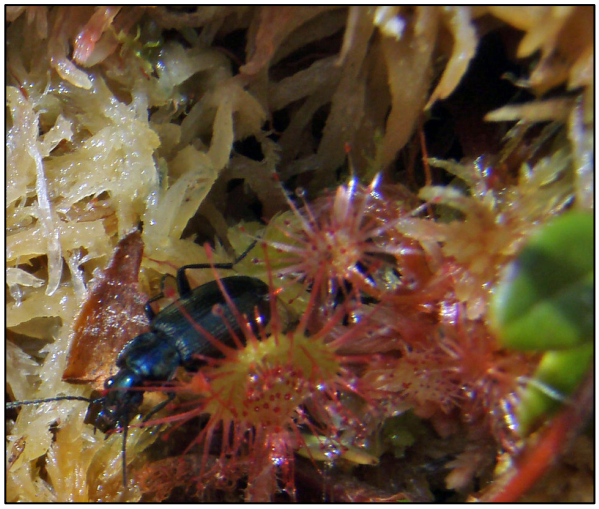
Project completion report to the
Interagency Special Status/Sensitive Species Program (ISSSSP)
Financial Assistance Agreement No. L08AC13768 - Modification 4

Surveys to determine the status of the rare Beller's Ground Beetle (*Agonum belleri)* and Hatch's Click Beetle (*Eanus hatchi*) in suitable bog habitat on FS lands in the Mt. Baker-Snoqualmie and Okanogan-Wenatchee National Forests of Washington



Suspected *Agonum* spp. crawling among *Sphagnum* spp. and *Drosera rotunifolia*, Springer Lake Bog, Washington. Photo by Michele Blackburn, Xerces Society, 2012.

Drosera rotundifolia (sundew), *Sphagnum* spp., and *Vaccinium oxycoccos* (bog cranberry) Darrington Ranger District, Washington. Photo by Alexa Carleton, Xerces Society, 2012.

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Abstract:
Beller's ground beetle (*Agonum belleri*) and Hatch's click beetle (*Eanus hatchi*) are both rare endemic wetland-dependent species restricted to *Sphagnum* bogs of the Pacific Northwest. The sensitive *Sphagnum* bog habitat on which these species rely is particularly vulnerable and these wetland complexes are rare in forested federal lands in Washington. With many bogs degraded or destroyed by development, water extraction, and logging, populations of both of these bog-dependent species are likely suffering due to limited suitable habitat. Suitable wetland bogs and marginal seep habitat does appear to exist in the localities surveyed in 2012. Habitat identified and surveyed included: bogs with floating mats of *Sphagnum* next to adjacent open water; marginal *Sphagnum* habitat patches near springs, seeps, and backwaters of streams; and late-successional grass meadows with *Sphagnum* and other bog-associated vegetation. In 2011, Xerces Society staff was unable to survey potential habitat for *A. belleri* and *E. hatchi* in *Sphagnum* bog sites on federally-owned lands in Washington due to an unusually high snow year. Snow conditions in spring of 2012 at higher elevation sites delayed survey efforts until August 2012 (beyond the known index period for Hatch's click beetle). Suspected *A. belleri* specimens were collected from several localities; no *E. hatchi* were collected at any of the survey sites, and no other members of the click beetle family (Elateridae) were seen. Identification of suspected *A. belleri* specimens revealed that all of the specimens collected were ground beetles (Carabidae). Though no *A. belleri* were found, three different species of *Agonum*, one species of *Anchomenus* and one species of *Bembidion* were collected. Absence of target species may indicate that the habitat is unsuitable, or the species is present at such low abundance and/or with such patchy distribution that they are unable to be detected with this level of survey effort. Additionally, in the case of *E. hatchi*, absence of this species could also be due to delay of survey efforts conducted beyond the species' index period; though it was assumed that if *E. hatchi* occurs at mid- to high-elevations, their active period would be delayed by weather conditions during spring.

We achieved all of the major goals of this project:

- determine the criteria for surveying areas for the Beller's ground beetle and Hatch's click beetle by mapping potential suitable habitat
- consult with BLM and USFS botanists and biologists on the appropriate districts and national forests to identify suitable BLM or USFS owned habitat near the historic collection localities in Washington
- survey suitable habitat in the west sides of the Okanogan-Wenatchee and Mt. Baker-Snoqualmie National Forests in Washington for the Beller's ground beetle and Hatch's click beetle
- record all data including documenting where surveys were conducted
- write a complete report that includes detailed maps of areas surveyed for the Beller's ground beetle and Hatch's click beetle

Project Background:
The purpose of this project was to identify and survey potential habitat and determine whether the bog-associated species Beller's ground beetle (*Agonum belleri*) and Hatch's click beetle (*Eanus hatchi*) occur in suitable *Sphagnum* bog habitat within forested USFS and BLM lands in Washington.

Eanus hatchi
This species is endemic to low- to mid-elevation bogs within Washington's Puget Sound area; with no known sites determined on federal lands (Foltz-Jordan, 2009b). Historic information is very limited, as this species has only been recorded from six sites in two counties in Washington: Chase

Lake and Carkeek Park in Snohomish County, and Kings Lake Bog, Snoqualmie Bog, Lake Marie, and Queen Anne Hill (Seattle) in King County. Extant populations are only known from King County and it is thought to be extirpated from historic Snohomish County sites and from the Queen Anne Hill site in Seattle. Additional populations at undisclosed sites in southern King County have been surveyed by James Bergdahl (Bergdahl, 2008, pers. comm.). The availability of suitable habitat in the Mt. Baker-Snoqualmie National Forest in proximity (the nearest bog site surveyed is about 22 miles from the historic site of Kings Lake Bog) to extant populations may be encouraging for surveys of *E. hatchi*. *E. hatchi* has not been found outside of Washington, though it may occur in suitable habitat in northwestern Oregon. This species is state ranked as critically imperiled in Washington (WDNR, 2012) and is a Federal Species of Concern (NatureServe Explorer, 2012). This species is 7.0 – 9.0 mm (0.28 – 0.35 in.) in length, with an elongated, parallel-sided body, and has a metallic-bronze color that may reflect green or purple. As is typical of all click beetles, the adult pronotum is extended into points at the posterior corners (Figure 1b). Surveys for *E. hatchi* indicate that adults are active on warm, sunny days in April and May; they may also be active in June at mid-elevations. Very little is known of adult feeding habits, though it is thought that they are similar to other related species and are herbivorous, feeding on pollen, nectar, and floral structures. Suitable habitat is rare within known population ranges for *E. hatchi*; populations have probably experienced decline due to urban development and logging, altering hydrology and water quality of the sensitive habitats on which they rely.

Agonum belleri

Historically, populations of *A. belleri* have been known from seven *Sphagnum* bogs in northern Oregon, western Washington, and southwestern British Columbia (Foltz-Jordan, 2009a). Although abundance estimates have not been determined for this species, extensive surveys from 1997-1999 for *Sphagnum* bogs in the Pacific Northwest revealed approximately 25 sites in Oregon, Washington, and British Columbia at which this species was extant (Foltz-Jordan, 2009a). *A. belleri* populations have not been documented on federal lands in Washington, though it is suspected to occur on National Forest lands in this state. This species' state rank for Washington is rare or uncommon (WDNR, 2012), and is state listed as critically imperiled in Oregon (NatureServe Explorer, 2012). Adults are flightless and 6.0 – 7.5 mm (0.24 – 0.29 in.) in length. The body appears metallic and typically coppery-bronze (though it may reflect green or blue), the antennae are densely covered with hairs, and the dorsal surface has an even covering of bristles (Figure 1a). Survey records indicate that adults are active April through September. Adults are omnivorous, eating seeds and other plant material as well as small invertebrates that may be gleaned from carnivorous sundew plants (*Drosera* spp.). Because this species is a habitat specialist and has limited dispersal capacity due to its flightlessness, populations may be particularly vulnerable to continued degradation and loss of suitable habitat due to drainage or filling, trampling, wetland bog succession, insecticide use, and logging.

Figure 1. Bog beetle specimens.

A. *A. belleri* B. *E. hatchi*

Photos by Celeste Mazzacano, Xerces Society; specimens are courtesy of Oregon State University Arthropod Collection (OSAC).

Methods:

Site selection

Potential *Sphagnum* bog habitat identified on U.S. Forest Service lands was determined first by mapping in ArcView v.10. Land ownership boundaries were overlaid with a USDA GAP land cover layer with the bog or fen attribute selected. Individual records for attributes of bog-associated plants were selected and added to the map: peat, *Sphagnum*, *Ledum* (Labrador Tea), *Tsuga* hemlock) *Drosera* (sundew), *Eriophorum* (cotton-grass), and *Vaccinium* (bog cranberry). *Tsuga* was included because *E. hatchi* is known to be linked with hemlock-associated bogs, and *Drosera*, *Eriophorum*, and *Vaccinium* were chosen since they have been associated with *A. belleri* bogs. Available records of *Ledum* locations from the Washington Natural History Program were also included. Washington County soils information from the Washington Department of Natural Resources website were selected for peat soils in the attribute table (this site contained information for King, Yakima, Klickitat, Kittitas, Chelan, Snohomish, Pierce, Skagit, and Whatcom Counties; Benton & Douglas Counties were not available).

Inquiries about bog habitat were made to multiple USFS staff (Table 1) to obtain specific site information. Sites with suitable habitat, GPS coordinates, and habitat descriptions provided by Ann Risvold (North Zone Botanist, USFS-Retired) were identified as potential habitat in ranger districts adjacent to historical sites and were prioritized as sites with high potential for species occurrence. Additionally, information about potential suitable habitat was obtained from Robin Lesher (Ecologist, USFS-Retired), who provided a file of plot locations where *Sphagnum* spp. or three bog-associated vascular plant species occurred within the Mt. Baker-Snoqualmie National Forest. This information as well as habitat descriptions provided by Robin Lesher assisted our selection of additional habitat locations near other priority sites within the Darrington and Skykomish Ranger Districts.

Consultation with USFS rangers, biologists, and botanists indicated that little additional information beyond that described above was known of *Sphagnum* bog habitat on federal lands in Washington. Several USFS contacts communicated to Xerces staff that bogs are an uncommon community in the

Mt. Baker-Snoqualmie National Forest of Washington, and even fewer exist from low elevations. Historic collection sites within the Puget Sound area led Xerces staff to concentrate on bog habitats in the adjacent and surrounding Snohomish and King Counties within the Darrington and Skykomish Ranger Districts, respectively. A planning visit was conducted in May 2012 to meet with rangers in the Skykomish Ranger District and a Wildlife Biologist with the Darrington Ranger District to discuss access to potential low to high elevation sites.

Very few true *Sphagnum* bog habitats are known from public lands in Washington, though several low elevation lake-associated bogs do exist in Washington's Puget Sound area on private lands. Potential suitable habitat was identified within ranger districts neighboring the documented historic sites of *A. belleri* and *E. hatchi* in the Puget Sound lowlands. Xerces staff focused survey efforts on bogs within the neighboring Snohomish and King Counties as well as one low elevation lake-associated bog in Chelan County (Fish Lake Bog). Although Fish Lake Bog is not located in a neighboring county to the historic sites, this site was prioritized because of its low elevation and large expanses of extensive floating *Sphagnum* mats, which appears to be the preferred habitat for *A. belleri* based on historic collections (Niwa *et al*., 2001).

Table 1. USFS Staff Consulted in 2011 & 2012

Name	Position	Agency
Rachel Lipsky	South Zone Environmental Coordinator	USFS
Ann Risvold	North Zone Botanist	USFS-Retired
Robin Lesher	Ecologist	USFS-Retired
Lauri Malmquist	District Botanist	USFS
Joe Neal	Skykomish District Ranger	USFS
Joan St. Hilaire	Wildlife Biologist	USFS
Jo Ellen Richards	Environmental Coordinator/Wildlife Biologist	USFS
Kelly Evans	Botanist	USFS
Helen Lau	District Botanist	USFS
Joe Rocchio	Vegetation Ecologist	WA DNR
Phyllis Reed	Wildlife Biologist/Environmental Coordinator	USFS
Diane Boyd	Forestry Technician	USFS
Don Youkey	District Wildlife Biologist	USFS
Rod Clausnitzer	Forest Botanist/Ecologist	USFS
Louise Kulzer	Botanist	USFS
Joe Arnett	Rare Plant Ecologist	WA NHP

Survey protocol

Surveys for *A. belleri* were conducted using a recommended treading technique (Martin, 2003a) on *Sphagnum* moss mats within bog communities. Pitfall trapping is also a technique used to capture *A. belleri* specimens by placing a wax-coated Dixie cup filled with water or a preserving agent flush with the surface of the *Sphagnum* (Foltz-Jordan, 2009a). Because of the time involved in travel and navigation to each site, this technique was not utilized, as it requires the trap to be left in place overnight before the contents are collected. Traps are difficult to secure in the floating habitat, and are also likely to have significant by-catch, as they capture any creature walking across the surface of the mat. Treading involves walking on *Sphagnum* mats, and submerging the vegetation for a minute to several minutes. If beetles are present in the flooded area, the individuals floated to the water's surface or climbed onto the boots of surveyors or vegetation to avoid drowning. In addition, beetle

activity on warm sunny days is such that they may easily be seen running around on the surface of the moss and can be collected without treading.

Because *E. hatchi* specimens have been collected by sweep-netting in patches of bog-associated *Ledum* and other flowering shrubs (Martin, 2003b), a standard sweep net technique was also performed to survey for *E. hatchi* in woody vegetation surrounding and within the bog complexes. The sweep net technique involves swinging a net from the bases to the tops of plants as the surveyor walks through a transect. The contents of nets were examined after every pass through a transect.

Bog habitats were surveyed in one to multiple random polygon transects, concentrating on areas with *Sphagnum* mats and avoiding drier areas where the *Sphagnum* mats were devoid of water. Areas with floating mats of *Sphagnum* were more challenging to survey, as walking in these areas caused the mat to move, submerging the surveyor's boot considerably below the substrate. Caution was needed as these floating mats were usually interspersed by deep pools or seeps.

The coordinates for each polygon were recorded using a Garmin Dakota 10 GPS unit (NAD83). The two-person survey team moved through a transect, slowly pressing down on mats and waiting several minutes to observe beetles that were floating up in the water. Beetles were then hand-collected and placed in screw-cap vials containing 80% ethanol as a preservative. Sweep-netting through and over the tops of marginal vegetation was also conducted to collect potential *E. hatchi* specimens. All surveyed polygons include transects walked for both the treading technique and sweep-netting. Surveys commenced around 8:30-9:30 am each day, and continued until 5-6 pm. The weather during the survey period was variable, with warm and sunny days and cooler, partly cloudy days.

Results:

Due to an extremely snowy winter and cold spring in Washington's National Forests, conditions were not suitable for surveys at selected bog sites until late July and early August, as regional staff reported substantial snow in the area until this time. Surveys were conducted for both *A. belleri* and *E. hatchi* by two surveyors the week of August 20-24, 2012. Surveys commenced during the documented survey period for adult *A. belleri* (April through September), but were beyond the documented index period for *E. hatchi* (April through June). Although adult *E. hatchi* are thought to be active from April through June, there have been very few searches completed in high elevation bogs on federal lands. Because these federal lands may have been largely overlooked in the past, it may be that, if present, *E. hatchi* would have a later index period in these cooler, mid- to high-elevation bogs than has been documented in the lowlands. During surveys, weather conditions were generally sunny and warm, with some days mixed with periods of clouds and occasional foggy conditions at higher elevations. The majority of mornings were cool and partly to mostly cloudy, though clouds usually burned off as the day progressed.

E. hatchi was not present at any of the sites surveyed, and no other click beetles were observed. Thirty-two carabid ground beetles resembling *A. belleri* were collected from five sites within the Mt. Baker-Snoqualmie National Forest and one site within the Okanogan-Wenatchee National Forest. Professional identification of beetle specimens was conducted by Jim Labonte, Taxonomic and Survey Entomologist with the Oregon Department of Agriculture, who is familiar with this species. Expert determination to confirm field identifications indicate that the smaller beetles collected are in the *Bembidion* genus, which is the most common genus (by number of species) in the family

Carabidae (See table 2 for results at each site). Results indicate that one species of *Bembidion*, one species of *Anchomenus*, and three different species in the *Agonum* genus were found at survey sites, though no *A. belleri* were collected. While the *Agonum* species collected were found in bog habitat, none are known to be restricted or endemic to *Sphagnum* or peat bogs as is *A. belleri* (Labonte, 2012b, pers. comm.). Beetle specimens will remain in collection at the Oregon Department of Agriculture.

Table 2. Washington – Bog Beetle Specimens

Collection Date	Locality	Polygon	County	National Forest	Species Identification
8/20/2012	Mt. Pilchuck	Mt. Pilchuck3	Snohomish	Mt. Baker - Snoqualmie	*Bembidion fortestriatum* (Motschulsky) (10)
8/22/2012	Kelcema Lake	Kelcema1	Snohomish	Mt. Baker - Snoqualmie	*Anchomenus quadratus* (LeConte) (2), *B.fortestriatum* (6)
8/22/2012	Darringon1	Darrington1-1	Snohomish	Mt. Baker - Snoqualmie	*Agonum mutatum* (Gemminger & Haldeman) (2), *Agonum* (*Melanagonum*) sp. (1)
8/22/2012	Darrington1	Darrington1-2	Snohomish	Mt. Baker - Snoqualmie	*B. fortestriatum* (1)
8/23/2012	Stone Lake	Stone Lake1	King	Mt. Baker - Snoqualmie	*A. quadratus* (2)
8/23/2012	Stone Lake	Stone Lake2	King	Mt. Baker - Snoqualmie	*B. fortestriatum* (1)
8/23/2012	Eagle Creek Meadow	Eagle Creek Meadow1	King	Mt. Baker - Snoqualmie	*Anchomenus quadratus* (LeConte) (1)
8/24/2012	Fish Lake Bog	Fish Lake1	Chelan	Okanogan-Wenatchee	*Agonum thoreyi* Dejean (1)
8/24/2012	Fish Lake Bog	Fish Lake2-A	Chelan	Okanogan-Wenatchee	*Agonum mutatum* (Gemminger & Haldeman) (3)
8/24/2012	Fish Lake Bog	Fish lake2-C	Chelan	Okanogan-Wenatchee	*Agonum mutatum* (Gemminger & Haldeman) (2)
8/24/2012	Fish Lake Bog	Fish Lake2-E	Chelan	Okanogan-Wenatchee	*Agonum mutatum* (Gemminger & Haldeman) (2)

Site surveys

See Appendix A for a detailed list of survey sites. One to multiple polygon transects were surveyed at each site; coordinates represent the approximate midpoint of the overall site. See Appendix B for maps of individual survey polygons within each area.

<u>Mt. Pilchuck, 08/20/2012, N 48.069424° W 121.811837°</u>:

USFS biologists had informed Xerces staff of the presence of a small *Sphagnum*-dominated bog community near the beginning of the trailhead to Mt. Pilchuck in Snohomish County in the Darrington Ranger District. This site was an old ski area and the habitat surrounding the bog had signs of heavy usage. Despite this, the polygon area surveyed at Mt. Pilchuck 3 (Figure 3) was surrounded by shrubs and trees and probably remains unknown to hikers in the area. Other polygons

surveyed, Mt. Pilchuck 1 and 2 (Figure 2), were drier bog meadow habitat containing *Sphagnum*, with signs of heavy usage. Although Mt. Pilchuck is at a higher elevation (3200 ft) compared to historic sites where *E. hatchi* has been collected (1000-1500 ft), we thought this site had potential, as low-elevation bog sites are rare on federal lands. Xerces staff surveyed one polygon at Mt. Pilchuck 1, but the *Sphagnum* was completely dry. Much of the *Sphagnum* at Mt. Pilchuck 2 was also dry except for areas that surrounded a small pond. No beetles were collected at Mt. Pilchuck 1 or 2. Xerces staff surveyed the entire bog at Mt. Pilchuck 3 by treading and used the sweep net in the shrub and tree vegetation surrounding and within the bog. Surveys totaled 668 square meters (sqm) from three polygons at this site. Conditions were warm and sunny to partly cloudy, ideal for insect activity. Ten beetle species, *Bembidion fortestriatum* were collected by treading at this site. None of the target beetles were collected through sweep netting, although other insects (Hemiptera, Coleoptera, Lepidoptera) and Arachnids were taken in the sweep nets. The bog meadow was dominated by *Sphagnum* and sedges and was surrounded by huckleberry shrubs and conifers.

Figure 2. Mt. Pilchuck 1 (A), Mt. Pilchuck 2 (B)

Photos by Alexa Carleton, Xerces Society, 2012

Figure 3. Mt. Pilchuck 3. Overview of bog habitat (A) and close up of *Sphagnum* (B)

Photos by Alexa Carleton, Xerces Society, 2012

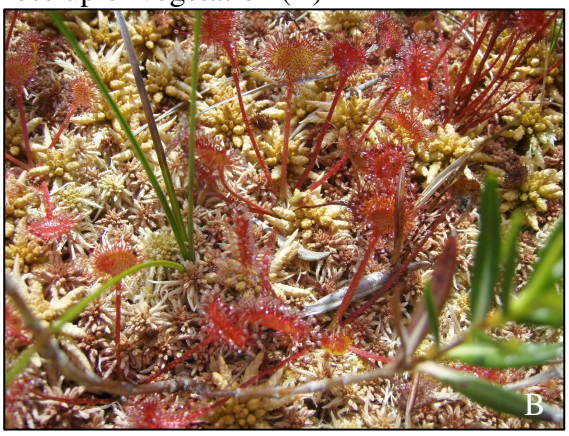
Black Creek Bench, 08/21/2012:
Black Creek Bench1: N 48.044867° W 121.724989°
Black Creek Bench2: N 48.045665° W 121.715420°

USFS staff provided information on three sites within the Black Creek Bench complex on USFS land in the Darrington Ranger District. This complex was described as an "extensive system of bogs" and as being the "nicest and largest bogs" the USFS contact (Ann Risvold, USFS) had seen. Although some of the sites were cross-country, the sites in this complex were prioritized as being potential suitable habitat based on the information provided by Ann Risvold. Two sites were off-trail and cross-country and very difficult to access. Xerces staff was unable to locate one site in this complex, as the terrain and understory made access too difficult. *Sphagnum* at both Black Creek Bench 1 (Figure 4) and Black Creek Bench 2 (Figure 5) was completely dry, and no water was found at these sites. Because the *Sphagnum* mats could not be submerged, a visual survey of the ground and inspection into the dry *Sphagnum* was conducted. One polygon comprising 477 sqm was surveyed at Black Creek Bench 2 by visually searching for active beetles on top of the substrate and within the *Sphagnum* mats and sweep netting the surrounding vegetation and also the shrubs within the meadow. Black Creek Bench 1 was not surveyed by sweep net; one polygon of 1642 sqm was surveyed by visual search for active beetles crawling on the *Sphagnum* mats and inspection deeper into the mat for burrowed beetles. No beetles were collected at either site. The habitat at the time of survey did not appear suitable for the species due to the absence of water, although there is no information in the known beetle life history as to what adaptations they may possess for exploiting *Sphagnum* sites that experience significant seasonal drying. Characteristic bog vegetation was found at both sites; *Sphagnum* spp., Labrador tea (*Ledum groenlandicum*), sundew (*Drosera* spp.), bog cranberry (*Vaccinium oxycoccos*), rushes, cotton grass (*Eriophorum*), and other sedges.

Figure 4. Black Creek Bench 1, Overview (A) and close up of vegetation at site (B)

Photos by Michele Blackburn, Xerces Society, 2012

Figure 5. Black Creek Bench 2, Overview of site (A), close up of vegetation (B)



Photos by Michele Blackburn, Xerces Society, 2012

Kelcema Lake Trailhead Bog, 08/22/2012, N 48.115588° W 121.593541°:
The Kelcema Lake bog site is located on USFS land in Snohomish County in the Darrington Ranger District. This bog was located about 0.5 mi. from Kelcema Lake and was not lake-associated. This was a high-quality bog with no apparent impact from its proximity to the heavily used Kelcema Lake trailhead (Figure 6). Small seeps were interspersed throughout the main meadow. The bog meadow was characterized by *Sphagnum* mats adjacent to seeps. The site was fringed by shrubs and trees. The *Sphagnum* mats were interspersed with sedges, bog cranberry, and skunk cabbage lining the edges of seeps. One polygon comprising 539 sqm was surveyed by treading the *Sphagnum* mat and sweep-netting of the surrounding shrubs. No target species were collected, but other carabids in the *Anchomenus* (2 individuals) and *Bembidion* (6 individuals) genus were collected with the treading technique at this site. The habitat surrounding the bog consisted of shrubs and tall coniferous trees. Sweep netting was done throughout the surrounding shrub vegetation. No beetles were collected by sweep net.

Figure 6. Kelcema Lake. Overview of site (A), close up of habitat (B)

Photos by Michele Blackburn, Xerces Society, 2012

Darrington 1 Bog, 08/22/2012, N 48.067228° W 121.513464°:
The Darrington 1 site is located on USFS land near the Big Four Ices Caves trailhead in Snohomish County, Washington within the Darrington Ranger District. This site is located directly off a

boardwalk trail at a Mt. Loop Highway pullout. The bog site was characterized by floating *Sphagnum* mats adjacent to seeps, and was fringed by shrubs and trees. The *Sphagnum* mats were interspersed with cotton grass and other sedges, bog cranberry, and skunk cabbage. The area was extremely wet and difficult to navigate because of the deep seeps interspersed throughout the site and the spongy nature of the floating mats. Two polygons in this complex encompassing 639 sqm were surveyed. No target beetles were found, but two *Agonum mutatum*, one *A.* (*Melanagonum*), and one *Bembidion fortestriatum* were collected using the treading technique through the floating bog. Surrounding shrub vegetation was surveyed by sweep net technique. No beetles were collected by sweep net.

Figure 6. Darrington 1 Bog. Overview of site (A), close up of habitat (B)

Photos by Michele Blackburn, Xerces Society, 2012

<u>Stone Lake Bog, 08/23/2012, N 47.790020° W 121.409336°:</u>
This bog meadow was located adjacent to Stone Lake in King County, Washington, within the Skykomish Ranger District. The Stone Lake site was accessed by a 2 mile hike into National Forest. The two bog meadows located on the north side of Stone Lake were characterized by *Sphagnum*, *Spirea* spp., cotton grass, and other sedges (Figure 7). Although adjacent to Stone Lake, this site did not have mats of floating *Sphagnum* associated with the open water of the lake. Two polygons totaling 1037 sqm were surveyed by treading and sweep netting. No target beetles were found, but three carabid ground beetles, *Anchomenus quadratus* (2 individuals) and *Bembidion fortestriatum* (1 individual) were collected using the treading method. The sweep net technique in surrounding shrubs and trees did not reveal any beetles.

Figure 7. Stone Lake. Overview of site (A), close up of habitat (B)

Photos by Michele Blackburn, Xerces Society, 2012

<u>Eagle Creek Meadow Bog, 08/23/2012, N 47.791362° W 121.404275°:</u>
Eagle Creek Meadow is located about 0.24 miles east from the Stone Lake site. This is an extensive wet meadow in the Eagle Creek valley (Figure 8). This site is thought to be a late-successional bog meadow dominated by sedges, with small creeks running throughout the habitat. Characteristic bog vegetation present in the meadow included bog cranberry, *Sphagnum*, rushes, cotton grass, and other sedge species. *Sphagnum* in the meadow was patchy, with some drier marginal areas and wetter interior areas. Six polygons totaling 970 sqm were surveyed by treading *Sphagnum* mats and sweep-netting shrubs and small trees. No target beetles were found, but one carabid beetle, *Anchomenus quadratus* was collected at Eagle Creek Meadow by treading. No beetles were collected by sweep netting the shrub and tree vegetation within and surrounding the meadow.

Figure 8. Eagle Creek Meadow Bog. Overview of site (A), close up of habitat (B)

Photo on left by Alexa Carleton, photo on right by Michele Blackburn, Xerces Society, 2012

<u>Fish Lake Bog, 08/24/2012, N 47.831226° W 120.722348°:</u>
Fish Lake Bog is a Research Natural Area (RNA) located in Chelan County within the Wenatchee River Ranger District. A separate research permit was obtained from the USFS (Todd Wilson, USFS Pacific Northwest Research Station) to survey this RNA. Fish Lake Bog is an extensive, lake-associated *Sphagnum* bog located on the west end of Fish Lake (Figure 9). Fish Lake Bog is a high-use recreational site with residential houses, camping, and motorized boats utilizing the surrounding lake. Despite this level of recreational use in the surrounding lake, the bog complex appeared to be

very healthy; residents of the lake noted that the floating bog mat continues to grow and extend over the lake. Bog habitat was surveyed along the southeastern portion of the bog; this area had about 30% canopy coverage by trees that backed this portion of the bog. Lauri Malmquist (Wenatchee River District Botanist) accompanied Xerces staff on a survey of this portion of the bog, which was accessed via a short trail through the forest. One polygon within *Sphagnum* patches was surveyed; no target beetles were found, but one carabid beetle, *Agonum thoreyi* Dejean was collected from the habitat by treading. The site was separated from the main bog by extensive growth of shrubs, cattails, and small channels. The forest along the western edge of the main bog complex made access to the main bog difficult due to a dense understory. Residents of Fish Lake, who were providing boat transportation for Wenatchee River Ranger District and Washington Department of Ecology (WA Ecology) Botanists, provided Xerces staff boat transportation to the main bog. Surveys were conducted along the eastern side of the bog, in proximity to the edge of the floating *Sphagnum* mat over the lake. In addition to an extensive, floating lake-associated *Sphagnum* mat, this site had a variety of forbs plus small, scattered shrubs within the bog complex. Cattails lined most of the *Sphagnum* mat along the lake edge. An invasive plant species (yellow loosestrife) was identified along the *Sphagnum* mat edge by botanists from WA Dept. of Ecology and the USFS, who were surveying the lake shore by boat that day. Other vegetation within the bog included patches of shrubs interspersed throughout the habitat, sundew (*Drosera* spp.), rushes, bog cranberry (*Vaccinium oxycoccos*), *Spirea* spp., cotton grass (*Eriophorum*), and other sedges. Xerces staff also surveyed some drier, interior portions and found beetles in this area. Beetles were also collected in the wetter areas closer to the water's edge. The spongy character of the floating *Sphagnum* mat, along with hidden, deep holes, made walking in the habitat very difficult and slow. Six polygons comprising 3336 sqm were surveyed by treading on *Sphagnum* mats and sweep netting interspersed shrubs. No target beetles were found, but seven *Agonum mutatum* were collected by treading in the main, open bog. No beetles were collected by sweep net.

Figure 9. Fish Lake Bog. Overview of site (A), close up of habitat (B).

Photos by Michele Blackburn, Xerces Society, 2012.

Discussion:

Hatch's click beetle (*Eanus hatchi*) is historically known from lowland eutrophic *Sphagnum* bogs of northwestern Washington. Endemic to the Puget Sound area of Washington, adult *E. hatchi* has not been found in bogs in Washington's National Forests. Beller's ground beetle (*Agonum belleri*) is a rare species restricted to *Sphagnum* bogs from sea level to forested areas of the Cascade Mountains (3300 ft) in the Pacific Northwest (Labonte *et al*., 2001). The range and habitat of adult *A. belleri* are

documented to overlap with *E. hatchi* at bog sites within the Puget Sound area of Washington. The Xerces Society selected survey areas within suitable potential habitat for both *E. hatchi* and *A. belleri* in the neighboring Skykomish and Darrington Ranger Districts, and one low elevation, extensive lake-associated *Sphagnum* bog with potential in the Wenatchee River Ranger District.

In Washington, all known distributional and life history information for *A. belleri* and *E. hatchi* is from data collected on private lands in lowland bogs of the Puget Sound region. Xerces staff identified suitable potential habitat within USFS lands, though neither of the targeted bog-dependent beetles were taken at any sites. Carabid ground beetles in the genus *Agonum*, *Anchomenus*, and *Bembidion* were collected at several sites surveyed in 2012; however the species collected are not characteristically bog-restricted species (Labonte, 2012b, pers. comm.) (See table 2 for a list of beetle specimens collected). Given the relatively short amount of time available for surveys, it is not possible to say with complete certainty that the absence of the target species from the sites surveyed confirms that they are not currently present on USFS lands. The target species may be present at such low numbers that they are unable to be detected given the limited available time, or they may be absent from these habitats, having either never occurred there or are no longer extant. Recent surveys conducted in lowland bogs near Olympia, Washington have not found *E. hatchi* at sites with active *A. belleri* populations (Maynard, 2004; C. Maynard, 2012, pers. comm.). This may indicate that *E. hatchi* has been extirpated from these lowland bogs or exists with patchy distribution.

Potential factors affecting unsuccessful surveys in suspected suitable habitat may result from the target species being undetectable outside of its documented index period, inadequate sunlight or weather conditions unsuitable for insect activity, inappropriate or degraded habitat, or amount of survey effort. Surveys were performed within the documented adult active period for *A. belleri* but outside of the known index period for *E. hatchi*; this may be one factor that resulted in this species being undetectable. Xerces staff was not able to survey many of the targeted sites until enough snow had melted that conditions were favorable. Warm, sunny days during April and May in the Pacific Northwest are particularly rare, and suitable habitat on federal lands is more than likely snow-covered in spring. Given this limitation, either *E. hatchi* is indeed restricted to active periods in spring at lower elevations, and has not moved up to the cooler, higher elevations, or it may be that the species has moved up to higher elevations and thus has adapted its life history to be active later in the season when the weather is more favorable. If this species does exist at these higher elevation sites, individuals were not able to be detected during Xerces' survey efforts.

Though mornings were generally cool (mid to upper 50s) with some clouds, August weather at survey sites was usually warm and sunny by mid-morning, appropriate for insect activity. Most sites surveyed, appeared to be suitable habitat not experiencing degradation, with the exception of Black Creek Bench, which was completely dry. There always exists the potential of less immediately obvious adverse impacts occurring at surveyed sites that may negatively impact invertebrates. Past logging practices were apparent from aerial photos in areas surrounding Black Creek Bench, and these may result in altered hydrology, increased sedimentation, and changed soil chemistry. Fish Lake, while managed as a Research Natural Area, is surrounded by residential homes and is used as a recreational site with boating and camping occurring in and around the lake. If resident activities involve pesticide or herbicide use, the proximity of houses to the *Sphagnum* mat and lake may pose risks in the form of runoff from residential property and petroleum input from motorized boats. Past

disturbances also include logging in the forest around Fish Lake Bog (Pacific Northwest Natural Areas, 2012).

Some of the sites surveyed may be considered marginal seep habitat (at least in the case of A. *belleri* (Niwa, 2001)) and the target beetles may prefer larger floating *Sphagnum* mats adjacent to open water (Maynard, 2003; Maynard, 2012, pers. comm.). Still, these sites were sampled as Xerces staff did not want to rule them out *a priori* because no known past sampling efforts for *A. belleri* and *E. hatchi* have occurred at the sites surveyed in 2012. Additionally, J. Labonte (2012a, pers. comm.) indicated he discovered *A. belleri* in non-floating *Sphagnum* mats at the margins of streams and non-bog lakes. Some of the bog habitat surveyed was challenging to access and/or survey entirely in the time available. Many of these unique habitats are restricted to remote locations within National Forest and are not easily accessible, which limited the number of sites that could be surveyed in the time available, as well as the amount of time that could be spent surveying each site. It is possible that with additional searches and increased survey effort in sites surveyed in 2012, the target species may be found at these sites. Recommended survey methods are easy, inexpensive, and require little specialized equipment, although confirmation of species identity requires an expert. The challenge is that true *Sphagnum* bog habitats are particularly rare on federal lands in this region; the Fish Lake Bog site appears to be a particularly unique floating bog habitat on USFS land. Because this site appears to be the most amenable to surveys (ease of access and characterized by habitat concordant with known open water bog lakes in the Puget Sound area) increased survey efforts at Fish Lake should be considered as this site was too extensive to exhaustively search.

Recommendations:
Additional surveys:

- *E. hatchi* is a flighted beetle, so populations may occur at additional sites beyond the current known distribution, although dispersal capacity of this species has never been directly examined. Increased survey efforts should continue in the surrounding Mt. Baker-Snoqualmie National Forest and bog sites that may exist in the neighboring Olympic National Forest. Additionally, because so little is known of the extent of this species on federal lands, additional target habitats may be mapped and surveyed.
- Because *A. belleri* is not capable of flight, populations may be restricted to contiguous patches of habitat in proximity to known populations in the Puget Sound region of Washington. Conservation of large, continuous habitat mosaics and maintenance of networks of bog habitats may be important in sustaining known and potential populations.
- Increased survey efforts in bogs neighboring existing sites might provide information on the beetle species inhabiting these sensitive habitats. *A. belleri* may prefer floating *Sphagnum* bog habitats associated with the open water of lakes (Niwa, 2001; Maynard, 2004; Maynard, 2012, pers. comm.) and it may be valuable to identify and search these distinctive habitats on federal lands.
- It may be worthwhile to train habitat managers working in districts with *Sphagnum* bog habitat to conduct beetle surveys. Sweep netting is a straightforward sampling technique that does not require expensive equipment. Additional regions of suitable habitat could be surveyed by staff that manage or regularly visit these sites. Staff could be provided with a pocket guide with photos of the target species and a description of how to identify members of the families Elateridae (click beetles) and Carabidae (ground beetles). Definitive specimen ID

by an expert would be required, but this may be a venue to allow for more extensive, ongoing surveys.

Habitat management:
Both *E. hatchi* and *A. belleri* are bog-dependent species that rely on quality wetland habitat. Peat bogs are a highly vulnerable type of wetland habitat that has been degraded by human activities. If one or both of the target species is present on federal lands in Washington, habitat protection would be critical to their survival. Based on species accounts it is clear that information currently known of the life history for both *A. belleri* and *E. hatchi* is insufficient to understand the specific requirements of all life stages. Increased survey efforts to collect natural history information and ecological data during suspected larval index periods may be important in the conservation and management of these species; especially if immature forms are particularly vulnerable to habitat changes or disturbances. Populations of both beetles are likely vulnerable to forest management practices, including logging and water extraction in proximity to suitable habitat. Pesticide management practices can pose risks for invertebrate fauna; adequate buffers or new management practices can be adopted where these species are known or likely to exist.

Acknowledgements:
Funding for *A. belleri and E. hatchi* surveys were provided by the Interagency Special Status/Sensitive Species Program (ISSSSP). Additional thanks to: Alexa Carleton (Xerces), who provided invaluable support as part of the Xerces survey team; Anne Risvold (USFS-Retired), Robin Lesher (USFS-Retired), for providing coordinates and information about bog localities in Washington; Sarina Jepsen (Xerces), for her correspondence with beetle experts; Lauri Malmquist (USFS) for assisting Xerces staff on surveys within Fish Lake Bog; and Celeste Mazzacano (Xerces), for contacting many agency personnel and conducting the initial analysis of bog locations in 2011, and for reviewing this document.

We greatly appreciate the assistance of Kelli Van Norman (BLM), and the many USFS staff cited in this report that provided site information and maps. We are tremendously grateful to James Labonte (Taxonomic and Survey Entomologist, Oregon Department of Agriculture) for dedicating his personal time to the identification of collected beetle specimens. We also thank the residents at Fish Lake Bog for providing boat transportation to the main bog site.

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Appendix A: 2012 Site Survey List

Sites surveyed by Xerces for *A. belleri* and *E. hatchi* in 2012.

Site name	County	Land ownership	Area Surveyed (m^2)	Coordinates[a]
Mt. Pilchuck	Snoqualmie	USFS	668	N 48.069424° W 121.811837
Black Creek Bench 1	Snoqualmie	USFS	1642	N 48.044867° W 121.724989°
Black Creek Bench 2	Snoqualmie	USFS	477	N 48.045665° W 121.715420°
Kelcema Lake	Snoqualmie	USFS	539	N 48.115588° W 121.593541°
Darrington1	Snoqualmie	USFS	639	N 48.067228° W 121.513464°
Stone Lake	King	USFS	1037	N 47.790020° W 121.409336°
Eagle Creek Meadow	King	USFS	970	N 47.791362° W 121.404275°
Fish lake Bog	Chelan	USFS	3336	N 47.831226° W 120.722348°

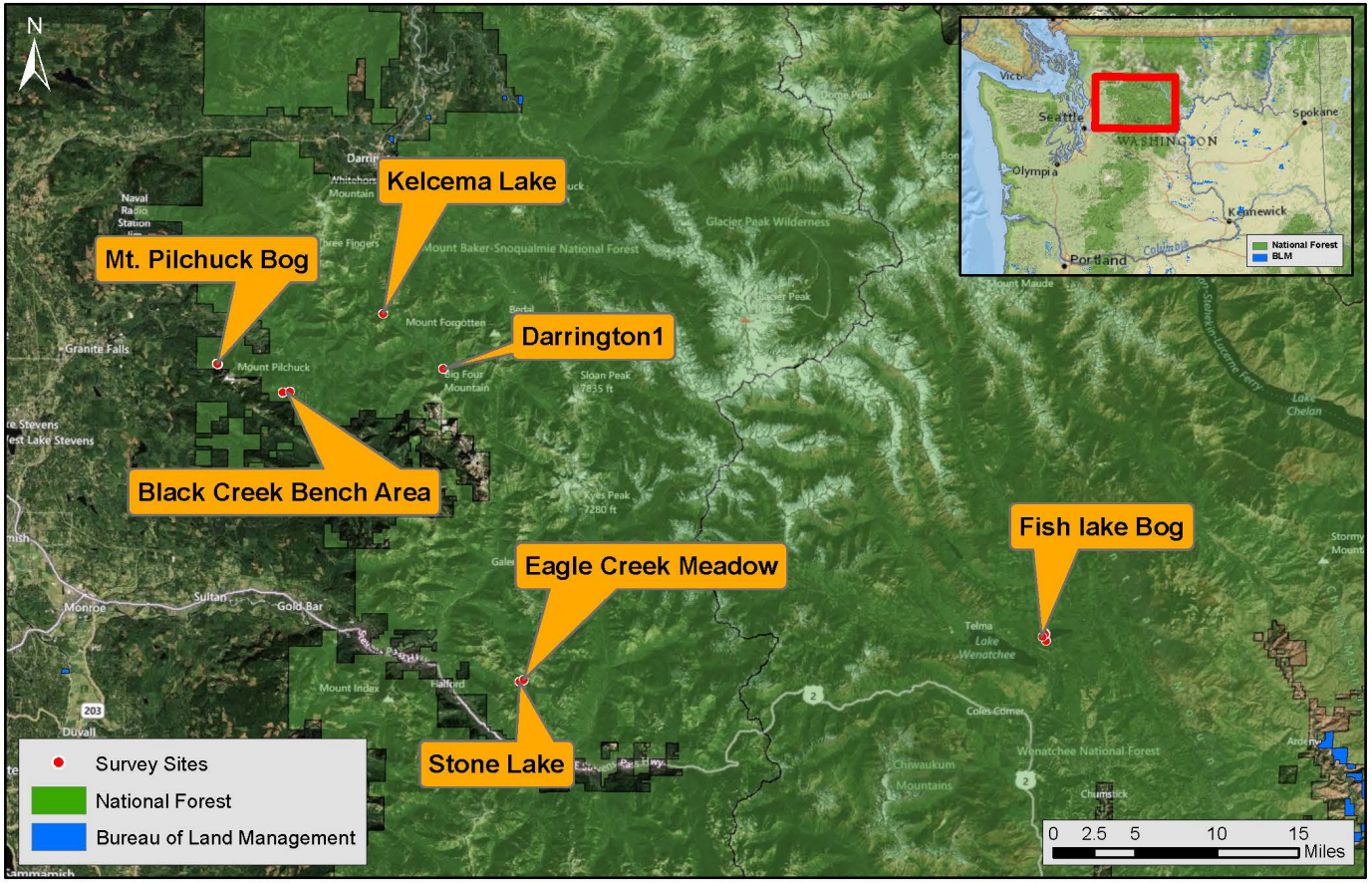
[a]Coordinates represent the approximate midpoint of a polygon surveyed at a site or of the overall site surveyed when multiple polygon transects were surveyed at each site. See Appendix B for maps of individual polygons within each survey area.

Appendix B. Site survey maps

A. Overview of survey sites for Beller's ground beetle and Hatch's click beetle in the Mt. Baker-Snoqualmie and Okanogan-Wenatchee National Forests.

Overview of A. belleri and E. hatchi survey sites on Mt. Baker-Snoqualmie and Okanogan-Wenatchee National Forests

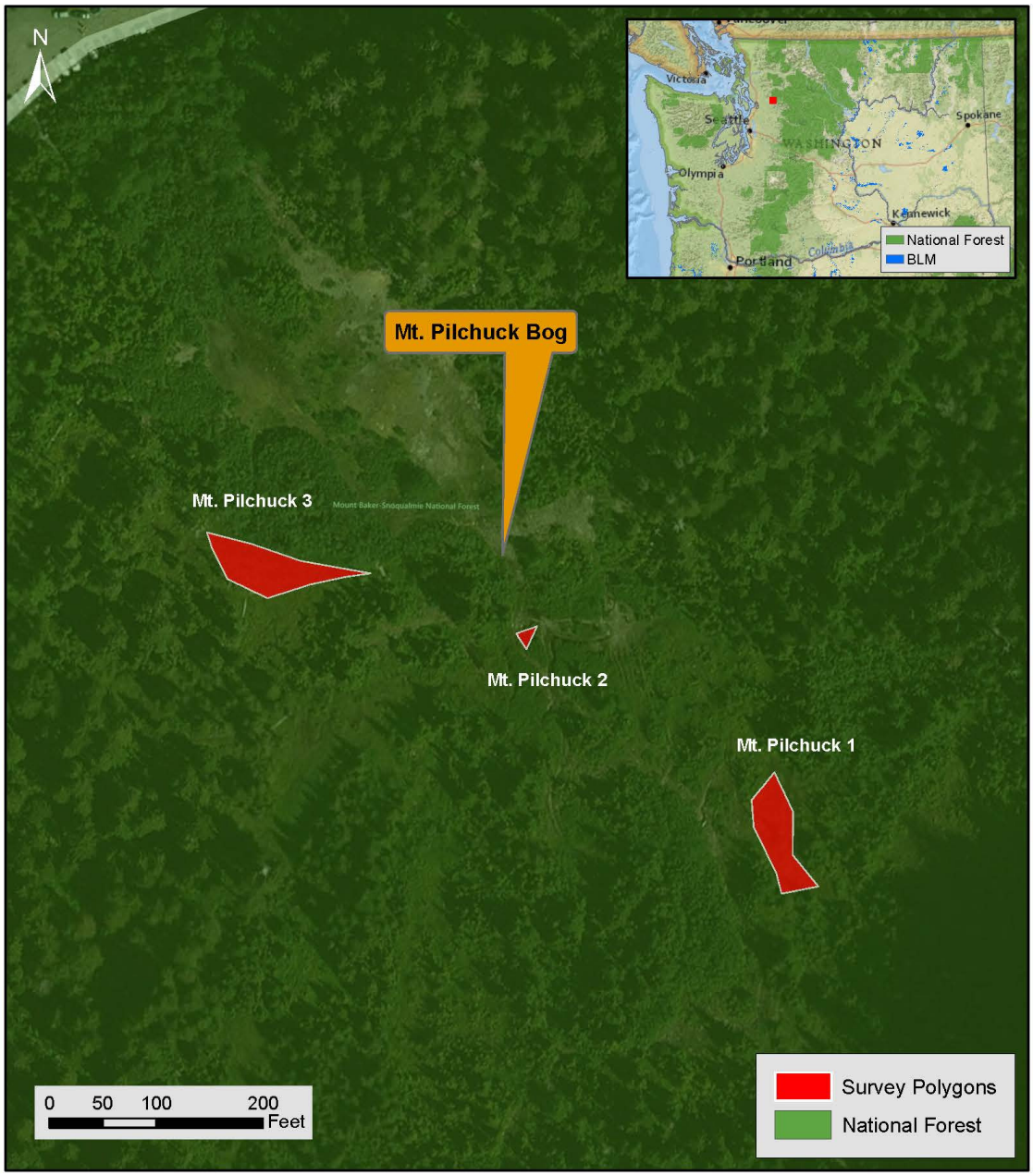
Surveys were conducted August 20-24, 2012. Bog habitat areas were surveyed for beetles by treading technique on Sphagnum mats and sweep-neeting shrubs and small trees. No A. belleri or E. hatchi were found at any of the sites surveyed.



B. *Sphagnum* bog habitat surveyed for Beller's ground beetle and Hatch's click beetle near the Mt. Pilchuck trailhead.

A. belleri and E. hatchi survey sites - Mt. Pilchuck Bog

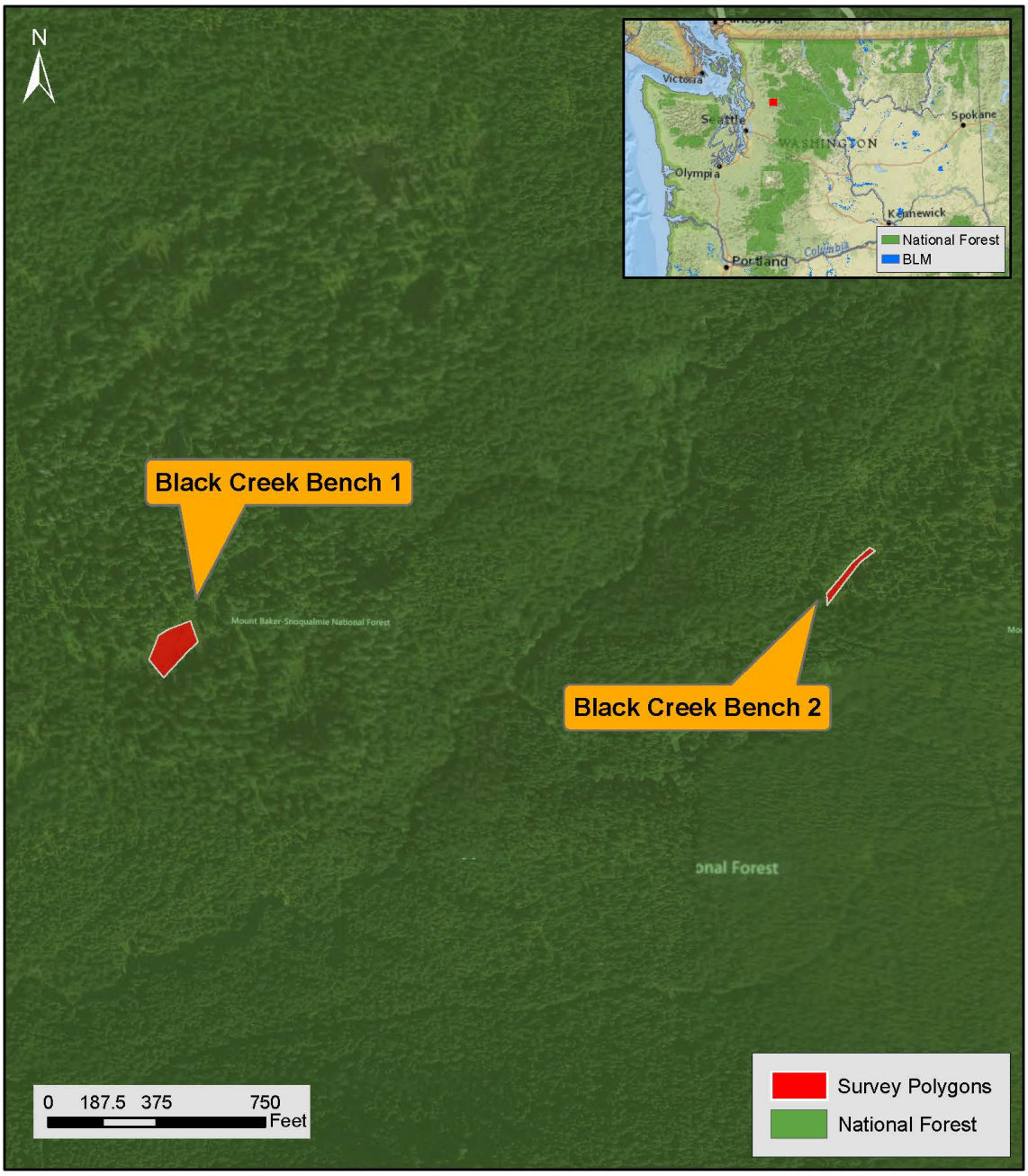
Surveys were conducted on August 20, 2012. Habitat areas surveyed were dry except for the low-lying Mt. Pilchuck 3 polygon. Proximity to a high use trail system and camping activities may be affecting these bogs.



C. *Sphagnum* bog habitat surveyed for Beller's ground beetle and Hatch's click beetle at Black Creek Bench near the Ashland Lakes trailhead.

A. belleri and E. hatchi survey sites - Black Creek Bench

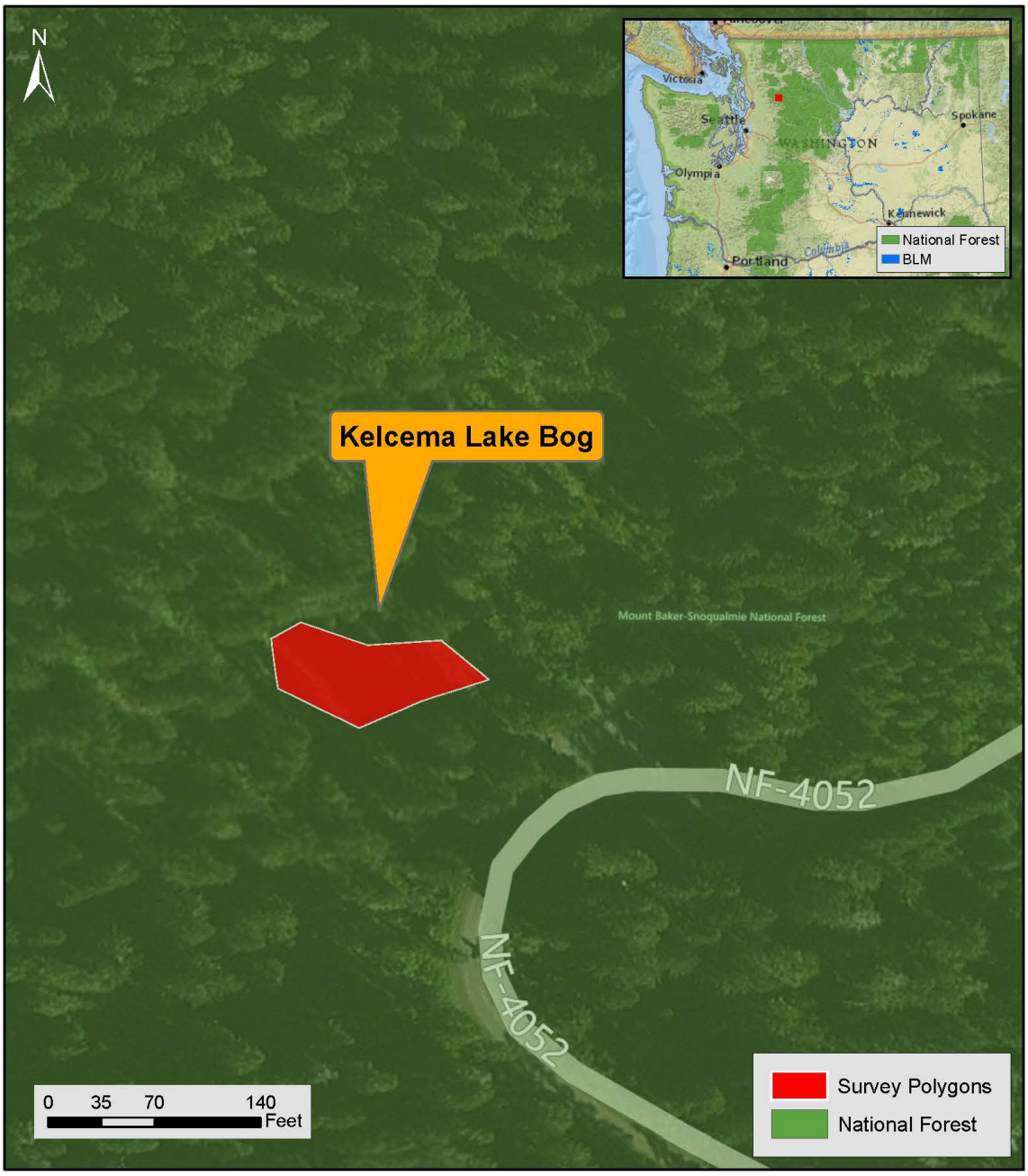
Surveys were conducted on August 21, 2012. Habitat areas surveyed were completely dry. Site 1 was about 0.5 mi off trail. Site 2 was adjacent to the Ashland lakes trailhead. This was the only site where no beetles were collected. Creeks in this area were completely dry or covered in algae. Nearby logging practices may be affecting these bogs.



D. *Sphagnum* bog habitat surveyed for Beller's ground beetle and Hatch's click beetle near Kelcema Lake.

A. belleri and E. hatchi survey sites - Kelcema Lake Trailhead Bog

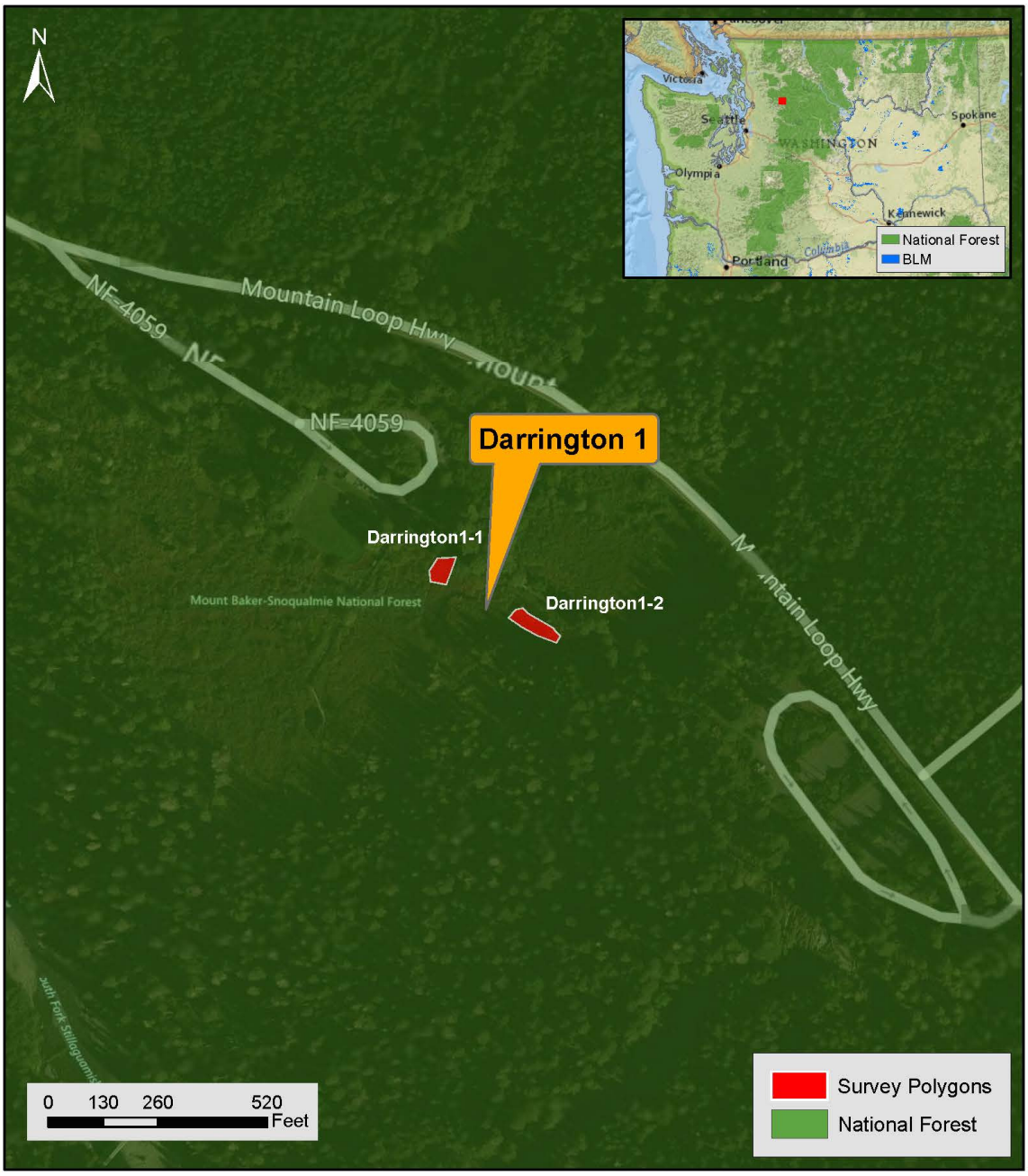
Surveys were conducted on August 22, 2012. This bog was located about 0.5 mi. from Kelcema Lake and was not lake-associated. This was a nice bog with no apparent impact from its proximity to the heavily used Kelcema Lake trailhead. Small seeps were interspersed throughout the main meadow.



E. *Sphagnum* bog habitat surveyed for Beller's ground beetle and Hatch's click beetle at the Darrington 1 bog near the Big Four Ice Caves trailhead.

A. belleri and E. hatchi survey sites - Darrington 1 Bog

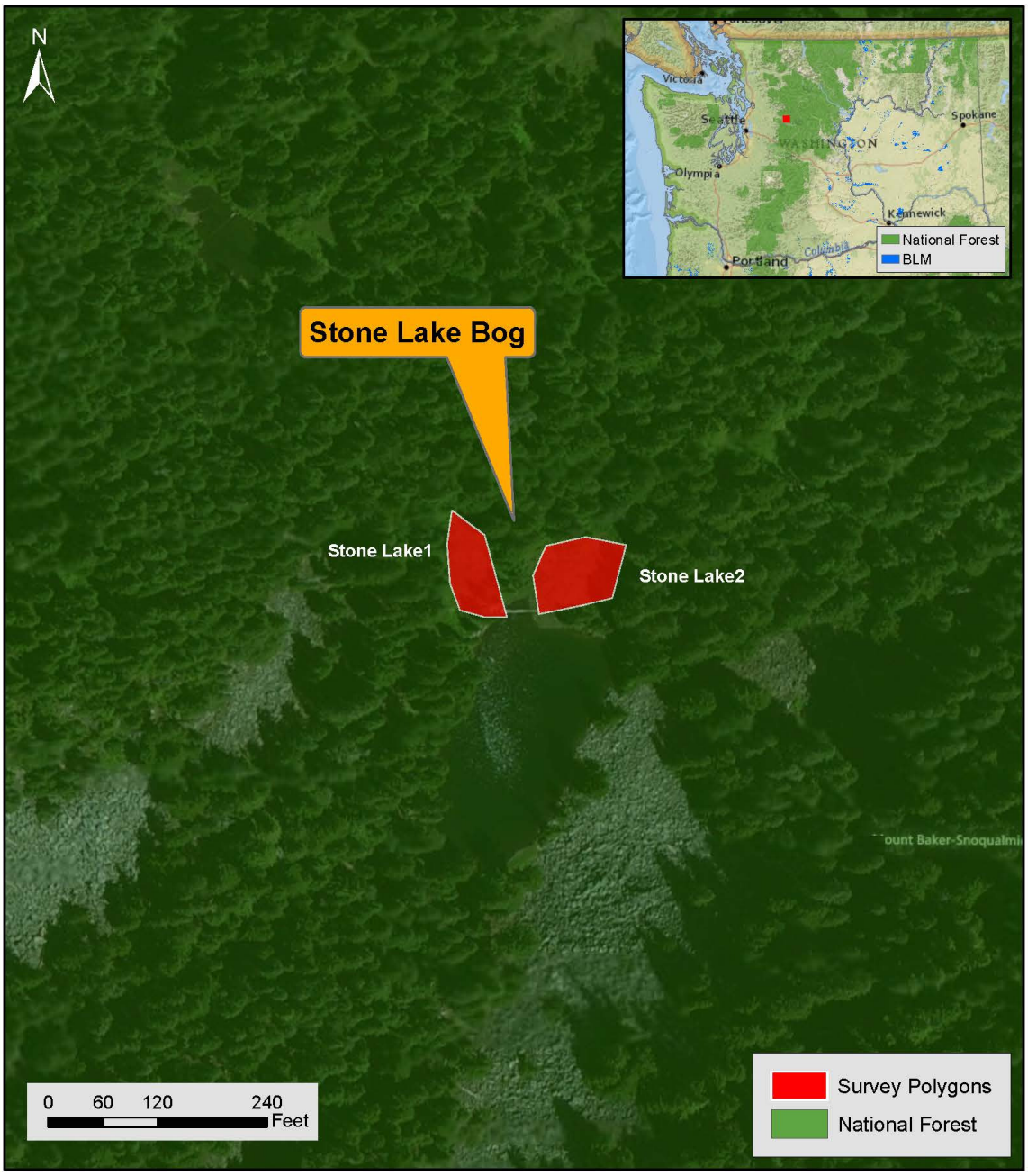
Surveys were conducted on August 22, 2012. This was a nice bog with no apparent impact from its proximity to the heavily used Big Four Ice Caves trailhead. Small seeps were interspersed throughout the floating mats. The spongy character of this bog made walking difficult.



F. *Sphagnum* bog habitat surveyed for Beller's ground beetle and Hatch's click beetle near Stone Lake.

A. belleri and E. hatchi survey sites - Stone Lake Bog

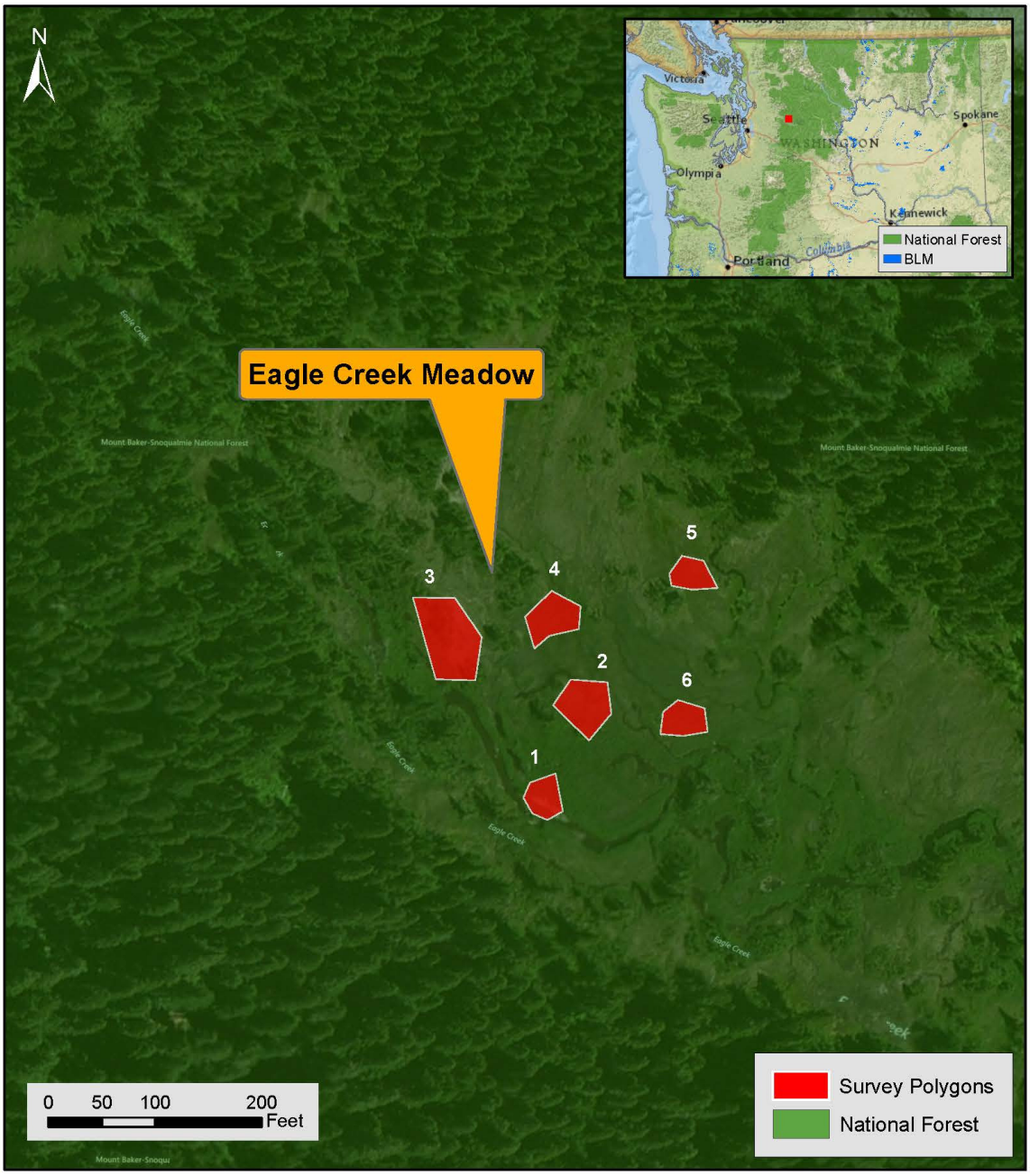
Surveys were conducted on August 23, 2012. This bog was a two mile hike into National Forest within the Skykomish Ranger District. Though adjacent to Stone Lake, there were no floating Sphagnum mats.



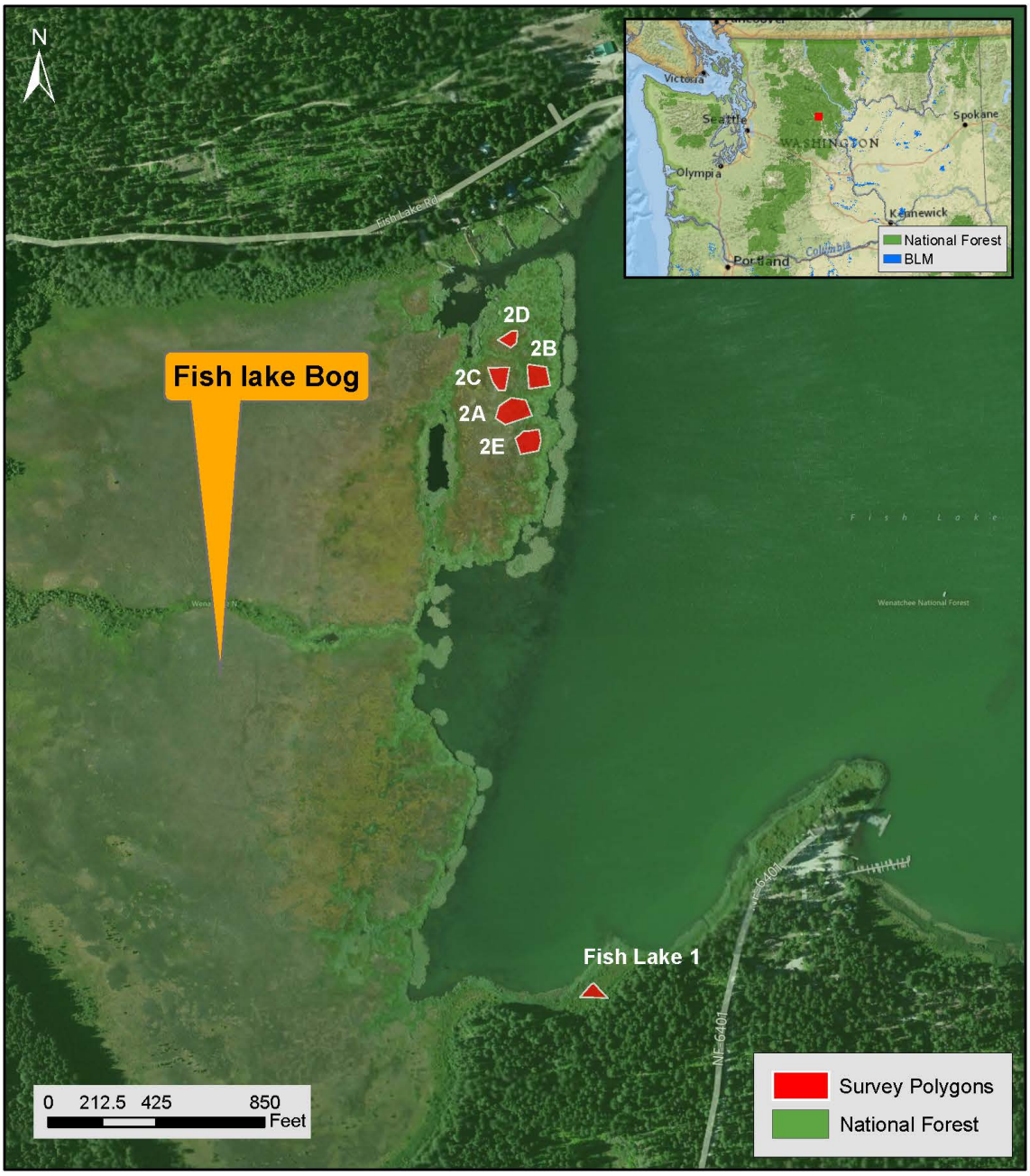
G. *Sphagnum* bog habitat surveyed for Beller's ground beetle and Hatch's click beetle near Eagle Creek.

A. belleri and E. hatchi survey sites - Eagle Creek Meadow Bog

Surveys were conducted on August 23, 2012. This bog was a two mile hike into National Forest within the Skykomish Ranger District. This site appeared to be a late successional bog meadow with seeps and streams running throughout the meadow.



H. *Sphagnum* bog habitat surveyed for Beller's ground beetle and Hatch's click beetle near Fish Lake.

A. belleri and E. hatchi survey sites - Fish Lake Bog

Surveys were conducted on August 24, 2012. Habitat areas surveyed to the south were more marginal bog habitat experiencing succession and encroachment by shrubs and trees. Habitat areas surveyed to the north were accessd by boat. Extremely spongy conditions of the floating mat made walking difficult.