristics (provided by Tom Burke)

Oreohelix strigosa	*Anguispira kochi*
Shell usually heavier, more calcareous.	Shell thinner, not as calcareous.
Periostracum usually light brown when present; often quite thin or lacking.	Periostracum usually dark brown, covering entire whorls, sometimes sloughing off in patches.
Dark peripheral bands usually present, sometimes lacking: • Lower band below the periphery; upper band near mid-dorsally. • The area between the bands may be the normal color of the shell or it may be distinctly white.	Dark peripheral bands sometimes appear as those of *Oreohelix*, but: • They are usually wider and the lower band is usually on or just above the periphery. • The norm is a yellowish band just above the periphery with dark areas above and below it that may be distinct bands or may extend onto the dorsal and/or basal whorl.
The aperture nearly round, slightly wider than high; the outer insertion attached to the penultimate whorl at an approximate right angle or slightly descending; the columellar insertion approximately vertical.	The Aperture is obliquely obovate; the outer insertion entering the penultimate whorl at an upward angle; the columellar insertion approximately vertical.
Whorls of young sharply angled at the periphery; the angle often still apparent in front of the aperture on mature or near mature specimens.	Whorls of young somewhat shouldered but not sharply angular. Periphery is round on nearly mature specimens.
Umbilicus narrowly tapering, funnelform, descending at a slight angle to the apex.	The umbilicus narrowly tapering funnelform descending straight toward the apex.
Apex sculpturing is very fine, sharp, rib-like collabrally arranged (at the angle of the aperture). However, the early whorls may be badly eroded so the sculpturing may not be discernible.	Apex sculpturing may be wider, fan-like ribbing, either collabral or more radially arranged. However, the early whorls may be badly eroded so the sculpturing may not be discernible.

POLYGYRELLA POLYGYRELLA

No specimens of *Polygyrella polygyrella* were collected during these surveys.

PRISTILOMA WASCOENSE

Pristiloma wascoense was previously considered Suspected on the Wallowa-Whitman National Forest, and was reported near Wallowa Lake by Pilsbry (1946). We collected 16 specimens of *P. wascoense* from 10 sites (Figure 8)**.** Tom Burke notes that

> *P. wascoense* is also fairly tightly coiled, but its umbilicus is perforate, and it has a more rounded spire [than *P. idahoense*]. *P. wascoense* looks very much like *Zonitoides arboreas*, but it is about half the diameter with the same number of whorls, and the wider umbilicus of *Zonitoides* is distinct.

He also reports that *Pristiloma idahoense*, represented by a single collection during these surveys and from the same collection site as *P. wascoense*, is

> one of the larger of the genus and has a strongly shouldered shell, otherwise of the typical shape, tightly coiled, imperforate with a distinct conic spire.

Other associated mollusks from surveyed sites include *Megomphix lutarius, Radiodiscus abietum, Anguispira kochi, Discus whitneyi, Euconulus fulvus, Fossaria modicella, Microphysula ingersolli, Punctum californicum, Punctum minutissimum, Punctum randolphi, Vertigo modesta sculptilis, Vitrina pellucida*, and *Zonitoides arboreas*. Similarly, Lucid et al. (2016) report collections of *Punctum randolphi, Radiodiscus abietum,* and *Zonitoides arboreas* at *Pristiloma wascoense* sites in Washington.

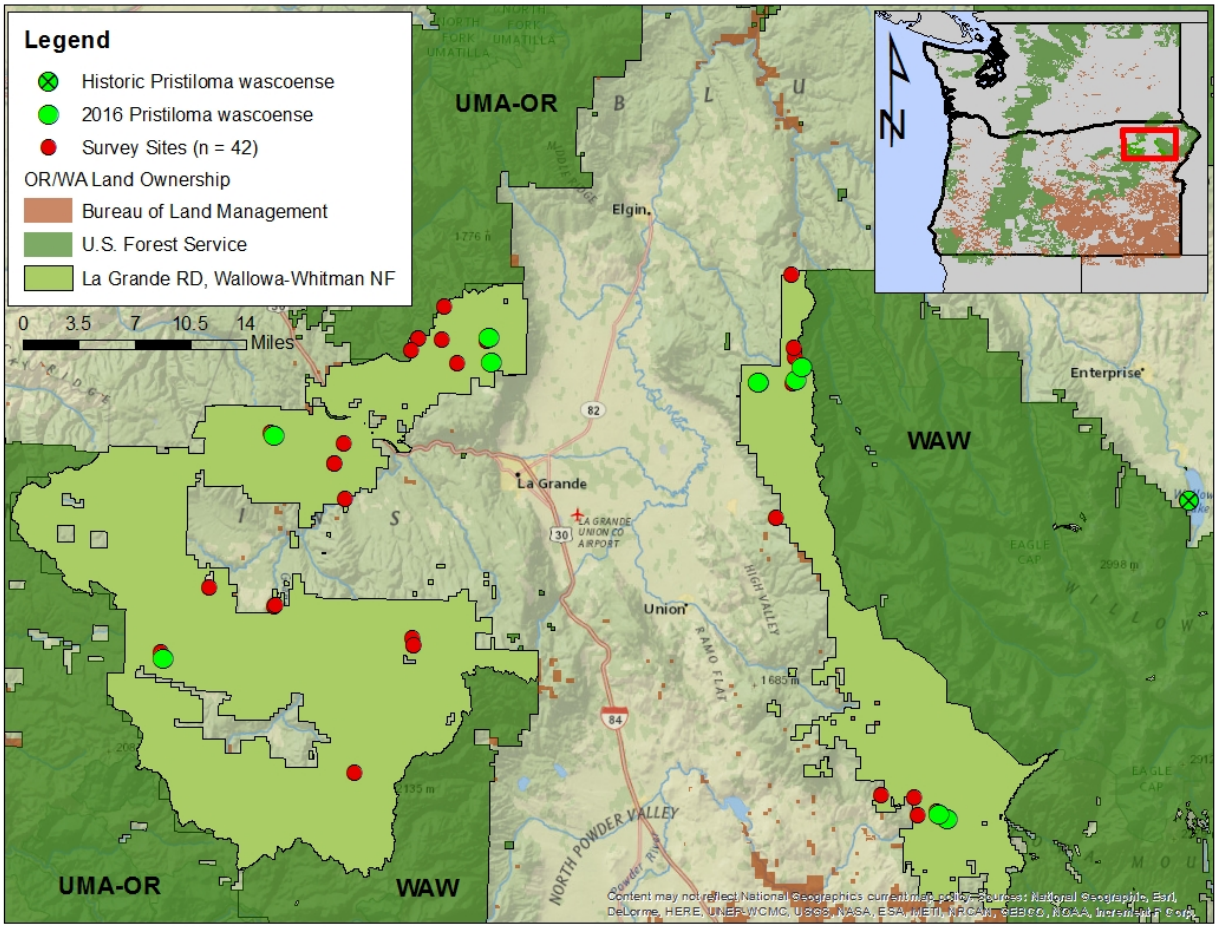

Figure 8. Collection records for *Pristiloma wascoense* from 2016 target terrestrial mollusk surveys.

RADIODISCUS ABIETUM

We collected six specimens of *Radiodiscus abietum* from four sites (Figure 9). Tom Burke notes that

> This species is easily identified whether mature or immature. Shells, up to nearly 7 mm wide, are amber to brown with a very low (nearly flat) spire. Whorls increase in size fairly slowly and are sculptured with fairly closely-spaced ribs. A unique characteristic is the distinct spiral impressed lines on the protoconch that extend over the teleoconch as spiral striae, so even on immature shells these spiral lines on the protoconch becoming ribs on the following whorls are unique to this species. The only other NW species with this sculpturing is the white microsnail *Striatura pugetensis* which is less than 2 mm wide, none of which were among these samples.

Other associated mollusks from surveyed sites include *Pristiloma wascoense, Euconulus fulvus, Oreohelix strigosa* (n. ssp.?), *Zonitoides arboreas, Discus whitneyi, Punctum randolphi, Vitrina pellucida,* and *Microphysula ingersolli*. Similarly, Lucid et al. (2016) report collections of *Radiodiscus abietum* with each of these species [excluding *O. strigosa* (n. ssp.?) and *Vitrina pellucida*] at sites in Washington, but also with *Pristiloma idahoense*, *Punctum minutissimum*, and *Anguispira kochi.*

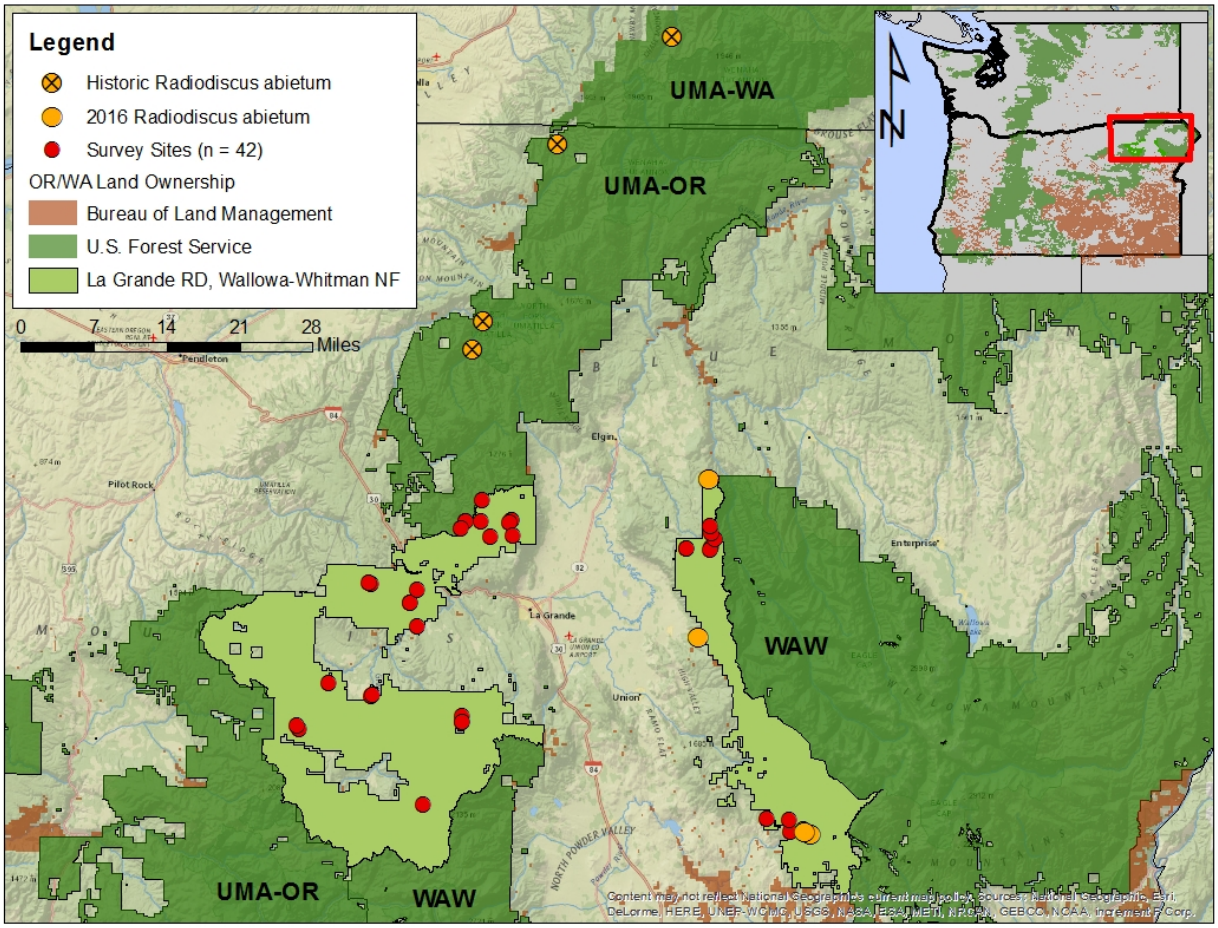

Figure 9. Collection records for *Radiodiscus abietum* from 2016 target terrestrial mollusk surveys.

OTHER MOLLUSKS

We collected nine non-target, sensitive, strategic, or otherwise notable species during surveys (Figure 10; Table 6). Appendix IV contains additional information about identification of these and other specimens provided by Tom Burke.

Table 6. Non-target sensitive, strategic, or notable species collected on the La Grande Ranger District, Wallowa-Whitman National Forest during 2016 surveys

Species	USFS (2015)	Occurrence Status/Comments
Oreohelix strigosa (n. ssp.?)	No	Potentially undescribed subspecies
Pristiloma idahoense	Sensitive (WA)	Documented on UMA-WA; now Documented on WAW
Megomphix lutarius	Strategic	Suspected; now Documented on WAW
Pristinicola hemphilli	Strategic (OR)	Documented on WAW
Punctum minutissimum	No	"generally found in the eastern United States and Canada but has been recorded as far west as…Wallowa and Umatilla counties, Oregon" (Burke 2013)
Punctum californicum	No	Not reported from Oregon but recently collected in California and Idaho (Burke 2013; Lucid et al. 2016)
Vertigo modesta sculptilis	No	Reported from Wallowa Lake but not elsewhere in Oregon (Burke 2013)
Fossaria modicella	No	Ranked S3 (Vulnerable) in Oregon and Washington (ORBIC 2016; WNHP 2016)
Planorbella oregonensis	No	Newly reported location (believed to be extant only at Borax Lake, OR)

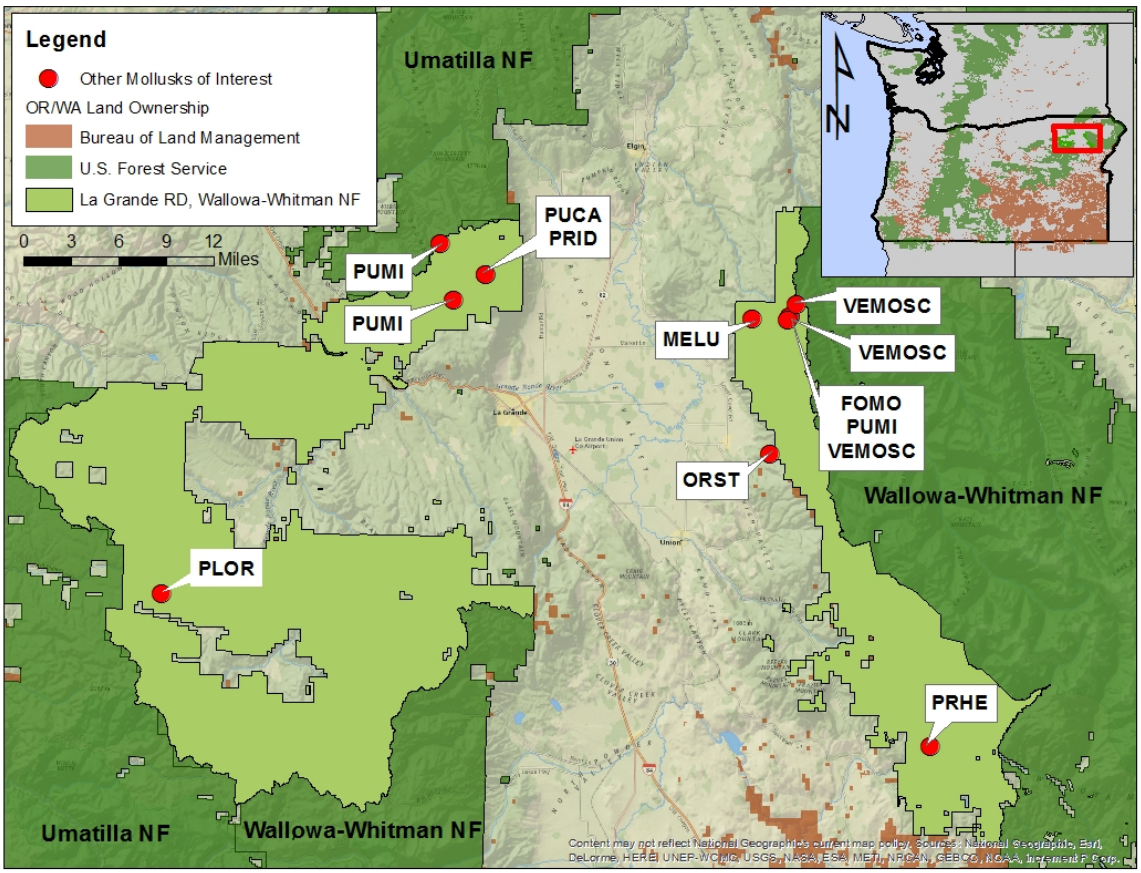

Figure 10. Locations where non-target mollusk species of interest were also collected. FOMO- *Fossaria modicella*, MELU- *Megomphix lutarius*, PRHE- *Pristinicola hemphilli*, PRID- *Pristiloma idahoense*, PLOR- *Planorbella oregonensis*, PUMI- *Punctum minutissimum*, PUCA- *Punctum californicum*, ORST- *Oreohelix strigosa* (n. ssp.?), VEMOSC- *Vertigo modesta sculptilis*.

DISCUSSION

Results from spring 2016 terrestrial mollusk surveys on the La Grande Ranger District of the Wallowa-Whitman National Forest reveal a diverse assemblage of species inhabiting a range of habitats. Of the four target species, two were collected from multiple sites. *Pristiloma wascoense* (Figure 11) was found to occur across the LGRD. Interestingly, Jepsen et al. (2011, 2012) did not collect this species during either spring or fall surveys in other portions of the Blue Mountains, though they did collect *Pristiloma idahoense*, a species collected from the same locality as *P. wascoense* during our surveys. Lucid et al. (2016) also report collections of both species, though never from the same site. *P. idahoense* was also collected from several Washington sites in association with *Radiodiscus abietum, Punctum randolphi*, and *Vertigo modesta sculptilis* (Lucid et al. 2016). Collection of *P. idahoense* from the WAW now establishes the species as Documented.

We also collected *Radiodiscus abietum* from multiple sites on the Forest, though all on the eastern portion of the LGRD. However, we did not collect another target species, *Polygyrella polygyrella*, with which it is reported to commonly co-occur, even though the species was recently collected by Jepsen et al. (2011). We searched similar habitat as reported and encountered several species commonly associated with *P. polygyrella,* including *Anguispira kochi, Microphysula ingersolli,* and *Radiodiscus abietum* (Figure 12). Given the proximity of recent occurrence

records, we recommend continued surveys for this species on the Forest. The species has been collected between late June and late September (Oregon/Washington records in Table 2; Idaho records in Lucid et al. 2016), but was not collected during spring (mid-May) mollusk surveys in the Blue Mountains (Jepsen et al. 2012). Thus, fall surveys may be more successful for this species.

We also did not collect specimens of *Oreohelix strigosa delicata,* even though the species was collected by Jepsen et al. (2012) in Umatilla County. However, we did recover a specimen of a potentially unique subspecies of *O. strigosa*. Further surveys in typical *O. strigosa* habitat are highly recommended in the area, as collection of less weathered specimens could provide valuable information for taxonomic refinement.

We targeted a number of distinct habitat types known or thought to be associated with terrestrial mollusks, especially target species. Of the four surveyed aspen stands, mollusks were encountered at only two (*Euconulus fulvus* at two and *Punctum minutissimum* and *Vitrina pellucida* at one site each). Of the two moonwort sites, *Pristiloma wascoense* was encountered at both. Other species collected include *Euconulus fulvus, Fossaria modicella, Punctum minutissimum*, and *Vertigo modesta sculptilis*. Of the ten spring or spring-adjacent sites we visited, *Pristiloma wascoense* and *Pristinicola hemphilli* were each encountered; *Anguispira kochi* and *Euconulus fulvus* were also commonly collected. Of the eight talus sites visited, mollusks were collected at only five but did include *Radiodiscus abietum* and *Pristiloma wascoense*. *Euconulus fulvus* was also commonly collected (half of the talus sites). The sites with the greatest number of species (5-6 per site) generally had a greater deciduous component, including brushy deciduous vegetation such as dogwood, currant, and willow, as well as cottonwood trees. Several sites were also dominated by coniferous species ranging from ponderosa pine, Douglas-fir, grand fir, lodgepole pine, or spruce.

We also collected a single live specimen of *Megomphix lutarius*, a species rarely collected and ranked S1 (Critically Imperiled) in Oregon (ORBIC 2016) and SH (Possibly Extirpated) in Washington (WNHP 2016). Interestingly, only one live specimen was recently collected by Jepsen et al. (2012; Table 7). In both our surveys and those of Jepsen et al. (2012) multiple shells were associated with the single live specimen (12 and 11 respectively). Other associated species reported at recent *M. lutarius* sites include *Deroceras reticulatum* and *Vitrina pellucida* (Jepsen et al. 2012) and *Pristiloma wascoense*, *Microphysula ingersolli*, *Zonitoides arboreas*, and *Euconulus fulvus* (this survey). Additional surveys for the species on the Wallowa-Whitman and Umatilla National Forests and further study of the three extant populations is recommended to improve management of the species' habitat.

Table 7. Past collection localities for *Megomphix lutarius* in Oregon and Washington.

State	County	Location	Date	Reference
Oregon	Umatilla	~5 miles above Weston, a few feet from the dry bed of Pine Creek	pre-1932 (10-Aug)	Baker 1932
Oregon	Umatilla	Weston	1879; pre-1886	CAS; Baker 1932
Oregon	Umatilla	NFJD1; NFJD2	16-May-2012	Jepsen et al. 2012
Oregon	Union	North Fork Indian Creek Road 85, WAW NF	9-May-2016	This study
Washington	Walla Walla	Blue Mountains	pre-1932	Baker 1932

We also collected specimens identified as the rare species *Planorbella oregonensis* (Appendix IV). The species is ranked S1 (Critically Imperiled) in Oregon and is currently known only from Borax Lake and adjacent pools and wetlands in Harney County, Oregon, though historically it was reported also from Tooele County, Utah and Washoe County, Nevada (Hietala-Henschell and Blevins 2016). Additional surveys for this species are recommended, particularly because identification of planorbid species can be difficult and understanding of this other species' ranges and habitat associations is incomplete (Hietala-Henschell and Blevins 2016; Appendix IV).

Other species collected during surveys are highlighted in Table 6 based on FS status, general rarity, or apparent extensions of ranges. Alternatively, we also collected six species of nonnative slugs from eight sites (Appendix II, Appendix IV). Collection sites were typically those with greater human use (Bird Track Springs Trail, Spool Cart Campground, Mine Tailings, etc.). One native slug species, *Deroceras leave*, was also collected from the talus site across the road from Spool Cart Campground.

Figure 11. Microsnails, including *Pristiloma wascoense*, can be difficult to see and require careful searching. Photo credit: Laura Rost © Xerces Society

Figure 12. *Anguispira kochi* was commonly collected during surveys.

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APPENDIX I. TERRESTRIAL GASTROPOD SURVEY PROTOCOL

Developed by Sarah Foltz Jordan, Sarina Jepsen, Candace Fallon, Emilie Blevins, and Katie Hietala-Henschell, Xerces Society

Updated January 2017

How: Hand collection in the appropriate habitat is the recommended survey method for species. Visit survey areas during appropriate season(s). Seek out key habitat features known to be utilized by the target species (e.g., rock outcrops and talus within ponderosa pine or Douglas-fir habitat) while driving or hiking in a selected area and survey promising areas (e.g., look under loose rocks near outcrops or in talus habitat and in crevices or hollows under soil and between rocks). Record geographic coordinates for each site surveyed.

Between 15 and 20 minutes of search time per person should be spent at each sample area, approximately 78.5 m^2 in size per Duncan et al. (2003); however, the total time spent at each site may vary based on the habitat present. If 15 to 20 minutes are spent searching for mollusks without finding additional species during that time period, surveyors may move on to a new site.

When mollusks are observed, collect voucher specimens (live snails or shells) from each survey area. Voucher specimens (shells and live snails) can be collected in small vials or recycled yogurt containers and kept in a cooler with ice. Shells should be carefully wrapped in materials from the field site (moss, leaf litter) or some other material such as paper towels to ensure they are not broken in transit. Wrap ice in the cooler with a towel and avoid putting live snails directly on the ice; snails may go into aestivation if they become too cold.

Identification of a taxon may be possible using only shell features, although dissection may also be necessary. As expert identification is required for documentation of special status, sensitive, and Survey and Manage species, this may require shipment of live animals. Detailed vouchering and shipping information is available at: http://www.fs.fed.us/r6/sfpnw/issssp/inventories/identification.shtml.

Anatomical examination: For surveys requiring only anatomical examination, drown larger (>3 mm) live snails in vials of water overnight or up to 52 hours in the case of some large-bodied snails to ensure appropriate relaxation. Powdered menthol (equivalent of two crystals) can be added to water-filled vials containing slugs and large snails to speed up the relaxing process. Specimens are ready for transfer when optic tentacles do not retract when touched. Transfer specimens from water to a solution of 40% ethanol for at least 24 hours and then a final 80% ethanol solution. Note that for some species (particularly large snails, such as *Monadenia*) it is best to put them through a graduated series of ethanol dilutions, moving from 40% to 60% and finally 80% ethanol, leaving them for 24 hours in each dilution. Borax powder can also be added to the 80% solution to buffer and protect shells. For microsnails (<3 mm; pupillids, *Pristiloma*, etc.) place directly in alcohol of 70% or weaker prior to death, as drowning may cause the body to obscure apertural or other key shell characteristics.

DNA analysis: For surveys requiring only DNA preservation, place specimens directly in 95% ethanol. For larger specimens, a tail clipping can be taken prior to drowning and preserved directly into 95% ethanol. This should be placed in a small cryovial with a label affixed to the outside of the vial (do not put labels inside the vial). The rest of the animal can then be processed as described below.

DNA analysis and anatomical examination: If preservation of tissue for both DNA and anatomical surveys is required, it may be necessary to split live-collected specimens into two collections (one in 95% ethanol and one following the 80% ethanol protocol above), depending on the size of the animal as some species may be too small for tail clips. Note that separate preservation methods would require verification of species identity preserved using each method.

When: Terrestrial mollusks of the Interior Columbia Basin are best surveyed for in the spring, from April to May following snowmelt or from September to November after the onset of rain but before the first heavy freeze (Frest and Johannes 1995). Duncan *et al.* (2003) suggests a general set of guidelines for fall surveys:

> 1) autumn rains have soaked the ground (i.e., generally after at least three days of moderate to heavy rains), and 2) the soil is wet to a 1" depth or morning dew or frost is present (in areas or years in which autumn rains may not occur before the ground freezes). Surveys may continue into the late fall or early winter until 1) soil temperatures fall below 0°C (32°F) and remain below 2°C (36°F) (under the canopy) for three consecutive days (i.e. when there is a constant period of three or more days of cold temperatures), or 2) the ground is frozen, or 3) snow prevents a reasonable search. Survey conditions are still within protocol if soil temperatures drop below 2°C (36°F) during the night and rise again during the day.

Likewise, spring surveys may resume:

> after 1) the snow has melted and the ground is thoroughly thawed and 2) the soil temperature remains above 5°C (40°F) for at least three consecutive days. A slightly higher temperature threshold is considered necessary in the spring in order to compensate for the need for animals to become active after a long dormant period and also to allow time for new hatchlings to emerge. Surveys may continue into early summer until 1) the top half-inch of soil is dry or 2) daytime air temperatures remain above 27ºC (80ºF) for three consecutive days. Surveys windows may re-open in late spring after dry periods if rainfall is sufficient to moisten the top half-inch of the duff layers (Duncan *et al.* 2003)

APPENDIX II. TABLE OF SITES SURVEYED AND SPECIES COLLECTED

Live collected specimen of each species unless otherwise noted.

Date	Site	County	Latitude	Longitude	SEN/STR Mollusks	Other Mollusks	General Site Type
5/8/2016	Spring Creek at Road 21	Union	45.35087	-118.309		*Arion circumscriptus*; *Deroceras laeve*; *Physella gyrina*; *Planorbella* sp.	Riparian
5/9/2016	Clark Creek 1	Union	45.41428	-117.727	*Pristiloma wascoense*	*Euconulus fulvus*; *Fossaria modicella*; *Punctum minutissimum*; *Vertigo modesta sculptilis*	Moonwort
5/9/2016	Clark Creek 2	Union	45.41127	-117.731		*Euconulus fulvus*; *Vertigo modesta sculptilis*	Riparian
5/9/2016	North Fork Indian Creek Road 85 Site 1	Union	45.41239	-117.776	*Pristiloma wascoense*	*Euconulus fulvus*	Moonwort
5/9/2016	North Fork Indian Creek Road 85 Site 2	Union	45.41239	-117.776	*Pristiloma wascoense* (shells only); *Megomphix lutarius*	*Euconulus fulvus*; *Microphysula ingersolli*; *Zonitoides arboreas*	Rock
5/9/2016	Mill/Bridge Creek (non-FS)	Union	45.28906	-117.752	*Radiodiscus abietum* (shells only)	*Euconulus fulvus*; *Oreohelix strigosa* (n. ssp.?); *Zonitoides arboreas* (shells only)	Talus
5/10/2016	Conundrum Creek 1	Baker	45.01594	-117.528			Riparian
5/10/2016	Conundrum Creek 2	Baker	45.01594	-117.528	*Pristiloma wascoense*; *Radiodiscus abietum*	*Discus whitneyi*; *Euconulus fulvus*; *Punctum randolphi*; *Vitrina pellucida*	Deciduous
5/10/2016	Sufferin Smith Spring	Baker	45.02283	-117.541	*Pristinicola hemphilli*	*Discus whitneyi*; *Euconulus fulvus*; *Physella* sp.	Spring
5/10/2016	Rock talus Road 67	Baker	45.02005	-117.539	*Pristiloma wascoense*; *Radiodiscus abietum*	*Discus whitneyi*; *Euconulus fulvus* (shells only); *Microphysula ingersolli*; *Vitrina pellucida* (shells only)	Talus
5/10/2016	Road 900 Rock Face and Adjacent	Union	45.03503	-117.57			Aspen/Rock
5/10/2016	Road 51075 Aspen Stand	Union	45.01853	-117.566			Aspen
5/10/2016	Road 7746 Aspen Stand	Union	45.03688	-117.613		*Euconulus fulvus* (shells only), *Vitrina pellucida* (shells only)	Aspen

Date	Site	County	Latitude	Longitude	SEN/STR Mollusks	Other Mollusks	General Site Type
5/11/2016	Spool Cart Campground	Union	45.20183	-118.396		*Anguispira kochi*; *Arion silvaticus*; *Limax maximus*; *Succinea oregonensis*; *Zonitoides arboreas*	Deciduous
5/11/2016	Talus across from Spool Cart Campground	Union	45.20346	-118.394		*Anguispira kochi* (shells only); *Euconulus fulvus* (shells only)	Talus
5/11/2016	Mine Tailings	Union	45.05146	-118.289		*Arion circumscriptus*; *Planorbella (Pierosoma) subcrenatum* (shells only); *Zonitoides arboreas* (shells only)	Rock
5/11/2016	Tin Trough Spring	Union	45.15879	-118.541		*Euconulus fulvus*	Spring
5/11/2016	Sullivan Spring/Stream by road	Union	45.21816	-118.479		*Anguispira kochi*; *Arion circumscriptus*; *Deroceras panormitanum*	Spring
5/11/2016	Bird Tracks Springs Trail	Union	45.30043	-118.307		*Arion circumscriptus*; *Deroceras reticulatum*; *Zonitoides arboreas*; *Physella* sp.; *Deroceras* sp.	Deciduous
5/11/2016	Flat Rock Spring	Union	45.15319	-118.537	*Pristiloma wascoense* (shells only)	*Planorbella (Pierosoma) oregonensis*	Spring
5/12/2016	Chicken Spring and Rocky Slope	Union	45.4259	-117.72			Spring
5/12/2016	East of Chicken Spring	Union	45.4259	-117.72	*Pristiloma wascoense*	*Vertigo modesta sculptilis*	Riparian
5/12/2016	Rock Field down the road	Union	45.43538	-117.728			Rock
5/12/2016	Unnamed spring	Union	45.44391	-117.73			Spring
5/12/2016	Seep above North Fork Clark Creek	Union	45.51051	-117.735	*Radiodiscus abietum*		Seep
5/16/2016	Road 680 Creek	Union	45.33266	-118.321		*Anguispira kochi* (shells only); *Arion circumscriptus*	Riparian
5/16/2016	Road 680 Rock Talus	Union	45.33266	-118.321		*Arion silvaticus*	Talus
5/16/2016	Tucker Spring Rock Talus	Union	45.35942	-118.404			Talus

Date	Site	County	Latitude	Longitude	SEN/STR Mollusks	Other Mollusks	General Site Type
5/16/2016	Road 2135 Boulder Slope	Union	45.35831	-118.4	*Pristiloma wascoense* (shells only)		Rock
5/17/2016	Forest West of Big Rock Spring	Union	45.45003	-118.124		*Anguispira kochi*; *Arion subfuscus*	Forest
5/17/2016	Willow Thicket West of Big Rock Spring	Union	45.45003	-118.124	*Pristiloma wascoense*; *Pristiloma idahoense*	*Anguispira kochi*; *Euconulus fulvus*; *Punctum californicum*; *Zonitoides arboreas*	Deciduous
5/17/2016	Top of Fiddler's Hell	Union	45.44716	-118.127			Rock
5/17/2016	Tie Creek Road Crossing	Union	45.42775	-118.121	*Pristiloma wascoense* (shells only)	*Anguispira kochi* (shells only); *Euconulus fulvus*; *Punctum randolphi*	Deciduous
5/17/2016	Green Mountain Aspen Stand	Umatilla	45.47714	-118.183		*Euconulus fulvus*; *Punctum minutissimum*	Aspen
5/17/2016	Road 3112/015 Slope	Union	45.42608	-118.164		*Punctum minutissimum*; *Vitrina pellucida*	Forest
5/17/2016	Lewis Spring	Union	45.44683	-118.184		*Euconulus fulvus*	Spring
5/17/2016	Daniel Spring Flat	Umatilla	45.44767	-118.215		*Anguispira kochi*	Spring
5/17/2016	Daniel Spring Source Wetland	Umatilla	45.44767	-118.215			Spring
5/17/2016	Hugh Spring Below Pond	Umatilla	45.437	-118.224		*Anguispira kochi*	Spring
5/18/2016	Road 4305/240 Rock Talus	Union	45.17503	-118.217			Talus
5/18/2016	Road 4305 Upper Rock Talus	Union	45.16813	-118.216		*Euconulus fulvus* (shells only)	Talus
5/18/2016	Road 4305 Lower Rock Talus	Union	45.16813	-118.216			Talus

APPENDIX III. SITE DESCRIPTIONS

Live collected specimen of a species unless otherwise noted.

SITE 1: SPRING CREEK AT ROAD 21

May 8, 2016 17:03, 27-minute survey. 3284 feet elevation. Flat. SW aspect. Temperature: 21.4°C (air), 12°C (soil). Soil moisture: moist. Light index: partial shade.

Site consists of a spring fed creek adjacent to road. The site showed evidence of restoration, including installed logs and log jams. The creek appears to have seasonally high flow given obvious evidence of debris at bankfull elevation. The soil was generally damp at less than an inch and especially so under thatch and debris, though the ground surface was mainly dry. No SEN/STR species collected. Other mollusks collected include *Arion circumscriptus*, *Deroceras leave*, *Physella gyrina,* and *Planorbella* sp.

SITE 2: CLARK CREEK 1

May 9, 2016 09:42, 40-minute survey. Some snowfall during survey. 5555 feet elevation. 5-7 percent slope. W aspect. Temperature: 6°C (air), 4°C (soil). Soil moisture: moist. Light index: partial shade.

This site was surveyed based on the known presence of moonwort (*Botrychium*) in the vicinity. The site tree canopy includes grand fir and lodgepole pine above a seepy slope with spruce and grouse huckleberry. SEN/STR species collected include *Pristiloma wascoense*. Other mollusks collected include *Euconulus fulvus*, *Fossaria modicella*, *Punctum minutissimum*, and *Vertigo modesta sculptilis*.

SITE 3: CLARK CREEK 2

May 9, 2016 10:32, 10-minute survey. Some snowfall during survey. 5466 feet elevation. 0-3 percent slope. E/NE aspect. Temperature: 6°C (air), 4.5°C (soil). Soil moisture: moist. Light index: partial shade.

The site was adjacent to Clark Creek. Understory reinitiation was evident, particularly under rotting logs. Tree species present include grand fir, spruce, and subalpine fir. Bushy-tailed woodrat was evidently nearby. No SEN/STR species. Other mollusks collected include *Euconulus fulvus* and *Vertigo modesta sculptilis*.

SITE 4: NORTH FORK INDIAN CREEK ROAD 85 SITE 1

May 9, 2016 11:36, 40-minute survey. Snowfall during survey. 4958 feet elevation. Flat. W/SW aspect. Temperature: 9.4°C (air), 4°C (soil). Soil moisture: moist. Light index: partial shade.

The site is located beside road 085. We searched near the snowbank on the road and adjacent to the creek under grand fir. Snails were collected under deciduous and coniferous damp litter. The site consisted of a thin soil above the gravel adjacent to the road. The area is designated old growth as well as a moonwort (*Botrychium*) site. SEN/STR species collected include *Pristiloma wascoense*. Other mollusks collected include *Euconulus fulvus*.

SITE 5: NORTH FORK INDIAN CREEK ROAD 85 SITE 2

May 9, 2016 12:26, 27-minute survey. Snowfall during survey. 4958 feet elevation. 18 percent slope. W/SW aspect. Temperature: 7.7°C (air), 10°C (soil). Soil moisture: moist. Light index: full sun.

We surveyed downslope of the road along and under cherty/platy rock. There was a visibly seepy area below the rock and road, likely from runoff. SEN/STR species collected include *Pristiloma wascoense* (shells only) and *Megomphix lutarius*. Other mollusks collected include *Euconulus fulvus, Microphysula ingersolli*, and *Zonitoides arboreas*.

SITE 6: MILL/BRIDGE CREEK

May 9, 2016 14:26, 67-minute survey. Rain, sleet, and hail during survey. 4101 feet elevation. 54 percent slope. E aspect. Temperature: 14.7°C (air), 10°C (soil). Soil moisture: dry/moist. Light index: full sun.

The site consisted of a talus slope with shrubs and trees (currant, grand fir) at the base with abundant moss and ferns. Additional microsnails were found under rocks in shaded/forested base rocks. A stream runs downslope of the talus. SEN/STR species collected include *Radiodiscus abietum* (shells only). Other mollusks collected include *Euconulus fulvus*, *Oreohelix strigosa* (n. ssp.?), and *Zonitoides arboreas* (shells only). Note that this site was believed to occur on FS land, but the talus slope lies just west of the Forest boundary.

SITE 7: CONUNDRUM CREEK 1

May 10, 2016 09:48, 20-minute survey. 4521 feet elevation. 10 percent slope. NW aspect. Temperature: 14.2°C (air), 6°C (soil). Soil moisture: dry/moist/wet. Light index: partial shade.

We searched near the creek under rocks, debris, and logs. We also searched a small shady and rocky area adjacent to the creek. Grand fir and some herbaceous understory (calypso orchids, low-growing shrubs) were present. The site is designated old growth. No mollusks collected.

SITE 8: CONUNDRUM CREEK 2

May 10, 2016 10:15, 25-minute survey. 4521 feet elevation. 10 percent slope. NW aspect. Temperature: 14.2°C (air), 6°C (soil). Soil moisture: dry/moist/wet. Light index: partial shade.

We surveyed across the road by a culvert, where a creek continues with a small cluster of cottonwood. Snails were found under damp cottonwood litter. The site is designated old growth. SEN/STR species collected include

Pristiloma wascoense and *Radiodiscus abietum*. Other mollusks collected include *Discus whitneyi, Euconulus fulvus*, *Punctum randolphi*, and *Vitrina pellucida*.

SITE 9: SUFFERIN SMITH SPRING

May 10, 2016 11:00, 17 minute survey. 4242 feet elevation. 12 percent slope. S/SW aspect. Temperature: 12.5°C (air), 5°C (soil). Soil moisture: wet. Light index: partial shade.

The site canopy is mostly grand fir and some Douglas-fir with currant, watercress, and duckweed below. We searched under rocks <12" wide. The soil was quite moist/wet underneath a seepy hillside with a piped spring. Rocks were embedded in moss and other low-lying vegetation. The site is steep and adjacent to the road and includes a mix of boulders and smaller rocks. SEN/STR species collected include *Pristinicola hemphilli*. Other mollusks collected include *Discus whitneyi*, *Euconulus fulvus*, and *Physella* sp.

SITE 10: ROCK TALUS ROAD 67

May 10, 2016 11:47, 45 minute survey. 4318 feet elevation. 12 percent slope. N/NW aspect. Temperature: 17.8°C (air), 12°C (soil). Soil moisture: dry/moist. Light index: full sun.

The site is a rock talus slope with a stream running along the base and lots of low brushy vegetation on both sides of the stream (currant/dogwood). Snails were found but mostly consisted of shells under rocks. The slope was

steep. Surveyors also found a rubber boa. The site receives lots of exposure, and there is some soil development between rocks. The site was very moist, but the moss was very dried out. SEN/STR species collected include *Pristiloma wascoense* and *Radiodiscus abietum*. Other mollusks collected include *Discus whitneyi, Euconulus fulvus* (shells only), *Microphysula ingersolli*, and *Vitrina pellucida* (shells only).

SITE 11: ROAD 900 ROCK FACE AND ADJACENT

May 10, 2016 13:38, 42 minute survey. 4377 feet elevation. 31 percent slope. W aspect. Soil moisture: dry. Light index: partial shade.

The site is found in larch and ponderosa and fir forest and was recently burned. It included an herbaceous understory with abundant arnica. We searched the rock face and associated boulders and stones. The litter was mostly dry needles. We searched here for 12 minutes and then down the road in dry rocky outcrop of loose talus for 10 minutes. We searched several other areas alongside the road, including near small aspen grove and another rocky outcrop but everything was very dry. No mollusks collected.

SITE 12: ROAD 51075 ASPEN STAND

May 10, 2016 14:34, 10 minute survey. 3822 feet elevation. 12 percent slope. S aspect. Soil moisture: dry. Light index: partial shade.

We surveyed an aspen grove next to the road. The site was a small, wet drainage with rushes near the road. It includes an herbaceous and shrub understory. We searched rocks, logs, and litter in wet and dry areas. No mollusks collected.

SITE 13: ROAD 7746 ASPEN STAND

May 10, 2016 15:14, 24 minute survey. 4082 feet elevation. 20 percent slope. S/SW aspect. Temperature: 16°C (air), 16°C (soil). Soil moisture: dry. Light index: partial shade.

The site consists of aspen and ponderosa pine on a rocky exposed hillslope. Snail shells were found under a rock and one under log overhangs. No live mollusks observed. The road bisects the aspen stand. A long-toed salamander was found under a rock. Rose and balsamroot were present. No SEN/STR species collected. Other mollusks collected include *Euconulus fulvus* and *Vitrina pellucida* (shells only for both).

SITE 14: SPOOL CART CAMPGROUND

May 11, 2016 8:24, 31 minute survey. 3543 feet elevation. Flat. E/NE aspect. Temperature: 10.4°C (air), 9°C (soil). Soil moisture: moist/wet. Light index: partial shade.

We searched the campground adjacent to the Grande Ronde River. Ponderosa pine and Douglas-fir made up the overstory. The site was not dense and was interspersed with campsites. The understory is rose, currant, dogwood, and herbaceous plants. We searched under rocks, bark, logs, duff, and near the river. Larger snails were abundant, and we collected only a portion of the individuals found. Western pearlshell shells were also found by the Grande Ronde River. No SEN/STR species collected. Other mollusks collected include *Anguispira kochi*, *Arion silvaticus*, *Limax maximus*, *Succinea oregonensis*, and *Zonitoides arboreas.*

SITE 15: TALUS ACROSS FROM SPOOL CART CAMPGROUND

May 11, 2016 9:25, 21 minute survey. 3501 feet elevation. 28 percent slope. W/SW aspect. Temperature: 11.7°C (air), 5°C (soil). Soil moisture: moist. Light index: partial shade.

The site included a talus slope, and we searched near the bottom in the transition zone from unvegetated to mossy, shaded rocks. Dogwood, cottonwood, maple, and willow were abundant near the damp ditch. There was also a thick leaf litter layer among scattered rocks with lots of woody debris. Rocks were damp on their underside and were a mix of medium to small (fist-sized). No SEN/STR species collected. Other mollusks collected include *Anguispira kochi* and *Euconulus fulvus* (shells only for both).

SITE 16: MINE TAILINGS

May 11, 2016 10:42, 15 minute survey. 4633 feet elevation. Flat. Temperature: 18.8°C (air), 5°C (soil). Soil moisture: moist/wet. Light index: full sun/partial shade.

This site includes old mine tailings that form cobble stacks next to the road and between ponds. Underneath medium-sized (1') rocks the soil was wet, especially at the edge of the pond. Mollusks were found along the line of vegetation where the pond meets cobble. There was a small understory of sedges. We observed Columbia spotted frog. No SEN/STR species collected. Other mollusks collected include *Arion circumscriptus*, *Planorbella (Pierosoma) subcrenatum* (shells only), and *Zonitoides arboreas* (shells only).

SITE 17: FLAT ROCK SPRING

May 11, 2016 12:39, 15-minute survey. 4974 feet elevation. Flat. Temperature: 19°C (air), 14°C (soil). Soil moisture: wet. Light index: full sun.

The site included very open forest/meadow vegetation with camas, sedges, horsetail, and lomatium. Snails were found in and adjacent to a dugout pond. No snails were found upslope in a seepy area with wet vegetation. SEN/STR species collected include *Pristiloma wascoense* (shells only). Other mollusks collected include *Planorbella (Pierosoma) oregonensis*.

SITE 18: TIN TROUGH SPRING

May 11, 2016 13:35, 15-minute survey. 4856 feet elevation. 2 percent slope. Temperature: 23.3°C (air), 6°C (soil). Soil moisture: wet. Light index: partial shade.

The site consisted of a seepy slope next to a springbrook with abundant downed logs. The site was generally mossy and herbaceous, but with little deciduous vegetation. Lodgepole pine, ponderosa pine, grand fir and larch were present. The site seemed well protected from cows (fence, downed trees), which are present in the area. No SEN/STR species collected. Other mollusks collected include *Euconulus fulvus.*

SITE 19: SULLIVAN SPRING/STREAM BY ROAD

May 11, 2016 15:07, 20-minute survey. 3770 feet elevation. Flat. NW aspect. Temperature: 21.6°C (air), 6°C (soil). Soil moisture: moist/wet. Light index: partial shade.

At the spring site we collected slugs below a pipe on wet boards. The spring also consists of a seepy hillslope. The seep feeds down to rocky area below road where snails collected. There is a small riparian zone next to the main road. Currant, alder, larch, Douglas-fir, spruce, and grand fir were all present. No SEN/STR species collected. Other mollusks collected include *Anguispira kochi*, *Arion circumscriptus*, and *Deroceras panormitanum.*

SITE 20: BIRD TRACKS SPRINGS TRAIL

May 11, 2016 16:00, 35-minute survey. 3127 feet elevation. Flat. Temperature: 21.6°C (air). Soil moisture: dry/moist. Light index: full sun.

The site included a shrub thicket beside the Grande Ronde River. The cobblestone bank was adjacent to clear, fast-moving water. Aspen and willow shrubs formed a tree canopy with a sparse cottonwood overstory. Herbaceous larger grass was also present. One kind of *Zonitoides arboreas* was found under a moist log. Slugs were found under rocks and downed wood. Western pearlshell (*Margaritifera falcata*) shells were found next to the Grande Ronde River. No SEN/STR species collected. Other mollusks collected include *Arion circumscriptus*, *Deroceras reticulatum*, *Zonitoides arboreas, Physella* sp., and *Deroceras* sp.

SITE 21: CHICKEN SPRING AND ROCKY SLOPE

May 12, 2016 8:38, 15-minute survey. 5597 feet elevation. 12 percent slope. E/NE aspect. Temperature: 17.7°C (air), 2°C (soil). Soil moisture: moist. Light index: partial shade.

The canopy consisted of grand fir, Douglas-fir, larch, and maple with a very sparse understory (small currant, mostly needle litter). Scattered snow patches were found nearby and interspersed at the site. The spring is dammed into a pond with large tree trunks. We searched the litter, under bark, along rotting logs, and within occasional boulders (mossy). No mollusks collected.

SITE 22: EAST OF CHICKEN SPRING

May 12, 2016 9:09, 17-minute survey. 5597 feet elevation. Flat. E/NE aspect. Temperature: 17.7°C (air), 4°C (soil). Soil moisture: moist/wet. Light index: full sun/partial shade.

We also searched east of the road where water continues to flow. We found shells under embedded logs (1-1.5" deep). The area had diffuse flowing water, was well trampled, and had partial shade, bare ground and needle litter. SEN/STR species collected include *Pristiloma wascoense*. Other mollusks collected include *Vertigo modesta sculptilis.*

SITE 23: ROCK FIELD DOWN THE ROAD

May 12, 2016 9:43, 5-minute survey. 5545 feet elevation. 7 percent slope. W/NW aspect. Temperature: 17.7°C (air). Light index: full sun/partial shade.

The site consisted of a rocky field with damp soil from snowmelt with an open lodgepole pine canopy. The understory was bare with some grass and lilies. No mollusks collected.

SITE 24: UNNAMED SPRING

May 12, 2016 9:56, 10-minute survey. 5443 feet elevation. 5 percent slope. NW aspect. Temperature: 17.7°C (air). Light index: full sun.

We searched under rocks bordering a small pool formed by spring water. Groundcover included wild onion, lilies, grass, moss in full sun. No mollusks collected.

SITE 25: SEEP ABOVE NORTH FORK CLARK CREEK

May 12, 2016 11:30, 15-minute survey. 4180 feet elevation. 12 percent slope. W aspect. Temperature: 20.4°C (air), 6°C (soil). Soil moisture: moist/wet. Light index: partial shade.

We searched rocks interspersed in moss, dandelions, wild strawberry, grass, and fern at a seepy hillside along road 600 above North Fork Clark Creek. Ponderosa pine, grand fir formed a small overstory. Some shrubs were present above the rocky area. SEN/STR species collected include *Radiodiscus abietum*.

SITE 26: ROAD 680 CREEK

May 16, 2016 13:38, 15-minute survey. 3356 feet elevation. Flat. E aspect. Temperature: 18°C (air), 10°C (soil). Soil moisture: wet. Light index: full sun.

Rain fell about one hour earlier. The site was an open small creek with evidence of periodic flooding (debris). Some deciduous cover was present but no litter, large rocks. The site is very exposed with some ponderosa pine. We located a snail shell likely washed down from upstream. No SEN/STR species collected. Other mollusks collected include *Anguispira kochi* (shells only) and *Arion circumscriptus.*

SITE 27: ROAD 680 ROCK TALUS

May 16, 2016 13:54, 15-minute survey. 3356 feet elevation. 4 percent slope. E aspect. Temperature: 18°C (air), 12°C (soil). Soil moisture: moist. Light index: partial shade.

The site consisted of a small rocky slope near the creek along Road 680. The site was very grassy and damp but also very exposed. Some balsamroot, currant, and rose was present. No SEN/STR species collected. Other mollusks collected include *Arion silvaticus*.

SITE 28: TUCKER SPRING ROCK TALUS

May 16, 2016 16:28, 20-minute survey. 4278 feet elevation. 30 percent slope. SW aspect. Soil moisture: moist. Light index: full sun.

The site included very damp bedrock and loose rock. Cat's ear, balsamroot, lichen and moss, saxifrage, sage, delphinium, and prairie smoke were all present. We briefly looked at Tucker Spring but observed no mollusks. No mollusks collected.

SITE 29: ROAD 2135 BOULDER SLOPE

May 16, 2016 17:04, 15-minute survey. 4242 feet elevation. 27 percent slope. S/SE aspect. Temperature: 13.2°C (air), 14°C (soil). Soil moisture: moist. Light index: full sun.

Site included damp soil, many boulders and cherty rock with clumps of flowers. *P. wascoense* was found under a rock near the road. Two skinks were present under the rocks. The site had evidence of a past burn. SEN/STR species collected include *Pristiloma wascoense* (shells only).

SITE 30: FOREST WEST OF BIG ROCK SPRING

May 17, 2016 08:59, 15-minute survey. 5233 feet elevation. Flat. S/SW aspect. Temperature: 12°C (air), 6°C (soil). Soil moisture: moist. Light index: partial shade.

Site had a grand fir canopy with lots of damp downed logs, rotting litter, and large snags. The area looked like it had been cut ~30 years ago. No SEN/STR species collected. Other mollusks collected include *Anguispira kochi* and *Arion subfuscus.*

SITE 31: WILLOW THICKET WEST OF BIG ROCK SPRING

May 17, 2016 09:21, 16-minute survey. 5233 feet elevation. 15 percent slope. S/SW aspect. Temperature: 12°C (air), 6°C (soil). Soil moisture: moist. Light index: full sun.

Site was a large willow thicket with adjacent shallow ponded water. It had greater sun exposure than the surrounding area and little coniferous cover, with corn lily, spruce, and grand fir. SEN/STR species collected include *Pristiloma wascoense* and *Pristiloma idahoense*. Other mollusks collected include *Anguispira kochi*, *Euconulus fulvus*, *Punctum californicum*, and *Zonitoides arboreas.*

SITE 32: TOP OF FIDDLER'S HELL

May 17, 2016 10:09, 15-minute survey. 5000 feet elevation. 52 percent slope. W/SW aspect. Temperature: 12°C (air). Soil moisture: dry/moist. Light index: full sun.

Site consisted of damp soil with rocks mainly embedded at the top of a steep slope. Bedrock was exposed as was scattered downed wood. We searched the area above the rock face and at treeline. Mountain mahogany, abundant flowers, some ponderosa, Douglas-fir, and grand fir were all present. No mollusks collected.

SITE 33: TIE CREEK ROAD CROSSING

May 17, 2016 10:58, 20-minute survey. 5076 feet elevation. 9 percent slope. W/NW aspect. Temperature: 23°C (air), 5°C (soil). Soil moisture: moist. Light index: partial shade.

Douglas-fir, grand fir, larch, spruce, willow, currant, elderberry, and huckleberry were all present at the site. Abundant deciduous vegetation was mixed in with coniferous vegetation and lots of debris and stumps. SEN/STR species collected include *Pristiloma wascoense* (shells only). Other mollusks collected include *Anguispira kochi* (shells only), *Euconulus fulvus*, and *Punctum randolphi.*

SITE 34: GREEN MOUNTAIN ASPEN STAND

May 17, 2016 12:28, 20-minute survey. 4757 feet elevation. 4 percent slope. S/SW aspect. Temperature: 18°C (air), 7°C (soil). Soil moisture: moist. Light index: partial shade.

The site was an aspen stand with ~10 large old shoots and multi-age resprouts in direct sun. Nearby are ponderosa pine and Douglas-fir trees with many downed logs. A small spring is present nearby with low flow, possibly seasonal. There is evidence of an old fence. No SEN/STR species collected. Other mollusks collected include *Euconulus fulvus* and *Punctum minutissimum.*

SITE 35: ROAD 3112/015 SLOPE

May 17, 2016 13:53, 15-minute survey. 4442 feet elevation. 8 percent slope. S/SE aspect. Temperature: 21°C (air), 9°C (soil). Soil moisture: moist. Light index: partial shade.

Ponderosa pine, grand fir, Douglas-fir, huckleberry, rose, grass, arnica, and Oregon grape are all present at the site, which is slightly downslope from the road. The area is very shaded and cool with a thick needle layer with some herbaceous litter and moist soil. No SEN/STR species collected. Other mollusks collected include *Punctum minutissimum* and *Vitrina pellucida*.

SITE 36: LEWIS SPRING

May 17, 2016 14:58, 15-minute survey. 4613 feet elevation. 7 percent slope. S/SE aspect. Temperature: 20°C (air), 10°C (soil). Soil moisture: moist. Light index: partial shade.

The site is a developed spring with a box and trough. We surveyed downslope of trough but away from the water flow. A snail was found in ponderosa pine needles against a stick. Herbaceous vegetation was prevalent (rose, huckleberry, grass), along with grand fir, ponderosa, and Douglas-fir). Several large downed logs were scattered in a narrow draw. No SEN/STR species collected. Other mollusks collected include *Euconulus fulvus.*

SITE 37: DANIEL SPRING FLAT

May 17, 2016 15:48, 15-minute survey. 4337 feet elevation. Flat. N/NW aspect. Temperature: 20°C (air), 9°C (soil). Soil moisture: moist. Light index: full shade.

We searched below a spring south of the road. The springbrook subs out from above. The area was flat with lots of downed logs, needle litter, rocks, and was very shaded. It had a large amount of yew. Maple, huckleberry, rose, and many short herbaceous plants were present. Spruce, grand fir, and Douglas-fir formed an overstory. No SEN/STR species collected. Other mollusks collected include *Anguispira kochi.*

SITE 38: DANIEL SPRING SOURCE WETLAND

May 17, 2016 16:24, 10-minute survey. 4337 feet elevation. Flat. N/NW aspect. Temperature: 20°C (air), 9°C (soil). Soil moisture: wet. Light index: partial shade.

We surveyed the wetland/spring above the flat. It was very seepy with multiple pools of water and mini-springbrooks. It had a large herbaceous understory with some cottonwood. No mollusks collected.

SITE 39: HUGH SPRING BELOW POND

May 17, 2016 17:03, 15-minute survey. 4301 feet elevation. 13 percent slope. SW aspect. Temperature: 20°C (air), 11°C (soil). Soil moisture: moist. Light index: partial shade.

Gallium, grass, snowberry, horsetail, ponderosa pine, hawthorn, and strawberry were all present with a thick lower herbaceous layer. There is a pond above the site but the spring originates much farther upslope. No SEN/STR species collected. Other mollusks collected include *Anguispira kochi.*

SITE 40: ROAD 4305/240 ROCK TALUS

May 18, 2016 07:52, 15-minute survey. 4882 feet elevation. 43 percent slope. S/SW aspect. Soil moisture: dry/moist. Light index: partial shade.

The site consisted of a large rock talus. We searched the greenline to the east and below. There was evidence of recent fire with lots of downed burnt debris. The slope had blocky rocks with pine needle litter and very little deciduous vegetation, though some shrubs were present. Mostly grass in the understory. Larch, Douglas-fir, and ponderosa pine formed the overstory. No mollusks collected.

SITE 41: ROAD 4305 UPPER ROCK TALUS

May 18, 2016 08:26, 20-minute survey. 4734 feet elevation. 50 percent slope. W/NW aspect. Temperature: 13°C (air), 6°C (soil). Soil moisture: dry/moist. Light index: partial shade.

This rock talus is split by the road. We searched the upper portion along the road where cottonwood, larch, lodgepole, strawberry, and needle litter were all present. There is evidence of a recent burn (charred logs, litter). No SEN/STR species collected. Other mollusks collected include *Euconulus fulvus* (shell only).

SITE 42: ROAD 4305 LOWER ROCK TALUS

May 18, 2016 08:57, 13-minute survey. 4734 feet elevation. 50 percent slope. W/NW aspect. Temperature: 13.4°C (air), 6°C (soil). Soil moisture: dry/moist. Light index: partial shade.

We searched south of the road also. There was similar burn evidence. The slope was damper than above but had little herbaceous or deciduous cover. It was very mossy. No mollusks collected.

APPENDIX IV. IDENTIFICATION NOTES AND COMMENTS PROVIDED BY TOM BURKE

Megomphix lutarius — Figure 14. Found only at North Fork Indian Creek Road 85 Site 2. One live *Megomphix* and 12 shells were collected. The most likely species to be confused with *Megomphix* is *Microphysula ingersolli*, two of which (1 in good condition and 1 crushed) were found among the *Megomphix*.

The *Megomphix* were all smaller than expected, the largest being the one collected live and three of the shells. Only the four larger shells, those with more than 3½ whorls (≥ 4.75 mm wide) were measured. Mature *M. lutarius* should have about 5 to 5¼ whorls and measure 9 to 10.5 mm wide, but the largest among these were 7.9 mm wide with 4 ½ whorls indicating that they were all immature. Some of the specimens found in the NF John Day River during the 2012 Blue Mountains Surveys by The Xerces Society were even larger but were comparable per their number of whorls.

The *Microphysula* found, although of very similar shape and color, were recognized as being smaller, more tightly coiled with a more crescentic aperture, and having a relatively smaller umbilicus. The one in good condition with 5 whorls was only 4¼ mm wide. The *Megomphix* with only 4½ whorls were nearly twice as wide.

Figure 13. *Megomphix lutarius*. Photo credit Tom Burke, used with permission and republished from Appendix IV of Jepsen et al. 2012.

Pristinicola hemphilli— Subclass Eugastropoda: Prosobranch snails; gill breathers with an operculum. Family Hydrobiidae: Mostly small snails with shells higher than wide, whorled to the right. Species: Minute, somewhat fusiform shells, usually found in springs. Five specimens were found at Sufferin Smith Spring.

***Punctum*:** Three species of *Punctum* were identified among these specimens. The *Punctum*, being some of our smallest snails, and with a moderately elevated spire and very fine riblets (sometimes not visible with a 10 power lens). A very small brown shell with a moderately elevated spire and relatively large, open umbilicus indicates a probable Punctidae. *Paralaoma*, of the same family, and *Planogyra* of the Valloniidae, are similar to *Punctum* but have noticeably higher riblets as well as being slightly larger.

> ***Punctum californicum***— were identified primarily by their shell sculpture, their riblets being more solid than those of the other *Punctum*. The shell is said to be chestnut in color, which does not appear uniform on these, but the amount of weathering is variable. Because this species has not been reported from northeast Oregon before, I rechecked the shells from these two sites and arrived at the same conclusion. We also discovered a range extension for this species through northern Idaho while working with the Idaho Department of Fish and Game in 2014 [Lucid et al. 2016]. This Wallowa-Whitman location along with that in Idaho, partially fills in a gap between the population in Glacier National Park and those in California.
>
> ***Punctum minutissimum***— are slightly smaller than *P. californicum*, but this is measured in tenths of a millimeter, and the growth-stage or number of whorls needs to be taken into consideration. Better indicators are the very thin cuticular riblets with some well-spaced and slightly higher than others (not nearly as high as those of *Paralaoma*) and the light brown color of the shell.

Punctum randolphi— have shells of about the same diameter as *P. minutissimum*. Their main distinction is the height of the spire and their whorls are narrower when viewed from above. Their cuticular riblets are also finer and more uniform in height, often not distinguishable with a hand lens.

Vertigo modesta sculptilis— the only pupillid in these samples, was collected at three sites. This species was determined by its varied dental formulas, mostly 1-1-1, only one of the 8 adult specimens having more than a single palatal tooth. The three immature specimens were assumed to be the same species as the adults with which they were found.

The single snail from East of Chicken Spring with a 2-1-2 dental formula could be *Vertigo modesta parietalis* or *V. concinnula*. However, on reexamining the shells from that site, I found that they were all of similar color and shape, and the apertural teeth of the specimen in question were weak by comparison with these other species, leading me to conclude that it is the same species as the others with which it was found.

Fossaria modicella— Subclass Pulmonata: Air-breathing snails; no operculum. Family Lymnaeidae: Shells higher than wide, whorled to the right. The only specimen was collected from Clark Creek 1.

Planorbella* (*Pierosoma*) *oregonensis— Subclass Pulmonata: Air-breathing snails; no operculum. Family Planorbidae – Shells wider than high, often whorled in a single plane (discoidal). From the keys in Burch (1982), the shells of all three samples [Flat Rock Spring, Mine Tailings, Spring Creek at Road 21] fit the description of genus *Planorbella*, and all have the raised transverse thread-like lirae of subgenus *Pierosoma*. The three larger shells from Mine Tailings measuring 22.96 mm wide by 11.06 high in a little over 4 whorls, key out to ***Planorbella (Pierosoma) subcrenata*, s**ynonym: *Helisoma (Pierosoma) trivolvis subcrenata* of Clarke (1981).

However, the specimens from Flat Rock Spring are much smaller, although, they have about 5 whorls, measuring 14.19 mm wide by 6.36 high. Some appear to be immature, while the largest two are mature. From Burch's keys, (although they are a little large but also have an extra whorl), this would be ***Planorbella* (*Pierosoma*) *oregonensis*** (Tryon, 1865): Small, shells w/~4 whorls, about 10 mm wide; from SE Oregon and NW Utah. H/D = .45; 2xH = 12.19 No illustration available.

Five other Possible Species from Burch (1980 and 1982), and Clarke (1981) are listed below. Underlined phrases indicate why the specimens 024 and 025 were not considered those species:

Helisoma anceps (Menke, 1830) ≤ 20mm x 12mm high in 4 ½ whorls. <u>Carinate top and bottom</u>.

Burch (1982) in endnote 92 explains relationships between the species of the *P*. (*P*.) *ammon* group, including: *P. ammon*, *P. binneyi*, *P. columbiensis*, *P. oregonensis*, and *P. traski*.

Planorbella (*Pierosoma*) *trivolvis ammon* ≥ 12mm; <u>greatest width < 2x greatest height</u>. <u>From Colorado or California.</u>

Planorbella (*Pierosoma*) *trivolvis binneyi* (Tryon, 1867) 20.5mm x 22.7mm high, <u>carinate on underside of whorls</u>. <u>H/D ratio > .57</u> California to British Columbia and Alberta.

Planorbella (*Pierosoma*) *columbiense* (F. C. Baker, 1945) <u>Known from farther north in BC.</u>

Planorbella (*Pierosoma*) *traski* (Lea, 1856) <u>West central and southern California</u>.

Slugs— Slugs found are of 7 species belonging to only 3 genera. Of the seven, only one, *Deroceras leave*, is native to North America. While the *Arion* are generally abundant, all of that genus are exotic. The genus can be recognized by its pneumostome being in the anterior half of the mantle, and it has a caudal mucous pit. They also lack any keel on the back behind the mantle. *Deroceras* and *Limax* are similar to each other in that their pneumostomes are in the back half of the mantle, they have no caudal mucous pit, they are more or less keeled behind the mantle, and the mantle is concentrically wrinkled resembling a fingerprint. Other slugs have similar characteristics in other combinations, but here I am only describing those found among these samples.

Whether or not the sole of the slug is tripartite (divided into three longitudinal sections) is also useful in identifying the genus as indicated in the following Table A-IV-1. However, that characteristic is not always obvious.

Once the genus is determined, the color and markings will help to recognize the species. Size of the adult is an important indicator, but many times only immature or juvenile specimens are all that are available with no way of knowing whether or not they are adult. The one *Limax maximus* was a juvenile. Although, a large slug as an adult, it could be recognized by its typical markings of horizontal black lines, either solid stripes or rows of dots or dashes. Its keel is also relatively long and low while *Deroceras* has a short, sharp keel at the tip of the tail.

Table A-IV-1. Soles of some Pacific Northwest slugs. Note that this characteristic still needs to be determined for some species.

Tripartite Soles	Undivided Soles
Superfamily Limacoidea: *Limax* *Deroceras* *Milax*	
Superfamily Arionoidea: *Arion rufus* (appears tripartite) *Arion subfuscus* (scarcely so)	Superfamily Arionoidea: *Arion distinctus* (not visibly tripartite) *Arion circumscriptus* (in alcohol mid-area is sunken and sides transversely wrinkled) *Arion silvaticus*
Hesperarion (indistinctly) *Zacoleus* *Udosarx*	*Ariolimax* (indistinctly or not noticeably) *Prophysaon* *Hemphillia*

Deroceras species are relatively small, 15 to 50 mm long. The three found during this survey are the ones most likely in the PNW. *Deroceras reticulatum* (3 to 5 cm) and *D. panormitanum* (about 3 cm), both exotics, are the larger ones. *D. reticulatum* is dark gray to buff to whitish, usually with darker gray or black irregular flecks on the mantle and tail. *D. panormitanum* is similar in appearance but is brown with a lighter colored mantle and may be speckled with fine blackish spots. *D. leave*, our native *Deroceras*, is smaller, and is varying shades of amber, to brown, to black; the mantle is generally the same color as the back or tail, except posteriorly where it may be somewhat lighter over the shell.

The *Arion* found are of the smaller ones, and all of these species have a dark dorsal-lateral band beginning near the anterior end of the mantle and running along each side and around the tail. Since most are immature, the size of these wasn't indicative of the species. *Arion circumscriptus* is brown to dark gray with irregular dark flecks dorsally on the mantle and tail. *Arion subfuscus* may be light reddish to dark gray or brown dorsally, much lighter below the band. It may have a tripartite sole, and its mucus is orange which may give the animal, especially the foot, an orange tint. *Arion silvaticus* is smaller, and is light gray dorsally, but quite white laterally below the band and on its sole.