

# SURVEYS TO DETERMINE THE STATUS OF THE NORTHERN FORESTFLY (*LEDNIA BOREALIS*) AND RAINIER ROACHFLY (*SOLIPERLA FENDERI*) ON THE OKANOGAN-WENATCHEE AND GIFFORD PINCHOT NATIONAL FORESTS OF WASHINGTON: YEAR 2

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**Alpine creek near Rampart Lakes in the Alpine Lakes Wilderness, Okanogan-Wenatchee National Forest, WA**

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## ABSTRACT

The northern forestfly (*Lednia borealis*) and Rainier roachfly (*Soliperla fenderi*) are both rare endemic stonefly species restricted to montane areas of Washington State. In August 2016, Xerces Society biologists surveyed potential habitat for these species on the Okanogan-Wenatchee and Gifford Pinchot National Forests, focusing on mid to high elevation glacial-fed lakes, ponds, and streams; montane seeps and springs; and first order rheocrenes. Much of this habitat was remote and only accessible by hiking trails. Surveyors spent 140 person-hours (7 days) traveling to and surveying sites; this effort included hiking over 50 trail miles and climbing over 10,500 feet in elevation. Despite visiting ten sites comprised of potential *Lednia* habitat, no northern forestflies were collected or observed during the course of this survey effort. Twenty *Soliperla* sp. specimens were collected from nine sites on the Gifford Pinchot National Forest in the Goat Rocks and Tatoosh Lakes Wildernesses and on the Okanogan-Wenatchee National Forest near Snoqualmie Pass. However, no adult males were collected, and because positive identification depends upon male genitalia, the species identity of these collections remain unknown. Currently, two species of *Soliperla* are known from Washington, including *S. fenderi* (known only from Mt. Rainier National Park) and *S. cowlitz* (known from several locations on or near the Gifford Pinchot National Forest).

We achieved all major goals of this project, including:

- Map potential suitable habitat for *L. borealis* and *S. fenderi* and identify priority survey areas,
- Revisit sites in the Goat Rocks Wilderness that were occupied by *Soliperla* sp. during the 2015 field season (see Fallon & Blevins 2015) and attempt to catch adults for positive species identification,
- Survey Gifford Pinchot National Forest lands to the south of Mt. Rainier National Park, especially in the Tatoosh Lakes area. We were unable to search this region in 2015 due to time constraints and wildfire hazards,
- Survey additional sites with appropriate suitable habitat on the target forests,
- Record all data including documenting where surveys were conducted,
- Write a complete report that includes detailed maps of areas surveyed for these two species.

We recommend continued survey efforts for adult *Soliperla* in both the Okanogan-Wenatchee and Gifford Pinchot National Forests. In particular, we suggest surveyors prioritize revisiting known *Soliperla* sp. sites that Xerces biologists documented in 2015 and 2016. Collection of adult males will provide more information about which *Soliperla* species inhabit these forests. If they are in fact *S. fenderi* (S1S2) or *S. cowlitz* (S1S2), these new populations will greatly expand the current known range of these species (see Figure 3). If repeat surveys to known *Soliperla* sites are not possible and genetic markers become available, we recommend DNA analyses of these specimens collected in 2015 and 2016 to identify them to species. Although we were unsuccessful in finding any *Lednia* species over two years of search efforts, we believe it is still possible this species may be found in

appropriate habitat in the Okanogan-Wenatchee National Forest. *Lednia* species in general are rare or rarely collected, and our short survey window and geographically restricted searches are far from comprehensive. Future search efforts for *L. borealis* could focus on the Glacier Peak Wilderness. Glacier Peak has more active glaciers than any other place in the lower 48 states (USFS 2016), and may well provide the necessary habitat for *L. borealis*. We did not survey this region in 2016 due to the limited time available and distance from other survey sites. In addition, the Colchuck Lake *L. borealis* site in the Alpine Lakes Wilderness (Giersch 2015, pers. comm.) could be revisited to confirm whether an extant population occurs here.

## INTRODUCTION

The purpose of this project was to identify and survey potential habitat and determine whether two species of rare stoneflies (*Lednia borealis* and *Soliperla fenderi*) occur in suitable habitat within USFS lands in Washington. *Lednia borealis* is documented on the Mt. Baker-Snoqualmie National Forest at Upper Bagley Lake (Baumann & Kondratieff 2010; Jordan 2013a; see Fig. 1), and may occur on the Okanogan-Wenatchee National Forest at Colchuck Lake (Giersch 2015, pers. comm.; see Fig. 1). It is suspected on the Gifford Pinchot National Forest (ISSSSP 2015). *Soliperla fenderi* is only known from Mt. Rainier National Park but is suspected from the adjacent Okanogan-Wenatchee and Gifford Pinchot National Forests (Jordan 2013b; ISSSSP 2015).

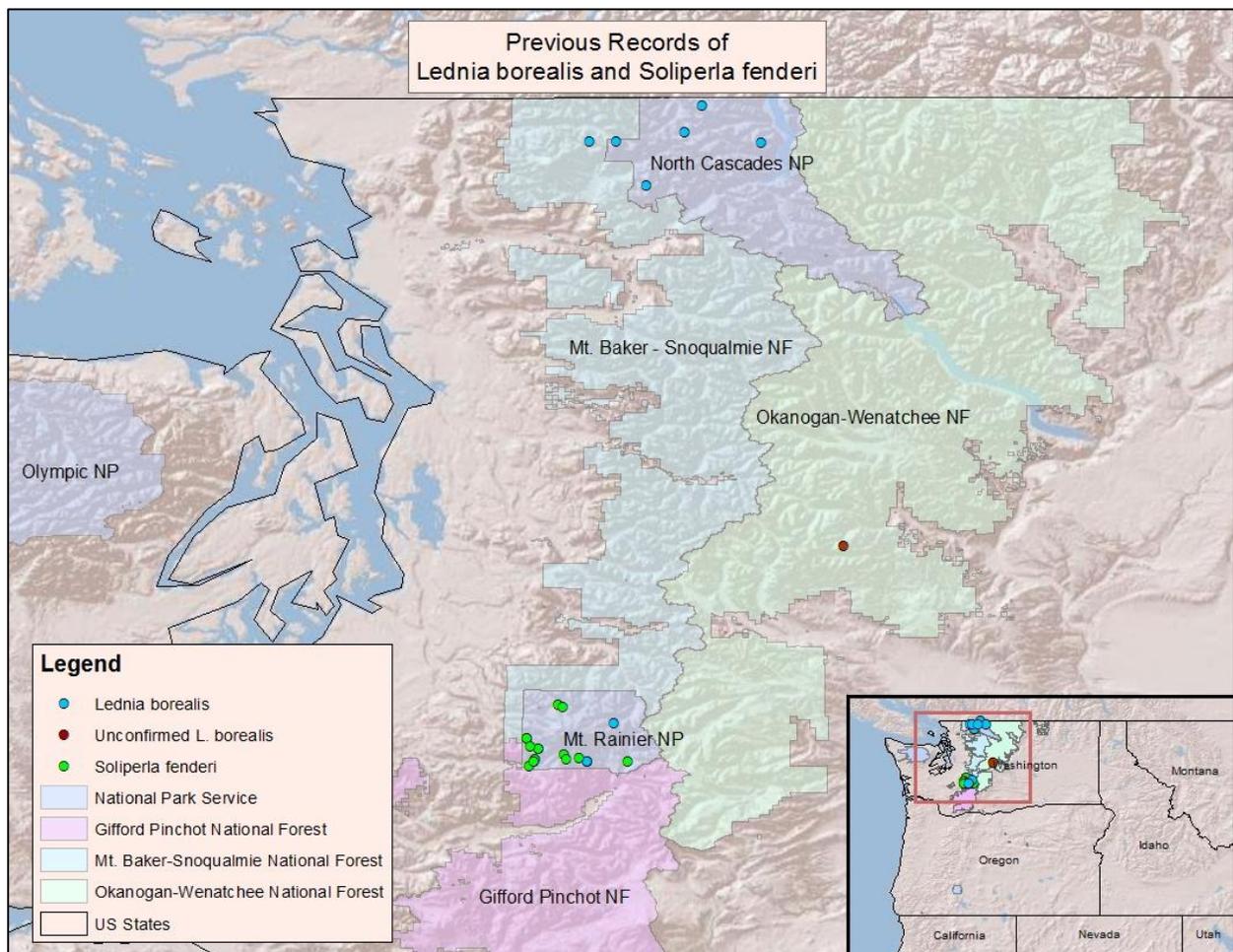


Figure 1: Map of previous known records of *Lednia borealis* and *Soliperla fenderi* in Washington

## LEDNIA BOREALIS

The northern forestfly, *Lednia borealis*, is a Washington state endemic known only from high elevation cold water habitat, including lakes, glacial-fed streams, and first order rheocrenes (channeled springs) in the Cascades, including Mt. Rainier and North Cascades National Parks and the Mt. Baker-Snoqualmie National Forest (Jordan 2013a; WDFW 2015). The species was described from specimens originally identified as *L. tumana*, a species now understood to occur only in Montana and Alberta, Canada (Baumann & Kondratieff 2010; Giersch et al. 2016). The earliest known record for *L. borealis* in Washington is from Upper Bagley Lake (Whatcom County) in Mt. Baker National Forest in 1987. Since then it has been described from just seven other sites in three counties: Frylingpan Creek in Pierce County; Redoubt Lake, Nert Lake, No Name Lake, Price Lake, and Middle Tapto Lake in Whatcom County; and Snow Lake in Lewis County (see Appendix I). In addition, this species was observed in 2013 at Colchuck Lake in Chelan County, although no collections were made (Giersch 2015, pers. comm.). Despite seven years of relatively intense stonefly collecting in Mt. Rainier National Park, this species was represented by only one collection in Kondratieff and Lechleitner's 2002 study. It appears to be more widespread in the North Cascades, although Baumann and Kondratieff (2010) note it could occur in the southern Cascade Range in Oregon and northern California. It is suspected on the Gifford Pinchot and Okanogan-Wenatchee National Forests (Jordan 2013a; ISSSP 2015).

*Lednia borealis* has not yet been ranked by NatureServe; however, it is still listed under its previous name of *L. tumana*, where it is given a state rank of S1 (critically imperiled) and a global rank of G1G2 (NatureServe 2015). The Washington Natural Heritage Program gives it a state rank of SNR (WNHP 2016). Adults of the northern forestfly are described as 5 to 7.5 mm long with dark brown body color and hyaline wings with darker veins near the cord (Baumann & Kondratieff 2010). Nymphs can reach 4.5 to 6.5 mm and have tiny light colored spines on their legs (Baumann & Kondratieff 2010). A distinguishing characteristic for *Lednia* nymphs is the absence of gills, which can make identification of the genus somewhat easier in the field (Baumann & Kondratieff 2010; Giersch 2015, pers. comm.). Past records for *L. borealis* indicate that adults are active from mid-July through mid-September. Little is known about *L. borealis* feeding habits, although most species in the Nemouridae family are shredders or collector-gatherers and use a variety of coarse plant materials (Merritt & Cummins 1996).

## SOLIPERLA FENDERI

The Rainier roachfly, *Soliperla fenderi*, was first recorded from St. Andrews Creek, Mt. Rainier National Park, in 1953 and is now known from about 15 occurrences throughout the park in Pierce County, Washington (Jordan 2013b) (see Appendix I). All known occurrences fall within Mt. Rainier National Park (Kondratieff & Lechleitner 2002; Kondratieff et al. 2006). It is suspected to occur on the Mt. Baker-Snoqualmie and Gifford Pinchot National Forests, based on close proximity to these known records. *Soliperla* from the Mt. Adams area were originally thought to be *S. fenderi* but have since been reclassified as a new species, *S. cowlitz* (Stark & Gustafson 2004).

*S. fenderi* has a global rank of G2 (imperiled) and a S1S2 rank in Washington (WNHP 2016; NatureServe 2015). Adults and nymphs of *Soliperla* are unusual in that they display distinctive pigmentation patterns, with adults typified by a dark mesal pronotal stripe that contrasts sharply with the yellow background, and nymphs having conspicuous white areas on the abdominal terga that contrast with the dark background (Stark 1983). Adults have been collected from mid-June through mid-August (see Appendix I). Data on feeding habits and habitat needs are minimal, but this species is known to occur in spring-fed seeps and streams (rheocrenes) draining mostly on the west side of Mt. Rainier National Park (Jordan 2013b). There is also a single record from a waterfall (Jordan 2013b).

In general, most *Soliperla* species utilize specialized habitats such as seeps and splash zones of small streams (Stark & Gustafson 2004).

## METHODS

### SITE SELECTION

Potential habitat for these stoneflies on USFS lands was first determined by mapping known locations in ESRI ArcMap 10.4. Forest Service land ownership boundaries were overlaid with a National Hydrography Dataset (NHD) layer and a US Glacier Database (PSU 2005) layer for Washington State. All four layers (known locations, land ownership, hydrography dataset, and glacier layer) were converted to KML files and imported to Google Earth, which were used to select potential sites for surveys. For potential *Lednia borealis* sites, the time lapse Historical Imagery feature on Google Earth was used to determine which areas were most likely to be influenced by year-round snow (a method suggested by Giersch 2015).

For *L. borealis*, we selected sites that are influenced by year-round snowpack, glaciers, or ice masses, including glacial-fed creeks, streams, and alpine lakes. This species has been observed in locations ranging from 1150-1750 m elevation and has been collected from springs draining into alpine lakes as well as glacial-fed streams. This genus needs permanent, cold water (Giersch 2015, pers. comm.). *Soliperla fenderi* has been observed at sites ranging from 650-1500 m elevation and is known to occur in spring-fed seeps and streams, including rheocrenes. Seeps and small streams with small cascades were targeted for *Soliperla*. Overall, our sites ranged from approximately 740 to 2030 m elevation.

In order to cover a broad geographic range, we surveyed both high elevation sites, where access was difficult, and mid-elevation sites close to the road or along short hiking trails, targeting *Soliperla* (which is known from elevations beginning at 650 meters). In two cases, we backpacked overnight in order to sample a larger number of sites in high elevation backcountry.

### SURVEY PERIOD

At the time of survey planning, all known records of *Lednia borealis* adults were from late July through early September, and *Soliperla fenderi* records were from late June through mid-August. Adults of the closely related *L. tumana* in Montana are thought to emerge in August once daytime water temperatures reach 10°C (50°F) (NatureServe 2015; Treanor et al. 2013). We timed our Goat Rocks surveys to occur slightly earlier than in 2015 to increase our chances of finding *Soliperla* adults. We again opted for late August to conduct surveys focused on *L. borealis*. This also helped minimize exposure to potentially dangerous early-season stream crossings in the mountains. Although we targeted each species at slightly different times of the month, we searched appropriate habitat for either species if we came across it.

### SAMPLING METHODOLOGY

All sites were surveyed by Xerces conservation biologists using standard recommended survey techniques for stoneflies, outlined by Jordan (2011). Stream, lake, and seep habitats were surveyed by overturning rocks, looking through the substrate, and sweep-netting and/or beating adjacent vegetation (when present). We spent a minimum of 20 person-minutes searching each site for our target species.

At each site, we recorded the waterbody name, locality information, water temperature, substrate type(s), water depth, stream width, canopy cover, and streamside vegetation. Site coordinates were recorded using a Garmin Rino 120 GPS unit (NAD83). Immature specimens were collected with forceps and placed in plastic screw-cap vials containing 95% ethanol as a preservative. Adults were collected from sweep nets or with forceps and preserved the same way. Surveys took place between 7:30AM and 6:00PM. The weather during the survey period was dry and calm, with variable cloud cover. Daytime temperatures ranged from 12 to 26° C (54 to 79° F).

## 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. Elevations were determined from site coordinates using Montana State University’s Graphical Locator (<http://www.esg.montana.edu/gl/index.html>). All material collected for this project were identified by aquatic macroinvertebrate taxa experts Robert Wisseman (Aquatic Biology Associates, Inc.), Jon Lee (Jon Lee Consulting, CA), and David Ruitter (independent contractor). *Soliperla* sp. collections will be deposited at the Oregon State Arthropod Collection in Corvallis, Oregon.

## RESULTS

One hundred and forty person-hours were spent traveling to and surveying 28 sites (see list of sites in Appendix II, maps in Appendix III, and habitat descriptions and photos in Appendix IV).

Surveyors collected 158 aquatic invertebrate specimens representing 20 families, 31 genera, and at least 34 species (Appendix V). Of these, 67 specimens could not be identified to species. No *Lednia* stoneflies were collected during this survey effort. Nineteen *Soliperla* larvae and a single adult female were collected from nine sites in the Gifford Pinchot and Okanogan-Wenatchee National Forests (Table 1), but only adult males of this genus can be identified to species. The majority of *Soliperla* larvae were collected from seeps or small creeks in splash zones. The single adult female was collected by sweep netting vegetation adjacent to an alpine creek. All *Soliperla* were collected between 798 and 2,034 m (2,618 and 6,673 ft.) elevation and in water temperatures ranging from 4.5 to 16°C (40 to 61°F).

Table 1: *Soliperla* collection sites in 2016. Sites in bold were originally discovered in 2015 and revisited by Xerces staff in 2016.

Date	Species	Site Name	Locality	County	Habitat
10 Aug 2016	<i>Soliperla</i> sp.	<b>Goat Rocks 2</b>	Goat Rocks Wilderness, Gifford Pinchot NF	Lewis	Perennial stream
10 Aug 2016	<i>Soliperla</i> sp.	<b>Goat Rocks 3</b>	Goat Rocks Wilderness, Gifford Pinchot NF	Lewis	Hillside seep
10 Aug 2016	<i>Soliperla</i> sp.	<b>Goat Rocks 4</b>	Goat Rocks Wilderness, Gifford Pinchot NF	Lewis	Hillside seep
10 Aug 2016	<i>Soliperla</i> sp.	<b>Goat Rocks 5</b>	Goat Rocks Wilderness, Gifford Pinchot NF	Lewis	Perennial stream
11 Aug 2016	<i>Soliperla</i> sp.	<b>Goat Rocks 6</b>	Goat Rocks Wilderness, Gifford Pinchot NF	Lewis	Hillside seep
12 Aug 2016	<i>Soliperla</i> sp.	Tatoosh Lakes 1	Goat Rocks Wilderness, Gifford Pinchot NF	Lewis	Intermittent creek
12 Aug 2016	<i>Soliperla</i> sp.	Unnamed Creek 2	Goat Rocks Wilderness, Gifford Pinchot NF	Lewis	Intermittent creek

Date	Species	Site Name	Locality	County	Habitat
25 Aug 2016	<i>Soliperla</i> sp.	Mirror Lakes 2	Okanogan-Wenatchee NF	Kittitas	Perennial stream
25 Aug 2016	<i>Soliperla</i> sp.	Mirror Lakes 5	Okanogan-Wenatchee NF	Kittitas	Perennial stream

No other sensitive or strategic species were encountered and the majority of the species we collected (n=32) are common, widespread species with globally secure populations. The remaining two, *Isoperla sordida* and *Frissonia picticeps*, have been assessed as vulnerable (G3G4/N2 and G3/N3, respectively) on NatureServe (2015). Neither have been ranked in Washington (WNHP 2015), although both species have been documented at sites in the state, including at Mt. Rainier National Park (Kondratieff & Lechleitner 2002). *I. sordida* is only known from three to four dozen occurrences, and many of the sites in which it occurs are being impacted by logging and water diversions (NatureServe 2015). We collected one adult male of this species from Lemah Creek at the inlet to Pete Lake on the Okanogan-Wenatchee National Forest. *F. picticeps* is known from about 20 occurrences in the West and is rarely collected (NatureServe 2015). It usually occurs in high gradient pristine streams (NatureServe 2015). We collected one larva of this species in an unnamed stream near Mirror Lake in the Okanogan-Wenatchee National Forest.

Of the non-target species that we collected, several have been documented by other researchers to co-occur with our two target species (Tables 2 and 3). Given the relatively widespread distribution of most of these species, however, it is difficult to say whether or not they could be used as indicators of target species' occurrence.

**Table 2: Stonefly species collected during our 2016 survey effort that are known to co-occur with *Soliperla fenderi* (based on Kondratieff & Lechleitner 2002). The third column notes whether or not we found *Soliperla* sp. at these sites. OKW = Okanogan-Wenatchee National Forest. GIP = Gifford Pinchot National Forest.**

Species	2016 Survey Site	Co-occurred w/ <i>Soliperla</i> sp. in 2016?
<i>Isoperla sordida</i>	Lemah Creek at inlet to Pete Lake (OKW).	No
<i>Malenka cornuta</i>	Stream along FS Rd 5270 (GIP).	Yes
<i>Moselia infuscata</i>	Hillside seep along Lily Basin trail (GIP).	Yes
<i>Sweltsa exquisita</i>	Lemah Creek (OKW).	No
<i>Sweltsa revelstoka</i>	Large seepy hillside along trail (GIP).	Yes
<i>Yoraperla siletz</i>	Stream along Snowgrass Basin trail (GIP).	Yes
<i>Zapada frigida</i>	Outlet creek from lower Tatoosh Lake (GIP).	No

**Table 3: Stonefly and caddisfly species collected during our 2016 survey effort that are known to co-occur with *Lednia borealis* (based on \*Kondratieff & Lechleitner 2002; \*\*Kubo et al. 2012). The third column notes whether or not we found *Lednia* sp. at these sites. OKW = Okanogan-Wenatchee National Forest.**

Species	2016 Survey Site	Co-occurred with <i>Lednia</i> sp. in 2016?
<i>Neothremma didactyla</i> **	Hillside seep along the trail to Spectacle Lake (OKW).	No
<i>Sweltsa exquisita</i> *	Lemah Creek (OKW).	No
<i>Zapada columbiana</i> **	Lemah Creek at inlet to Pete Lake (OKW).	No

## DISCUSSION

Although 2015/2016 surveys have not confirmed the presence of the two target species, we consider it likely that these species may be found with additional searches and increased survey efforts. *Soliperla* appears to be relatively widespread in the Gifford Pinchot National Forest and populations at higher elevations may be those of

our target species, *S. fenderi*. Although we have not encountered any *Lednia* species during our survey efforts, members of this genus are rarely collected and are often associated with remote alpine locations that are difficult to survey. Suitable habitat exists for *L. borealis* in other areas of the state, particularly in the Glacier Peak Wilderness.

Traditional survey methods for stoneflies are easy, inexpensive, and require little specialized equipment, although confirmation of species identity requires an expert and may require collection of adult specimens for positive species identification (as is the case with *Soliperla*). Successful surveys for both of these species may require multiple search attempts over the entire known adult emergence period. For example, Fallon et al. (2016) were successful in finding rare caddisfly and stonefly species in Oregon's Columbia River Gorge by visiting appropriate habitat multiple times (2-3 days a month) over a five-month period.

For rare species such as *Lednia borealis* that are difficult to detect, land managers could also consider novel approaches such as the use of environmental DNA (eDNA), a molecular approach to detecting organisms based on collection of DNA from their habitats. While most aquatic applications to date have involved fish or amphibians, several recent studies have shown promise using this technique with invertebrates (Thomsen et al. 2012, Goldberg et al. 2013, Mächler et al. 2014, Deiner et al. 2016). Most notably, Mächler et al. (2014) recently compared eDNA surveillance methods with conventional kick-netting and found that a rare mayfly species (*Baetis buceratus*) was not only detected by both methods at all sites where it was found, but was also detected by eDNA methods at two sites where it was not detected by the kick-net method. More research is needed to fully evaluate the use and benefits of eDNA in monitoring and detecting rare macroinvertebrates, but in its early stages it shows potential for helping researchers overcome survey limitations posed by species that are rare or found in low densities. However, because this method can detect DNA from upstream locations, traditional survey methods may still be needed to identify localized populations for the time being.

## LEDNIA BOREALIS

We recommend continued search efforts for *Lednia borealis* in the Okanogan-Wenatchee National Forest. Although we were unsuccessful in finding any *Lednia* species over two years of search efforts (see also Fallon & Blevins 2015), we believe it is still possible this species may be found in appropriate habitat. Many of the unique habitats needed by *Lednia borealis* are restricted to high alpine or more remote areas within wilderness areas of national forests and are not easily accessible, which limits the number of sites that can be surveyed each day, as well as the amount of time spent surveying each site. *Lednia* species in general are rare or rarely collected, and our short survey window and geographically restricted searches are far from comprehensive.

Until 2010, *Lednia* was considered a monotypic genus. Now, four species have been described from high elevation areas of the western United States: *L. tumana*, *L. borealis*, *L. sierra*, and *L. tetonica* (Baumann & Kondratieff 2010; Baumann & Call 2012). All four species appear to be rare or at least rarely collected. In the case of *L. tetonica*, specimens were found only after years of surveys, highlighting the fact that a lack of detection data does not necessarily mean species absence. Similarly, in seven years of relatively intense stonefly collecting in Mt. Rainier National Park, *Lednia borealis* was represented by only one collection in Kondratieff and Lechleitner's 2002 study. The originally described species, *Lednia tumana*, is known from Glacier National Park, Flathead National Forest, and the Mission Mountain Tribal Wilderness (all in MT) and Waterton Lakes National Park in Alberta, Canada (Baumann & Kondratieff 2010; Giersch et al. 2016). This glacier-dependent stonefly was recently proposed for listing as a threatened species under the Endangered Species Act (USFWS 2016). The fourth species in this genus, *Lednia sierra*, is known only from alpine habitat in California's Sierra Nevada (Baumann & Kondratieff 2010). Yet despite their apparent rarity, these somewhat disjunct populations of *Lednia* suggest that the genus may be more

widespread than currently known. Additional surveys in remote, backcountry alpine habitats are needed to determine the distribution, population trends, and conservation needs of this group of stoneflies.

In Washington State, the most abundant appropriate habitat for *L. borealis* may be located in the North Cascades. Additional potential habitat also occurs in the Goat Rocks Wilderness, Alpine Lakes Wilderness, and Mt. Adams Wilderness. In the Goat Rocks, most glaciers and permanent ice and snow features are located on the northern slopes of the ridgelines on the Okanogan-Wenatchee National Forest, where trails are minimal and access is difficult or requires multiple days in the backcountry. Surveys in the Mt. Adams Wilderness may also require off-trail travel to search the most appropriate habitats for this species. Fallon and Blevins (2015) were unsuccessful in confirming the one *L. borealis* observation at Colchuck Lake in the Alpine Lakes Wilderness (Giersch 2015, pers. comm.). This site could be revisited to confirm whether an extant population occurs here. The Glacier Peak Wilderness looks particularly promising for future surveys. Glacier Peak has more active glaciers than any other place in the lower 48 states (USFS 2016), and may well provide the necessary habitat for *Lednia borealis*. We did not survey this area in 2016 given our short survey window and the amount of travel that would be required (both by vehicle and on foot).

### SOLIPERLA FENDERI

We recommend continued survey efforts for adult *Soliperla* in both the Okanogan-Wenatchee and Gifford Pinchot National Forests. In particular, we suggest surveyors prioritize revisiting *Soliperla* sites documented by Xerces biologists in 2015 and 2016 (this report and Fallon & Blevins 2016). Survey protocols could include targeting these sites multiple times over the entire adult emergence period to ensure adult males are encountered. Collection of adult males will provide more information about which *Soliperla* species inhabit these forests.

There are currently two *Soliperla* species described from Washington: *S. fenderi* (known only from Mt. Rainier National Park) and *S. cowlitz* (see Stark & Gustafson 2004; Stark 2015, pers. comm.). It is unclear which species our collections may represent, or if they would be a new species altogether. If our collections are in fact *S. fenderi* (S1S2) or *S. cowlitz* (S1S2), these new populations will greatly expand the current known range of these species (see Figure 3). *S. cowlitz* has been collected from lower elevation sites ranging from approximately 60-700 m elevation, whereas *S. fenderi* is mostly known from mid-elevation sites (most records appear to be within 650-1500 m elevation). Our *Soliperla* sp. collections come from even higher elevations, ranging from 1430 to over 2000 m (with two collections found around 790 m elevation). See Appendix VI for all known *Soliperla* spp. collections in Washington. If repeat search efforts to known *Soliperla* sites are not possible, we suggest confirming species identification of the twenty specimens collected during this survey effort with genetic analyses, once genetic markers become available. Although limited barcoding has been done for this genus, the *Soliperla campanula* COI gene was used in a recent outgroup analysis of *Sierraperla* (see Stark et al. 2015), and work by other researchers may be forthcoming.

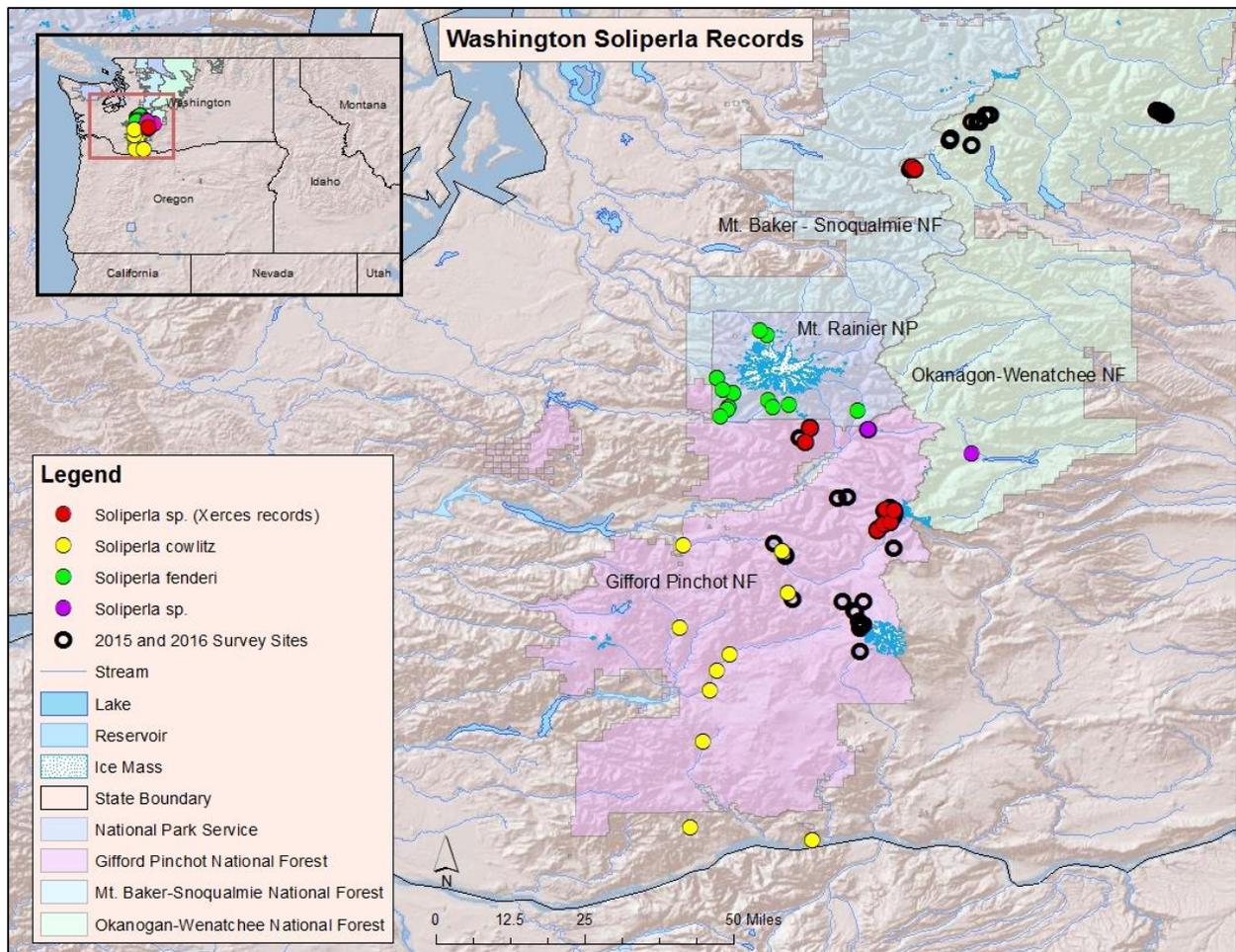


Figure 2: Known *Soliperla* records in Washington State. The red *Soliperla* sp. records are from 2015 and 2016 Xerces surveys in the Goat Rocks and Tatoosh Lakes Wildernesses on the Gifford Pinchot National Forest and the Snoqualmie Pass area on the Okanogan-Wenatchee National Forest.

## STONEFLY CONSERVATION

From a conservation standpoint, the largest threats to both of these species is lack of data on population status and distribution, and potential for habitat to disappear due to climate change and severe weather events (WDFW 2015). Land managers can help these species by determining their distribution and population statuses and monitoring species-specific habitats, including montane seeps and springs, glacial-fed streams, and alpine lakes (WDFW 2015). Further documentation of these species' ranges and habitats is especially critical for advancing understanding of their statuses and taking the appropriate conservation measures.

Alpine habitats in particular are generally under-surveyed, and alpine species are especially vulnerable to climate change and can serve as bioindicators of ecosystem function and health. Assessments by the Washington Department of Fish and Wildlife have determined that *Lednia borealis* has a high climate vulnerability ranking, and *S. fenderi* has a ranking of moderate to high (WDFW 2015). Muhlfeld et al. (2011) found that that future projected distribution of another range-restricted endemic stonefly, *L. tumana*, was shown to contract dramatically (losing over 80% of its potential current range) under future glacier and perennial snowfield loss due to projected warming trends. This species has recently been recommended for listing as a threatened species under the

Endangered Species Act (ESA) due to climate change-induced habitat loss (USFWS 2016). Similarly, populations of the rare endemic stonefly *Zapada glacier* appear to have contracted and declined over the past several decades due to increasing water temperatures and decreasing glacial masses (Giersch et al. 2015). *Z. glacier* has also recently been proposed for listing as a threatened species under ESA (USFWS 2016). Plecoptera in general have low dispersal abilities (Petersen et al. 1999; Brown et al. 2009) and for alpine species such as *L. borealis*, distributional shifts or dispersal to other suitable habitats is probably unlikely given their location. With glaciers receding and Washington Cascades snowpack levels decreasing in recent years, populations of both of these species are likely to suffer due to limited suitable habitat. The seep and spring habitats where *Soliperla* are sometimes found can also be particularly vulnerable to natural disturbances and should be monitored. In particular, the construction of roads, ditches, or rights-of-way that interfere with water flow in seep and stream habitats can be especially damaging to this species. Recreational use in the form of backpacking, camping, and hiking may also have negative impacts on this species, particularly in popular high alpine areas such as the Goat Rocks Wilderness, where fragile seep and spring habitats with documented *Soliperla* presence often overlap with hiking trails.

## ACKNOWLEDGEMENTS

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## APPENDIX I: PRIOR TARGET SPECIES RECORDS IN WASHINGTON

### LEDNIA BOREALIS

Location	County	State	UTM_E (NAD83)	UTM_N (NAD83)	L_Zone	Loc_Acc	Land_ Owner	BLM_ NF	Elev (m)	Date
Colchuck Lake, Alpine Lakes Wilderness, Okanogan-Wenatchee NF*	Chelan	WA	663277.8	5261597.6	10	MAN6	USFS	OKW	1700	17 Aug 2013
spring source Snow Lake, Snow Lake Basin, Mount Rainier National Park	Lewis	WA	599241.5	5178904.3	10	GPS	NPS		1430	8 Sep 2010
spring source Snow Lake, Snow Lake Basin, Mount Rainier National Park	Lewis	WA	599241.5	5178904.3	10	GPS	NPS		1430	25 Aug 2010
spring source Snow Lake, Snow Lake Basin, Mount Rainier National Park	Lewis	WA	599241.5	5178904.3	10	GPS	NPS		1430	23 Aug 2010
Fryingpan Creek at Sunrise Road Bridge, Mount Rainier National Park	Pierce	WA	605912.7	5193653.3	10	MAN4	NPS		1161	16 Jul 2000
Redoubt Lake, North Cascades National Park	Whatcom	WA	623516.6	5425916.0	10	GPS	NPS		1615	29 Aug 1989
Nert Lake, North Cascades National Park	Whatcom	WA	610241.2	5395731.7	10	GPS	NPS		1389	11 Sep 1989
Middle Tapto Lake, Red Face Mountain Basin, North Cascades National Park	Whatcom	WA	619553.0	5415682.6	10	GPS	NPS		1747	8 Sep 1989
Price Lake, North Cascades National Park	Whatcom	WA	60248.0	5412128.0	10	GPS	NPS		1192	6 Sep 1989
No Name Lake, North Cascades National Park	Whatcom	WA	638436.5	5412528.2	10	GPS	NPS		1171	24 Aug 1989
Upper Bagley Lake, Mount Baker National Forest	Whatcom	WA	596064.4	5412135.3	10	MAN3	USFS	MBS	1295	30 Jul 1987

\*Note: This record was provided to us based on a personal observation by a stonefly researcher (Giersch 2015, pers. comm.); however, no collections were made and the population should be verified.

*SOLIPERLA FENDERI*

Location	County	State	UTM_E (NAD83)	UTM_N (NAD83)	L_Zone	Loc_Acc	Land_Owner	BLM_NF	Elev	Date
Small stream at jct. Westside Road and Hwy 706, Mt. Rainier National Park	Pierce	WA	584315.1	5177037.9	10	MAN4	NPS		652	14 Jul 2003
Small stream 1.5 miles N Westside Road, Mt. Rainier National Park	Pierce	WA	585522.1	5178973.4	10	MAN4	NPS		740	14 Jul 2003
Dick Creek at Wonderland Trail, Mount Rainier National Park	Pierce	WA	592554.8	5199313.9	10	MAN4	NPS		1251	27 Jul 2001
Cataract Creek at Wonderland Trail, Mount Rainier National Park	Pierce	WA	591391.2	5200311.5	10	MAN4	NPS		971	9 Jul 2000
Stream on Westside Road 1.5 miles from Paradise Road, Mount Rainier National Park	Pierce	WA	585522.1	5178973.4	10	MAN4	NPS		740	26 Jun 2000
Boggy stream tributary to Tahoma Creek, Mount Rainier National Park	Pierce	WA	586524.6	5183456.6	10	MAN6	NPS		1089	17 Aug 1999
Small tributary on Westside Road 2 miles N of Paradise Road, Mount Rainier National Park	Pierce	WA	585913.5	5179695.0	10	MAN4	NPS		764	17 Aug 1999
Paradise River, Paradise Valley, Mt. Rainier National Park	Pierce	WA	593939.2	5179777.7	10	MAN6	NPS		1115	16 Aug 1999
Falls Creek at Stevens Canyon Road, Mount Rainier National Park	Pierce	WA	609705.9	5179054.4	10	MAN3	NPS		715	8 Jul 1999
Small tributary on Westside Road 2 miles N of Paradise Road, Mount Rainier National Park	Pierce	WA	585913.5	5179695.0	10	MAN4	NPS		764	8 Jul 1999
Tributary to Tahoma Creek, Mount Rainier National Park	Pierce	WA	586524.6	5183456.6	10	MAN6	NPS		1089	8 Jul 1999
Seeps along Puyallup River, Mount Rainier National Park	Pierce	WA	584584.9	5184431.4	10	MAN6	NPS		1057	29 Jun 1981
Spring seeps along St. Andrews Creek, Mount Rainier National Park	Pierce	WA	583477.8	5187493.5	10	MAN6	NPS		1146	29 Jun 1981
Small stream at Reflection Lake, Mount Rainier National Park	Pierce	WA	597032.8	5180412.9	10	MAN4	NPS		1483	14 Jul 1979

Location	County	State	UTM_E (NAD83)	UTM_N (NAD83)	L_Zone	Loc_Acc	Land_Owner	BLM_NF	Elev	Date
Spring seeps along St. Andrews Creek, Mount Rainier National Park	Pierce	WA	583477.8	5187493.5	10	MAN6	NPS		1146	13 Jul 1979
Christina Falls, Mount Rainier National Park	Pierce	WA	593123.1	5181639.4	10	MAN4	NPS		1147	15 Jun 1969
St. Andrews Creek, Mount Rainier National Park	Pierce	WA	583477.8	5187493.5	10	MAN6	NPS		1146	27 Jul 1953

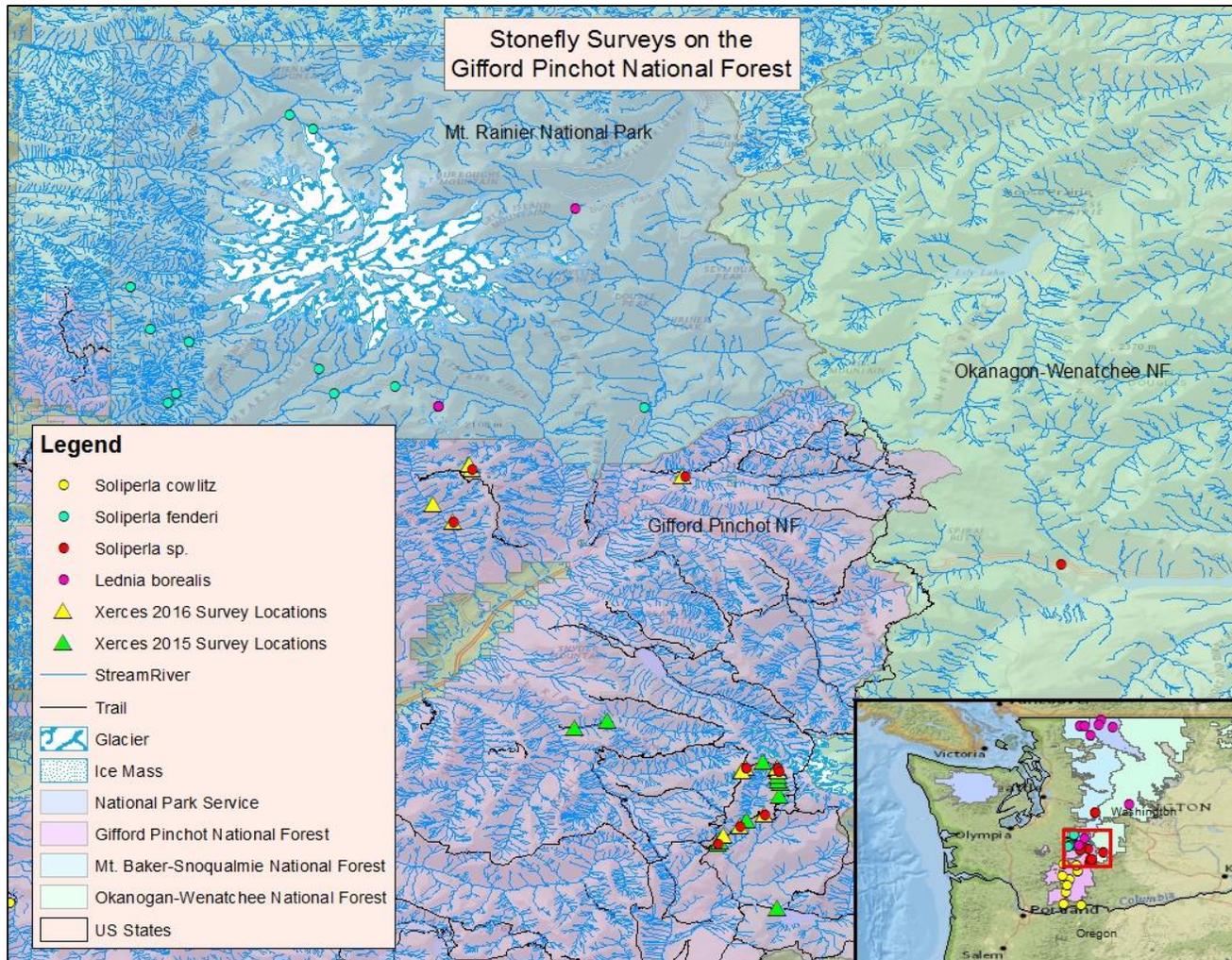
## APPENDIX II: SITES SURVEYED IN 2016

Note: Under the Land Ownership column, the Gifford Pinchot National Forest is abbreviated as USFS - GIP and the Okanogan-Wenatchee National Forest is abbreviated as USFS - OKW.

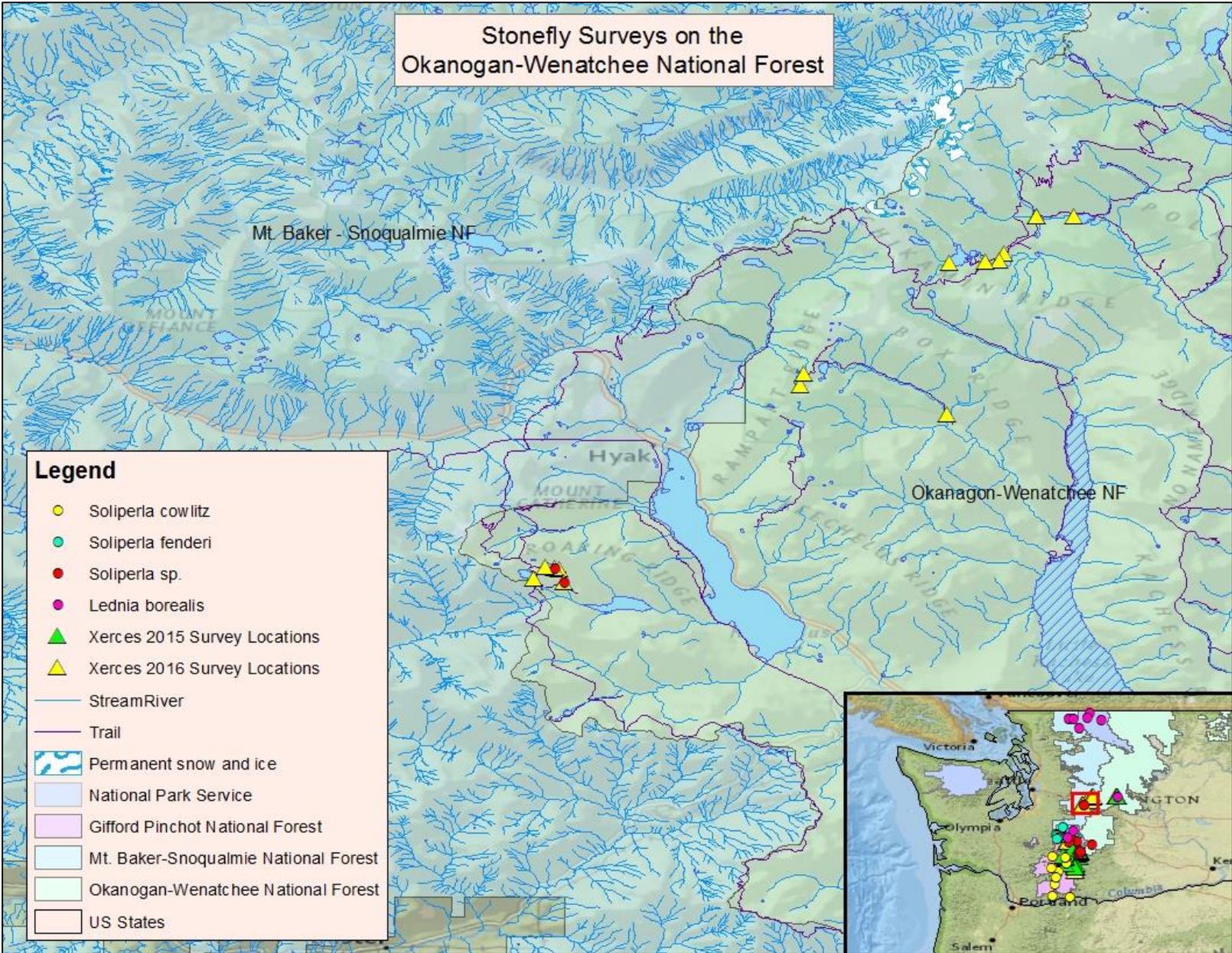
Survey Date	Site Name	County	Land Ownership	UTME (NAD83, Zone 10)	UTMN (NAD83, Zone 10)	Loc Acc (ft.)
10-Aug-16	Goat Rocks 1	Lewis	USFS - GIP	614348.6	5147476.5	11
10-Aug-16	Goat Rocks 2	Lewis	USFS - GIP	615123.7	5148245.9	18
10-Aug-16	Goat Rocks 3	Lewis	USFS - GIP	616383.4	5149104.8	17
10-Aug-16	Goat Rocks 4	Lewis	USFS - GIP	617023.6	5152294.4	9
10-Aug-16	Goat Rocks 5	Lewis	USFS - GIP	616975.5	5152520.8	9
11-Aug-16	Goat Rocks 6	Lewis	USFS - GIP	615381.7	5152562.5	9
11-Aug-16	Goat Rocks 7	Lewis	USFS - GIP	615190.4	5152252.1	9
11-Aug-16	Summit Creek	Lewis	USFS - GIP	611739.9	5173997.1	19
12-Aug-16	Tatoosh Lakes 1	Lewis	USFS - GIP	601023.5	5174275.6	12
12-Aug-16	Tatoosh Lakes 2	Lewis	USFS - GIP	600946.7	5174615.5	9
12-Aug-16	Unnamed Creek 1	Lewis	USFS - GIP	599142.7	5171640.0	14
12-Aug-16	Unnamed Creek 2	Lewis	USFS - GIP	599142.7	5171640.0	17
22-Aug-16	Rampart Lakes 1	Kittitas	USFS - OKW	625287.7	5252597.5	9
22-Aug-16	Rampart Lakes 2	Kittitas	USFS - OKW	625287.7	5252597.5	9
22-Aug-16	Rampart Lakes 3	Kittitas	USFS - OKW	629346.9	5251480.4	9
23-Aug-16	Lemah Creek	Kittitas	USFS - OKW	631630.9	5259596.9	12
23-Aug-16	Spectacle Lake 1	Kittitas	USFS - OKW	630771.0	5258079.8	9
23-Aug-16	Spectacle Lake 2	Kittitas	USFS - OKW	630655.3	5257777.8	9
23-Aug-16	Spectacle Lake 3	Kittitas	USFS - OKW	629293.7	5257638.1	9
24-Aug-16	Spectacle Lake 4	Kittitas	USFS - OKW	630273.7	5257712.4	9
24-Aug-16	Lemah Creek	Kittitas	USFS - OKW	631630.9	5259596.9	12
24-Aug-16	Spectacle Lake 5	Kittitas	USFS - OKW	632656.4	5259618.2	11
25-Aug-16	Mirror Lake 1	Kittitas	USFS - OKW	618792.3	5244986.9	14
25-Aug-16	Mirror Lake 2	Kittitas	USFS - OKW	618679.8	5245046.4	11
25-Aug-16	Mirror Lake 3	Kittitas	USFS - OKW	618395.7	5245078.2	9
25-Aug-16	Mirror Lake 4	Kittitas	USFS - OKW	618081.7	5244600.9	9
25-Aug-16	Mirror Lake 5	Kittitas	USFS - OKW	618947.6	5244471.5	9

## APPENDIX III: SITE MAPS

Below we provide two larger scale maps that show survey locations on the two different National Forests, followed by more detailed maps for each area surveyed (arranged by survey date).



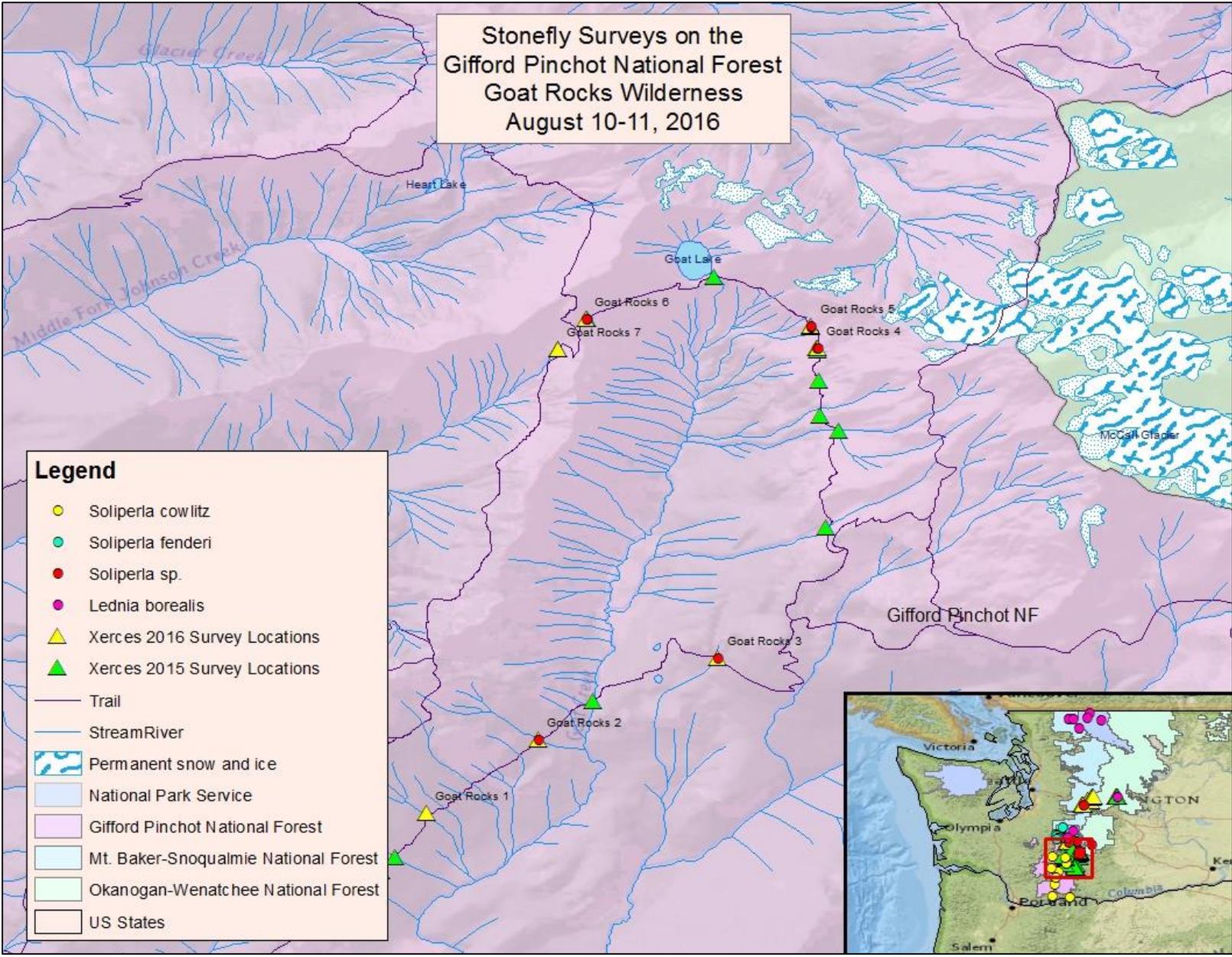
## Stonefly Surveys on the Okanagan-Wenatchee National Forest



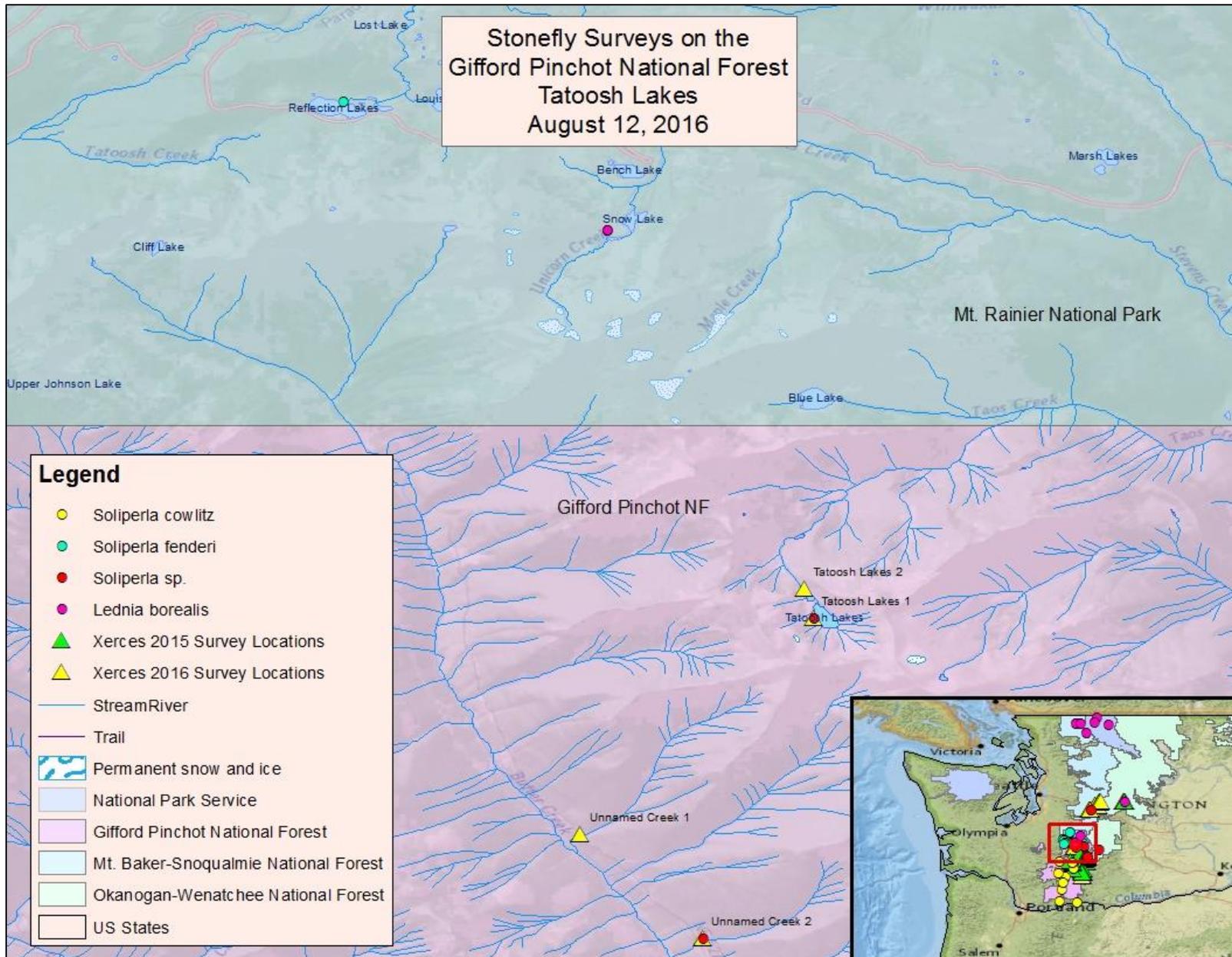
Stonefly Surveys on the  
Gifford Pinchot National Forest  
Goat Rocks Wilderness  
August 10-11, 2016

**Legend**

- Soliperla cowlitz
- Soliperla fenderi
- Soliperla sp.
- Lednia borealis
- ▲ Xerces 2016 Survey Locations
- ▲ Xerces 2015 Survey Locations
- Trail
- Stream/River
- Permanent snow and ice
- National Park Service
- Gifford Pinchot National Forest
- Mt. Baker-Snoqualmie National Forest
- Okanogan-Wenatchee National Forest
- US States

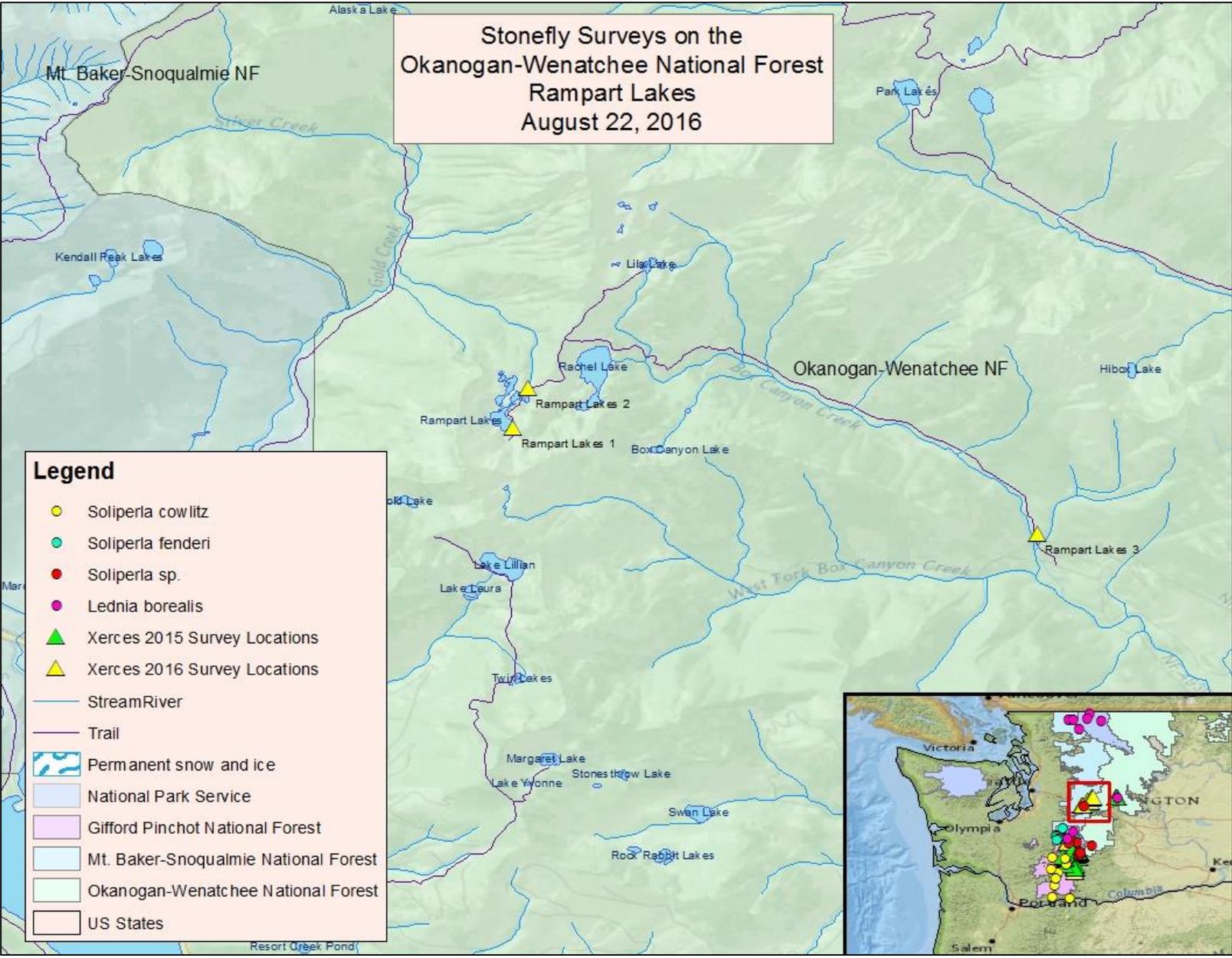


Stonefly Surveys on the  
Gifford Pinchot National Forest  
Tatoosh Lakes  
August 12, 2016



Stonefly Surveys on the  
 Okanogan-Wenatchee National Forest  
 Rampart Lakes  
 August 22, 2016

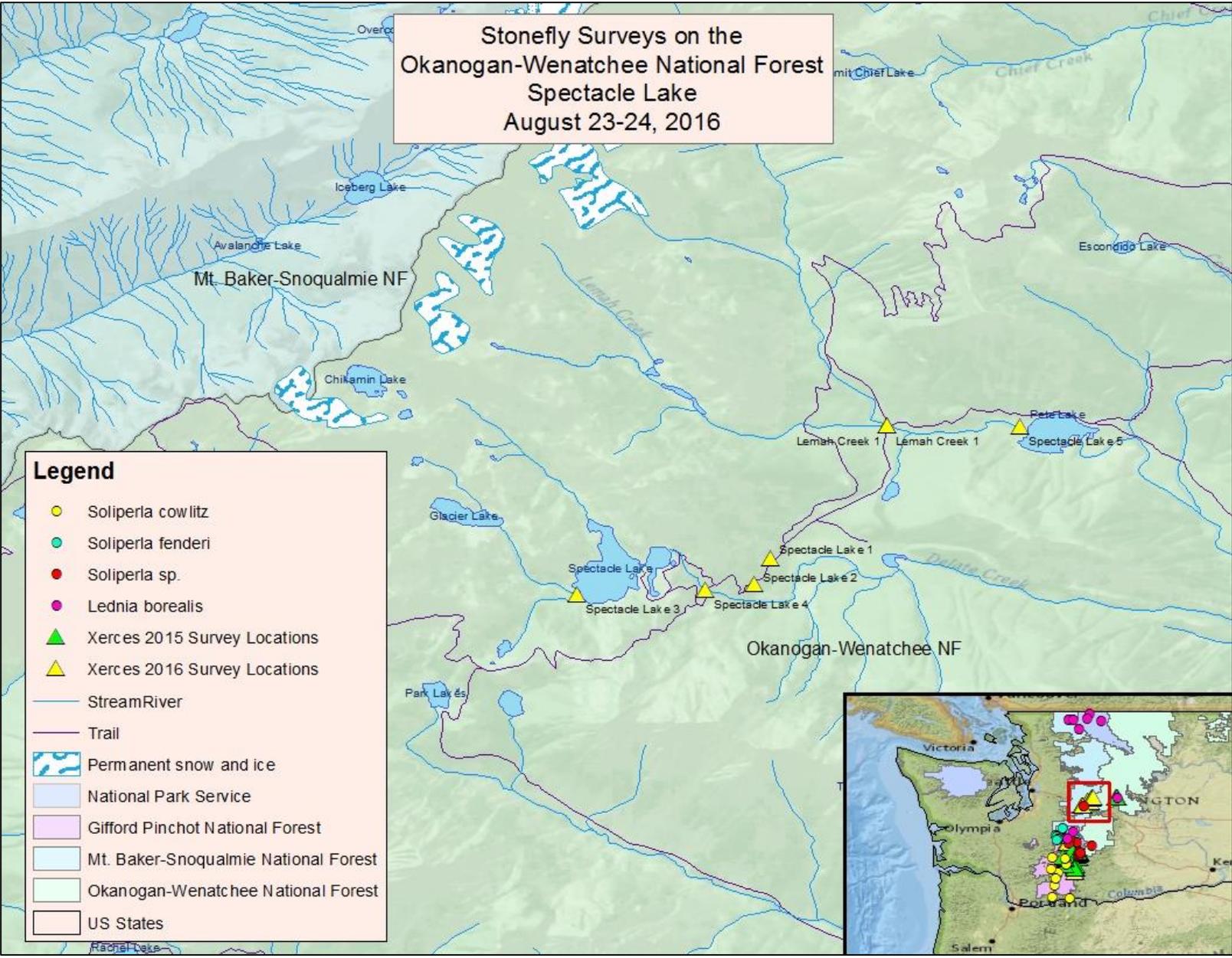
- Legend**
- Soliperla cowlitz
  - Soliperla fenderi
  - Soliperla sp.
  - Lednia borealis
  - ▲ Xerces 2015 Survey Locations
  - ▲ Xerces 2016 Survey Locations
  - Stream/River
  - Trail
  - Permanent snow and ice
  - National Park Service
  - Gifford Pinchot National Forest
  - Mt. Baker-Snoqualmie National Forest
  - Okanogan-Wenatchee National Forest
  - US States



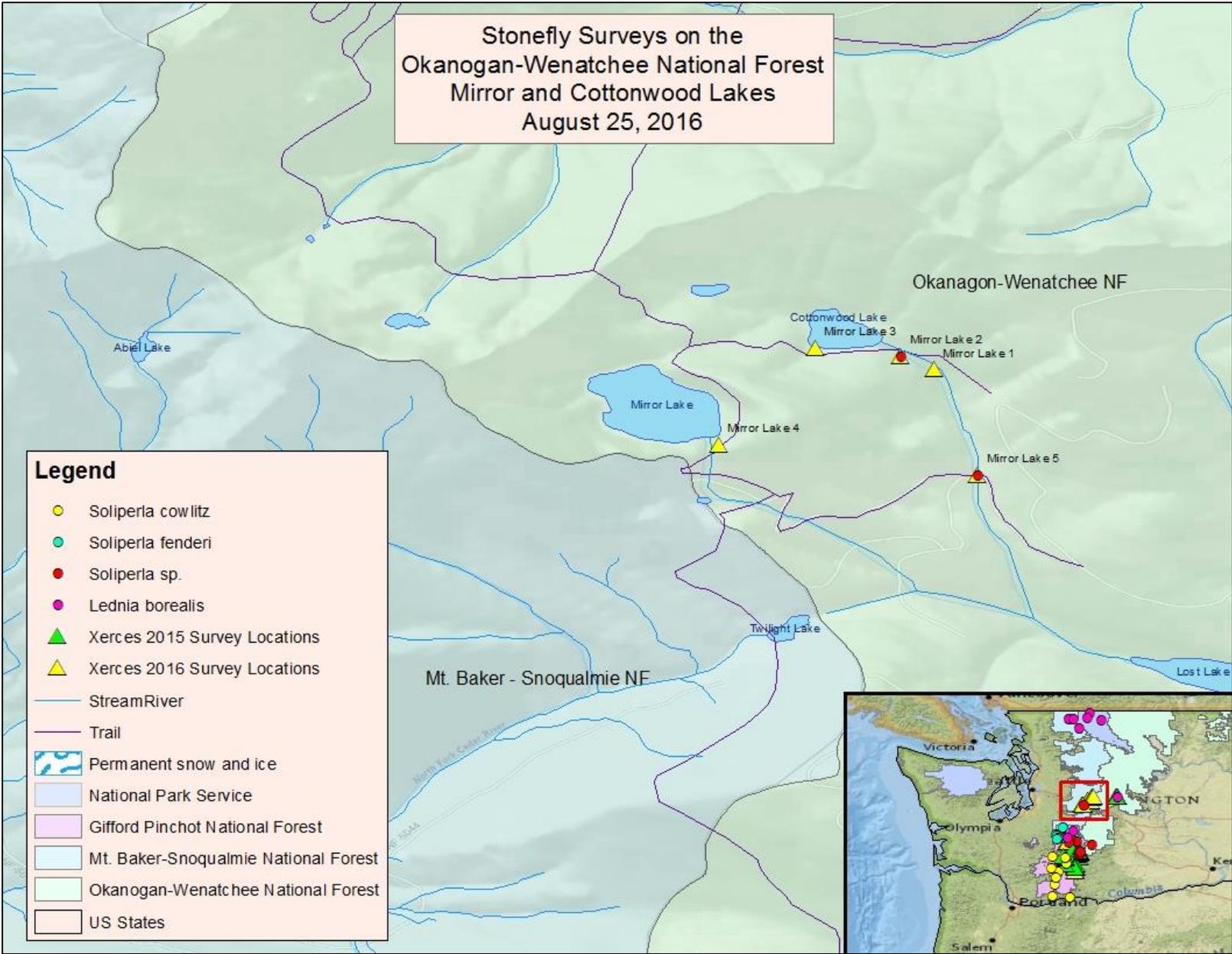
Stonefly Surveys on the  
 Okanogan-Wenatchee National Forest  
 Spectacle Lake  
 August 23-24, 2016

**Legend**

- Soliperla cowlitz
- Soliperla fenderi
- Soliperla sp.
- Lednia borealis
- ▲ Xerces 2015 Survey Locations
- ▲ Xerces 2016 Survey Locations
-  Stream/River
-  Trail
-  Permanent snow and ice
-  National Park Service
-  Gifford Pinchot National Forest
-  Mt. Baker-Snoqualmie National Forest
-  Okanogan-Wenatchee National Forest
-  US States



Stonefly Surveys on the  
 Okanagon-Wenatchee National Forest  
 Mirror and Cottonwood Lakes  
 August 25, 2016



## APPENDIX IV: HABITAT DESCRIPTIONS

Note: All stonefly species listed under “Collections” are in **bold** print.

AUGUST 10, 2016: GOAT ROCKS WILDERNESS, GIFFORD PINCHOT NF

### GOAT ROCKS 1



Habitat: Seasonal stream crossing on Snowgrass Flat trail. Substrate is composed of boulders, cobble, downed limbs, and some conifer needles. Stream is in partial to full shade. Stream width is 24-48 inches with a depth of 1-2 inches. Streamside vegetation consists of alder and huckleberry with a Douglas-fir overstory. Small cascade is covered in moss with large boulders and lush vegetation. No stoneflies of any species observed. One adult caddisfly (likely *Rhyacophila*) and several case makers found in stream.

Water temperature: 8° C

Elevation: 1,435 m

Collections: None

## GOAT ROCKS 2



Habitat: Small perennial creek, 4-6 feet wide and up to 4 inches deep. Substrate composed of bedrock, boulders, cobble, and rotting downed logs. Full shade, canopy cover 70%. Vegetation includes Douglas-fir, cedar, and salmonberry. Stream flows across Snowgrass Basin trail. *Soliperla* were found primarily in splash zones directly under small falls and cascades under smooth rocks, both upstream and downstream of trail. No adult stoneflies observed.

Water temperature: 9° C

Elevation: 1,428 m

Collections: *Soliperla* sp. (5 mid-instar larvae) and *Epeorus grandis* group (1 mid-instar larva).

NOTE: This site was surveyed by Xerces staff in 2015 (then called Goat Rocks 1), when a single *Soliperla* larva was collected.

### GOAT ROCKS 3



Habitat: Small perennial stream crossing Snowgrass Basin Trail. Water depth up to 8" and stream width 12-24 inches. Habitat is composed of cobble, boulders, and large woody debris inputs (slabs of conifer bark, twigs, logs), with riffles, small cascades, pools, pockets, and moss. Partial shade with mostly open canopy directly above the survey site. Streamside vegetation includes huckleberry, ferns, skunk cabbage, Douglas-fir, moss, and small forbs. This is the second of two adjacent streams as you walk away from the Snowgrass Basin trailhead. *Soliperla* were observed under the small cascade shown in the photos above. Larval collections were taken from under bark slabs in the creek just below this cascade. One adult female tailed frog observed.

Water temperature: 9° C

Elevation: 1,505 m

Collections: *Soliperla* sp. (2 mid-instar larvae), *Yoraperla nigripennis/siletz* (1 mid-instar larva) and *Wormaldia occidea* (1 male adult).



Habitat: Seepy hillside with multiple small channels flowing across the trail. Substrate composed of cobble, gravel, and silt. Exposed alpine site in full sun. Water depth of about 1-2 inches in channels, which are up to 6 inches wide. Hillside vegetation is thick with flowering forbs and rushes, including *Mimulus*, lupine, corn lily, daisy, bistort, valerian, and rushes. Lily Basin trail runs through the survey site, crossing the channels. Found a single dead stonefly adult on vegetation. Nymphs collected from cobble in water channels.

Water temperature: 4.5° C

Elevation: 1,875 m

Collections: *Moselia infuscata* (1 female adult), *Soliperla* sp. (4 mid-instar larvae), and *Wormaldia* sp. (1 female adult, probably *W. occidea*).

NOTE: This site was surveyed by Xerces staff in 2015 (then called Goat Rocks 8), when seven *Soliperla* larvae were collected.

## GOAT ROCKS 5



Habitat: Hillside seep located in a small, forested patch on an otherwise open and exposed alpine talus slope. Substrate composed of cobble and boulders. Partial to full shade. Seep vegetation includes mosses, corn lily, bistort, daisy, bear grass, paintbrush, and valerian.

Water temperature: 16° C

Elevation: 1,882 m

Collections: *Soliperla* sp. (1 mid-instar larva) and *Rhyacophila visor* (1 male and 1 female, adults).

NOTE: This site was surveyed by Xerces staff in 2015 (then called Goat Rocks 7), when a single *Soliperla* larva was collected.

GOAT ROCKS 6



Habitat: Seepy south-facing hillside with multiple braided channels (4-6 within survey area). Substrate composed of cobble and gravel, with a few boulders and rocky outcroppings. Water depths in channels less than 1" deep, 5-12" wide. No canopy cover. Lush streamside vegetation includes *Mimulus*, *Castilleja*, lupine, reeds, and valerian. *Nostoc* algae present in channels. The hillside and small channels are bisected by the Lily Basin trail. *Soliperla* nymphs found in splash zones. *Sweltsa revelstoka* adults found by beating the channel vegetation over the net, then quickly closing the net.

Water temperature: 6.5° C

Elevation: 2,034 m

Collections: *Soliperla* sp. (3 mid-instar larvae), *Setvena* sp. (1 mid-instar larva), *Sweltsa revelstoka* (1 male, 3 female adults), and *Malenka flexura* (possibly, 2 mid-instar larvae).

NOTE: This site was surveyed by Xerces staff in 2015 (then called Goat Rocks 10), when a single *Soliperla* larva was collected.

## GOAT ROCKS 7



Habitat: Small stream that may be seasonal in dry years. Substrate composed of cobble, boulders, and some sand. Fully exposed alpine site. Water depth 3 to 6 inches and 24-36 inches wide. Streamside vegetation includes moss, *Mimulus*, heather, reeds, and grasses. Camping occurs in the basin, which features multiple channels running through grasses, reeds, and wildflowers. The basin floor is relatively flat but drops off steeply (see photos). Rocks in the channels are covered in algae and mosses.

Water temperature: 9.5° C

Elevation: 1,937 m

Collections: *Setvena* sp. (2 larvae).

NOTE: This site was surveyed by Xerces staff in 2015 (then called Goat Rocks 11). No target species were found.

## SUMMIT CREEK



Habitat: Mid-size stream up to 3 feet deep and 15-25 feet wide. Partial shade with 30% canopy cover. Stream substrate composed of boulders, cobble, gravel, and sand, with some bedrock. Vegetation includes Douglas-fir, vine maple, cedar, and hemlock. The stream channel itself cuts through rocky hillsides and has good flow with many types of microhabitats. This site is very different from the Goat Rocks *Soliperla* sites. Cascades frog observed.

Water temperature: 14° C

Elevation: 740 m

Collections: *Calineuria californica* (3 larvae), *Drunella coloradensis* (1 larva), *Brachycentrus americanus* (1 larva), and *Rhyacophila hyalinata* group (1 larva).

NOTE: This site was visited based on a *Soliperla* sp. collection record from Bill Stark (pers. comm., 2015) labeled "Summit Cr./Summit Cr. Campground." However, the habitat does not seem right, and this site is very different from other places we have collected *Soliperla*. We surveyed a long stretch of the creek but found only one type of stonefly nymph (*C. californica*). Many exuviae of this species is scattered throughout the creek. We targeted splash zones and some stream margins but did not encounter any seeps or smaller tributaries flowing into the creek, which may be more appropriate for *Soliperla*.

TATOOSH LAKES 1



Habitat: First order intermittent stream up to 6 inches deep and 2-4 feet wide. Flows into upper Tatoosh Lake. Canopy cover of about 20%. Streamside vegetation includes corn lily, valerian, and spruce. This is a steep stream channel running through unsecured talus slopes with cobble, gravel, and downed logs. It is potentially quite active during snowmelt. In some areas, heavily eroded banks reach up to 3 feet high.

Water temperature: 10.5° C

Elevation: 1,523 m

Collections: *Sweltsa revelstoka* (1 male, 7 female adults), *Cinymugla* sp. (1 larva), *Setvena* sp. (1 mid-instar larva), and *Soliperla* sp. (1 female adult).



Habitat: Third order perennial mountain stream up to one ft. deep in pockets and 6-10 inches wide. Substrate composed of bedrock, boulders, cobble, and downed logs. No canopy cover. Streamside vegetation consists of daisy, *Mimulus*, sedges, bistort, and aster. Water is very warm and rocks in stream are covered in moss and scum. Abundant wildflowers. Many stonefly exuviae observed on rocks. This stream is likely too warm for our target species.

Water temperature: 17.5° C

Elevation: 1,558 m

Collections: *Doroneuria* sp. (2 larvae), *Sweltsa revelstoka* (1 male, 1 female adult), and *Zapada frigida* (1 female adult).

## UNNAMED CREEK 1



Habitat: Intermittent second order stream up to 1.5 feet deep and 5-10 feet wide. Dappled canopy cover. Streamside vegetation consists of devil's club, sword fern, alder, and bigleaf maple. Stream substrate composed of boulders, cobble, gravel, sand, and some bedrock. This stream flows into a large culvert under FS Road 5270. Moss covered boulders are strewn throughout the stream with multiple small pockets, pools, and cascades. Rocks are heavily embedded and difficult to move. Tailed frog tadpoles very abundant. *Yoraperla* nymphs were found under the few rocks that were not embedded.

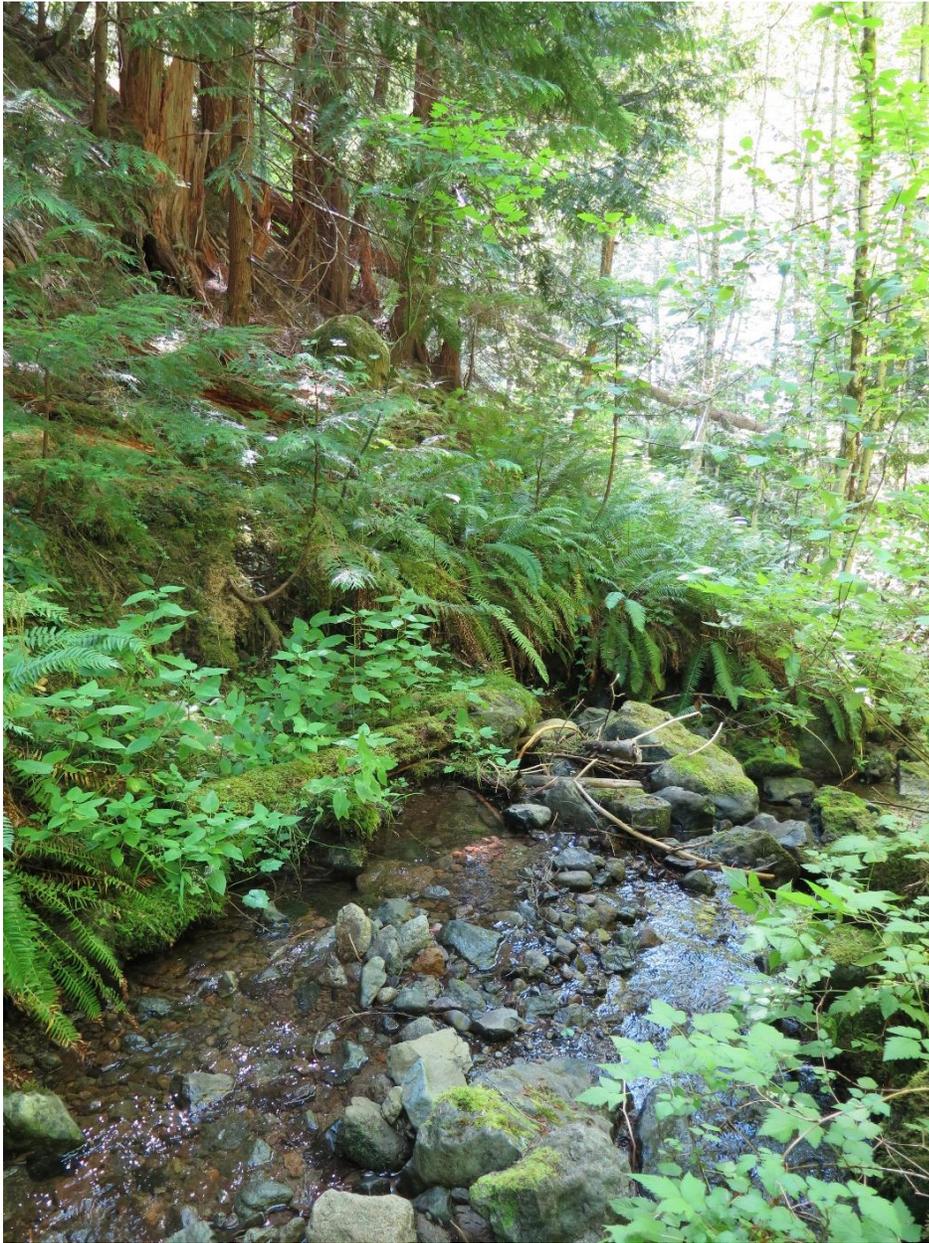
Water temperature: 14.5° C

Elevation: 769 m

Collections: *Yoraperla mariana* (2 larvae).

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UNNAMED CREEK 2



Habitat: Intermittent second order stream up to 2 ft. deep and 3-8 ft. wide. Flows under FS Road 5270. Streamside vegetation includes Douglas-fir, cedar, vine maple, alder, and salmonberry. Partial shade. This stream channel has lush vegetation and steep walls. Leaf litter input is abundant from deciduous and coniferous canopy. Stream substrates include moss-covered boulders, cobble, and gravel.

Water temperature: 13.5° C

Elevation: 798 m

Collections: *Doroneuria* sp. (1 larva), *Soliperla* sp. (1 mid-instar larva), and *Malenka cornuta* (1 female adult).

RAMPART LAKES 1



Habitat: Intermittent stream, potentially seasonal. Water depth reaches only to 3 inches, with an overall stream width of 1-5 feet. Full sun alpine site with streamside vegetation of sedges, *Mimulus*, daisy, and mosses. Talus stream bank with boulder, cobble, and gravel. This is an inlet to the largest of the Rampart Lakes. Elevation grade is slight and stream has very low water flow, mostly just pockets in areas. Relatively few stoneflies observed; mayfly adults and nymphs were dominant.

Water temperature: 11° C

Elevation: 1,589 m

Collections: *Setvena* sp. (2 larvae), *Sweltsa revelstoka* (1 male, 1 female adult), *Lepidostoma* sp. (1 female adult), and *Chyranda centralis* (1 female adult).

## RAMPART LAKES 2



Habitat: Perennial first order stream with boulders, bedrock, and cobble. Very mossy with abundant flowering forbs, grasses, and mosses, including *Mimulus* and daisy. Open alpine site with almost no canopy.

Water temperature: 15° C

Elevation: 1,550 m

Collections: *Cingma* sp. (2 larvae), *Sweltsa* sp. (1 larva).

RAMPART LAKES 3



Habitat: Perennial second order stream composed of boulders, cobble, and gravel. Partial shade with vegetation consisting of salmonberry, sword fern, and conifers. Crosses Rachel Lake Trail #1313. Microhabitats include small pockets and cascades.

Water temperature: Unknown.

Elevation: 942 m

Collections: *Drunella coloradensis* (2 larvae).

LEMAH CREEK



Habitat: Mid-size third order perennial stream 20-25 feet wide and up to 2 feet deep. Substrate composed of boulders, cobble, and gravel. Partial shade with streamside vegetation consisting of salmonberry, alder, fir, willow, ferns, and *Sorbus*. Hikers cross the creek here during low flow to reach an adjacent trail. Very few invertebrates observed in-stream other than mayflies. No stonefly nymphs observed. This stream may be too turbulent during winter flows to support our target species. Did not observe any side seeps or tributaries but did not venture far from the trail crossing. Cascade frog observed.

Water temperature: 9° C

Elevation: 945 m

Collections: *Sweltsa exquisita* (1 male adult), *Suwallia* sp. (1 female adult), *Despaxia augusta* (1 male adult), and *Lepidostoma roafi* (2 male adults).

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SPECTACLE LAKE 1



Habitat: Hillside spring with boulders and cobble. Full sun. Water depth to 3" in pockets, width of channel within spring is approximately 2-3 feet. Mostly shrub vegetation including alder, *Sorbus*, fireweed, goat's beard, and pearly everlasting. Spring channel crosses the trail. Located within an old burn area. Caddisflies relatively abundant. Many downed trees from the fire located in the spring and in dry channel adjacent to spring flow. Giant boulders and bedrock exposed above and adjacent to survey area.

Water temperature: 8° C

Elevation: 1,015 m

Collections: *Setvena* sp. (1 mid-instar larva) and *Despaxia augusta* (1 male adult).

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SPECTACLE LAKE 2



Habitat: Hillside spring in full sun with bedrock, boulders, cobble, and downed logs. Spring channel depths up to 6", and width 1-4 feet. Minimal canopy cover, mostly shrubs, including alder, *Sorbus*, fireweed, goat's beard, and pearly everlasting. Located within an old burn area.

Water temperature: 10.5° C

Elevation: 1,055 m

Collections: *Baetis tricaudatus* (2 larvae), *Rhyacophila oreta* (1 male adult), and *Neothremma didactyla* (1 female adult).

## SPECTACLE LAKE 3



Habitat: Small first order perennial stream composed of cobble, boulders, and gravel in partial shade. Water source is Glacier Lake. Water depths up to 2 feet, up to 8 feet wide. Canopy cover is up to 70% further upstream, but much more open at inlet to lake. Streamside vegetation includes willow, alder, and fir. This is a difficult-to-reach site via a faint social path along talus slopes ringing Spectacle Lake. Near the lake, the stream splits into two channels and flows around a cobble bar into the lake. Site is densely vegetated in sections with willow, alder, and thin bands of conifers, with much higher conifer overstory further upstream (as in photo above). Rocks in the stream are slick with algae. Tailed frog tadpoles observed in the creek.

Water temperature: 14° C

Elevation: 1,300 m

Collections: *Setvena* sp. (1 larva), *Doroneuria* sp. (2 larvae), *Sweltsa* sp. (2 larvae), and *Mystacides alafimbriata* (2 males, 1 female adult).

SPECTACLE LAKE 4



Habitat: Third order perennial stream (Delate Creek) flowing from Spectacle Lake over a steep drop-off into a series of bedrock waterfalls. Water is deep in pools, likely several feet. Width of the stream is 20-35 feet at the widest part of the falls. Full sun with streamside vegetation composed of fir, alder, and some forbs such as asters. A large hiker's bridge crosses the creek at this site. Some madicolous habitat at falls. Flow is fast at the falls but there are multiple calm pools scattered among the boulders adjacent to and just downstream of the falls. Several small side channels flow along the edges of the main falls. Substrate composed of bedrock, boulder, and cobble.

Water temperature: 15° C

Elevation: 1,190 m

Collections: *Paraleptophlebia* sp. (1 larva), *Calineuria californica* (3 larvae), *Doroneuria* sp. (1 larva), *Suwallia* sp. (1 female adult), *Rhyacophila brunnea* group (1 female adult), *Rhyacophila visor* (1 female adult), and *Polycentropus variegatus* (1 male adult).

## LEMAH CREEK



Habitat: Fast-flowing third order mid-size perennial stream composed of boulders, cobble, and gravel. Partial shade. Water depth is 1-2 feet and width is 20-25 feet. Streamside vegetation includes salmonberry, alder, fir, willow, ferns, and Sorbus. Hikers cross the creek here to an adjacent trail during low flow. Flow may be too swift and turbulent during winter snowmelt and storms to support target species.

Water temperature: 9° C

Elevation: 945 m

Collections: *Doroneuria baumanni* (1 male adult) and *Suwallia* sp. (1 female adult).

NOTE: We revisited this site on our way back to the trailhead in order to check additional habitat just up and downstream of the trail crossing.

## SPECTACLE LAKE 5



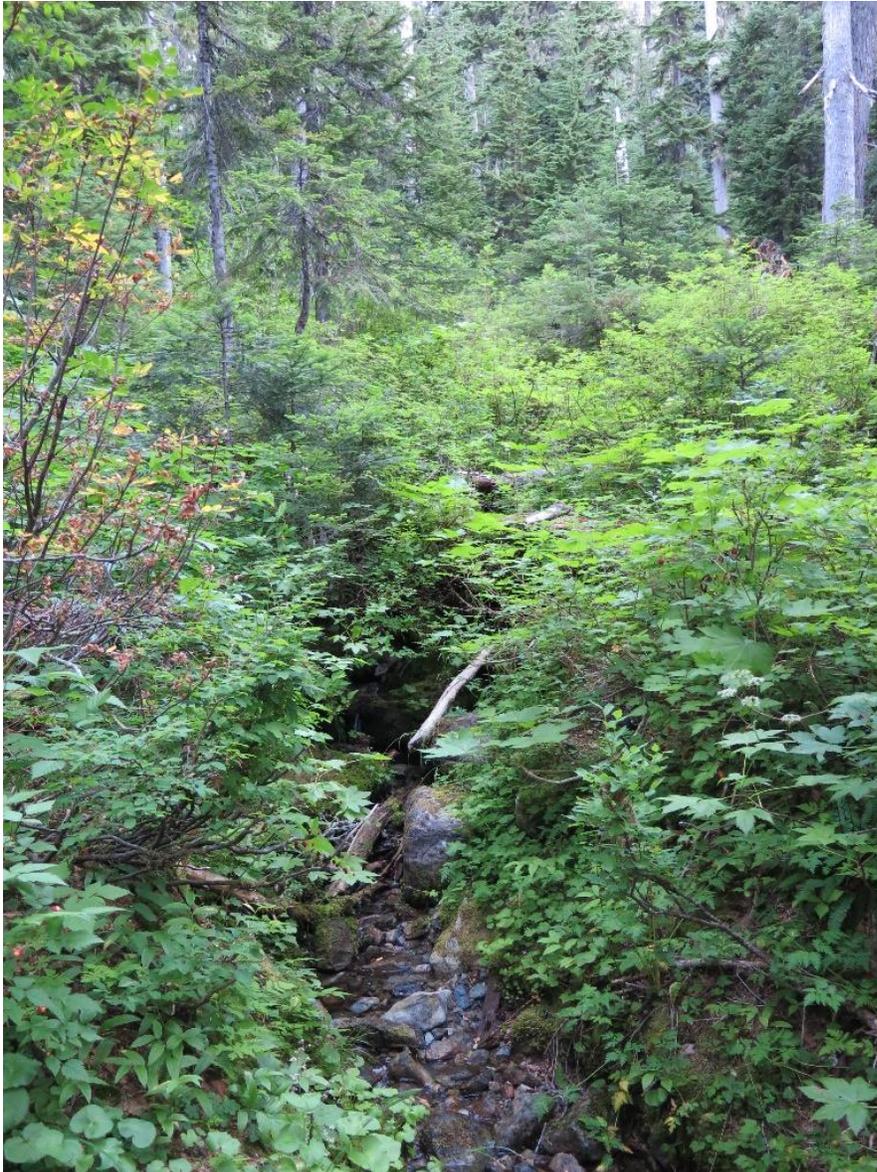
Habitat: Mid-size third order perennial stream (Lemah Creek) in partial shade at inlet to Pete Lake. Multiple channels and cobble bars. Substrate composed of cobble and gravel. Water depth up to 6 inches, width 25-30 feet. Streamside vegetation consists of fir, spruce, dogwood, and salmonberry. Survey site is adjacent to a backcountry camp. Abundant exuviae of small stoneflies on rocks adjacent to channels. Mayflies super abundant.

Water temperature: 9.5° C

Elevation: 934 m

Collections: *Suwallia* sp. (1 male adult), *Cinygmula* sp. (2 larvae), *Drunella coloradensis* (1 larva), unknown **Capniidae** species (3 mid-instar larvae), *Zapada columbiana* (1 larva), and *Isoperla sordida* (1 male adult).

MIRROR LAKE 1



Habitat: First order perennial stream, potentially spring source. Stream crosses Mirror Lake Trail #1302. Substrate composed of boulder, cobble, and gravel. Water depths up to 4 inches, width 12-24 inches. Canopy cover 75%. Streamside vegetation consists of spruce, salmonberry, and huckleberry. There is abundant conifer input into the creek and thick sediment at the creek bottom. Only mayflies were observed at this site.

Water temperature: 8.5° C

Elevation: 1,202 m

Collections: None.

## MIRROR LAKE 2



Habitat: First order perennial stream flowing from Cottonwood Lake. Stream crosses Mirror Lake Trail #1302. Upstream stream segment from Mirror Lake 1. Water depth up to 6 inches, width 5-6 feet. Partial shade with streamside vegetation of devil's club, fir, salmonberry, and spruce. This is an active-looking creek composed primarily of bedrock with small groupings of loose cobbles and the occasional boulder. *Soliperla* larva was found in the splash zone of a small cascade.

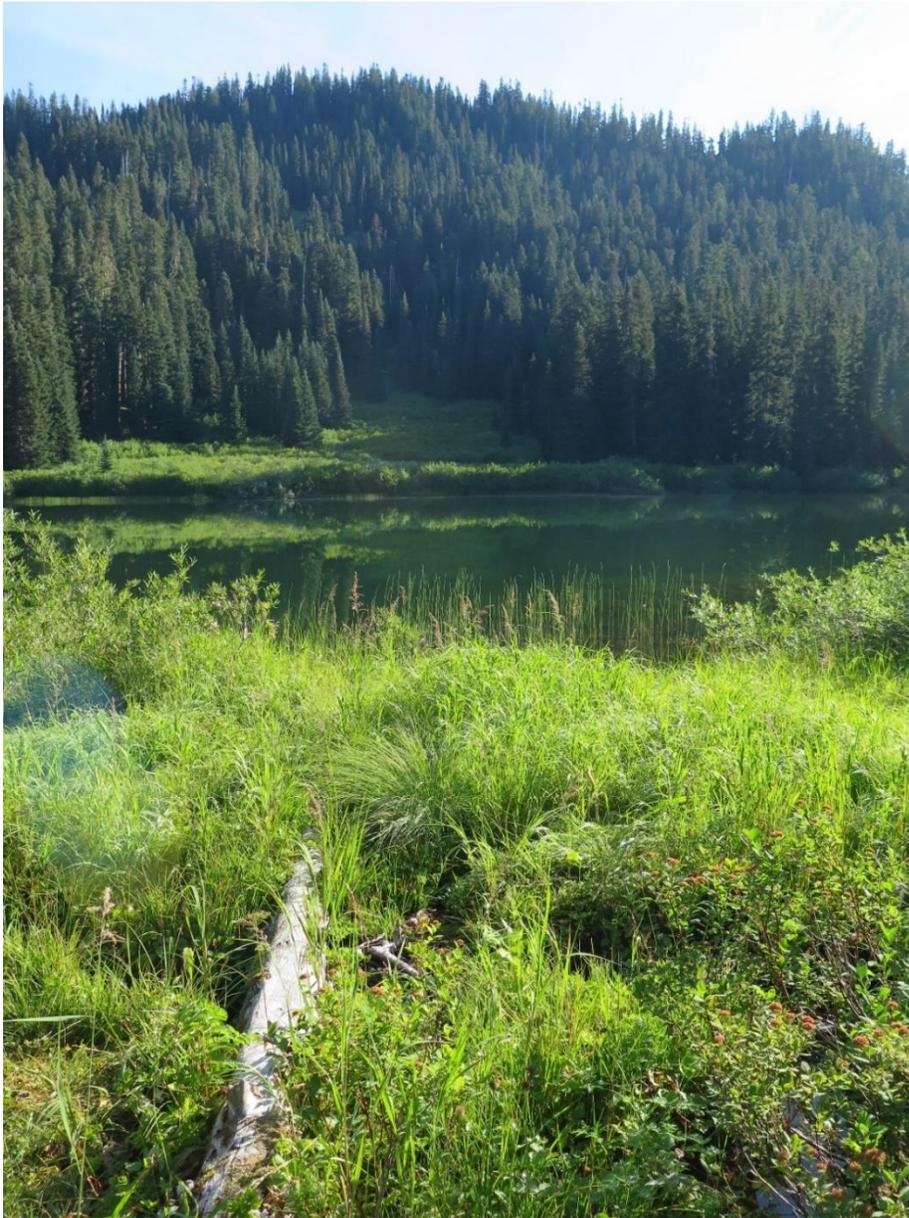
Water temperature: 8.5° C

Elevation: 1,201 m

Collections: *Calineuria californica* (1 larva), *Doroneuria* sp. (3 larvae), *Paraleptophlebia* sp. (1 larva), and *Soliperla* sp. (1 larva).

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MIRROR LAKE 3



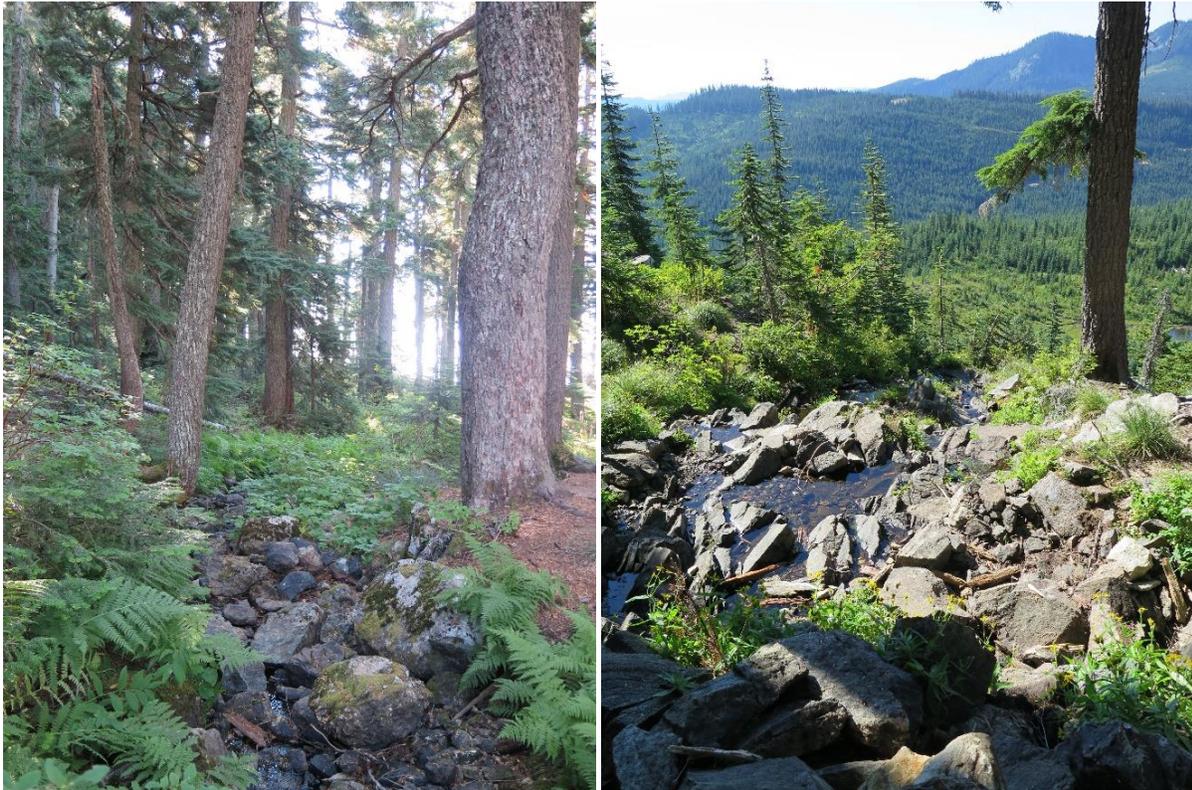
Habitat: Seep flowing into Cottonwood Lake. Multiple small channels of various widths, from 6-12 inches. Water depth less than 2 inches. Seep substrate composed of cobble and gravel with lush vegetation of marsh marigolds, ferns, hemlock, willow, and sedges. Minimal water flow. There is a social trail around the lake and the seep is trampled in areas near the pond. Higher up, the seep appears dry with just a few small pockets of water.

Water temperature: 9° C

Elevation: 1,202 m

Collections: *Sweltsa* sp. (1 larva) and *Leuctridae* sp. (1 larva).

## MIRROR LAKE 4



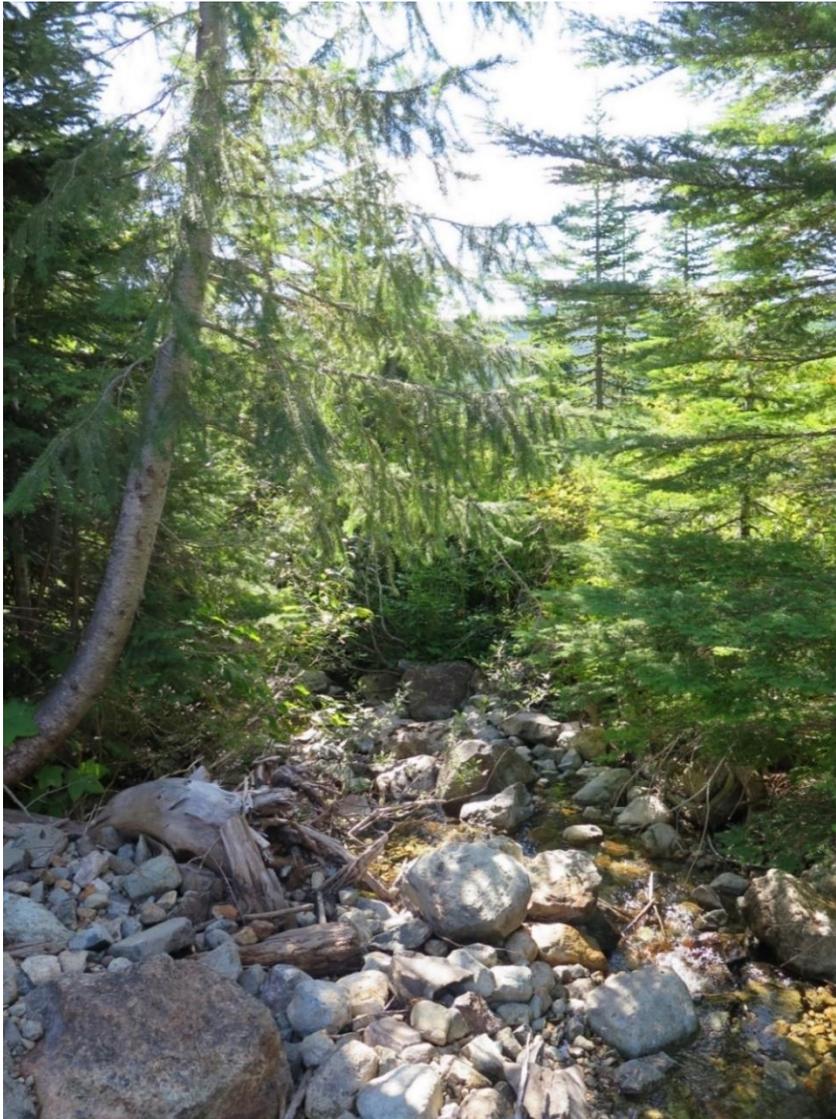
Habitat: First order perennial stream flowing from Mirror Lake along the Pacific Crest Cle Elum South Trail #2000.061703A. Water depth up to 6 inches, width 1-3 feet. Partial shade with canopy cover of about 80% in the survey area. Substrate composed of cobble, gravel, boulder, bedrock, logs, twigs, and bark. Streamside vegetation consists of bracken fern, huckleberry, Douglas-fir, and spruce. The stream is adjacent to lakeside campsites, with a trail running alongside. Stream is slow flowing with multiple small pools. Heavy conifer needle input from canopy. Large logjam directly at lake outlet with heavy sediment. Observed three Cascade frogs.

Water temperature: 15.5° C

Elevation: 1,297 m

Collections: *Calineuria californica* (6 early instar larvae), *Paraleptophlebia* sp. (1 larva), *Baetis tricaudatus* (1 larva), *Sweltsa* sp. (3 larvae), and *Menetus* sp. (2 specimens).

## MIRROR LAKE 5



Habitat: First order perennial stream 3-15 feet wide and up to 12 inches deep in small pools. Stream crosses Twilight Lake Trail #1302.1. Downstream stream segment of Mirror Lake 1 and Mirror Lake 2. Substrate composed of cobble, gravel, boulders, and sand. Vegetation consists of Douglas-fir, willow, hemlock and alder. Mixed, mostly shrubby canopy offering partial shade. Stonefly exuviae on rocks. Very eroded streambanks at trail crossing. Adult *Despaxia augusta* stoneflies were found under dry rocks along the creek as well as in the vegetation. Observed one Cascade frog.

Water temperature: 11° C

Elevation: 1,103 m

Collections: *Yoraperla mariana* (6 larvae), *Soliperla* sp. (2 early instar larvae), *Despaxia augusta* (7 males, 1 female), *Sweltsa* sp. (1 larva), *Frisonia picticeps* (1 larva), *Baetis bicaudatus* (1 larva), *Ecclisocosmoecus scylla* (2 male adults), *Rhyacophila vaccua* (1 female adult), *Micrasema* sp. (1 female adult), *Drunella doddsii* (1 larva).

## APPENDIX V: LIST OF ALL SPECIES COLLECTED BY SITE

Note: Species of interest (including *Soliperla* sp.) are in **bold**.

	Site	Taxa Group	Species	Quantity	Life Stage	
10-Aug-16	Goat Rocks 2	Ephemeroptera	<i>Epeorus grandis</i> group	1	Mid-instar larva	
		Plecoptera	<b><i>Soliperla</i> sp.</b>	<b>5</b>	<b>Mid-instar larvae</b>	
	Goat Rocks 3	Plecoptera	<i>Yoraperla nigripennis/siletz</i>	1	Mid-instar larva	
		Trichoptera	<i>Wormaldia occidea</i>	1	Male adult	
		Plecoptera	<b><i>Soliperla</i> sp.</b>	<b>2</b>	<b>Mid-instar larvae</b>	
	Goat Rocks 4	Plecoptera	<i>Moselia infuscata</i>	1	Female adult	
			<b><i>Soliperla</i> sp.</b>	<b>4</b>	<b>Mid-instar larvae</b>	
		Trichoptera	<i>Wormaldia</i> sp.	1	Female adult	
Goat Rocks 5	Plecoptera	<b><i>Soliperla</i> sp.</b>	<b>1</b>	<b>Mid-instar larva</b>		
	Trichoptera	<i>Rhyacophila visor</i>	2	Adults (1 male, 1 female)		
11-Aug-16	Goat Rocks 6	Plecoptera	<i>Malenka ?flexura</i>	2	Mid-instar larvae	
			<i>Setvena</i> sp.	1	Mid-instar larva	
			<b><i>Soliperla</i> sp.</b>	<b>3</b>	<b>Mid-instar larvae</b>	
			<i>Sweltsa revelstoka</i>	4	Adults (1 male, 3 females)	
	Goat Rocks 7	Plecoptera	<i>Setvena</i> sp.	2	Larvae	
	Summit Creek	Ephemeroptera	<i>Drunella coloradensis</i>	1	Larva	
		Plecoptera	<i>Calineuria californica</i>	3	Larvae	
		Trichoptera	<i>Brachycentrus americanus</i>	1	Larva	
<i>Rhyacophila hyalinata</i> group			1	Larva		
		<i>Rhyacophila vao</i>	1	Male adult		
12-Aug-16	Tatoosh Lakes 1	Ephemeroptera	<i>Cinygmula</i> sp.	1	Larva	
		Plecoptera	<i>Setvena</i> sp.	1	Mid-instar larva	
			<b><i>Soliperla</i> sp.</b>	<b>1</b>	<b>Female adult</b>	
			<i>Sweltsa revelstoka</i>	8	Adults (1 male, 7 females)	
	Tatoosh Lakes 2	Plecoptera	<i>Doroneuria</i> sp.	2	Larvae	
			<i>Sweltsa revelstoka</i>	2	Adults (1 male, 1 female)	
			<i>Zapada frigida</i>	1	Female adult	
	Unnamed Creek 1	Plecoptera	<i>Yoraperla mariana</i>	2	Larvae	
Unnamed Creek 2	Plecoptera	<i>Doroneuria</i> sp.	1	Larva		
		<i>Malenka cornuta</i>	1	Female adult		

	Site	Taxa Group	Species	Quantity	Life Stage	
			<b><i>Soliperla</i> sp.</b>	<b>1</b>	<b>Mid-instar larva</b>	
22-Aug-16	Rampart Lakes 1	Plecoptera	<i>Setvena</i> sp.	2	Larvae	
			<i>Sweltsa revelstoka</i>	2	Adults (1 male, 1 female)	
		Trichoptera	<i>Chyranda centralis</i>	1	Female adult	
			<i>Lepidostoma</i> sp.	1	Female adult	
	Rampart Lakes 2	Ephemeroptera	<i>Cingma</i> sp.	2	Larvae	
		Plecoptera	<i>Sweltsa</i> sp.	1	Larva	
Rampart Lakes 3	Ephemeroptera	<i>Drunella coloradensis</i>	2	Larvae		
23-Aug-16	Lemah Creek 1	Plecoptera	<i>Despaxia augusta</i>	1	Male adult	
			<i>Suwallia</i> sp.	1	Female adult	
			<i>Sweltsa exquisita</i>	1	Male adult	
		Trichoptera	<i>Lepidostoma roafi</i>	2	Male adults	
	Spectacle Lake 1	Plecoptera	<i>Despaxia augusta</i>	1	Male adult	
			<i>Setvena</i> sp.	1	Mid-instar larva	
	Spectacle Lake 2	Ephemeroptera	<i>Baetis bicaudatus</i>	2	Larvae	
		Trichoptera	<i>Neothremma didactyla</i>	1	Female adult	
			<i>Rhyacophila oreta</i>	1	Male adult	
	Spectacle Lake 3	Plecoptera	<i>Doroneuria</i> sp.	2	Larvae	
			<i>Setvena</i> sp.	1	Larva	
			<i>Sweltsa</i> sp.	2	Larvae	
		Trichoptera	<i>Mystacides alafimbriata</i>	3	Adults (2 males, 1 female)	
24-Aug-16	Lemah Creek 1	Plecoptera	<i>Doroneuria baumanni</i>	1	Male adult	
			<i>Suwallia</i> sp.	1	Female adult	
	Spectacle Lake 4	Ephemeroptera	<i>Paraleptophlebia</i> sp.	1	Larva	
		Plecoptera	<i>Calineuria californica</i>	3	Larvae	
			<i>Doroneuria</i> sp.	1	Larva	
			<i>Suwallia</i> sp.	1	Female adult	
		Trichoptera	<i>Polycentropus variegatus</i>	1	Male adult	
			<i>Rhyacophila brunnea</i> group	1	Female adult	
	<i>Rhyacophila visor</i>		1	Female adult		
	Spectacle Lake 5	Ephemeroptera	<i>Cinygmula</i> sp.	2	Larvae	
			<i>Drunella coloradensis</i>	1	Larva	
Plecoptera		<i>Capniidae</i> sp.	3	Mid-instar larvae		
		<b><i>Isoperla sordida</i></b>	<b>1</b>	<b>Male adult</b>		
			<i>Suwallia</i> sp.	1	Male adult	

	Site	Taxa Group	Species	Quantity	Life Stage	
			<i>Zapada columbiana</i>	1	Larva	
25-Aug-16	Mirror Lake 2	Ephemeroptera	<i>Paraleptophlebia</i> sp.	1	Larva	
		Plecoptera	<i>Calineuria californica</i>	1	Larva	
			<i>Doroneuria</i> sp.	3	Larvae	
			<b><i>Soliperla</i> sp.</b>	<b>1</b>	<b>Larva</b>	
	Mirror Lake 3	Plecoptera	<i>Leuctridae</i> sp.	1	Larva	
			<i>Sweltsa</i> sp.	1	Larva	
	Mirror Lake 4	Ephemeroptera	<i>Baetis tricaudatus</i>	1	Larva	
			<i>Paraleptophlebia</i> sp.	1	Larva	
		Gastropoda	<i>Menetus</i> sp.	2	Unknown	
		Plecoptera	<i>Calineuria californica</i>	6	Early instar larvae	
	<i>Sweltsa</i> sp.		3	Larvae		
	Mirror Lake 5	Ephemeroptera	<i>Baetis bicaudatus</i>	1	Larva	
			<i>Drunella doddsii</i>	1	Larva	
		Plecoptera	<i>Despaxia augusta</i>	8	Adults (7 males, 1 female)	
			<b><i>Frisonia picticeps</i></b>	<b>1</b>	<b>Larva</b>	
			<b><i>Soliperla</i> sp.</b>	<b>2</b>	<b>Early instar larvae</b>	
<i>Sweltsa</i> sp.			1	Larva		
<i>Yoraperla mariana</i>			6	Larvae		
Trichoptera		<i>Ecclisocosmoecus scylla</i>	2	Male adults		
	<i>Micrasema</i> sp.	1	Female adult			
	<i>Rhyacophila vaccua</i>	1	Female adult			

**APPENDIX VI: WASHINGTON SOLIPERLA SP. RECORDS**

Note: *Soliperla* spp. collections made by Xerces biologists are in **bold**.

Species	Date	Locality	Land Mgr.	County	Habitat	Water temp. (°C)	Elev. (m)
<i>Soliperla cowlitz</i>	18-Jun-04	Dog Creek, Hwy 14, 5 mi East Carson		Skamania			60
<i>Soliperla cowlitz</i>	15-May-03	Dog Creek, Hwy 14, Cook		Skamania			60
<i>Soliperla cowlitz</i>	13-Jun-04	Tributary Rock Creek, 5 mi NW Stevenson		Skamania			290
<i>Soliperla cowlitz</i>	14-Jun-04	Iron Creek Falls, FR 25		Skamania			352
<i>Soliperla cowlitz</i>	14-Jun-04	FR 90 2 mi below Big Creek Falls Viewpoint		Skamania	Small cascade		460
<i>Soliperla cowlitz</i>	14-Jun-04	FR 90 near Lewis Riv Cmpgnd		Skamania	Small cascade		478
<i>Soliperla cowlitz</i>	14-Jun-04	Wind Rivr Paradise Crk Cmpgnd, Hwy 30		Skamania			516
<i>Soliperla cowlitz</i>	7-Jun-91	Slippery Rock Creek [Smoothrock Cr.], Hwy 23		Lewis			525
<i>Soliperla cowlitz</i>	7-Jun-91	Slippery Rock Creek [Smoothrock Cr.], Hwy 23		Lewis			525
<i>Soliperla cowlitz</i>	14-Jun-04	FR 90, 1 mi above Big Creek Falls Viewpoint		Skamania	Small cascade		566
<i>Soliperla cowlitz</i>	7-Jun-91	Tributary East Canyon Creek, Hwy 23		Skamania			738
<i>Soliperla cowlitz</i>	7-Jun-91	Tributary East Canyon Creek, Hwy 23		Skamania			738
<i>Soliperla cowlitz</i>	14-Jun-04	At FR 25, 6 mi S Elk Pass		Skamania	Seep		953
<i>Soliperla fenderi</i>	14-Jul-03	Small stream at jct. Westside Road and Hwy 706, Mt. Rainier National Park	MRNP	Pierce			652
<i>Soliperla fenderi</i>	8-Jul-99	Falls Creek at Stevens Canyon Road, Mount Rainier National Park	MRNP	Pierce			715
<i>Soliperla fenderi</i>	26-Jun-00	Small stream 1.5 miles N Westside Road, Mt. Rainier National Park	MRNP	Pierce			740
<i>Soliperla fenderi</i>	14-Jul-03	Stream on Westside Road 1.5 miles from Paradise Road, Mount Rainier National Park	MRNP	Pierce			740
<i>Soliperla fenderi</i>	8-Jul-99	Small tributary on Westside Road 2 miles N of Paradise Road, Mount Rainier National Park	MRNP	Pierce			764
<i>Soliperla fenderi</i>	17-Aug-99	Small tributary on Westside Road 2 miles N of Paradise Road, Mount Rainier National Park	MRNP	Pierce			764
<i>Soliperla fenderi</i>	9-Jul-00	Cataract Creek at Wonderland Trail, Mount Rainier National Park	MRNP	Pierce			971
<i>Soliperla fenderi</i>	29-Jun-81	Seeps along Puyallap River, Mount Rainier National Park	MRNP	Pierce			1057

Species	Date	Locality	Land Mgr.	County	Habitat	Water temp. (°C)	Elev. (m)
<i>Soliperla fenderi</i>	8-Jul-99	Boggy stream tributary to Tahoma Creek, Mount Rainier National Park	MRNP	Pierce			1089
<i>Soliperla fenderi</i>	17-Aug-99	Tributary to Tahoma Creek, Mount Rainier National Park	MRNP	Pierce			1089
<i>Soliperla fenderi</i>	16-Aug-99	Paradise River, Paradise Valley, Mt. Rainier National Park	MRNP	Pierce			1115
<i>Soliperla fenderi</i>	27-Jul-53	Spring seeps along St. Andrews Creek, Mount Rainier National Park	MRNP	Pierce			1146
<i>Soliperla fenderi</i>	13-Jul-79	Spring seeps along St. Andrews Creek, Mount Rainier National Park	MRNP	Pierce			1146
<i>Soliperla fenderi</i>	29-Jun-81	St. Andrews Creek, Mount Rainier National Park	MRNP	Pierce			1146
<i>Soliperla fenderi</i>	15-Jun-69	Christina Falls, Mount Rainier National Park	MRNP	Pierce			1147
<i>Soliperla fenderi</i>	27-Jul-01	Dick Creek at Wonderland Trail, Mount Rainier National Park	MRNP	Pierce			1251
<i>Soliperla fenderi</i>	14-Jul-79	Small stream at Reflection Lake, Mount Rainier National Park	MRNP	Pierce			1483
<i>Soliperla</i> sp.	15-Jun-04	Summit Crk, FR 44, Summit Crk Cmpgnd		Lewis			784
<b><i>Soliperla</i> sp.</b>	12-Aug-16	<b>Stream by FS 5270 road crossing</b>	<b>GIP</b>	<b>Lewis</b>	<b>Stream</b>	<b>13.5</b>	<b>798</b>
<i>Soliperla</i> sp.	15-Jun-04	5 mi E White Pass, Hwy 12		Yakima	Small cascades		1065
<b><i>Soliperla</i> sp.</b>	25-Aug-16	<b>Small perennial stream</b>	<b>OKW</b>	<b>Kittitas</b>	<b>Stream</b>	<b>11</b>	<b>1103</b>
<b><i>Soliperla</i> sp.</b>	25-Aug-16	<b>Outlet stream from Cottonwood Lake</b>	<b>OKW</b>	<b>Kittitas</b>	<b>Stream</b>	<b>8.5</b>	<b>1201</b>
<b><i>Soliperla</i> sp.</b>	20-Aug-15	<b>Perennial stream flowing across Snowgrass Basin trail</b>	<b>GIP</b>	<b>Lewis</b>	<b>Stream</b>	<b>11</b>	<b>1428</b>
<b><i>Soliperla</i> sp.</b>	10-Aug-16	<b>Unnamed creek #1 - first one flowing since starting on the trail from Snowgrass TH</b>	<b>GIP</b>	<b>Lewis</b>	<b>Stream</b>	<b>9</b>	<b>1428</b>
<b><i>Soliperla</i> sp.</b>	10-Aug-16	<b>Stream along Snowgrass Basin trail</b>	<b>GIP</b>	<b>Lewis</b>	<b>Stream</b>	<b>9</b>	<b>1505</b>
<b><i>Soliperla</i> sp.</b>	12-Aug-16	<b>Inlet creek to upper Tatoosh Lake</b>	<b>GIP</b>	<b>Lewis</b>	<b>Lake inlet</b>	<b>10.5</b>	<b>1523</b>
<b><i>Soliperla</i> sp.</b>	20-Aug-15	<b>Hillside seep with multiple small channels</b>	<b>GIP</b>	<b>Lewis</b>	<b>Seep</b>	<b>4</b>	<b>1875</b>
<b><i>Soliperla</i> sp.</b>	10-Aug-16	<b>Widespread seepy area on a hillside along the trail</b>	<b>GIP</b>	<b>Lewis</b>	<b>Seep</b>	<b>4.5</b>	<b>1875</b>
<b><i>Soliperla</i> sp.</b>	20-Aug-15	<b>Hillside seep</b>	<b>GIP</b>	<b>Lewis</b>	<b>Seep</b>	<b>12.5</b>	<b>1882</b>
<b><i>Soliperla</i> sp.</b>	10-Aug-16	<b>Unnamed seep</b>	<b>GIP</b>	<b>Lewis</b>	<b>Seep</b>	<b>16</b>	<b>1882</b>
<b><i>Soliperla</i> sp.</b>	21-Aug-15	<b>Hillside seep west of camp</b>	<b>GIP</b>	<b>Lewis</b>	<b>Seep</b>	<b>8</b>	<b>2034</b>
<b><i>Soliperla</i> sp.</b>	11-Aug-16	<b>Large seepy hillside along trail from Goat Lake</b>	<b>GIP</b>	<b>Lewis</b>	<b>Seep</b>	<b>6.5</b>	<b>2034</b>