

2006 Bryophyte Monitoring Project -- Cedar River Watershed

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PROJECT OBJECTIVES

A. Monitoring in the 700 Road Forest Habitat Restoration Project

(adapted from description provided by Melissa Borsting, Plant Ecologist, Cedar River Watershed and the Site Management Plan [Boeckstiegel, et al. 2005])

Upland forest restoration to actively accelerate the development of late successional forest conditions and increase habitat complexity in second-growth forest is a key component of the Cedar River Watershed Habitat Conservation Plan (CRW-HCP). Implemented in April of 2000, the CRW-HCP effectively placed nearly 85,500 acres of forests in the Cedar River Municipal Watershed (CRMW) in reserve status by prohibiting the harvest of timber for commercial purposes and mandating management to accelerate the development of late successional forest conditions through silvicultural intervention. This effort is aimed at facilitating and restoring natural forest processes while increasing the habitat available for late-successional forest dependent species (e.g., northern spotted owl, marbled murrelet) and improving the overall water quality in the CRMW by restoring a water cycle more typical of pre-development forest conditions. Second-growth forest, occupying land harvested prior to the adoption of the CRW-HCP, currently make up 71,500 acres of the CRMW, while the remaining 14,000 acres are late-successional or old-growth forest.

Of the 90,546 acres encompassed by the CRW-HCP, 85,477 acres are forested, with 13,980 acres currently in late-successional or old-growth forest conditions. The remaining 71,497 acres are second-growth forest. These younger forests are available for recruitment into late-successional forest habitat and are potentially available for restoration intervention. As stated in the CRW-HCP:

The general objective of the late-successional and old-growth communities component of the watershed management mitigation and conservation strategies is to develop significantly more mature and late-successional forest habitat in the watershed that will support species addressed in this HCP that are dependent on late-successional or old-growth forests, as well as old-growth biological communities in general. (CRW-HCP 4.2-33).

The importance of natural processes and biological diversity is recognized in the CRW-HCP, and a major objective is to:

...develop strategies to restore and sustain the natural processes that create and maintain key habitats for species addressed by the HCP and that foster natural biological diversity of native species and their communities. (CRW-HCP 4.2-10).

Understory plant diversity, including bryophytes, is an area receiving increasing attention in the CRMW. The first part of the bryophyte monitoring project is focused on an area known as the 700 Road Ecological Thinning Project.

Cedar River Watershed is doing a thinning project starting summer 2006. This is an area of

Wagner, David H., Ph.D. 2006. Bryophyte Monitoring Project—Cedar River Watershed. Report prepared for Seattle Public Utilities, Seattle, Washington. July.

second growth (approx 60 year old) Douglas-fir, hemlock and a smattering of cedar, silver fir, noble fir and even 3-4 western white pines and occasional hardwoods. Despite the overstory diversity, the trees are so dense that the vascular flora is quite limited (some diversity, virtually no cover). Most of the area has significant bryophyte cover.

The 700 Road Ecological Thinning Project Area "...was clearcut logged from 1929-1934, which was probably followed by burning to remove logging debris (there is evidence of fire, including charred stumps and DW). The area was likely naturally reseeded, although no documentation of burning or reseeded is available for this site. The existing forest ranges from 61 to 67 years old, with the older trees at lower elevations in E1 and E2, and the younger trees on the ridge top in E7 and RT. The Project Area has not been previously thinned." (Boeckstiegel et al. 2005)

"Specific restoration objectives are: 1) maintain or increase growth rate of trees, 2) increase plant species diversity and facilitate understory development, 3) increase forest structural complexity, 4) create and facilitate maintenance and recruitment of large-diameter snags and down wood (DW), and 5) protect special habitats and water quality." (Boeckstiegel, et al. 2005)

The work described in this report serves two purposes: expanding on an existing inventory of bryophyte diversity in the watershed (Stout 2001) and establishing pre-treatment monitoring plots in the forest restoration project. Bryophyte monitoring should help the project team evaluate success in achieving objective 2 mentioned above. Note that success in objective 4 will contribute to success in objective 2, since bryophyte diversity can be expected to increase as extent of rotting wood habitat is expanded.

B. Stream Survey

The second objective of this project was to design a study that would augment the existing cryptogam survey (Stout 2001). The value of bryophyte monitoring in water quality management (Bates 2000) led to a decision to focus on aquatic and riparian bryophytes. At the suggestion of Todd Bohle, watershed hydrologist for the Cedar River Watershed, two streams known to be prime bull trout habitat were selected for surveys. Three other stream sites were surveyed to compare and contrast with the prime trout streams.

METHODS

A.700 Road Forest Habitat Restoration Project

Monitoring plots previously established for trees, understory vascular plants, and downed wood were used in this project. The bryophyte plots were overlain on the sites of these permanent plots. Bryophyte plots in this part of the project were circular, centered on the center post of circular plots in subunits E2 and E8 or on the start post of transect 1 in E5 and E6. There were three plots in each of these subunits except E6, where only two permanent plots had been previously established.

The size of the plots, ca. 31 m², was determined by previous experience in SW Oregon (Wagner unpublished). This plot was developed as part of a protocol for reconnaissance surveys of bryophyte diversity on a landscape wide scale. The objectives of the survey plots were 1) to

define a relatively uniform unit area so comparisons between and among plots are justified, 2) be large enough to characterize bryophyte associations on at least one important substrate of a single habitat, 3) be small enough to be completed in an efficient and timely manner, 4) be of a size easily estimated without use of measuring devices, and 5) use units of measurement that can be accurately estimated without employing special measuring devices.

The final basis for of the plot size was the distance from which a competent botanist can distinguish different species of bryophytes. Experience proves that reasonable confidence can be placed on observations up to about ten feet away, a circle with a radius of approximately two body lengths. This distance is around 3.14 meters, and since the area of a circle is πr^2 , and π is ~ 3.14 , this has been designated the $\pi^3 \text{ m}^2$ Plot (pi cubed square meters). The nominal area $\sim 31 \text{ m}^2$ is most important, however, not the circular shape of the plot (see below, stream survey).

Many common bryophytes can be recognized to species within this area so most data can be recorded standing in one spot. If there are different species present their occurrence and extent can be recorded even if they cannot be identified to species. Some common species cannot be positively identified in the field; collections must be taken for laboratory examination. Unknowns likewise must be sampled. All bryophyte collections were identified as precisely as possible and processed as voucher specimens into standard, archival herbarium packets. Lichens were also collected and recorded as encountered and processed as vouchers in similar fashion. However lichen identification was minimal, without performing usual chemical tests; some specimens to genus only. All lichen names should be viewed with caution pending verification by a lichen expert. References for moss identification were Norris and Shevock (2004), Lawton (1971), and Smith (2004); liverworts were identified using Wagner (2006); the lichen reference was McCune and Geiser (1997).

Abundance codes were used to give a semi-quantitative value to the cover and biomass of a species at a site. It is important to remember that the codes were used to describe single records and are specific to one substrate at one site. If a species is reported as abundant on a particular substrate in a particular habitat but in a habitat that is itself uncommon in the landscape, then the species will not be abundant in the landscape. The codes themselves are quite simple: a = Abundant, f = Frequent, o = Occasional, s = Sparse (or Scarce), and t = Trace. It is not by accident that these codes (and terms) sort alphabetically into a graduated series. The definitions I have used are relatively broad, so that they may be applied in the field without instruments or exhaustive effort yet may be accurately repeatable:

Abundant	the plants seem to be nearly everywhere; found on two-thirds or more of suitable substrate
Frequent	easy to find but not everywhere; occurs on less than two thirds but more than one third of the substrate in suitable habitat
Occasional	if you look closely in the right kind of place you should find it; typically on 6-33% of a suitable substrate
Scarce	typically found in less than 5% of suitable substrates, or substrate

is restricted and/or unevenly distributed; easy to overlook.

Trace very small amounts present and hard to find without being shown; an experienced botanist might never see it; finding it is so close to accidental that quantification is meaningless. Used also when a few stray strands are found in a collection during microscope examination in the laboratory when the species was not noted in the field at that site.

Plot data were recorded on field forms developed by Wagner (appendix A). Plot numbers previously established by Cedar River Watershed were recorded on the field forms along with a site number based on Wagner's collection numbers. The site numbers allow databasing of all observations and collections, whether from an official plot or not. Interesting bryophytes noticed while traversing the hillside between plots, ones not recorded in the formal plots, were collected and site data captured so that a complete inventory of the project area might be generated.

Other codes were created specifically for classifying habitats and substrates in data entry. These codes were not used when recording habitat and substrate in the field. Brief, site specific, descriptions were written on the field forms. These descriptions were translated into codes at the time of entry in the office. The original substrate and habitat descriptions were loaded into the database as well as the codes. Original field descriptions are often identically worded as code definitions. However, field recorded habitat and substrate descriptions reappear on the specimen labels. The codes were used extensively in sorting and arranging the record for analysis. Habitat codes and substrate codes used for this project are listed in Appendix B and Appendix C.

B. Stream Survey

The stream survey plots generally followed methods for the 700 Road monitoring plots, except the shape of the 31 m² plots was adjusted to fit the nature of each site. Because the habitat of interest is the stream itself, a typical plot would be elongated and sinuous. A typical plot would be, for example, ca. 3 X 10 m or 4 X 8 m; the shape chosen is recorded with plot data. Permanent plots had not been established previously, so the site number was used as plot number. No posts or flagging were placed to mark the plots; however the plots are all located by precise descriptions in relation to a road crossing and can easily be revisited for follow up monitoring.

The streams for survey were selected 1) for their biological significance and 2) for comparison among different stream types. Cabin Creek and Eagle Ridge Creek were suggested by Todd Bohle as streams known to be prime bull trout habitat. Shotgun Creek, Boulder Creek, and Rex River were examined as a series of streams of increasing size to compare with the first two streams. Shotgun Creek is a stream of steep gradient, like the upper part of Cabin Creek, while both Boulder Creek and Rex River were examined in reaches with a low gradient.

The focus in stream surveys was on bryophytes growing in the stream bed, both submerged and emergent, and the stream banks immediately adjacent to the water channels. Riparian habitat away from the stream channel was excluded from the survey.

RESULTS

A. 700 Road Habitat Restoration Project Plot data

The following pages give complete plot data for the bryophyte monitoring plots recorded at the sites of all permanent plots in the 700 Road Habitat Restoration Project Area.

The first three plots are in the area designated as E8. This area is on a sloping terrace between the 700 Road and Rex River. Being closer to the valley bottom, the three plots here are richer than the other sites upslope. This bryophyte richness indicates more mesic conditions.

Three plots are located on a plateau on the an east-west trending ridge above E8; this area has been designated E2. The remaining five plots are on a steep, southwest facing slope on the side of the ridge above Road 700. Three plots are in the area designated E5 and two in E6.

Prominent in all the 700 Road project area is the dense moss cover on the forest floor. Out of eleven plots, six are tallied as having 100% moss cover, one with 90%, three 80%, and only one plot with less than half; plot # 2209343131 (Wagner # m1938) has only 25% moss cover on the forest floor. Four mosses dominate this association. Their distribution is summarized in Table 1. *Kindbergia oregana* is clearly the dominant moss in this habitat, it has a frequency of 100% and is abundant in about three-quarters of the area.

Taxon	Abundant	Frequent	Occasional	Sparse	Trace	Total	Frequency
<i>Kindbergia oregana</i>	8 plots	2 plots	1 plot			11 plots	100%
<i>Rhytidiopsis robusta</i>		2	4	3	1	10	91%
<i>Hylocomium splendens</i>		3	2	3		8	73%
<i>Rhytidiadelphus loreus</i>		1	5	2		8	73%

Table 1. Number of plots in each abundance category for forest floor moss species with over 50% frequency on this substrate.

The forest floor actually has a depauperate flora; beyond the four prominent mosses only three other mosses were found to occupy this substrate: *Buckiella (Plagiothecium) undulata* in three plots, *Isothecium stoloniferum* and *Pseudotaxiphyllum elegans* in one each. The richest substrate in terms of diversity is rotting wood. Effort was made to sort out forest floor mosses which covered well decayed down wood from species that grow specifically on wood. There are six species which occur on rotting wood with a frequency above 50%; these are summarized in Table 2 on the next page. Note that only at one site was one of these abundant on the substrate: *Scapania bolanderi*. It is one of the two species with 100% frequency on rotting wood. The other, *Lepidozia reptans*, although always present, is present in much smaller amounts "Occasional" in three plots and only "Sparse" in eight! *Cephalozia lunulifolia* probably belongs in this group because it is so small and often grows in tiny amounts and is easily overlooked.

Taxon	Abundant	Frequent	Occasional	Sparse	Trace	Total	Frequency
<i>Scapania bolanderi</i>	1	6	4			11	100%
<i>Lepidozia reptans</i>			3	8		11	100%
<i>Dicranum fuscescens</i>			3	5	1	9	82%
<i>Hypnum circinale</i>		3	2	2		7	64%
<i>Pseudotaxiphyllum elegans</i>		1	2	4		7	64%

Table 2. Rotting Wood. Species with over 50% frequency on rotting wood.

The only substrate with a bryophyte association that has species with frequencies above 50% (meaning being present in at least six of eleven plots) was on tree bases. Here three species occurred regularly. Note that *Hypnum circinale* and *Scapania bolanderi* are found here as well as on rotting wood. The distribution of the three species is summarized in Table 3.

Taxon	Abundant	Frequent	Occasional	Sparse	Trace	Total	Frequency
<i>Isothecium stoloniferum</i>		1	4	4		9	82%
<i>Hypnum circinale</i>		5	2	1		8	73%
<i>Scapania bolanderi</i>		3	3	1		7	64%

Table 3. Tree Bases. Species with more than 50% frequency on tree bases.

Lichens were not the focus of this study but were recorded as encountered. Lichen associations are poorly developed in these second growth forests. The only abundant at ground level species is a *Cladonia* sp., possibly *C. fimbriata*, on wood and tree trunks. Three species are commonly found on fallen twigs: *Platismatia glauca* (abundant on most twigs; 100% frequency in plots), *Hypogymnia inactiva* (91% frequency), and *Hypogymnia physodes* (64% frequency). Note that the identification of *Hypogymnia* awaits confirmation with chemical tests.

Plot No. 2209283218 **Date recorded:** 12 Jun 2006 **Site No.** m1898

Locality: Washington, King County: Cascade foothills ca. 13 miles/21 km SE of the town of North Bend; Cedar River Watershed, slopes North of Rex River. 700 Road Ecological Thinning Project.

Coordinates: Lat. 47° 21' 18" N; Long. 121° 40' 13" W

Elevation 1840'/561m. **Site details:** WSW aspect; mod 23 slope; 100 % cover.

Plot description: Plot center is marked by flag on a stick in the ground; an aluminum tag on a bearing tree indicating plot center is 2.36 m at 169°. Cryptogam plot is 31 m² around plot center.

Habitat: 61-67 year old second-growth forest dominated by *Tsuga heterophylla* with lesser amount of *Thuja plicata* and *Pseudotsuga menziesii*. 100% moss cover on forest floor.

Forest floor, unspecified substrate

Kindbergia oregana Abundant

Rhytidiadelphus loreus Frequent

Rhytidiopsis robusta Frequent

Hylocomium splendens Occasional

On trunk of conifer, at base

Scapania bolanderi Occasional

Hypnum circinale Occasional

Isothecium stoloniferum Occasional

Dicranum fuscescens Sparse

Ptilidium californicum Sparse

On rotting wood

Hypnum circinale Frequent

Scapania bolanderi Frequent

Cephalozia lunulifolia Sparse

Lepidozia reptans Sparse

Calypogeia fissa Sparse

Calypogeia azurea Sparse

On trunk of young Thuja

Kindbergia oregana Frequent

Hypnum circinale Frequent

Scapania bolanderi Occasional

Chiloscyphus profundus Sparse

Frullania nisquallensis Sparse

Cladonia (squamules) Sparse

Scapania bolanderi Trace

On dead twigs and branches of conifer

Platismatia glauca Frequent

Usnea Occasional

Hypogymnia physodes Occasional

Hypogymnia apinnata Sparse

Hypogymnia inactiva Sparse

Plot No. 2209332003 **Date recorded:** 12 Jun 2006 **Site No.** m1905

Locality: Washington, King County: Cascade foothills ca. 13 miles/21 km SE of the town of North Bend; Cedar River Watershed, slopes North of Rex River. 700 Road Ecological Thinning Project.

Coordinates: Lat. 47° 21' 17" N; Long. 121° 40' 19" W

Elevation 1740/530m. **Site details:** W aspect; mod 25 slope; 100 % cover.

Plot description: Plot well marked by tags on trees around NE side of pvc pipe at plot center. Cryptogam plot is 31 m² around plot center.

Habitat: 61-67 year old second-growth forest dominated by *Tsuga heterophylla* with lesser amount of *Thuja plicata* and *Pseudotsuga menziesii*. 100% moss cover on forest floor.

Forest floor, unspecified substrate

Kindbergia oregana Abundant

Rhytidiadelphus loreus Occasional

Buckiella undulata Occasional

Rhytidiopsis robusta Sparse

On rotting wood

Scapania bolanderi Frequent

Rhytidiadelphus loreus Occasional

Lepidozia reptans Occasional

Hypnum circinale Occasional

Pseudotaxiphyllum elegans Occasional

Dicranum fuscescens Sparse

Calypogeia muelleriana Sparse

Cephalozia lunulifolia Sparse

Cephalozia bicuspidata Sparse

On dead twigs and branches of conifer

Platismatia glauca Frequent

Hypogymnia inactiva Sparse

Hypogymnia physodes Sparse

Hypogymnia apinnata Sparse

On trunk of conifer, at base

Kindbergia oregana Frequent

Scapania bolanderi Occasional

Cladonia Sparse

Hypnum circinale Sparse

Chiloscyphus profundus Sparse

Cephalozia lunulifolia Sparse

Lepidozia reptans Trace

On trunk of small Thuja snag

Cephalozia lunulifolia Frequent

Scapania bolanderi Frequent

Hypnum circinale Sparse

Kindbergia oregana Sparse

Isoetecium stoloniferum Sparse

Plot No. 2209322011 **Date recorded:** 12 Jun 2006 **Site No.** m1915

Locality: Washington, King County: Cascade foothills ca. 13 miles/21 km SE of the town of North Bend; Cedar River Watershed, slopes North of Rex River. 700 Road Ecological Thinning Project.

Coordinates: Lat. 47° 21' 14" N; Long. 121° 40' 9" W

Elevation 1855'/565m. **Site details:** S aspect; gentle slope; 100 % cover.

Plot description: Plot is marked by pvc pipe. Cryptogam plot is 31 m² around plot center.

Habitat: 61-67 year old second-growth forest dominated by *Tsuga heterophylla* with lesser amount of *Thuja plicata* and *Pseudotsuga menziesii*. 100% moss cover on forest floor.

Forest floor, unspecified substrate

Kindbergia oregana Abundant

Hylocomium splendens Frequent

Rhytidiadelphus loreus Occasional

Rhytidiopsis robusta Sparse

On dead twigs and branches of conifer

Platismatia glauca Frequent

Hypogymnia inactiva Sparse

Hypogymnia physodes Sparse

Hypogymnia apinnata Sparse

Bryoria Trace

On trunk of conifer, at base

Scapania bolanderi Frequent

Kindbergia oregana Occasional

Isothecium stoloniferum Occasional

Cladonia Sparse

Hypnum circinale Sparse

Ptilidium californicum Trace

Usnea Trace

On rotting wood, mostly of stumps

Scapania bolanderi Frequent

Cladonia Occasional

Lepidozia reptans Occasional

Cephalozia lunulifolia Sparse

Pseudotaxiphyllum elegans Sparse

On rotting wood (near but not within cryptogam plot area)

Ptilidium californicum Occasional

Porella navicularis Sparse

Calypogeia azurea Sparse

On *Acer circinatum* near plot, to SW

Isothecium stoloniferum Abundant

Neckera douglasii Sparse

Plot No. 2209283224 **Date recorded:** 12 Jun 2006 **Site No.** m1925

Locality: Washington, King County: Cascade foothills ca. 13 miles/21 km SE of the town of North Bend; Cedar River Watershed, slopes North of Rex River. 700 Road Ecological Thinning Project.

Coordinates: Lat. 47° 21' 18" N; Long. 121° 39' 54" W

Elevation 1985'/605m. **Site details:** aspect; level slope; 100 % cover.

Plot description: Plot center is a stick with pink flag; bearing tree is 8 m away. Cryptogam plot is 31 m² around plot center.

Habitat: 61-67 year old second-growth forest dominated by *Tsuga heterophylla* with lesser amount of *Thuja plicata* and *Pseudotsuga menziesii*. 80% moss cover on forest floor.

Forest floor, unspecified substrate

Hylocomium splendens Frequent

Kindbergia oregana Frequent

Rhytidiopsis robusta Occasional

Pseudotaxiphyllum elegans Sparse

On rotting wood

Scapania bolanderi Frequent

Hypnum circinale Frequent

Rhytidiadelphus loreus Sparse

Kindbergia oregana Sparse

Lepidozia reptans Sparse

Dicranum fuscescens Trace

On trunk of conifer, at base

Scapania bolanderi Frequent

Hypnum circinale Frequent

Cladonia Occasional

Isothecium stoloniferum Sparse

On trunk of conifer, 1+ meter above base

Parmeliopsis hyperopta Sparse

On dead twigs and branches of conifer

Platismatia glauca Occasional

Hypogymnia inactiva Sparse

Plot No. 22092831 **Date recorded:** 12 Jun 2006 **Site No.** m1929

Locality: Washington, King County: Cascade foothills ca. 13 miles/21 km SE of the town of North Bend; Cedar River Watershed, slopes North of Rex River. 700 Road Ecological Thinning Project.

Coordinates: Lat. 47° 21' 23" N; Long. 121° 39' 41" W

Elevation 2056/627m. **Site details:** NW aspect; gentle slope; 100 % cover.

Plot description: Plot center is marked by pvc pipe with pink flagging; aluminum tags on bearing trees nearby. Cryptogam plot is 31 m² around plot center.

Habitat: 61-67 year old second-growth forest dominated by *Tsuga heterophylla* with lesser amount of *Thuja plicata* and *Pseudotsuga menziesii*. 100% moss cover on forest floor; 50% of this site occupied by rotten logs and stumps.

Forest floor, unspecified substrate

Kindbergia oregana Abundant

Rhytidiadelphus loreus Occasional

Buckiella undulata Sparse

On rotting wood

Scapania bolanderi Abundant

Rhytidiadelphus loreus Occasional

Cladonia Occasional

Hypnum circinale Sparse

Dicranum fuscescens Sparse

Lepidozia reptans Sparse

On dead twigs and branches of conifer

Platismatia glauca Sparse

Hypogymnia inactiva Sparse

On trunk of conifer, at base

Hypnum circinale Frequent

Scapania bolanderi Occasional

Cladonia Occasional

Isothecium stoloniferum Occasional

Plot No. 220928243 **Date recorded:** 14 Jun 2006 **Site No.** m1930

Locality: Washington, King County: Cascade foothills ca. 13 miles/21 km SE of the town of North Bend; Cedar River Watershed, slopes North of Rex River. 700 Road Ecological Thinning Project.

Coordinates: Lat. 47° 21' 17" N; Long. 121° 39' 36" W

Elevation 2025'/617m. **Site details:** S aspect; gentle slope; 100 % cover.

Plot description: Plot center is marked by pvc pipe with pink flagging; aluminum tags on bearing trees nearby. Cryptogam plot is 31 m² around plot center.

Habitat: 61-67 year old second-growth forest dominated by *Tsuga heterophylla* with lesser amount of *Pseudotsuga menziesii*, little *Thuja plicata*. 100% moss cover on forest floor.

Forest floor, unspecified substrate

Kindbergia oregana Abundant

Rhytidiopsis robusta Sparse

Hylocomium splendens Sparse

On trunk of conifer, at base

Scapania bolanderi Frequent

Hypnum circinale Frequent

Cladonia Occasional

On trunk of conifer, 1+ meter above base

Hypnum circinale Occasional

Cladonia Frequent

Dicranum fuscescens Sparse

On rotting wood

Scapania bolanderi Frequent

Hypnum circinale Occasional

Dicranum fuscescens Sparse

Pseudotaxiphyllum elegans Sparse

Lepidozia reptans Sparse

Isothecium stoloniferum Sparse

On dead twigs and branches of conifer

Platismatia glauca Frequent

Plot No. 220934060 **Date recorded:** 14 Jun 2006 **Site No.** m1931

Locality: Washington, King County: Cascade foothills ca. 13 miles/21 km SE of the town of North Bend; Cedar River Watershed, slopes North of Rex River. 700 Road Ecological Thinning Project.

Coordinates: Lat. 47° 21' 6" N; Long. 121° 38' 47" W

Elevation 2142'/653m. **Site details:** S aspect; mod-steep slope; 100 % cover.

Plot description: Plot center is marked by pvc pipe with pink paint with marking indicating start of Transect 1. Cryptogam plot is 31 m² around plot center.

Habitat: 61-67 year old second-growth forest dominated by *Tsuga heterophylla* with lesser amount of *Thuja plicata* and *Pseudotsuga menziesii*, occasional *Abies* sp. 100% moss cover on forest floor.

Forest floor, unspecified substrate

Kindbergia oregana Abundant
Rhytidiadelphus loreus Occasional
Rhytidiopsis robusta Occasional
Hylocomium splendens Sparse
Buckiella undulata Sparse
Isoetecium stoloniferum Sparse

On rotting wood

Hypnum circinale Frequent
Dicranum fuscescens Occasional
Scapania bolanderi Occasional
Lepidozia reptans Occasional
Pseudotaxiphyllum elegans Occasional
Rhizomnium glabrescens Sparse
Cephalozia lunulifolia Sparse

On dead twigs and branches of conifer

Platismatia glauca Abundant
Hypogymnia inactiva Occasional
Hypogymnia physodes Sparse

Plot No. 2209342029 **Date recorded:** 14 Jun 2006 **Site No.** m1932

Locality: Washington, King County: Cascade foothills ca. 13 miles/21 km SE of the town of North Bend; Cedar River Watershed, slopes North of Rex River. 700 Road Ecological Thinning Project.

Coordinates: Lat. 47° 21' 10" N; Long. 121° 38' 45" W

Elevation 2325'/709m. **Site details:** SW aspect; steep 38 slope; 90 % cover.

Plot description: Plot center is marked by pvc pipe with pink paint with marking indicating start of Transect 1. Cryptogam plot is 31 m² around plot center.

Habitat: 61-67 year old second-growth forest dominated by *Tsuga heterophylla* with lesser amount of *Thuja plicata* and *Pseudotsuga menziesii*. 80% moss cover on forest floor.

Forest floor, unspecified substrate

Kindbergia oregana Abundant

Hylocomium splendens Sparse

Rhytidiadelphus loreus Sparse

Rhytidiopsis robusta Trace

On rotting wood

Scapania bolanderi Occasional

Lepidozia reptans Sparse

Pseudotaxiphyllum elegans Sparse

Dicranum fuscescens Sparse

Cladonia Sparse

Calypogeia azurea Trace

Calypogeia fissa Trace

On trunk of conifer, at base

Isothecium stoloniferum Frequent

On dead twigs and branches of conifer

Platismatia glauca Abundant

Hypogymnia inactiva Frequent

Plot No. 2209342047 **Date recorded:** 14 Jun 2006 **Site No.** m1933

Locality: Washington, King County: Cascade foothills ca. 13 miles/21 km SE of the town of North Bend; Cedar River Watershed, slopes North of Rex River. 700 Road Ecological Thinning Project.

Coordinates: Lat. 47° 21' 8" N; Long. 121° 38' 38" W

Elevation 2360/720m. **Site details:** S aspect; mod-steep 30 slope; 100 % cover.

Plot description: Plot center is marked by pvc pipe with pink paint with marking indicating start of Transect 1. Cryptogam plot is 31 m² around plot center.

Habitat: 61-67 year old second-growth forest dominated by *Tsuga heterophylla* with lesser amount of *Thuja plicata* and *Pseudotsuga menziesii*. 80% moss cover on forest floor.

Forest floor, unspecified substrate

Kindbergia oregana Abundant

Rhytidiopsis robusta Frequent

Rhytidiadelphus loreus Sparse

On rotting wood

Scapania bolanderi Frequent

Dicranum fuscescens Occasional

Pseudotaxiphyllum elegans Sparse

Hypnum circinale Sparse

Lepidozia reptans Sparse

Isothecium stoloniferum Sparse

Hylocomium splendens Sparse

On trunk of conifer, at base

Hypnum circinale Frequent

Parmeliopsis hyperopta Occasional

Cladonia Sparse

Isothecium stoloniferum Sparse

On dead twigs and branches of conifer

Platismatia glauca Abundant

Hypogymnia physodes Sparse

Hypogymnia inactiva Sparse

Plot No. 2209342066 **Date recorded:** 14 Jun 2006**Site No.** m1934

Locality: Washington, King County: Cascade foothills ca. 13 miles/21 km SE of the town of North Bend; Cedar River Watershed, slopes North of Rex River. 700 Road Ecological Thinning Project.

Coordinates: Lat. 47° 21' 5" N; Long. 121° 38' 23" W

Elevation 2520'/768m. **Site details:** WSW aspect; mod-steep 30 slope; 100 % cover.

Plot description: Plot center is marked by pvc pipe with pink paint with marking indicating start of Transect 1. Cryptogam plot is 31 m² around plot center.

Habitat: 61-67 year old second-growth forest dominated by *Tsuga heterophylla* with lesser amount of *Thuja plicata* and *Pseudotsuga menziesii*. 90% moss cover on forest floor.

Forest floor, unspecified substrate

Kindbergia oregana Frequent

Hylocomium splendens Frequent

Rhytidiopsis robusta Occasional

On rotting wood

Rhytidiadelphus loreus Occasional

Scapania bolanderi Occasional

Dicranum fuscescens Occasional

Lepidozia reptans Sparse

Cephalozia lunulifolia Sparse

On trunk of conifer, at base

Hypnum circinale Frequent

Kindbergia oregana Occasional

Isothecium stoloniferum Occasional

Dicranum fuscescens Sparse

Cladonia Sparse

Pseudotaxiphyllum elegans Sparse

On trunk of conifer, 1+ meter above base

Parmeliopsis hyperopta Occasional

Cladonia Sparse

Hypnum circinale Sparse

Hypogymnia physodes Sparse

Hypogymnia apinnata Sparse

On dead twigs and branches of conifer

Platismatia glauca Abundant

Hypogymnia inactiva Occasional

Hypogymnia physodes Sparse

Plot No. 2209342131 **Date recorded:** 14 Jun 2006 **Site No.** m1938

Locality: Washington, King County: Cascade foothills ca. 13 miles/21 km SE of the town of North Bend; Cedar River Watershed, slopes North of Rex River. 700 Road Ecological Thinning Project.

Coordinates: Lat. 47° 20' 58" N; Long. 121° 38' 24" W

Elevation 2410'/735m. **Site details:** SW aspect; mod 12 slope; 100 % cover.

Plot description: Plot center is marked by pvc pipe with pink paint with marking indicating start of Transect 1. Cryptogam plot is 31 m² around plot center.

Habitat: 61-67 year old second-growth forest dominated by *Tsuga heterophylla* with lesser amount of *Thuja plicata* and *Pseudotsuga menziesii*, occasional *Abies* sp. Only 25% moss cover on forest floor.

Forest floor, unspecified substrate

Hylocomium splendens Occasional

Kindbergia oregana Occasional

Rhytidiopsis robusta Occasional

Rhytidiadelphus loreus Occasional

On trunk of conifer, at base

Cladonia Occasional

Pseudotaxiphyllum elegans Occasional

Hypnum circinale Occasional

Isothecium stoloniferum Sparse

Dicranum fuscescens Sparse

Scapania bolanderi Sparse

On trunk of conifer, 1+ meter above base

Cladonia Occasional

Hypogymnia apinnata Sparse

Parmeliopsis hyperopta Sparse

Hypnum circinale Trace

On rotting wood

Pseudotaxiphyllum elegans Frequent

Scapania bolanderi Occasional

Lepidozia reptans Sparse

Dicranum fuscescens Sparse

Isothecium stoloniferum Sparse

Chiloscyphus profundus Sparse

On dead twigs and branches of conifer

Platismatia glauca Frequent

Hypogymnia inactiva Sparse

Hypogymnia physodes Sparse

RESULTS

B. Stream Survey Plot Data

The following pages give complete plot data for the bryophyte monitoring plots recorded at the site of five streams.

Three plots were recorded on Cabin Creek, each with quite different habitat characteristics and consequently different bryophyte associations. The uppermost site (plot # m1945) is close to the headwaters of the stream, where it emerges from a midslope wetland and begins its descent down the hill. It is interesting that this wetland has another stream (unnamed) emerging at the opposite (east) end. The streambed here is a peaty muck and lacks rocks. No bryophytes occur as submerged aquatics except a small amount of liverwort on a stick. The middle plot (m1953) is near the bottom of the steep reach of the stream. The streambed is quite rocky here, with bryophytes covering all rock surfaces emergent from the water. The lowermost plot (m1963) is quite different from the previous two, in that the streambed is very nearly level. The substrate is a sandy alluvium which is colonized by pioneer bryophytes above average water level. A substantial amount of wood is in the water; this is festooned with an aquatic moss. The appearance is quite dramatic.

One plot, m1970, was established on the stream known as Eagle Ridge Creek (name does not appear on USGS topo map) just above the bridge over the stream. This site was very similar to the third of the Cabin Creek sites. Presumably, these are comparable bull trout habitats. This stream had many rocks in the stream bed to which the aquatic bryophytes were attached.

The other three streams each received one site examination. Rex River (m1976) has no aquatic bryophytes and only one moss is prominent on streamside rocks. Shotgun Creek (m1980) is quite similar to Cabin Creek site m1953. It has a more open streambed than the middle Cabin Creek site, which may contribute to its somewhat lower diversity. Boulder Creek (m1984) was totally devoid of bryophytes, either submerged in the water or on rocks out of or adjacent to the water.

Plot No. m1945 **Date recorded:** 15 Jun 2006 **Site No.** m1945

Locality: Washington, King County: Cascade foothills ca. 13 miles/21 km SE of the town of North Bend; Cedar River Watershed, Cabin Creek at junction of road 200 and road 210.

Coordinates: Lat. 47° 21' 19" N; Long. 121° 41' 40" W

Elevation 2310/704m. **Site details:** NW aspect; level slope; 90 % cover.

Plot description: Cryptogam plot is 31 m² along stream, ca 3 m wide and 10 m long beginning ca 5 m above upper end of culvert under road 200.

Habitat: Riparian, *Alnus* overstory, with *Rubus spectabilis* understory and ground layer of *Athyrium*, *Lysichiton*, *Maianthemum*, *Hydrophyllum*, and *Dicentra*. Streamside part of plot has ca 50% bryophyte cover.

On compressed peaty soil

Rhytidiadelphus subpinnatus Frequent

Plagiomnium insigne Occasional

Kindbergia oregana Sparse

Leucolepis acanthoneura Sparse

Conocephalum conicum Sparse

Brachythecium asperrimum Sparse

Bryum bimum Sparse

Rhizomnium glabrescens Trace

On log in stream

Hypnum dieckii Frequent

Rhizomnium glabrescens Frequent

Rhytidiadelphus subpinnatus Occasional

Scapania undulata Occasional

Scapania bolanderi Occasional

Conocephalum conicum Occasional

Kindbergia oregana Sparse

Riccardia multifida Sparse

Scapania umbrosa Trace

Cephalozia bicuspidata Trace

On stick in stream bed, submerged

Scapania undulata Sparse

Plot No. m1953 **Date recorded:** 15 Jun 2006 **Site No.** m1953

Locality: Washington, King County: Cascade foothills ca. 13 miles/21 km SE of the town of North Bend; Cedar River Watershed, Cabin Creek just above first culvert on road 200.

Coordinates: Lat. 47° 21' 42" N; Long. 121° 41' 42" W

Elevation 1800/549m. **Site details:** N aspect; gentle slope; 80 % cover.

Plot description: Cryptogam plot is 31 m² along stream, ca 3 m wide and 10 m long beginning ca 5 m above upper end of culvert under road 200.

Habitat: Riparian, in second growth timber; rocky streambed; no hardwoods in overstory; *Rubus spectabilis*, *Ribes bracteosum*, and *Corydalis* present in understory. Nearly 100% bryophyte cover on rock surfaces above waterline in streambed.

On rock in streambed

Hypnum dieckii Frequent
Kindbergia praelonga Occasional
Scleropodium obtusifolium Occasional
Leucolepis acanthoneura Occasional
Rhytidiadelphus loreus Sparse
Hygrohypnum molle Sparse
Rhizomnium glabrescens Sparse
Chiloscyphus polyanthos Sparse
Scapania undulata Sparse
Pellia neesiana Sparse
Fontinalis neomexicana Sparse
Dichodontium pellucidum Sparse

On log in stream

Leucolepis acanthoneura Frequent
Rhizomnium glabrescens Frequent
Rhytidiadelphus loreus Occasional
Hylocomium splendens Sparse
Conocephalum conicum Sparse
Riccardia multifida Sparse
Scapania bolanderi Sparse
Cephalozia bicuspidata Trace
Blepharostoma trichophyllum Trace
Calypogeia fissa Trace
Hypnum dieckii Trace
Scapania undulata Trace

On soil of stream bank

Leucolepis acanthoneura Frequent
Hylocomium splendens Occasional
Rhytidiadelphus loreus Occasional
Rhizomnium glabrescens Occasional
Plagiochila porelloides Sparse

Plot No. m1963 **Date recorded:** 15 Jun 2006 **Site No.** m1963

Locality: Washington, King County: Cascade foothills ca. 13 miles/21 km SE of the town of North Bend; Cedar River Watershed, Cabin Creek above culvert on road 300.

Coordinates: Lat. 47° 21' 52" N; Long. 121° 41' 23" W

Elevation 1600'/488m. **Site details:** N aspect; level slope; 60 % cover.

Plot description: Cryptogam plot is 31 m² along stream, 4 m wide and 7.5 m long, beginning ca 20 m above culvert under road 300, where stream turns south, away from ditch beside road.

Habitat: Slow stream in alluvium; sandy stream bed and stream banks; shrubby overstory. Bryophytes with 50% cover on stream banks, nearly 100% on sticks in stream.

On stick in stream, submerged

Fontinalis neomexicana Abundant

Kindbergia praelonga Sparse

Hygrohypnum ochraceum Sparse

On soil of stream bank

Pohlia longibracteata (identification tentative) Frequent

Leucolepis acanthoneura Frequent

Plagiomnium insigne Occasional

Kindbergia praelonga Occasional

Pellia neesiana Sparse

Conocephalum conicum Sparse

Dichodontium pellucidum Sparse

On rotting wood

Hypnum dieckii Frequent

Kindbergia praelonga Frequent

Conocephalum conicum Occasional

Antitrichia curtipendula Sparse

Rhizomnium glabrescens Sparse

Metaneckera menziesii Trace

On sandy soil over small log

Plagiomnium rostratum Frequent

Hypnum lindbergii Occasional

Plot No. m1970 **Date recorded:** 15 Jun 2006 **Site No.** m1970

Locality: Washington, King County: Cascade foothills ca. 13 miles/21 km SE of the town of North Bend; Cedar River Watershed, Eagle Ridge Creek, above bridge on road 100-300.

Coordinates: Lat. 47° 21' 40" N; Long. 121° 37' 43" W

Elevation 1590/485m. **Site details:** E aspect; level slope; 75 % cover.

Plot description: Cryptogam plot is 31 m² of streambed, ca 3 m wide and 10 m long beginning ca 10 m above upper end of bridge on road 100-300.

Habitat: Riparian; *Alnus* overstory; *Rubus spectabilis* understory; rocky streambed, shallow, relatively level flow. Most of the bryophytes are attached to rocks at the bottom of the streambed, ca 80 % cover.

On rock in streambed, submerged

Hygrohypnum molle Abundant

Fontinalis neomexicana Frequent

Chiloscyphus polyanthos Occasional

Chiloscyphus polyanthos Occasional

On log in stream

Kindbergia praelonga Frequent

Rhytidiadelphus loreus Sparse

Rhizomnium glabrescens Sparse

Brachythecium frigidum Sparse

Chiloscyphus polyanthos Sparse

Conocephalum conicum Sparse

On rock emergent from stream

Plagiochila porelloides Occasional

Plot No. m1976 **Date recorded:** 15 Jun 2006 **Site No.** m1976

Locality: Washington, King County: Cascade foothills ca. 13 miles/21 km SE of the town of North Bend; Cedar River Watershed, Rex River just below bridge on road 300.

Coordinates: Lat. 47° 21' 37" N; Long. 121° 40' 44" W

Elevation 1595'/486m. **Site details:** N aspect; level slope; 0 % cover.

Plot description: Cryptogam plot is 31 m² of river edge rocky beach, 3 m wide and 10 m long, on E side of river, beginning 10m below bridge.

Habitat: River side rocky beach. No aquatic bryophytes in river; less than 25% cover on beach.

On rock on beach

Racomitrium varium Occasional

Hypnum dieckii Sparse

Blindia acuta Sparse

Plot No. m1980 **Date recorded:** 15 Jun 2006 **Site No.** m1980

Locality: Washington, King County: Cascade foothills ca. 13 miles/21 km SE of the town of North Bend; Cedar River Watershed, Shotgun Creek just above bridge on road 300.

Coordinates: Lat. 47° 22' 57" N; Long. 121° 42' 21" W

Elevation 1617/493m. **Site details:** N aspect; mod slope; 50 % cover.

Plot description: 31 m² along stream, 3 m wide and 10 m long, beginning ca 5 m above upper end of bridge on road 300.

Habitat: Small stream, but bigger and faster than Cabin Creek. In shadow of garage size rock. Rocks in streambed ca 90% cover above waterline.

On rock in streambed

Hypnum dieckii Frequent
Hypnum lindbergii Occasional
Dichodontium pellucidum Occasional
Kindbergia praelonga Occasional
Scleropodium obtusifolium Occasional
Hygrohypnum molle Sparse
Plagiomnium rostratum Sparse
Brachythecium frigidum Sparse
Scapania undulata Sparse
Mnium spinulosum Trace

On sand and gravel in streambed

Leucolepis acanthoneura Abundant
Plagiomnium insigne Occasional
Polytrichastrum alpinum Sparse
Rhytidiadelphus loreus Sparse

Plot No. m1984 **Date recorded:** 15 Jun 2006 **Site No.** m1984

Locality: Washington, King County: Cascade foothills ca. 13 miles/21 km SE of the town of North Bend; Cedar River Watershed, Boulder Creek just below bridge on road 300.

Coordinates: Lat. 47° 21' 59" N; Long. 121° 41' 33" W

Elevation 1620/493m. **Site details:** N aspect; level slope; 0 % cover.

Plot description: Cryptogam plot is 31 m² of streambed, beginning 10m below bridge.

Habitat: River side rocky beach and rocks in stream.

No bryophytes found in this plot!

RESULTS

C. Other Sites

The following records give complete site information for bryophytes of interest which were found outside of the permanent monitoring plots. All except the last are within the 700 Road Monitoring Project Area.

Plot No. none **Date recorded:** 12 Jun 2006 **Site No.** m1921

Locality: Washington, King County: Cascade foothills ca. 13 miles/21 km SE of the town of North Bend; Cedar River Watershed, slopes North of Rex River. 700 Road Ecological Thinning Project. on road bed, not in plots

Coordinates: Lat. 47° 21' 18" N; Long. 121° 40' 9" W

Elevation 1890'/576m. **Site details:** S aspect; gentle slope; 80 % cover.

Plot description: No plot data recorded; site has interesting weedy liverworts.

Habitat: 61-67 year old second-growth forest dominated by *Tsuga heterophylla* with lesser amount of *Thuja plicata* and *Pseudotsuga menziesii*.

On trail or road bed

Pellia neesiana Frequent

Conocephalum conicum Sparse

Gyrothyra underwoodiana Sparse

Plot No. none **Date recorded:** 12 Jun 2006 **Site No.** m1924

Locality: Washington, King County: Cascade foothills ca. 13 miles/21 km SE of the town of North Bend; Cedar River Watershed, slopes North of Rex River. 700 Road Ecological Thinning Project. On hillside just above road 700, not in a plot.

Coordinates: Lat. 47° 21' 14" N; Long. 121° 39' 52" W

Elevation 1972'/601m. **Site details:** S aspect; mod slope; 100 % cover.

Plot description: Not plot data recorded; site notes presence of interesting moss.

Habitat: 61-67 year old second-growth forest dominated by *Tsuga heterophylla* with lesser amount of *Thuja plicata* and *Pseudotsuga menziesii*.

Forest floor, unspecified substrate

Trachybryum megaptilum Sparse

Plot No. none **Date recorded:** 14 Jun 2006 **Site No.** m1936

Locality: Washington, King County: Cascade foothills ca. 13 miles/21 km SE of the town of North Bend; Cedar River Watershed, slopes North of Rex River. 700 Road Ecological Thinning Project. Along N boundary of unit E6, not in plots

Coordinates: Lat. 47° 21' 3" N; Long. 121° 38' 24" W

Elevation 2526'/770m. **Site details:** WSW aspect; moderate slope; 100 % cover.

Plot description: No plot data recorded; site has interesting liverwort not seen elsewhere.

Habitat: 61-67 year old second-growth forest dominated by *Tsuga heterophylla* with lesser amount of *Thuja plicata* and *Pseudotsuga menziesii*.

On rock, boulder in forest floor

Marsupella emarginata Frequent

Plot No. none **Date recorded:** 14 Jun 2006 **Site No.** m1937

Locality: Washington, King County: Cascade foothills ca. 13 miles/21 km SE of the town of North Bend; Cedar River Watershed, slopes North of Rex River. 700 Road Ecological Thinning Project. Along N boundary of unit E6, in a slight draw not in plots

Coordinates: Lat. 47° 21' 2" N; Long. 121° 38' 22" W

Elevation 2520/768m. **Site details:** WSW aspect; moderate slope; 100 % cover.

Plot description: No plot data recorded; site has interesting moss not seen elsewhere.

Habitat: 61-67 year old second-growth forest dominated by *Tsuga heterophylla* with lesser amount of *Thuja plicata* and *Pseudotsuga menziesii*.

On forest floor, unspecified substrate

Rhytidiadelphus triquetrus Sparse

Plot No. none **Date recorded:** 14 Jun 2006 **Site No.** m1939

Locality: Washington, King County: Cascade foothills ca. 13 miles/21 km SE of the town of North Bend; Cedar River Watershed, slopes North of Rex River. 700 Road Ecological Thinning Project.

Coordinates: Lat. 47° 20' 57" N; Long. 121° 38' 26" W

Elevation 2365/720m. **Site details:** SW aspect; mod slope; 100 % cover.

Plot description: No plot data recorded; site has interesting liverwort not seen elsewhere in project area.

Habitat: 61-67 year old second-growth forest dominated by *Tsuga heterophylla* with lesser amount of *Thuja plicata* and *Pseudotsuga menziesii*.

On rotting wood of large stump

Bazzania denudata Frequent

Plot No. none **Date recorded:** 15 Jun 2006 **Site No.** m1979

Locality: Washington, King County: Cascade foothills ca. 13 miles/21 km SE of the town of North Bend; Cedar River Watershed, hillside next to Cabin Creek above culvert on road 300.

Coordinates: Lat. 47° 21' 52" N; Long. 121° 41' 23" W

Elevation 1600/488m. **Site details:** N aspect; level slope; 60 % cover.

Plot description: No plot data recorded; site has interesting liverwort.

Habitat: Old growth forest (?) on hillside above. This is a large stump just above the roadside ditch.

On rotting wood of large stump

Bazzania ambigua Frequent

RESULTS

D. Species List by Taxon with Index to Sites

LICHENS

- Bryoria* Sites: m1915
Cladonia Sites: m1898, m1905, m1915, m1925, m1929,
m1930, m1932, m1933, m1934, m1938
Hypogymnia apinnata Goward & McCune Sites: m1898, m1905, m1915, m1934, m1938
Hypogymnia inactiva (Krog) Ohlsson Sites: m1898, m1905, m1915, m1925, m1929
m1931, m1932, m1933, m1934, m1938
Hypogymnia physodes (L.) Nyl. Sites: m1898, m1905, m1915, m1931, m1933
m1934, m1938
Parmeliopsis hyperopta (Ach.) Arnold Sites: m1925, m1933, m1934, m1938
Platismatia glauca (L.) Culb. & C. Culb. Sites: m1898, m1905, m1915, m1925, m1929
m1930, m1931, m1932, m1933, m1934, m1938
Usnea Sites: m1898, m1915

LIVERWORTS

- Bazzania ambigua* (Lindenb.) Trev. Site m1979
Bazzania denudata (Torr.) Trev. Site m1939
Blepharostoma trichophyllum (L.) Dum. Sites: m1953
Calypogeia azurea Stotler & Crotz Sites: m1898, m1915a, m1932
Calypogeia fissa (L.) Raddi Sites: m1898, m1932, m1953
Calypogeia muelleriana (Schiffn.) K. Muell. Sites: m1905
Cephalozia bicuspidata (L.) Dum. Sites: m1905, m1945, m1953
Cephalozia lunulifolia (Dum.) Dum. Sites: m1898, m1905, m1915, m1931, m1934
Chiloscyphus polyanthos (L.) Corda Sites: m1953, m1970
Chiloscyphus profundus (Nees) J.J. Engel et R.M. Schust. Sites: m1898, m1905, m1938
Conocephalum conicum (L.) Underw. Sites: m1921, m1945, m1953, m1963, m1970
Frullania nisquallensis Sull. Sites: m1898
Gyrothyra underwoodiana M.A. Howe Sites: m1921
Lepidozia reptans (L.) Dum. Sites: m1898, m1905, m1915, m1925, m1929
m1930, m1931, m1932, m1933, m1934, m1938
Marsupella emarginata Site m1936
Pellia neesiana (Gott.) Limpr. Sites: m1921, m1953, m1963
Plagiochila porelloides (Torrey ex Nees) Lindenb. Sites: m1953, m1970
Porella navicularis (Lehm. & Lindenb.) Pfeiff. Sites: m1915a
Ptilidium californicum (Aust.) Underw. Sites: m1898, m1915, m1915a
Riccardia multifida (L.) S. F. Gray Sites: m1945, m1953
Scapania bolanderi Aust. Sites: m1898, m1905, m1915, m1925, m1929
m1930, m1931, m1932, m1933, m1934, m1938, m1945, m1953
Scapania umbrosa (Schrad.) Dum. Sites: m1945
Scapania undulata (L.) Dum. Sites: m1945, m1953, m1980

MOSSES

- Antitrichia curtipendula* (Hedw.) Brid. Sites: m1963

Blindia acuta (Hedw.) Bruch & Schimp. in B.S.G. Sites: m1976
Brachythecium asperimum (Mitt.) Sull. Sites: m1945
Brachythecium frigidum (C. Muell.) Besch. Sites: m1970, m1980
Bryum bimum (Schreb.) Turner Sites: m1945
Buckiella undulata (Hedw.) Ireland Sites: m1905, m1929, m1931
Dichodontium pellucidum (Hedw.) Schimp. Sites: m1953, m1963, m1980
Dicranum fuscescens Turn. Sites: m1898, m1905, m1925, m1929, m1930
m1931, m1932, m1933, m1934, m1938
Fontinalis neomexicana Sull. & Lesq. Sites: m1953, m1963, m1970
Hygrohypnum molle (Hedw.) Loeske Sites: m1953, m1970, m1980
Hygrohypnum ochraceum (Turn. ex Wils.) Loeske Sites: m1963
Hylocomium splendens (Hedw.) Schimp. in B.S.G. Sites: m1898, m1915, m1925, m1930
m1931, m1932, m1933, m1934, m1938, m1953
Hypnum circinale Hook. Sites: m1898, m1905, m1915, m1925, m1929
m1930, m1931, m1933, m1934, m1938
Hypnum dieckii Ren. & Card. in Roell Sites: m1945, m1953, m1963, m1976, m1980
Hypnum lindbergii Mitt. Sites: m1963, m1980
Isothecium stoloniferum Brid. Sites: m1898, m1905, m1915, m1925, m1929
m1930, m1931, m1932, m1933, m1934, m1938
Kindbergia oregana (Sull.) Ochyra Sites: m1898, m1905, m1915, m1925, m1929
m1930, m1931, m1932, m1933, m1934, m1938, m1945
Kindbergia praelonga (Hedw.) Ochyra Sites: m1953, m1963, m1970, m1980
Leucolepis acanthoneura (Schwaegr.) Lindb. Sites: m1945, m1953, m1963, m1980
Metaneckera menziesii (Hook. in Drumm.) Steere Sites: m1963
Mnium spinulosum Bruch & Schimp. in B.S.G. Sites: m1980
Plagiomnium insigne (Mitt.) T. Kop. Sites: m1945, m1963, m1980
Plagiomnium rostratum (Schrad.) T. Kop. Sites: m1963, m1980
Pohlia longibracteata Broth. in Roell Sites: m1963
Polytrichastrum alpinum (Hedw.) G.L. Sm. Sites: m1980
Pseudotaxiphyllum elegans (Brid.) Iwats. Sites: m1905, m1915, m1925, m1930, m1931
m1932, m1933, m1934, m1938
Racomitrium varium (Mitt.) Jaeg. Sites: m1976
Rhizomnium glabrescens (Kindb.) T. Kop. Sites: m1931, m1945, m1953, m1963, m1970
Rhytidiadelphus loreus (Hedw.) Warnst. Sites: m1898, m1905, m1915, m1925, m1929
m1931, m1932, m1933, m1934, m1938, m1953, m1970, m1980
Rhytidiadelphus subpinnatus (Lindb.) T. Kop. Sites: m1945
Rhytidiadelphus triquetrus (Hedw.) Warnst. Site: m1937
Rhytidiopsis robusta (Hook.) Broth. Sites: m1898, m1905, m1915, m1925, m1930
m1931, m1932, m1933, m1934, m1938
Scleropodium obtusifolium (Jaeg.) Kindb. in Mac. & Kindb. Sites: m1953, m1980
Trachybryum megaptilum (Sull.) Schof. Sites: m1924

DISCUSSION

Interesting or unusual species found in the surveys: 1) 700 Road Forest Habitat Restoration Project Area

There were several species found in the 700 Road Forest Habitat Restoration Project Area that are not treated in plot studies or discussed in the results section. These are listed by site under Results C. Other sites, on p. 27. Three liverworts (*Conocephalum conicum*, *Gyrothyra underwoodiana* and *Pellia neesiana*) were noted on the road bed of Road 700A (site m1921). They were gathered and processed to remind workers that weedy species are an important part of the biodiversity of the area. All three species seen here are native to the Pacific Northwest. Unlike vascular plants, weedy, pioneer species of bryophytes are almost all native. Very few exotics have entered our flora. Habitats such as old roads are important habitats for these species. These three liverworts were not seen anywhere else in the 700 Road project area although two (*Conocephalum conicum* and *Pellia neesiana*) were found in stream sites.

Trachybryum megaptilum was found just above the 700 Road (site m1924) on the way to one of the plots. It is a species characteristic of drier areas, not common in the Cascade foothills of Washington, and is to be looked for in future monitoring. My prediction is that its extent will expand as openings are created as a result of the thinning project. Only one other population of this moss was seen in the course of the survey, it was near the upper boundary of area E6, near plot 2209342066 (= Wagner plot m1934).

A similar species is *Rhytidiadelphus triquetrus*, found in a swale in E6 not far from the plot 2209342066 mentioned above. This is a species very common in the foothills of the Oregon Cascades, where the climate is warmer and drier than in the Cedar River Watershed. This one is also likely to expand its distribution with thinning of the dense forest. It tolerates full sun and quite dry soil.

Marsupella emarginata was found on the hillside close to the *Rhytidiadelphus triquetrus* site. It grew on a small boulder on the forest floor. The occurrence here is a reminder that substrate uniformity restricts the diversity of the area. Like the roadbed, rocks are a scarce substrate in the project area. Species are found on rocks and inorganic substrates in very distinct associations.

Bazzania denudata was found on a stump on the steep hillside below plot 2209342131 (m1938) in area E6. This species characteristically grows on rotting wood. Its scarcity in the project area is an indication of the area's early stage of succession. In my experience, this species is more abundant in old growth forests. Just as the tree species mature on a site, so do the bryophyte associations. All of the abundant bryophyte species in the project area (and the lichens as well) are typical of young forest stands. With stand age will come increasing diversity; more species like *B. denudata* will invade the area.

Bazzania ambigua was not found in the 700 Road Forest Habitat Restoration Project Area; it was found once adjacent to the lowermost Cabin Creek site (plot m1963). It is, however, a forest species like *B. denudata*. *Bazzania ambigua* is a much less common and has not always been recognized as a species distinct from *B. denudata*. The Cedar River Watershed material has been

photographed while fresh and will be incorporated into a comparative study of the two taxa.

Interesting or unusual species found in the surveys: 2) Streams

Several interesting bryophytes were encountered while establishing stream inventory/monitoring plots, beginning with *Rhytidiadelphus subpinnatus* that grew robustly along the upper reach of Cabin Creek (plot m1945). This species is closely related to *Rhytidiadelphus squarrosus*, a common weed of lawns in the Seattle area. The weedy species is prominent in the lawns of the Cedar Falls headquarters. *Rhytidiadelphus subpinnatus* is sometimes lumped under the lawn weed because its recognition is subtle. Although not listed in Lawton (1971), recent workers affirm the taxon is a distinct species (Norris and Shevock 2004, Smith 2004). I have seen it only one other place, in Oregon. Smith (2004) comments, "*R. subpinnatus* is listed as endangered in the Red List of British Mosses." I believe this species is worth adding to Washington's list of Species of Concern.

At the foot of the hill Cabin Creek has a very different aspect as it flows across a nearly level alluvial terrace before crossing Road 300. Prominent in the stream is *Fontinalis neomexicana*. This genus is well known as a species used for biomonitoring of heavy metals in streams (Sérgio et al. 2000). Its prominence both here and in Eagle Ridge Creek (Plot/Site m1970) is a striking concordance with these streams being prime bull trout habitat. The population in Cabin Creek is further remarkable in that it has abundant production of capsules. Capsule production in these aquatic mosses is not often seen because they are dioecious. Large clones are often of a single sex; obviously both males and females are in Cabin Creek.

Recommendations for future monitoring 1) 700 Road Forest Habitat Restoration Project

The site management plan for the 700 Road Ecological Thinning Project describes a protocol for forest stand monitoring (p. 57 et. seq.; Boeckstiegel, et al. 2005). Bryophyte monitoring may follow the schedule for understory vegetation and tree regeneration, "at one and five years post-thinning, then coincident with the tree monitoring." The tree monitoring will be done at ten year intervals. This schedule should be suitable for noting the effects of the thinning project on the bryophyte community. An increase of diversity is expected. Plots as defined in this report should be readily replicated using the form supplied (Appendix A).

An important task in the monitoring is to be sure all plots are truly permanently marked. Two of the plots in the E8 area were marked only by flags on sticks. Aluminum bearing tags are in place but these should be complemented with steel posts and/or plastic pipes.

Recommendations for future monitoring 2) Streams

The seven plots located in this study should be expanded to incorporate a more complete array of stream situations. Monitoring of stream bryophytes should be established on a decadal basis in streams which appear relatively stable. My experience is that little change will be expected in the basic composition of the stream bryophyte community. Impacts on streams from projects are a different matter. In the recently released "Draft Supplement to the 2004 final SEIS to remove or modify the survey and manage mitigation measure standards and guidelines" the following

comment is found under a discussion of issues surrounding an aquatic liverwort:

"...there are recent studies (Paavola et al. 2003, Muotka and Laasonen 2002) indicating that stream management directed toward habitat improvement for fish or aquatic macroinvertebrates may have negative effects on aquatic bryophytes and that key physical factors in the stream environment differ among aquatic bryophytes, fish, and aquatic macroinvertebrates. These studies suggest that management decisions affecting in-stream environments that do not include consideration of aquatic bryophytes may result in loss of aquatic bryophyte habitat and sites." (p. 61, Anonymous 2006)

This should be kept in mind as fishery habitat improvement activities are contemplated. I have not examined the two paper cited in this quote but have included them in the list of references at the end of this report.

The presence of *Fontinalis* in the two prime bull trout habitats offers an opportunity for heavy metal monitoring. A baseline level could be obtained relatively easily. For recent references, use Google Scholar with "Fontinalis heavy metals" as search terms.

Recommendations for future monitoring 3) General

There are 97 permanent sample plots established throughout the watershed (M. Borsting, pers. comm.). Adding bryophyte information to this database would be an excellent program for coordinated monitoring of the ecosystems in the Cedar River Watershed Habitat Conservation Plan. The plot data already on hand provide baseline information for a high quality study. This work could be completed in a single season.

The work of Stout (2001) could well be followed up to be sure all the plots are suitable marked with permanent markers and to identify the bryophytes more precisely. Expanding the plot size to the 3 m^2 (31 m^2) used in this study would provide a basis for a more accurate characterization of the bryophyte communities at the sites in the 2001 project.

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APPENDIX A

cutad

Site No. ²²⁰⁹²⁸³²¹⁸ Date: 12 June 2006 Special: _____
 Locality: ^{WASHINGTON} Oregon, County: ^{PIERCE}, Cedar River Watershed, _____
 Twisp: 22 R. 09 Sec. 28 QQ S Lat. 47° 21' 18" N Long 121° 40' 13" W
 Elevation: 1840 feet 561 meters Slope: mod 25° Aspect: WSW Cover: 100 %
 Quad _____ Aerial photo: _____
 Plot No. 1898 Plot definition 1.3 m² around plot with _____
 Tags & Flags? Tag on tree plot is 2.36 m, 16 ft from bearing tree
 Habitat: 2nd growth Tshc 60% TH PL 20% PSM 20%
 Substrate/species/abun repro/coll/notes.
 forest floor - 100% moss cover over all well decayed org. on
 natural EURORE (A) RHYLOR (F) HYL SPL (C) PHY ROB (C)
 bark - tree bases & stumps SCABOL (C) HYP CIR (C) ISO MYO (C)
 DICUS (C) PTICAL (C) [m1898]
 rotting wood of stumps (log) HYP CIR (C) SCABOL (F) CEALUN (C) [m1899]
 LOP REP (C) CAL MUR? (C) [m1904]
 bark of young cedar LOCHET (C) [m1900] FRUNIS (C) [m1901]
 CEALUN (R) [m1900a] SCABOL (C) EURORE (F) HYP CIR (C)
 CLADOMIA sp. (Squamules only) (C)
 Twigs from trees - PLAGLA (F) USNEA (C) [m1902] HYP sp. (C) [m1903]

APPENDIX B

Habitat Code Habitats as recorded in database

astp	Permanent stream in alluvium, shrubby overstory
astp	Permanent stream with <i>Alnus rubus</i> overstory, <i>Rubus spectabilis</i> understory.
astp	Permanent stream, in area of second growth conifers dominated by <i>Tsuga</i> and <i>Thuja</i> .
astp	Permanent stream, in bordered by forest dominated by <i>Tsuga</i> and <i>Thuja</i>
astp	Permanent stream, open streambed
astp	Permanent stream, with <i>Alnus rubra</i> , <i>Rubus spectabilis</i> , <i>Athyrium</i> , <i>Lysichiton</i> , <i>Maianthemum</i> , <i>Hydrophyllum</i> , and <i>Dicentra</i> .
fcy	Young second-growth conifer forest dominated by <i>Tsuga heterophylla</i>
fcy	Young second-growth conifer forest dominated by <i>Tsuga heterophylla</i> , in a draw with <i>Populus</i>
ndrd	Disturbed ground along road

APPENDIX C

Note that substrate codes used for sorting, such as a3w for rotting wood, have been entered with finer definition in the database for individual species records.

<u>Code</u>	<u>Substrates as recorded in database</u>
a1ab	On trunk of conifer, at base
a1am	On trunk of conifer, 1+ meter above base
a1ath	On trunk of small Thuja snag
a1ath	On trunk of young Thuja
a1b1	On dead twigs and branches of conifer
a1c1f	On log in stream
a1c2a	On stick in stream bed
a1c2a	On stick in stream bed, submerged
a3e	On compressed peaty soil
a3w	On rotting wood
a3w	On rotting wood and bark of log
a3w	On rotting wood of stump
a3w	On rotting wood, charred
a3w	On rotting wood, mostly of stumps
a5	Forest floor, unspecified substrate
b1	On big overhanging rock close to stream
b1	On rock emergent from stream
b1	On rock on beach
b1	On rock, boulder on forest floor
b1f	On rock in streambed
b1f	On rock in streambed, submerged
b2b	On trail or road bed
b2d	On sandy soil over small log
b2dg	On sand and gravel in streambed
b2gs	On soil of stream bank