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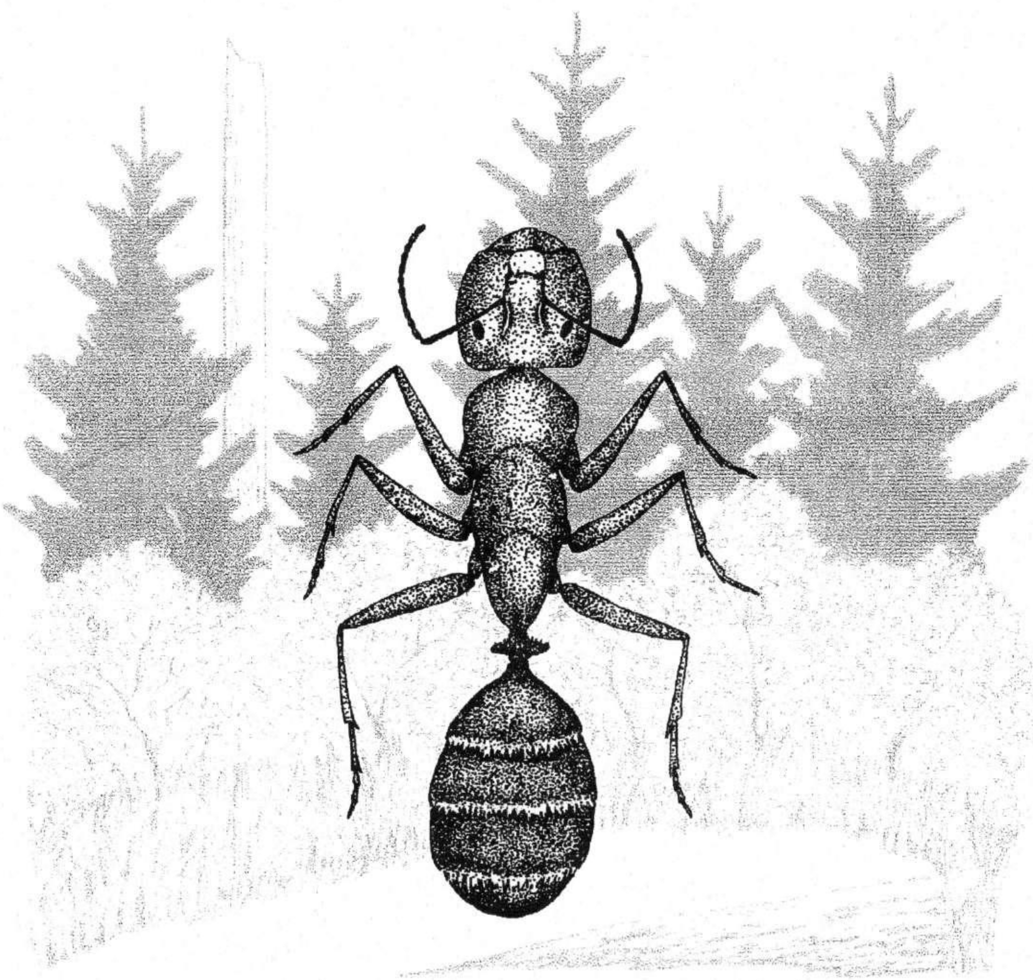

U.S. Department of the Interior
National Park Service - Pacific West Region
North Cascades National Park Service Complex
Sedro-Woolley, WA 98284
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United States Department of Interior - National Park Service - Pacific West Region

North Cascades National Park Service Complex, comprising North Cascades National Park, Ross Lake National Recreation Area, and Lake Chelan National Recreation Area, was established in October, 1968 and is located in northwestern Washington. North Cascades National Park was established to preserve certain majestic mountain scenery, snow fields, glaciers, alpine meadows, and other unique natural features in the North Cascade Mountains for the benefit, use, and inspiration of present and future generations. Ross Lake and Lake Chelan National Recreation Areas were established to provide for outdoor recreation use and enjoyment and to conserve scenic, scientific, historic, and other values contributing to public enjoyment of these lands and waters.

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Foreword

Primary objectives of the National Park Service Natural Resource Management Program are to manage the natural resources to maintain, restore, and perpetuate the inherent integrity of ecosystems and their component habitats and community assemblages. Arthropods represent a fundamental component of these ecosystems, comprising the majority of the biological diversity and are essential to processes of nutrient cycling, decomposition, predation, herbivory, parasitism, and pollination. Knowledge of arthropod diversity, abundance and distribution can provide extremely useful information in the evaluation of environmental perturbations and biological integrity. Arthropods are ideal study organisms because of their short generation times and rapid population growth. These characteristics make them ideal as early-warning indicators of environmental change and for monitoring recovery at disturbed sites. The vast diversity of species offers the opportunity to integrate a number of sensitive indicator species into environmental assessments.

This report represents one of a series of five technical reports on our efforts to document arthropod occurrence, abundance, and habitat associations in the Big Beaver Creek Research Natural Area of North Cascades National Park Complex (NOCA), located in northwestern Washington. The first four reports document occurrence, life history information, and information concerning taxonomy of species from four major arthropod groups including the Heteroptera (Hemiptera), Coleoptera, Arachnida (Araneae), and Hymenoptera (Formicidae). Individuals from these groups largely represent ground dwelling taxa and accounted for over 70% of the total of all specimens collected by pitfall traps in the study area.

The final report of this series utilizes concepts from statistical and community ecology to classify habitats based on their arthropod assemblages, to describe structural and functional characteristics of these communities, and to identify environmental factors that influence community structure. This report also provides recommendations for development of future arthropod monitoring programs in the park.

There is much left to be learned from the samples collected during 1995 and 1996 in the study area. Specimens from several other groups of arthropods still require identification. Among these groups, the Diptera are the most numerous making up greater than 20% of all individuals collected. Working collections will be maintained at NOCA and efforts will be made in the future to seek assistance in documenting the various species found in the remaining collection.

Funding support for this initial effort to document arthropod communities in the park was provided by the Skagit Environmental Endowment Commission. This project could also not have been done without the gracious support of John D. Lattin, Professor of Entomology, Oregon State University, and research assistants James R. LaBonte and Greg Brenner. Administrative support for transfer of funds to OSU from the park was provided by the Forest and Rangeland Ecosystem Science Center, Biological Resources Division, USGS, Corvallis, Oregon. This report series satisfies the conditions of Subagreement No. 31 between the Biological Resources Division and OSU.

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Abstract

Ant communities of nine distinct habitat types were sampled within the riparian corridor of lower Big Beaver Creek, North Cascades National Park Service Complex during the snow-free seasons of 1995 and 1996. This study is part of a comprehensive program to begin development of protocols for the assessment of biological diversity and integrity in the Park Complex. Specific objectives were to document species occurrence, relative abundance, and habitat associations of ant communities. Ants represent a functionally important group of arthropods. They are central to many ecosystem processes and are actively involved in decomposition of dead wood, nutrient cycling, plant pollination, seed dispersal, and predation on other arthropods. They also provide are also prey for many wildlife species and other arthropods. The assessment of their status can provide much information useful in monitoring the integrity of biotic communities.

Nine riparian habitat types within the Big Beaver Creek Research Natural Area (BBCRNA were sampled with pitfall traps, for five months, in 1995. A subset of five of the habitats was resampled with pitfall traps, for four months, during 1996. A total effort of 17,880 trap-days yielded 2,772 individuals, representing 22 species of ants. Ant species richness in the BBCRNA study area compared to species richness for other areas in Western Canada and the Pacific Northwest.

Results indicated that there was very little difference in abundance and number of taxa collected among most the habitat types. Most habitats, with the exception of gravel bars, exhibited relatively low species richness and low abundance. Gravel bar habitats were represented by 13 of the 22 taxa collected during the study, and approximately 45% of all ant specimens collected. Most of the ant species collected in the BBCRNA study area were considered rare and /or vagrant, being collected in low abundance at few sample sites. Seven species, of the 22 taxa collected during the study, comprised over 90% of all individuals captured in each of the years sampled. Four species were considered as habitat generalists, and two species as habitat specialists - *Formica pacifica* and *Myrmica nr. brevispinosa*. Both of these species were found almost entirely at gravel bar habitat sites. Indicator values (Dufrene and Legendre 1997) associated with these two habitat specialist species were expectedly high, offering the potential for use in future habitat monitoring.

Acknowledgments

My sincere appreciation is extended to Dr. John D. Lattin, Oregon State University, for his tremendous support and guidance throughout the duration of this project. In addition to his support for this study, he provided the inspiration and the technical direction that initiated our overall efforts to include terrestrial arthropods as a component of inventory and monitoring at the North Cascades National Park Complex.

I am very much indebted to James R. LaBonte, Oregon State Department of Agriculture, Salem Oregon, and Dr. Greg Brenner, Pacific Analytics, Albany, Oregon, for their interest in this project and their gracious assistance. James R. LaBonte trained project personnel, assisted in writing the description of the study area and methods sections, reviewed the final manuscript, and facilitated communications between Park and University staff. Dr. Greg Brenner developed the sampling design and provided editorial assistance and technical guidance. Dr. Regina Rochefort, North Cascades National Park Complex, Sedro Woolley, Washington, also provided valuable editorial assistance.

My sincere thanks to Dr. Patrick Sugg, Seattle, WA, and Dr. David R. Smith, Systematic Entomology Laboratory, Smithsonian Institute, Washington, D.C., for their assistance with the identification of ant specimens. Ron Holmes who served as the field project supervisor, assisted in writing the description of study area and methods sections, reviewed the final manuscript, and made many other contributions to this project; Brenda Cunningham who assisted with field data collection, provided oversight for all laboratory operations and management of collections, and for her cover illustration; Sherry Bottoms and Kathleen McEvoy who labored in the field and laboratory to make this report possible. Their enthusiasm, dedication, and skill is greatly appreciated.

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Introduction

There are over 15,000 living ant species of which approximately 9,000 to 10,000 have been described (Bolton 1994). Approximately 580 species are found in North America (Smith 1979). Ants as a group are ubiquitous, found in all terrestrial habitats, and often make up a significant proportion of the total arthropod biomass. They are also central to many ecosystem processes and are actively involved in decomposition of dead wood, nutrient cycling, plant pollination, seed dispersal, and predation on other arthropods. They also are a food source for wildlife (Petal 1978) and other arthropods (Holldobler and Wilson 1990). Torgersen and Bull (1995) documented their importance as a food source for pileated woodpeckers, and similarly bears have been shown to seasonally rely on ants as a food source (Noyce *et al.* 1997, Raine and Kansas 1999). Ants can be a significant predator of certain pest species of insects. In the Pacific Northwest they actively prey on Western spruce budworm (*Choristoneura occidentalis* (Freeman)) (Youngs and Campbell 1984, Torgersen *et al.* 1990).

Ants can make good indicators of ecological change, because of their role in ecosystem processes and their ubiquitous distribution. Ants are generally locally abundant and easy to collect. A number of authors have used ants to compare insect assemblages in habitats under various disturbance intensities (York 1994, Andersen 1995, Read 1996, and Kidd and Longair 1997). There has been extensive use of ants in Australia for monitoring (Majer 1983, Greenslade and Greenslade 1984, Andersen 1990, 1995). The Australian mining industry has used ant species richness and composition metrics to assess restoration success over the last 20 years (Andersen 1997).

Ants were chosen as one of the four groups of epigeal arthropods considered for long-term ecological monitoring in North Cascades National Park (see Foreword). The objectives of this report are to present basic information concerning occurrence, relative abundance, life history information, and taxonomic information for ants collected from various riparian habitats in the Big Beaver Creek Research Natural Area (BBCRNA) during 1995 and 1996.

Study Area

Watershed Characteristics

Big Beaver Creek is located approximately 25 km south of the Canadian border and about 75 km east of Bellingham (Figure 1). Big Beaver Creek flows to the southeast into the south end of Ross Lake, a power-generating impoundment occupying the northern portion of the Skagit River Valley. The Big Beaver watershed is a pristine natural area that encompasses approximately 17,000 hectares including the tributary drainages of Luna Creek and McMillan Creek. The elevation ranges from 488 m on the east where Big Beaver Creek flows into Ross Lake to 2502 m at the summit of Mt. Challenger on the western boundary of the watershed. Within this watershed, there are 174 km of streams and 62 lake/ponds represented on the USGS 7.5' topographical maps.

The climate in Big Beaver Valley is determined by general weather patterns in the North Cascades, which are modified by topographic features in and around the valley. Air masses originating as frontal systems over the Pacific Ocean release moisture in the form of rain or snow as they rise over the Pickett Range. This results in a rainshadow effect for Big Beaver Valley. Miller and Miller (1971) reported a moisture gradient within the valley, with the west end receiving more moisture than the east end. Based on records from nearby weather stations rainfall is estimated to range from approximately 150 cm in the lower eastern end of the valley to 250 cm in the higher western end of the watershed (Taber and Raedeke 1976). The orientation of the valley on a northwest-southeast axis creates strong microclimatic variation. For example, the north facing slopes stay cool and moist through the summer months because they receive very little direct sunlight.

The bedrock of Big Beaver Valley is composed almost entirely of Skagit Gneiss with a few scattered outcrops of Cascade River Schist (Misch 1966). Several periods of glaciation have carved a typical flat-bottomed, steep-walled valley. The headwaters of all streams begin in the steep upper canyons, often flowing down into a loose talus slope and finally entering the lower gradient valley bottom. There is a soil moisture gradient from the well-drained rocky soils on the upper slopes to the saturated silty-peat soils of the valley bottom. The area surrounding Ross Lake is a transition zone between moist coastal forests west of the Cascade crest and dry interior forests (Franklin and Dyrness, 1973). This situation is evident in Big Beaver Valley, which shares plant associations and floristic affinities with both regions (Vanbianchi and Wagstaff 1988).

Study Area Characteristics

Only the lower 13 km of the creek were sampled during this study. Along this part of the reach, Big Beaver Creek is a fourth order, low-gradient stream with many meanders. Study site elevations are modest, ranging from 494 to 579 meters. There are substantial gravel bars along this section, while the low-gradient and relatively broad valley floors have enabled the formation of extensive swamps and marshes.

The vegetation and hydrography in the lower gradient sections of the study area are profoundly affected by the activities of beavers. They constantly reshape their channels, alter water levels, and harvest vegetation for food and construction materials. They create and maintain wetlands and kill large areas of riparian forest by inundation (Vanbianchi and Wagstaff 1988). Beavers are responsible for the formation of most of the pond habitat in the lower valley. Thus, aquatic and riparian communities of the lower valley are largely dependent on these animals.

The vegetation of the study area can be divided roughly into wetland and montane forested communities. Finer resolution divisions can be made based on dominant species and age structure. Common wetland plant species include: aquatic species, *Potamogeton natans*, *Nuphar polysepalum*, and *Menyanthes trifoliata;* emergent species, *Carex* spp., *Potentilla palustris*,

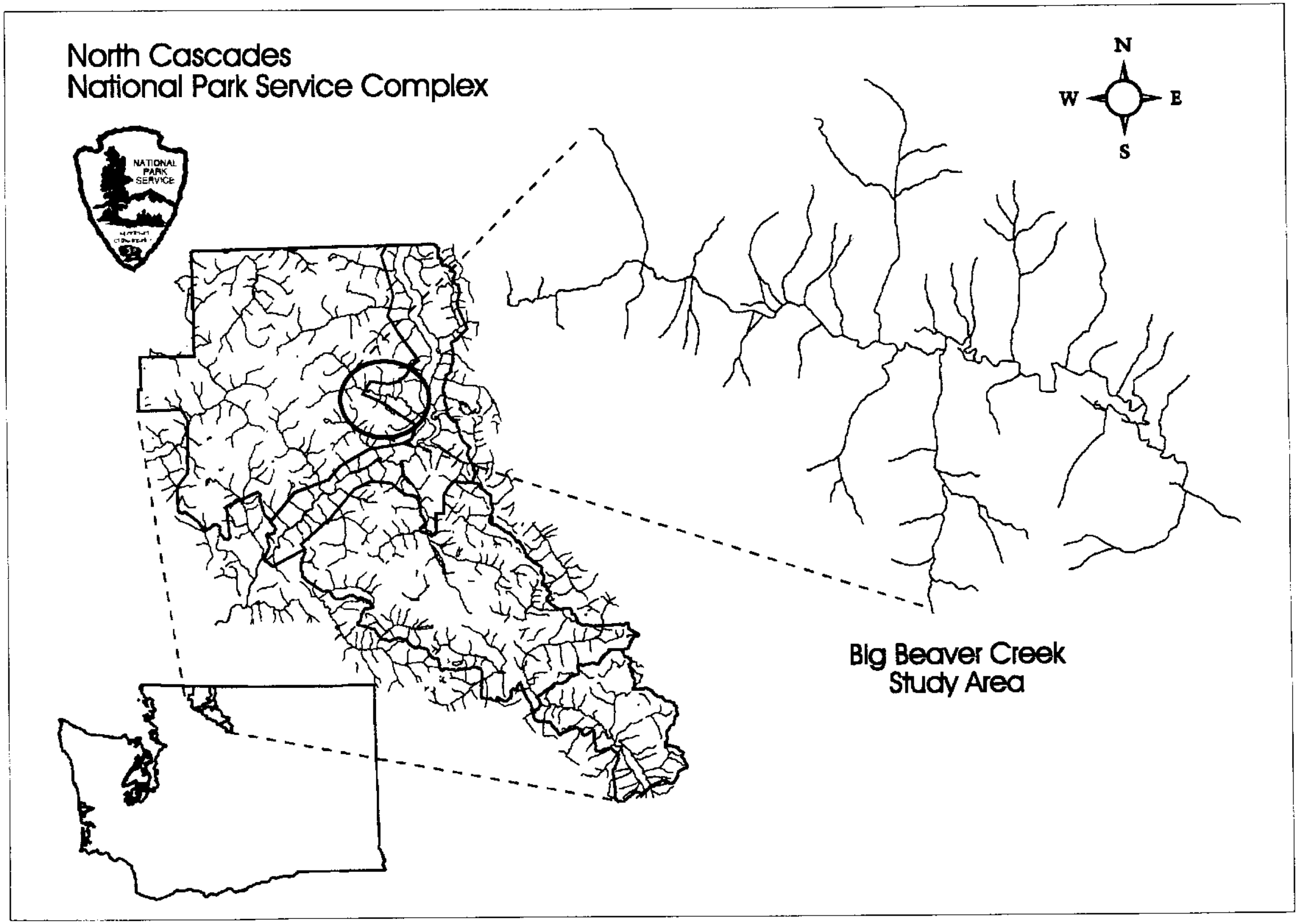

Figure 1. Location of the Big Beaver Creek study area in North Cascades National Park Service Complex, Washington.

Habernaria dilatata, Glyceria elata, and *Equisetum* spp.; bog species, *Sphaghnum* spp., *Drosera rotundifolia, Tofieldia glutinosa*; shrub species, *Salix sitchensis, Salix lasiandra, Spiraea douglasii,Cornus stolonifera, Acer circinatum, Alnus sinuata*, and *Sambucus racemosa*. Common trees in forest communities include deciduous trees, *Alnus rubra, Acer macrophyllum, Populus trichocarpa*, and conifers, *Thuja plicata, Pseudotsuga menziesii, Tsuga heterophylla, Abies amabilis, Pinus contorta, Pinus monticola* and *Picea engelmanni.*

Methods

A survey of the terrestrial riparian Arthropod fauna of Big Beaver Creek, North Cascades National Park (Washington) was conducted during the snow-free seasons of 1995 and 1996. A map of sample site locations are shown in Figure 2 and in aerial photographs in the Appendix (Figures A1 to A8). Sample site locations were based upon a high-resolution vegetation map (Vanbianchi and Wagstaff 1988) of this stretch of Big Beaver Creek. Nine habitat types representing dominant vegetation associations, or habitats of special interest, were selected for survey in 1995 and included the following: alder swamp (AS), maple thicket (AT), sphagnum bog (BOG), gravel bar (GVL), Douglas-fir forest (PF), willow-sedge swamp (SCS), willow-spiraea swamp (SSS), cedar-willow-sedge swamp (TSCS) and cedar-hemlock forest (TTF). In 1996, five habitats were sampled: AS, GVL, PF, SCS and TTF.

Pitfall traps were used for collection of all specimens. Pitfall trapping is a well-established method for sampling ground-active arthropods, with extensive literature dealing with the protocols and limitations of this technique (*e.g.*Greenslade 1964, Luff 1975, Uetz and Unzicker 1976, Adis 1979, Topping and Sunderland 1992, Spence and Niemela 1994, Mommertz *et al.* 1996). Pitfall traps selectively sample surface-active arthropods (versus litter-dwelling or arboreal species) and therefore do not provide direct unbiased measures of abundance. There has been some debate over the utility of pitfall traps for estimation of population abundance. However, there is general agreement that pitfall traps are useful for comparing relative abundance of invertebrate species between sites (Adis 1979, Southwood 1978, Luff and Eyre 1988). For example, pitfall traps preferentially capture large, active species. All species are not equally susceptible to this sampling method. Pitfall capture rates are also a function of climatic conditions, since these affect arthropod activity. For instance, very cold or dry conditions often result in reduced catches since many arthropods are less active under these circumstances. A further complication is that pitfalls trapping for relatively long periods may strongly attract necrophagous (carrion-feeding) insects (e.g. blowflies and burying beetles), especially traps that incidentally capture vertebrates and those with dilute preservative. There is also evidence that ethylene glycol, a standard preservative used in pitfalling, actively attracts some species or genders of insects (Holopainen 1990). No such evidence exists regarding the preservative used in the Big Beaver Creek study, propylene glycol, but it seems likely that it would have similar effects.

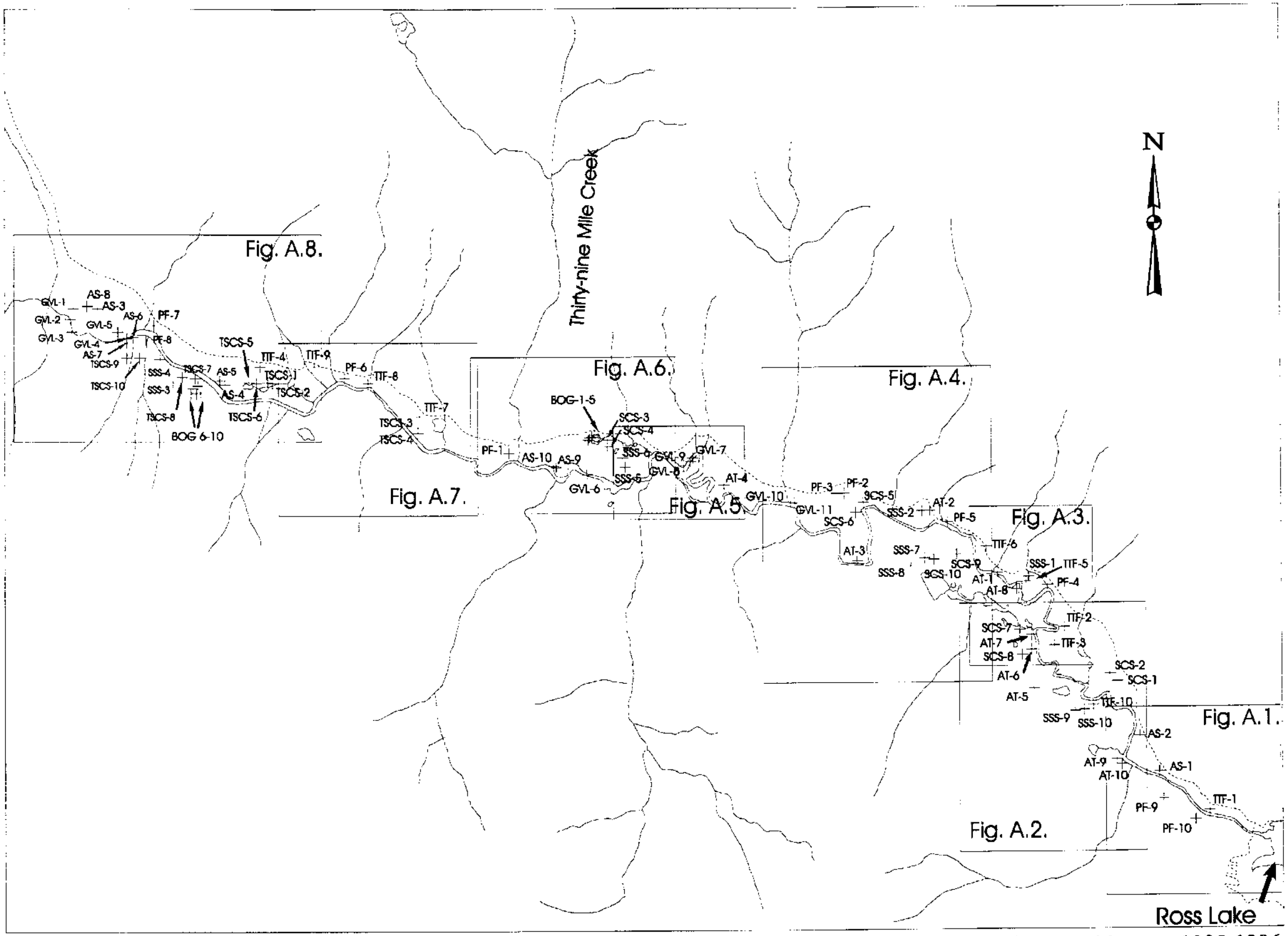

Figure 2. Arthropod pitfall trap locations, Big Beaver Creek, North Cascades National Park Service Complex, Washington, 1995-1996. (Boxes refer to aerial photos found in the Appendix, Figures A.1. - A.8.)

The pitfall traps consisted of a plastic bucket 18 cm tall with a diameter of 14 cm at the top and 12 cm at the bottom. An aluminum funnel was placed inside the top to prevent arthropods from crawling or jumping out. This funnel extended about 8 cm down into the bucket with a bottom opening of 3 to 4 cm and the top tightly wedged inside and near the rim of the bucket. A 16 oz plastic cup, filled with approximately 100 ml of propylene glycol (non-toxic antifreeze), was placed inside the bucket.

The plastic buckets were set into the ground so that the top of the bucket was even with the level of the surrounding substrate. A hand trowel was used to excavate the hole for the bucket, with backfill and litter repositioned to approximate the original condition of the trapsite. The cup, containing the antifreeze, was set inside the bucket and then the funnel was installed. Finally a 2 x 25 x 25 cm wooden board supported by 2 x 2 x 5 cm legs was set over the pitfall trap to keep unwanted debris and rain out of the trap.

Ten separate habitat patches were randomly selected for each habitat type and one pitfall trap was used per habit patch (Figure 2), with the exception of BOG and GVL sites in 1995. There were only two patches of the BOG habitat type in the valley, for which five pitfall traps were placed at each of these sites. For GVL sites, 11 separate patches were selected in 1995 and 10 in 1996. Traps operated continuously throughout the sampling period, from early May through October of 1995. In 1996, resource constraints and extensive bear damage to early season traps (up to 70% of May traps/habitat were destroyed in 1995), resulted in restricting the sampling period to early June through early October. Thus, 91 traps were utilized in 1995 and 50 in 1996. In order to reduce "trap-out" effects and individual trap location bias, each 1996 trap position was shifted approximately 10 m from the 1995 position.

Extensive habitat information (from an 8 × 8 m grid centered upon the trap) was recorded for the area immediately surrounding each trap site. Information collected for each site included UTM coordinates, elevation, crude soil type (*e.g.* clay versus loam), soil moisture during August, litter depth, percent canopy closure, slope, aspect, percent herb and shrub cover (by species - herb and shrub cover measured in 4x4 m plot centered upon the trap), tree species inventory (number of individuals and dbh.) and coarse woody debris inventory. The number and species of vertebrates collected by the pitfalls were also recorded, and all such specimens were retained.

Pitfall samples were collected once a month. Specimens collected from each trap were placed in bottles with the antifreeze preservative and returned to the lab for processing. In the laboratory, samples were washed, sorted, and all spiders were placed in vials of 70% ethanol. Spiders were identified to the lowest possible taxonomic level. All species identifications were based on intact adult male and female specimens. Taxonomic references by Allred (1982), and Wheeler and Wheeler (1986) were used for identifications. Most of the identification work was accomplished by Dr. Patrick Sugg, Seattle, WA. Dr. David Smith, Systematic Entomology Laboratory, Smithsonian Institute, Washington, D.C., provided verifications of most of the taxa that were identified in the study.

Results and Discussion

Sample Site Habitat Characteristics

A summary of soil and site characteristics by habitat type is shown in Table 1. Plant species richness and common herb, shrub, and tree species found within the sample sites are shown in Tables 2-4. All plant species encountered during the survey, by habitat type, are found in the Appendix (Tables A1 - A3).

Alder swamp (AS) site soils were moist to wet, predominantly sandy or loamy, with an average litter depth of 5.6 cm. The average coarse woody debris volume was 2.3 m^3 per plot (Table 1). The sites were essentially flat, with an average slope of 0.6% and canopy closure averaged 96%. Seventeen herb species were found among the AS sites, with an average of 4.3 species/plot (Table 2). *Athryium filix-femina* was the only herb species considered as common (occurring at 50% or more of the plots) to this habitat. Herb cover averaged 53%. Sixteen species or shrubs were indentified within the AS habitat type. Several shrub species were commonly encountered in AS habitat sites (Table 3), of which *Rubus spectabilis* was the most abundant and widely distributed species. AS habitat sites had an average species richness of 4.6 species per plot. Average shrub cover was 64%. Red alder (*Alnus rubra)* and vine maple (*Acer circinatum*) were the only common tree species observed of the total of 8 species found in this habitat type.

Maple thickets (AT) had moist soils that were predominantly organic or loamy, with an average litter depth of 3.5 cm. Average coarse woody debris volume was 2.0 m^3 per plot. The average site slope was 5.4%. Canopy closure averaged 99%. Common herb species included mosses and *Athryium filix-femina*. Herb cover averaged 45%, with average species richness of 3.6 species per plot. The most common shrubs were *Acer circinatum* and *Cornus stolenifera*. Maple thickets had the greatest average shrub cover of all sampled habitats. Shrub canopy cover consisted of multiple layers and the average shrub cover was 106%. Twelve species of shrubs were found in the AT habitat, with average species richness of 2.6 species per plot. The dominant trees were *A. circinatum* and *Pyrus fusca*, with five species found among the eight plots sampled. Tree density, as measured by % basal area in the plot, ranked 4th among the nine habitats sampled.

Douglas-fir forest (PF) soils were dry, organic or loamy, with an average litter depth of 8.2 cm. The average coarse woody debris volume was 5.7 m^3 per plot, greatest among all of the habitat types being compared. Slopes averaged 7.8%. Canopy closure averaged 100%. Mosses and *Linnaea borealis* were the most commonly occurring herb species. Herb cover averaged 55% and average species richness of 3.3 species per plot. Average shrub cover was 26%, with an average species richness of 2.7 species per plot, and a total of eleven species encountered in the habitat. Eight species of trees were found in PF habitat with an average of 2.9 species/plot. The most common trees included *Tsuga heterophylla* and *Thuja plicata*. These forests were the steepest of all sampled habitats, had the greatest average canopy closure, the greatest average woody debris volume, the greatest basal area of trees and the greatest average litter depth of all sampled habitats.

Table 1. Summary of soil and site attribute characteristics by habitat type at arthropod pitfall trap sites, Big Beaver Creek Research Natural Area, North Cascades National Park Service Complex, Washington, 1995. (AS = Alder swamp, AT = Maple thicket, BOG = Sphagnum bog, GVL = Gravel bar, PF = Douglas Fir forest, SCS =Willow - Carex swamp, SSS = Willow - Spiraea swamp, TSCS = Cedar - Willow - Carex swamp, TTF = Hemlock - Cedar Forest)

	AS	AT	PF	TTF	GVL	TSCS	BOG	SCS	SSS
	(10)	(8)	(9)	(9)	(10)	(10)	(10)	(10)	(9)
	Soil moisture and soil type class frequency (%) by habitat types (sample size)								
Soil Moisture									
Wet	60	12.5	0	0	0	70	100	100	67
Moist	20	75	0	22	0	30	0	0	33
Dry	20	12.5	100	78	100	0	0	0	0
Soil Type									
Peat	0	0	0	0	0	0	100	0	0
Organic debris/litter	20	25	56	22	0	90	0	90	89
Clay - sandy loam	80	75	44	78	20	10	0	10	11
Sand and rock	0	0	0	0	80	0	0	0	0
	Mean and standard deviation of site attributes by habitat type								
	AS	**AT**	**PF**	**TTF**	**GVL**	**TSCS**	**BOG**	**SCS**	**SSS**
CWD (m^3)									
Mean	2.26	2.04	5.69	3.46	1.31	0.18	0.25	0.01	0.13
Stand. Dev.	*4.17*	*2.57*	*3.65*	*2.18*	*2.23*	*0.38*	*0.76*	*0.04*	*0.23*
% Herb Cover									
Mean	52.5	45	54.9	49.2	5.5	119.8	242.5	157.3	109.4
Stand. Dev.	*40.9*	*50.5*	*40.8*	*41.1*	*5.25*	*42.8*	*34.8*	*48.1*	*62.9*
% Shrub Cover									
Mean	63.6	105.6	26.1	36.6	9.4	82.1	20.9	39.9	69.2
Stand. Dev.	*45.9*	*9.6*	*23.8*	*35.8*	*11.5*	*45*	*20.3*	*27*	*39.8*
% Tree Basal Area									
Mean	1.73	1.08	3.03	1.98	0.08	0.46	n.s	0	0
Stand. Dev.	*1.37*	*1.29*	*1.21*	*1.13*	*0.27*	*0.84*	-	*0*	*0*
% Canopy Cover									
Mean	96	99	100	99.3	12.7	62.6	7	4.5	16.6
Stand. Dev.	*5.9*	*2.1*	*0*	*1.1*	*16.1*	*26.5*	*10.6*	*6.6*	*29.4*
Litter Depth (cm)									
Mean	5.6	3.5	8.2	5.3	0	5.4	0	6.3	4.9
Stand. Dev.	*2.5*	*3.2*	*2.2*	*2.2*	*0*	*2.9*	*0*	*2.6*	*2.1*

Table 2. Herbaceous plant species summary by habitat type at arthropod pitfall trap sites, Big Beaver Creek Research Natural Area, North Cascades National Park Service Complex, Washington, 1995.

Habitat Type	Common Species[1]	Total No. of Species	Avg. No. of Species/Plot[2]	Range No. of Species/Plot
Alder Swamp (AS)	*Athyria filix femina*	17	4.3	2-7
Maple Thicket (AT)	Moss spp. *Athyria filix femina*	18	3.6	1-7
Sphagnum Bog (BOG)	*Sphagnum sp.* *Carex spp.* *Drosera rotundifolia* *Menyanthes trifoliata* *Trientalis latifolia*	15	6.3	3-11
Gravel Bar (GVL)	*Epilobium latifolium* Graminoid spp. *Anaphalis margaritacea*	13	2.8	0-9
Douglas Fir Forest (PF)	Moss spp. *Linnaea borealis*	14	3.3	1-6
Willow-Carex Swamp (SCS)	*Carex spp.* *Equisetum sp.* Graminoid spp. *Angelica genuflexa* *Lysichitum americanum* *Aster modestus*	21	6.1	2-10
Willow-Spiraea Swamp (SSS)	*Carex spp.* *Potentilla palustris* *Athyria filix femina* *Lysichitum americanum*	16	5.2	2-8
Cedar-Willow-Carex Swamp (TSCS)	*Carex spp.* *Athyria filix femina* *Lysichitum americanum* *Equisetum sp.* Graminoid spp.	20	6.3	4-9
Hemlock-Cedar Forest (TTF)	*Tiarella trifoliata* *Athyria filix femina*	26	6	1-11

[1]Common species included those which occurred in 50% or more of the sites sampled within a particular habitat type.

[2]Plot size for herbaceous plant data collection was 4x4 meters, and centered on arthropod pitfall trap location.

Table 3. Shrub plant species summary by habitat type at arthropod pitfall trap sites, Big Beaver Creek Research Natural Area, North Cascades National Park Service Complex, Washington, 1995.

Habitat Type	Common Species[1]	Total No. of Species	Avg. No. of Species/Plot[2]	Range No. of Species/Plot
Alder Swamp (AS)	*Rubus spectabilis* *Cornus stolenifera* *Sambucus racemosa*	16	4.6	3-7
Maple Thicket (AT)	*Acer circinatum* *Cornus stolenifera*	12	2.6	1-5
Sphagnum Bog (BOG)	*Thuja plicata* *Spiraea douglasii*	9	2.5	0-5
Gravel Bar (GVL)	*Salix sitchensis* *Alnus rubra*	9	1.7	0-4
Douglas Fir Forest (PF)	*Tsuga heterophylla* *Acer circinatum*	11	2.7	1-4
Willow-Carex Swamp (SCS)	*Spiraea douglasii* *Salix sitchensis*	5	2.2	1-4
Willow-Spiraea Swamp (SSS)	*Spiraea douglasii* *Salix sitchensis* *Cornus stolenifera*	9	3.3	1-6
Cedar-Willow-Carex Swamp (TSCS)	*Salix sitchensis* *Spiraea douglasii* *Cornus stolenifera*	18	4.8	2-12
Hemlock-Cedar Forest (TTF)	*Acer circinatum*	13	2.7	1-5

[1]Common species included those which occurred in 50% or more of the sites sampled within a particular habitat type.

[2]Plot size for shrub data collection was 4x4 meters, and centered on arthropod pitfall trap location.

Table 4. Tree plant species summary by habitat type at arthropod pitfall trap sites, Big Beaver Creek Research Natural Area, North Cascades National Park Service Complex, Washington, 1995.

Habitat Type	Common Species[1]	Total No. of Species	Avg. No. of Species/Plot[2]	Range No. of Species/Plot
Alder Swamp (AS)	*Alnus Rubra* *Acer cercinatum*	8	1.7	0-4
Maple Thicket (AT)	*Alnus sinuata* *Acer cercinatum* *Pyrus fusca*	5	0.8	0-2
Sphagnum Bog (BOG)	(none - one tree at one plot)	1	0.1	0-1
Gravel Bar (GVL)	(none - two trees at one plot)	1	0.1	0-1
Douglas Fir Forest (PF)	*Tsuga heterophylla* *Thuja plicata*	8	2.9	1-6
Willow-Carex Swamp (SCS)	None	0	0	0
Willow-Spiraea Swamp (SSS)	None	0	0	0
Cedar-Willow-Carex Swamp (TSCS)	*Thuja plicata*	3	0.6	0-2
Hemlock-Cedar Forest (TTF)	*Thuja plicata*	7	2.2	1-4

[1]Common species included those which occurred in 40% or more of the sites sampled within a particular habitat type.

[2]Plot size for herbaceous plant data collection was 4x4 meters, and centered on arthropod pitfall trap location.

Cedar-hemlock forest (TTF) soils were dry, with organic or loamy soils and had an average litter depth of 5.3 cm. Average coarse woody debris volume was second to PF habitats, 3.5 m^3 per plot. Average slope per plot was 4.8% and canopy closure averaged 99.3%. TTF habitat exhibited the greatest diversity of herb species (26) and averaged 6 species/plot. *Tiarella trifoliata* and *Atherix filix femina* were the most common species of herbs. Herb cover averaged 49%. *Acer circinatum* was the dominant shrub found among the TTF sites; shrub cover averaged 37%, with average species richness of 2.7 species per plot. Thirteen species of shrubs were observed in the TTF habitat. Seven species of trees were observed with an average of 2.2 species/plot. *Thuja plicata* was the most common tree found in the habitat. Tree basal area in TTF habitat ranked second among the nine habitats sampled.

Gravel bar (GVL) soils were dry, lacked litter and were composed of sand, gravel and cobbles. The average coarse woody debris volume was 1.3 m^3 per plot. The average slope was 3.2% and canopy closure averaged 13%. Mean herbaceous plant cover was 5.5%, the lowest of all the habitats sampled. Thirteen herb species were found in the GVL sites, with an average of 2.8 species/plot. *Epilobium latifolium* and grass species were the most common taxa. Shrub cover was also lowest at GVL sites (mean 9.4%). Nine shrub species were found in this habitat, with an average of 1.7 species/plot. *Salix sitchensis* and *Alnus rubra* were the most common species of shrubs encountered at GVL sites. Two trees were found at one of the GVL plots. None of the other plots had trees.

Cedar-willow-sedge swamp (TSCS) soils were organic, wet and had an average litter depth of 5.4 cm. Average coarse woody debris volume was negligible, <0.2 m^3 per plot. All of the sites were flat and canopy closure averaged 63%. Twenty herb species were observed in TSCS sites, with an average of 6.3 species/plot. Several species were widely distributed among the TSCS plots (Table 2), with *Carex* spp., *Athryium filix-femina* and *Lysichitum americanum* the most common. Herb cover was found in multiple layers and averaged 120%. Percent shrub cover was high in TSCS habitat (mean 82%). The greatest number of shrub species (18) and highest number of species/plot (4.8) were observed in TSCS habitat. The most common species of shrubs observed included *Salix sitchensis*, *Spiraea douglasii*, and *Cornus stolenifera*. *Thuja plicata* was the most common tree species. Only two other species of trees were found in the habitat. Tree basal are a was low (< 0.5 % of the plot area) compared to other forested habitats sampled.

Sphagnum bogs (BOG) had wet, peaty "soils" without a litter layer. The average coarse woody debris volume was 0.3 m^3 per plot. Bog sites were flat, with no discernable slope, and canopy closure averaged 7%. Fifteen herb species were observed at BOG sites, with an average of 6.3 species/plot (ranking first with TSCS habitat, Table 2). The most common species found at BOG sites included *Sphagnum* spp., *Carex* spp., *Drosera rotundifolia*, and *Menyanthes trifoliata*. Herbaceous plants were the dominant plant group observed at BOG sites. They were encountered in multiple layers, and percent cover was very high at 242%. Shrub cover at BOG sites was low (21%). Nine species of shrubs were observed, with an average of 2.5 species/plot. *Thuja plicata* and *Spiraea douglasii* were the most common shrubs encountered. Only one tree was found in the ten plots surveyed.

Willow-sedge swamp (SCS) soils were wet and organic, with an average litter depth of 6.3 cm. A small amount of coarse woody debris was found at only one of the ten sites. These swamps were essentially flat, with an average slope of 0.3%, and canopy closure averaged 4.5%. SCS sites exhibited a diverse herbaceous flora represented by 20 species and an average of 6.1 species/plot. Many herb species were widely distributed among the plots sampled, with most common including *Carex* spp. and *Equisetum* spp. and grass species. Herbaceous plants in this habitat also were found in multiple layers. Herb cover was high and averaged 157%. Five species of shrubs were observed and common taxa included *Spiraea douglasii* and *Salix sitchensis*. Shrub cover averaged 40%. Trees were not found at any of the SCS plots.

Willow-spiraea swamp (SSS) soils were wet, organic and had an average litter depth of 4.9 cm. Average coarse woody debris volume was negligible, approximately 0.1 m^3 per plot. These sites were flat, with no discernable slope, and canopy closure averaged 19%. Sixteen species of herbaceous plants were observed with an average of 5.2 species/plot. Most common herb species encountered included *Carex* spp., *Potentilla palustris, Athyria filix femina, and Lysichitum americanum*. Herb cover averaged 109%. Nine species of shrubs were observed within the habitat and the most common species included *Spiraea douglasii, Salix sitchensis, and Cornus stolenifera*. Shrub cover averaged 69%, with average species richness of 3.3 species per plot. There were no trees in any of the plots.

In summary, the various habitats can be generally characterized by gradients in soil moisture and canopy cover. These characteristics largely affect the plant community structure and consequently affect other environmental attributes such as litter and coarse woody debris. Habitat types exhibiting wet soil conditions and open canopies included bogs and swamps (BOG, SCS, SSS). Gravel bars (GVL) exhibited dry soils and open canopies. Wet to moist soil conditions and closed canopies were found at AT, AS, and TSCS sites. Dry soils and closed canopies were common to forested habitats of PF and TTF sites.

Species Abundance and Distribution

Ants were the third most abundant arthropod group collected from pitfall traps in the BBCRNA during 1995 and 1996. A total of 2,722 ant specimens were collected during the two sampling seasons. In contrast, a total of 18,766 beetles (LaBonte 1998), 8,922 spiders (Glesne 1998), and 464 Heteroptera (Lattin 1997) were also collected during the same period.

The number of ant taxa and individuals collected from the different habitat types during the 1995 and 1996 sample periods are displayed in Table 5. Individual species capture data by habitat type for 1995 and 1996 are shown in Tables 6 and 7. A total of 22 ant species were collected from pitfall traps in the BBCRNA during 1995 and 1996. The nine habitat types sampled during 1995 yielded 19 species. Resampling of 5 of the habitat types in 1996 yielded a total of 17 species, adding an additional 3 species to the total for 1995. The number of species found in each habitat type ranged from 3 (AT - maple thicket) to 13 (GVL - gravel bar) during 1995. Number of species collected during 1996 at the five habitats sampled ranged from 5 (AS - alder swamp) to 9 (PF - Douglas fir forest).

Table 5. Number of Ant (Formicidae) taxa and number of individuals collected from the Big Beaver Creek study area, North Cascades National Park Complex, Washington, 1995 and 1996. (AS = Alder swamp, AT = Maple thicket, BOG = Sphagnum bog, GVL = Gravel bar, PF = Douglas Fir forest, SCS = Willow - Carex swamp, SSS = Willow - Spiraea swamp, TSCS = Cedar - Willow - Carex swamp, TTF = Hemlock - Cedar Forest).

Sample Period: May - Oct. 1995 **Sample Effort: (Trap - days)* =**	**AS** **1380**	**AT** **1200**	**BOG** **1500**	**GVL** **1620**	**PF** **1200**	**SCS** **1410**	**SSS** **1410**	**TSCS** **1290**	**TTF** **1230**	**TOTAL** **12240**
NO. OF SPECIES	6	3	7	13	6	8	7	6	5	19
NO. OF INDIVIDUALS	64	35	85	826	110	136	49	142	78	1525
ACTIVITY-DENSITY (No./100 trap-days)	4.6	2.9	5.7	51.0	9.2	9.6	3.5	11.0	6.3	12.5

Sample Period: June - Oct. 1996 **Sample Effort: (Trap - days)* =**	**AS** **1140**	**AT**	**BOG**	**GVL** **1170**	**PF** **1110**	**SCS** **1140**	**SSS**	**TSCS**	**TTF** **1080**	**TOTAL** **5640**
NO. OF SPECIES	5			8	9	7			6	17
NO. OF INDIVIDUALS	27			411	140	177			492	1247
ACTIVITY-DENSITY (No./100 trap-days)	2.4			35.1	12.6	15.5			45.5	22.1

* Trap - days varied for each habitat type depending on the level of disturbance by bears and other animals.

Table 6. Ant taxa and number of individuals collected in pitfall traps from the Big Beaver Creek study area, North Cascades National Park Service Complex, Washington, May-October, 1995. (AS = Alder swamp, AT = Maple thicket, BOG = Sphagnum bog, GVL = Gravel bar, PF = Douglas Fir forest, SCS = Willow - Carex swamp, SSS = Willow - Spiraea swamp, TSCS = Cedar - Willow - Carex swamp, TTF = Hemlock - Cedar Forest).

		Habitat									
Genus	**Species**	**AS**	**AT**	**BOG**	**GVL**	**PF**	**SCS**	**SSS**	**TSCS**	**TTF**	**TOTAL**
Aphaenogaster	*occidentalis* (Emery)	0	0	0	0	0	0	0	0	0	0
Camponotus	*modoc* W.M. Wheeler	37	32	7	29	34	9	16	49	61	274
Camponotus	*novaeboracensis* (Fitch)	0	0	1	0	0	6	9	0	0	16
Camponotus	*herculeanus* (Linnaeus)	0	0	0	3	4	0	7	0	5	19
Camponotus	*vicinus* Mayr	0	0	1	0	0	0	0	0	0	1
Formica	*densiventris* Viereck	4	0	10	14	0	0	0	0	0	28
Formica	*pacifica* Francoeur	6	0	0	547	0	0	0	0	0	553
Formica	*obscuripes* Forel	0	0	0	8	0	4	0	0	0	12
Formica	*neorufibarbis* Emery	5	0	5	73	0	30	11	21	7	152
Formica	*propinqua* W.M. Wheeler	0	0	0	0	0	26	0	0	0	26
Lasius	*pallitarsis* (Provancher)	8	2	2	4	69	1	1	54	2	143
Lasius	*alienus* (Foerster)	0	1	0	1	1	0	0	0	3	6
Lasius	*vestitus* W.M. Wheeler	0	0	0	0	0	0	0	0	0	0
Leptothorax	*sp01*	0	0	0	0	0	0	1	0	0	1
Leptothorax	*muscorum* (Nylander)	0	0	0	3	0	1	0	0	0	4
Leptothorax	*rugatulus* W.M. Wheeler	0	0	0	0	0	0	0	0	0	0
Manica	*hunteri* (W.M. Wheeler)	0	0	0	5	0	0	0	0	0	5
Myrmica	*nr. brevispinosa*	4	0	0	94	0	0	0	0	0	98
Myrmica	*incompleta* Provancher	0	0	59	40	1	59	4	15	0	178
Myrmica	*nr. fracticornis*	0	0	0	0	0	0	0	2	0	2
Myrmicine	*unident.*	0	0	0	5	0	0	0	0	0	5
Stenamma	*diecki* Emery	0	0	0	0	1	0	0	1	0	2
	TOTAL	64	35	85	826	110	136	49	142	78	1525

Table 7. Ant taxa and number of individuals collected in pitfall traps from the Big Beaver Creek study area, North Cascades National Park Service Complex, Washington, June-October, 1996. (AS = Alder swamp, AT = Maple thicket, BOG = Sphagnum bog, GVL = Gravel bar, PF = Douglas Fir forest, SCS = Willow - Carex swamp, SSS = Willow - Spiraea swamp, TSCS = Cedar - Willow - Carex swamp, TTF = Hemlock - Cedar Forest).

				Habitat			
Genus	**Species**	**AS**	**GVL**	**PF**	**SCS**	**TTF**	**TOTAL**
Aphaenogaster	*occidentalis* (Emery)	0	0	0	0	1	1
Camponotus	*modoc* W.M. Wheeler	18	12	56	7	62	155
Camponotus	*novaeboracensis* (Fitch)	0	0	0	17	0	17
Camponotus	*herculeanus* (Linnaeus)	0	6	19	0	419	444
Camponotus	*vicinus* Mayr	0	0	0	0	0	0
Formica	*densiventris* Viereck	0	0	0	0	0	0
Formica	*pacifica* Francoeur	1	292	0	0	0	293
Formica	*obscuripes* Forel	0	2	0	0	0	2
Formica	*neorufibarbis* Emery	4	5	4	32	2	47
Formica	*propinqua* W.M. Wheeler	0	0	0	4	0	4
Lasius	*pallitarsis* (Provancher)	2	0	45	2	7	56
Lasius	*alienus* (Foerster)	0	0	5	0	0	5
Lasius	*vestitus* W.M. Wheeler	0	0	0	1	0	1
Leptothorax	*sp01*	0	0	0	0	0	0
Leptothorax	*muscorum* (Nylander)	0	1	4	0	0	5
Leptothorax	*rugatulus* W.M. Wheeler	0	0	1	0	0	1
Manica	*hunteri* (W.M. Wheeler)	0	0	0	0	0	0
Myrmica	*nr. brevispinosa*	2	90	0	0	0	92
Myrmica	*incompleta* Provancher	0	3	0	114	0	117
Myrmica	*nr. fracticornis*	0	0	3	0	1	4
Myrmicine	*unident.*	0	0	0	0	0	0
Stenamma	*diecki* Emery	0	0	3	0	0	3
	TOTAL	27	411	140	177	492	1247

Comparisons of activity-density are presented in Table 5. These values may be only useful for very generalized comparisons between habitat types, and between years within habitat types. Random placement of pitfall traps that locate traps near ant colonies will most likely capture more individuals than traps located on the periphery of ant colonies, consequently wide variations in abundance may be expected. Total activity-density for 1996 (22.1 ants/100 trap-days) was almost twice as high as the 1995 value (12.5 ants/100 trap-days), however it is difficult to discern if ants were more abundant during 1996 or if the pitfall traps were more effective. Considering the five habitat types that were sampled during both 1995 and 1996, there was relatively little variation in activity-density values between years, with the exception of the cedar/hemlock forest type (TTF). The activity-density values for TTF habitat in 1995 was 6.3 ants/100 trap-days and 45.5 ants/100 trap-days in 1996. This was attributed to a large number *of Camponotus herculeanus* (Linnaeus) specimens collected in 1996 (5 specimens in 1995, Table 6, and 444 specimens collected in 1996, Table 7). Ants were collected in high abundance at gravel bar sites during both years of sampling and can be attributed to the dominance of *Formica spp.* and *Myrmica spp.* in the collection.

The inherent problems of using pitfall traps to obtain arthropod abundance data (discussed in the Methods section) make it difficult to determine differences in species assemblages between sites. These problems are even greater when considering the colonial nature of ants. Assessment of quantitative differences among sites may require other collection methods and more intensive sampling. However, analyses of pitfall trap data using frequency of occurrence and relative abundance may diminish some of the sampling bias encountered in comparisons of arthropod catches between sites. Dufrene and Legendre (1997) proposed the use of a species Indicator Value index for identifying indicator species and species assemblages characterizing groups of sites. The index is based on only within-species abundance (% relative abundance) and occurrence (% frequency of occurrence) comparisons, without any comparison among species. The index reaches its maximum (100) when all individuals of a species are found in a single habitat type and when the species occurs in all sites of that habitat type. Relative abundance (RA), Relative Frequency (RF), and Indicator Values (IV) for the predominant ant species (Seven of the 22 taxa of ants collected during the study accounted for 93% of all ants collected during 1995 and 97% of all ants collected during 1996) by habitat type and year are compared in Table 8.

Examining species capture data from Tables 6 and 7, and Relative abundance (RA) and Relative Frequency (RF) in Table 8, four patterns of ant distribution and abundance can be observed:

1. <u>Habitat generalists/common</u> - species that are collected in moderate abundance, exhibit a wide distribution among habitat types, and are also frequently occurring within sites of the same habitat type. *Camponotus modoc* W.M. Wheeler was found in every habitat type during both 1995 and 1996. RA values for *C. modoc* ranged from 2.6 to 40 %, and they were found in 30 to 82% of all sites within each habitat type during both years of the study (Table 8).

Table 8. Percent relative abundance[1] (RA), percent relative frequency[2] (RF), and indicator values[3] (IV) of selected Big Beaver Creek ants collected from pitfall traps set in various riparian habitats (AS = Alder swamp, AT = Maple thicket, BOG = Sphagnum bog, GVL = Gravel bar, PF = Douglas Fir forest, SCS = Willow - Carex swamp, SSS = Willow - Spiraea swamp, TSCS = Cedar - Willow - Carex swamp, TTF = Hemlock - Cedar Forest). Indicator values >30 are highlighted in bold. Methods for calculating indicator values are from Dufrene and Legendre (1997).

Habitat Type	AS			AT			Bog			GVL			PF			SCS			SSS			TSCS			TTF		
	RA	RF	IV	RA	RF	IV	RA	RF	IV	RA	RF	IV	RA	RF	IV	RA	RF	IV	RA	RF	IV	RA	RF	IV	RA	RF	IV
1995 Pitfall Traps																											
Camponotus modoc	13.5	70	9.5	11.7	60	7.0	2.6	50	1.3	10.6	82	8.7	12.4	70	8.7	3.3	40	1.3	5.8	40	2.3	17.9	80	14.3	22.3	70	16
Camponotus herculeanus	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	15.8	27	4.3	21.1	10	2.1	0.0	0	0.0	36.8	20	7.4	0.0	0	0.0	26.3	20	5.3
Formica pacifica	1.1	20	0.2	0.0	0	0.0	0.0	0	0.0	98.9	91	**90.0**	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0
Formica neorufibarbis	3.3	30	1.0	0.0	0	0.0	3.3	50	1.6	48.0	45	21.6	0.0	0	0.0	19.7	50	9.9	7.2	40	2.9	13.8	70	9.7	4.6	20	0.9
Lasius pallitarsis	5.6	40	2.2	1.4	20	0.3	1.4	10	0.1	2.8	27	0.8	48.3	20	9.7	0.7	10	0.1	0.7	10	0.1	37.8	40	15.1	1.4	10	0.1
Myrmica nr. brevispinosa	4.1	10	0.4	0.0	0	0.0	0.0	0	0.0	95.9	64	**61.4**	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0
Myrmica incompleta	0.0	0	0.0	0.0	0	0.0	33.1	60	19.9	22.5	27	6.1	0.6	10	0.1	33.1	50	16.6	2.2	10	0.2	8.4	40	3.4	0.0	0	0
1996 Pitfall traps																											
Camponotus modoc	11.6	60	7.0							7.7	30	2.3	36.1	40	14	4.5	40	1.8							40.0	60	24.0
Camponotus herculeanus	0.0	0	0.0		**not**			**not**		1.4	20	0.3	4.3	30	1.3	0.0	0	0.0		**not**			**not**		94.4	30	28.3
Formica pacifica	0.3	10	0.0		**sampled**			**sampled**		99.7	50	**49.8**	0.0	0	0	0.0	0	0.0		**sampled**			**sampled**		0.0	0	0.0
Formica neorufibarbis	8.5	20	1.7							10.6	20	2.1	8.5	20	1.7	68.1	30	20.4							4.3	20	0.9
Lasius pallitarsis	3.6	20	0.7							0.0	0	0.0	80.4	30	24	3.6	10	0.4							12.5	20	2.5
Myrmica nr. brevispinosa	2.2	10	0.2							97.8	40	**39.1**	0.0	0	0	0.0	0	0.0							0.0	0	0.0
Myrmica incompleta	0.0	0	0.0							2.6	10	0.3	0.0	0	0	97.4	20	19.5							0.0	0	0.0

[1] % Relative abundance = abundance of a species in a given group of plots over the abundance of that species in all plots expressed in percent.

[2] % Relative frequency = percent of plots in a given group where given species is present.

[3] Indicator values = percent of perfect indication of a species in a given habitat group, and is calculated as the product of the relative abundance and relative frequency. Perfect indication is equal to 100 %.

2. Habitat generalists/uncommon - species that are collected in low to moderate abundance, are widely distributed among habitat types, but exhibit low to moderate frequency of occurrence within sites of the same habitat type. Species representing this group include *Formica neorufibarbis* Emery, *Lasius pallitarsis* (Provancher), and *Myrmica incompleta* Provancher.

3. Habitat specialists - species only found in one or two habitat types, and are generally abundant in only one habitat. This group is represented by two species, *Formica pacifica* Francoeur and *Myrmica nr. brevispinosa*. *F. pacifica* was collected at 10 of the 11 gravel bar sites during 1995, and at 5 of the 10 gravel bar sites sampled during 1996. Greater than 98% of all F. pacifica specimens were collected from gravel bar sites. *M. nr. brevispinosa* specimens were collected from 7 gravel bar sites during 1995 and from 4 gravel bar sites during 1996. Greater than 95 % of all *M. nr. brevispinosa* specimens were collected from gravel bar sites. Both species were also collected in low abundance from the alder swamp habitat type.

4. Rare/Vagrant species - species which were only found in low abundance at a few sample sites (includes 15 of the 22 taxa observed during 1995 and 1996, see Tables 6 and 7).

One other species was collected during the study that did not seem to fit any of the observed distribution and abundance patterns. *Camponotus herculeanus* (Linnaeus) was found in 4 of the 9 habitat types, but was generally found at less than 30 % of the sites within any one given habitat and generally in low abundance. *C. herculeanus* was rarely collected in cedar-hemlock forest habitat during 1995, but was very abundant in this habitat during 1996 (Tables 6 and 7).

Indicator values (IV) for most species among the habitat types, with the exception of habitat specialist species *F. pacifica* and *M. nr. brevispinosa*, ranged from 0 to 30 (Table 8). Most species had IV scores of less than 10. Habitat specialist species by definition are expected to be good indicator species, and as expected, the two habitat specialist species found in this study, *F. pacifica* and *M. nr. brevispinosa*, had IV scores ranging from 39.1 to 90 for the gravel bar habitat type. IV scores for taxa found at habitats other than gravel bars were not high enough to warrant designation of any taxon as an indicator species. It is expected that taxa from other, more species rich groups (ie. Coleoptera or Araneae), may provide indicator species for the other habitats (See Part V of this report series for detailed analysis of indicator species).

Genus and Species Accounts

Subfamily: Formicinae

Camponotus
The genus *Camponotus* represents the largest group of ants with over 600 species worldwide and 40 subgenera. There are 7 subgenera and 43 nearctic species (Wheeler and Wheeler 1986).

Members of this genus are generally large with workers up to 13 mm. Two subgenera , *Camponotus* Mayr and *Tanaemyrmex* Ashmead were collected in the BBCRNA study area during 1995 and 1996. The subgenus *Camponotus* (also known as carpenter ants) excavate nests in snags and down woody debris. Workers primarily feed on dead or live insects and do not feed on wood. They are also known to actively prey on some forest insect pests including western spruce budworm (Youngs and Campbell 1984). Species of the *Tanaemyrmex* subgenus prefer to nest in gravelly soils (Wheeler and Wheeler 1986)

Three species of the subgenus *Camponotus* were collected within the BBCRNA study area (Tables 6 and 7). These include *C. modoc*, *C. herculeanus*, and *C. novaeboracensis* (Fitch). The distribution of *C. modoc* and *C. herculeanus*, the most abundant of the *Camponotus* species, was described in the previous section. *C. novaeboracensis* was found in wet and open canopy habitat types including bogs, willow-spiraea and willow-carex swamps. Their occurrence among these habitats was rare with only a total of 33 individuals sampled during the two years of the study. Only one species (*C. vicinus*) of the subgenus *Tanaemyrmex*, represented by only one individual from a bog site, was collected during the 1995 and 1996 sample period.

Formica Linnaeus

Formica is the largest genus in the Nearctic ant fauna represented by 78 species. Species of *Formica* are polymorphic with workers varying in size. They are one of the most abundant ants, generally medium size (7-9 mm), and nest in soil or rotten logs. Some species are known to tend aphids for "honeydew". Other species are important predators of some forest pest species such as western spruce budworm (Youngs and Campbell 1984).

Five species of *Formica* from two different groups, *rufa* and *fusca* were collected from the BBCRNA during 1995 and 1996. The *Formica rufa* group was represented by 3 species including *F. densiventris* Viereck, *F. obscuripes* Forel, and *F. propinqua* W.M. Wheeler. All three of these species exhibited rare occurrence within the BBCRNA study area (Table 6 and 7). *F. densiventris* was only collected during 1995 from alder swamp, bog, and gravel bar habitats. A total of 28 individuals were collected. Eight individuals of *F. obscuripes* were collected from a gravel bar site in 1995, and two specimens in 1996, also from a gravel bar. *F. propinqua* was represented by 26 specimens from willow-carex swamp habitat during 1995, and 4 specimens from the same habitat in 1996.

The *Formica fusca* group was represented by two species including *F. pacifica* and *F. neorufibarbis*. *F. neorufibarbis* was collected in low to moderate abundance at all of the habitats, with the exception of maple thicket sites and Douglas fir forest sites during 1995 (Table 6 and 7). *F. pacifica* was one of the top two most abundant species collected during the study, however it was almost exclusively found in gravel bar habitat (7 of the 846 specimens collected during 1995 and 1996 were from alder swamp habitat). As previously discussed *F. pacifica* is considered a habitat specialist and a strong indicator species for gravel bar habitats

Lasius Fabricius
In North America, north of 35^0N latitude, members of this genus are among the commonest of ants (Wheeler and Wheeler 1986). They are most frequently associated with forested areas and nest in rotting logs and in soil under stones. They primarily forage on other insects and honeydew produced by aphids.

Three species of *Lasius* were collected from the BBCRNA during the study period. These include *L. pallitarsis* (Provancher), *L. alienus* (Foerster), and *L. vestitus* W.M. Wheeler. *L. pallitarsis* was the most commonly occurring species of this group, found in all nine of the habitat types (Table 6). They were most abundant in habitats with high canopy cover (Douglas fir forest and cedar-willow-carex swamps, Tables 6 and 7). The other two species of *Lasius* were rarely encountered in the study area. One of these species, *Lasius alienus*, has been reported as native to Europe (The Social Insects Web, Non-Native Ants, http://research.amnh.org/ entomology/social insects).

Subfamily: Myrmicinae

Myrmica Latrielle
"Moderate size colonies nest in soil, rotten wood, or under cover of wood or rocks. Workers are carnivorous, but also feed on honeydew and exudates of plants." (Wheeler and Wheeler, 1986). Myrmica in the BBCRNA study area seemed to prefer open canopy habitats, primarily bogs, gravel bars, and willow-carex swamps. Three species of *Myrmica* were found in the study area and included *M. nr. brevispinosa*, *M. incompleta*, and *M. nr. fracticornis*. *Myrmica nr. brevispinosa* is also considered as a good indicator species for gravel bar habitat (Table 8), 94 of the 98 specimens collected in 1995 and 90 of the 92 specimens collected in 1996 were from gravel bars (Tables 6 and 7). *Myrmica incompleta* was collected from 6 of the 9 habitat types sampled in 1995 and two of the five habitats sampled in 1996 (Tables 6 and 7). They were most abundant in bogs, willow-carex swamps, and gravel bars. Only a total of 6 specimens of *M. nr. fracticornis* were collected from the study area during 1995 and 1996. They were found in habitats exhibiting greater canopy cover than for habitats where other *Myrmica* species were collected (cedar-willow-carex swamp, Douglas fir forest, and cedar-hemlock forest habitats).

Other Myrmicinae
Seven other taxa representing 4 genera (*Aphaenogaster* Mayr, *Leptothorax* Mayr, *Manica* Jurine, and *Stenamma* Westwood) and 6 species were also collected in very low abundance (less than 22 total individuals for all 6 species for 1995 and 1996 combined, Tables 6 and 7).

Summary and Conclusions

This work represents the first effort in the North Cascades National Park Complex to document taxonomic and habitat association information concerning ant communities. Although limited in scope to one portion of one watershed, the study encompasses several important habitat types that are representative of many other localities in the park. Several of the habitats have not been systematically sampled anywhere in the Pacific Northwest. Information gained from this study will complement other inventory and monitoring efforts and greatly enhance future efforts to design structured inventories and develop comprehensive ecological monitoring programs for the assessment of biological diversity and integrity in the park.

The focus of this study was on ground-dwelling taxa and pitfall trapping was the method of choice. Limitations of pitfall trapping are discussed in the Methods, and Results and Discussion sections. Although pitfall traps may not be representative of ant abundance they appeared to be effective for sampling presence-absence at the various habitats, as only three of the 22 species documented were collected in the five habitats sampled during the second year of the study. In comparison, similar but more comprehensive collecting using a variety of methods has been done on the H.J. Andrews Experimental Forest located in the Western Cascade Range of Oregon where 27 species of ants have been recorded (Parsons *et al.* 1991). It is expected that similar efforts in the Big Beaver Creek watershed would yield a similar or greater richness of species. It is also interesting to note that nearly one half of the species collected in the BBCRNA were not reported by Parsons *et al.* 1991 in the H.J. Andrews Forest. This may indicate a difference in species distributions along a latitudinal gradient in the Western Cascades and/or result from differences in habitats sampled at the two locations. Other ant faunal studies in the Pacific Northwest and Western Canada have found similar numbers of species. Francoeur (1997) estimated a total of 25 species of ants for the Yukon Territory of Canada. Ants of central interior British Columbia have been studied around the Prince George area by Dr. Staffan Lindgren (University of Northern British Columbia, *see* http//research.amnh.org/entomology /social_insects), where 19 species have been collected so far, with 8 species in common with those from the BBCRNA study area.

Results indicated that there was very little difference in abundance and number of taxa collected among most the habitat types. Most habitats, with the exception of gravel bars, exhibited relatively low species richness and low abundance. Gravel bar habitats were represented by 13 of the 22 taxa collected during the study, and approximately 45% of all ant specimens collected. Most of the ant species collected in the BBCRNA study area were considered rare and /or vagrant, being collected in low abundance at few sample sites. Seven species, of the 22 taxa collected during the study, comprised over 90% of all individuals captured in each of the years sampled. Four species were considered as habitat generalists, and two species as habitat specialists - *Formica pacifica* and *Myrmica nr. brevispinosa*. Both of these species were found almost entirely at gravel bar habitat sites. Indicator values (Dufrene and Legendre 1997) associated with these two habitat specialist species were expectedly high, offering the potential for use in future habitat monitoring.

Future efforts should continue to document ant diversity and species-habitat associations in the Park. Sampling programs should be designed to evaluate the environmental attributes that structure these communities and affect their component distributions and abundance. Additional investigations are needed to determine how ant species richness, community structure, and abundance respond to various disturbances. Examination of sites, exhibiting various levels of human impairment, outside of the park boundaries will be necessary to assess the utility of ants as indicators for monitoring. This basic information will provide diagnostic tools for future use in the assessment of 'Biological Integrity'.

Of a more specific nature, the importance of down woody debris and snags as colonization sites for many species of ants is of interest to park management. Growing concern over catastrophic fires by the public is likely to accelerate removal of dead wood in certain areas of the park in order to reduce fire fuel loads. The effects of these activities on ant communities and their function in ecological roles, such as predation on forest pests or as prey for wildlife, is not well understood and requires further investigation.

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Appendix

Figure A.1. Arthropod pitfall trap locations, Big Beaver Creek, North Cascades National Park Service Complex, 1995-1996.

Figure A.2. Arthropod pitfall trap locations, Big Beaver Creek, North Cascades National Park Service Complex, Washington, 1995-1996.

Figure A.3. Arthropod pitfall trap locations, Big Beaver Creek, North Cascades National Park Service Complex, 1995-1996.

Figure A. 4. Photo 4. Arthropod pitfall locations, Big Beaver Creek, North Cascades National Park Service Complex, 1995-1996.

Figure A.5. Arthropod pitfall trap locations, Big Beaver Creek, North Cascades National Park Service Complex,1995-1996.

Figure A.6. Photo 6. Arthropod pitfall trap locations, Big Beaver Creek, North Cascades National Park Service Complex, 1995-1996.

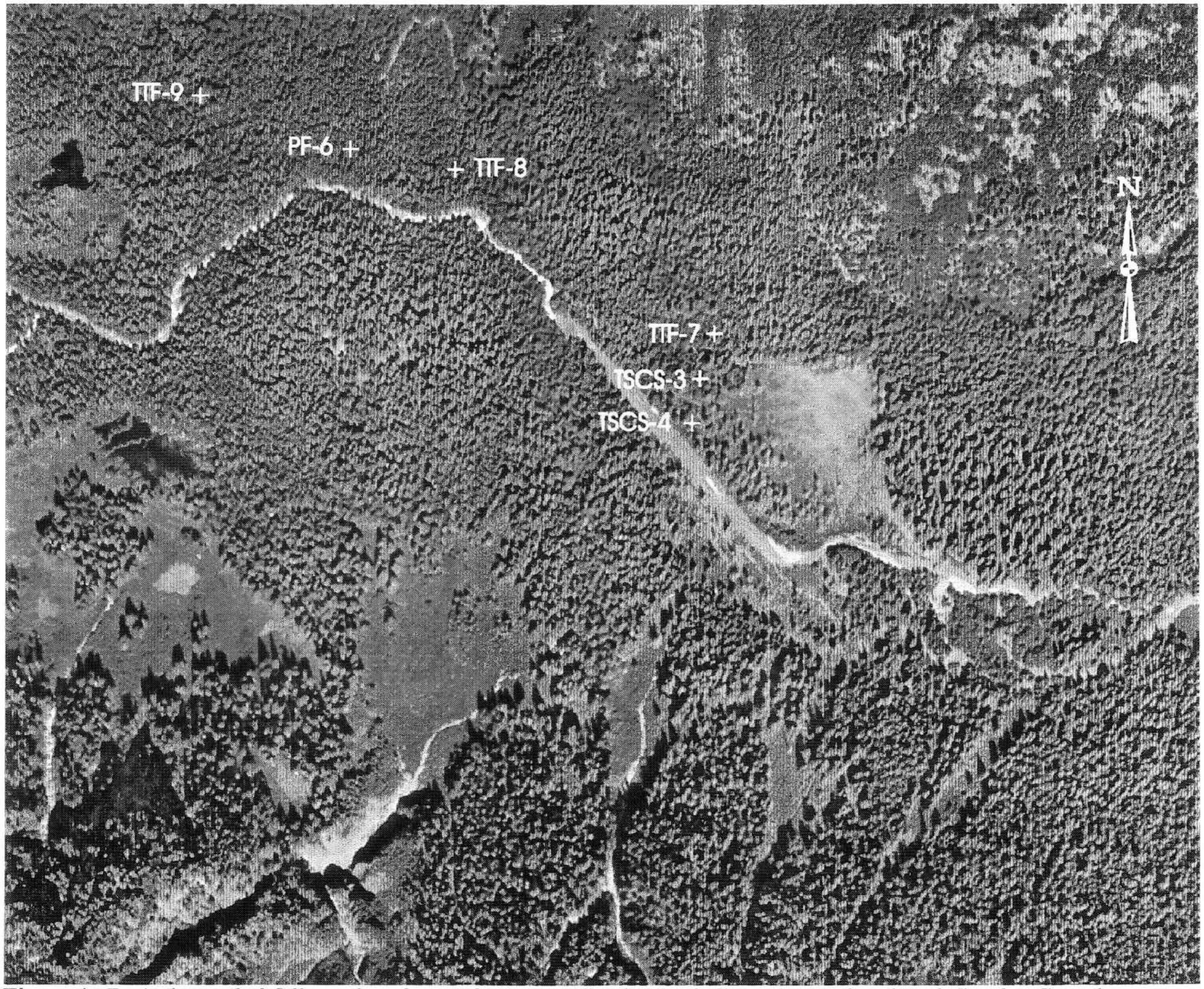

Figure A. 7. Arthropod pitfall trap locations, Big Beaver Creek, North Cascades National Park Service Complex, 1995-1996.

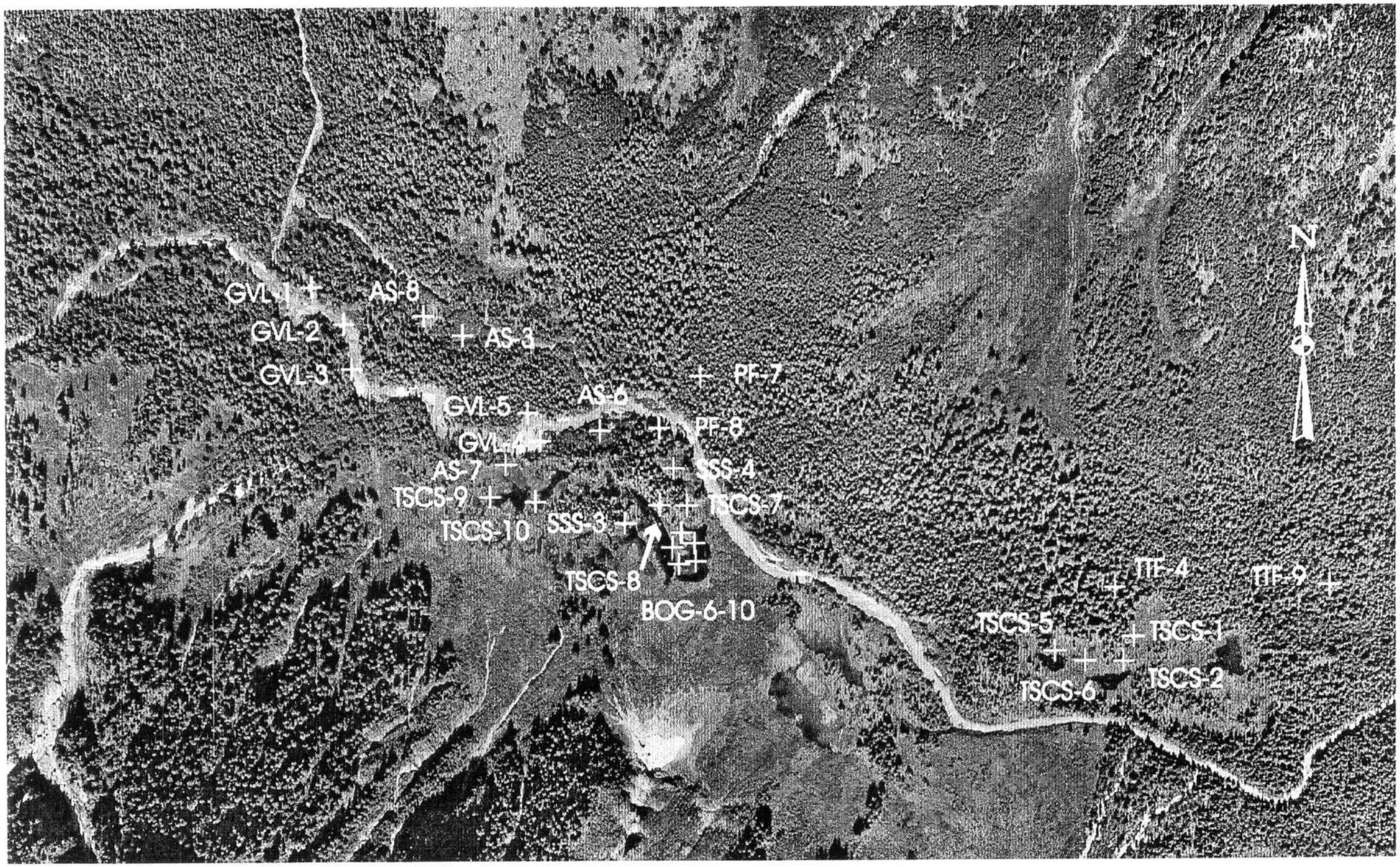

Figure A. 8. Arthropod pitfall trap locations, Big Beaver Creek, North Cascades National Park Service Complex, 1995-1996.

Table A1. Average percent cover and relative frequency of occurrence (RF) of herbaceous plant species by habitat type at arthropod pitfall trap sites, Big Beaver Creek Research Natural Area, North Cascades National Park Complex, Washington, 1995.

Herb Species	Habitat																	
	AS		AT		BOG		GVL		PF		SCS		SSS		TSCS		TTF	
	%	RF	%	RF	%	RF	%	RF	%	RF	%	RF	%	RF	%	RF	%	RF
Achillea millefolium	0	0	0	0	0	0	0.2	18.2	0	0	0	0	0	0	0	0	0	0
Adiantum pedatum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	10
Angelica arguta	0	0	0	0	0	0	0	0	0	0	3	10	0.1	10	0	0	0	0
Angelica genuflexa	0	0	0	0	3.1	20	0	0	0	0	13	50	5.8	40	1.5	30	0	0
Anaphalis margaritacea	0	0	0	0	0	0	0.9	45.5	0	0	0.2	10	0.5	10	0.5	10	0	0
Apocynum androsaemifolium	0	0	0	0	0	0	0.1	9.1	0	0	0	0	0	0	0	0	0.1	10
Aquilegia formosa	0	0	0	0	0	0	0.5	9.1	0	0	0	0	0	0	0	0	0	0
Asarum caudatum	0	0	0.1	10	0	0	0	0	0.6	20	0	0	0	0	0	0	4.2	30
Aster modestus	0	0	0	0	0	0	0	0	0	0	3	60	0.6	50	2.4	40	0	0
Athyria filix-femina	17	90	5.6	50.0	0.5	30	0	0	0	0	0.6	20	7.1	60	20	80	4.7	60
Blechnum spicant	0	0	0	0	0	0	0	0	0	0	0	0	0.1	10	0	0	0	0
Carex spp.	0	0	0	0	75	100	0	0	0	0	65	90	34	60	35	70	0	0
Cerastium viscosum	0	0	0	0	0	0	0	0	0	0	2	10	0	0	0	0	0	0
Chimaphila umbellata	0	0	0	0	0	0	0	0	2	10	0	0	0	0	0	0	0	0
Circaea alpina	7.5	40	4.5	20	0	0	0	0	0	0	0	0	0	0	0	0	1.1	30
Clintonia uniflora	0	0	0	0	0	0	0	0	0.7	30	0	0	0	0	0	0	0.5	50
Cornus canadensis	0	0	0	0	0	0	0	0	0.6	20	0	0	0	0	5	10	0.6	20
Dicentra formosa	2.3	40	0	0	0	0	0.1	9.1	0	0	0	0	0	0	0	0	0.1	10.0
Disporum hookeri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	10
Disporum smithii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	10
Dryopteris austriaca	0	0	0	0	0	0	0	0	0.1	10	0	0	0	0	0	0	0.1	10
Drosera rotundifolia	0	0	0	0	25	80	0	0	0	0	0	0	0	0	0	0	0	0
Dulichium arundinaceum	0	0	0	0	2.2	30	0	0	0	0	0	0	0	0	0	0	0	0
Epilobium angustifolium	0	0	0	0	0.2	10	0	0	0	0	0	0	0.2	10	1	10	0	0
Epilobium latifolium	0	0	0	0	0	0	2.3	63.6	0	0	1.5	10	0	0	0.1	10	0	0
Equisetum spp.	0	0	0.1	10	2.5	10	0	0	0	0	25	70	1.7	30	9.1	60.0	0	0
Galium triflorum	1.5	20	0.2	20	0	0	0.1	9.1	0	0	0	0	0	0	0.6	20	0.2	20
Geum macrophyllum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	10	0	0
Goodyera oblongifolia	0	0	0	0	0	0	0	0	0.4	40	0	0	0	0	0	0	0.4	40
Graminoid spp.	0.6	20	2.7	30.0	0	0	0.4	45.5	0	0	17	50	13	30	7.8	50	0.5	10
Gymnocarpium dryopteris	1.1	20	0.1	10	0	0	0	0	0	0	0	0	0	0	0.5	10	1.6	40
Habenaria dilatata	0	0	0	0	0	0	0	0	0	0	0.7	20	0.7	20	0	0	0	0
Heracleum lanatum	0.2	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrophyllum fendleri	0	0	0	0	0	0	0.7	18.2	0	0	0	0	0	0	0	0	0	0
Kalmia microphylla	0	0	0	0	5.7	30	0	0	0	0	0	0	0	0	0	0	0	0
Lactuca muralis	0.5	10	0.1	10	0	0	0.1	9.1	0	0	0	0	0	0	0	0	0.5	10
Lactuca serriola	0	0	0	0	0	0	0.1	9.1	0	0	0	0	0	0	0	0	0	0
Linnaea borealis	0	0	0	0	0	0	0	0	1.6	50	0	0	0	0	0	0	0.4	30
Lichen spp.	0	0	0	0	0	0	0	0	0.5	10	0	0	0	0	0	0	0	0
Lysichitum americanum	12	40	0	0	0.3	20	0	0	0	0	3.2	60	4.4	60	13	70	4	10
Lycopodium clavatum	0	0	5	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maianthimum dilatatum	0.1	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mentha arvensis	0	0	0	0	0	0	0	0	0	0	0.5	10	0	0	0	0	0	0
Menyanthes trifoliata	0	0	0	0	15	80	0	0	0	0	4	20	6	40	1.5	20	0	0
Montia sibirica	0	0	0	0	0	0	0.1	9.1	0	0	0	0	0	0	0	0	0	0
Moss spp.	1.5	20	26	50	0	0	0.2	18.2	54	90	8	10	0	0	10	20	17	40
Pachistima myrsinites	0	0	5	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Petasites frigidus	0	0	0	0	0	0	0	0	0	0	0	0	0.1	10	0	0	0	0
Polystichum munitum	0.1	10	0	0	0	0	0	0	0.1	10	0	0	0	0	0	0	2	10
Potentilla palustris	0	0	0	0	3.6	30	0	0	0	0	0.9	30	17	60	0.5	10	0	0
Pteridium aquilinum	0	0	5	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rubus pedatus	0	0	0	0	0	0	0	0	0.1	10	0	0	0	0	0	0	0	0
Scirpus microcarpus	3.5	20	0	0	0.1	10	0	0	0	0	6.2	30	8.3	20	11	40	0	0
Senecio triangularis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	10	0	0
Smilacina racemosa	0.2	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	20
Smilacina stellata	0	0	0.1	10	0	0	0	0	0	0	0	0	0	0	0	0	0.1	10
Sphagnum moss	0	0	0	0	92	100	0	0	0	0	0	0	0	0	0	0	0	0
Streptopus amplexifolius	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.6	20
Stachys paulstris	0	0	0	0	0	0	0	0	0	0	3	20	0	0	0	0	0	0
Streptopus roseus	0	0	0.4	30	0	0	0	0	0.1	10	0	0	0	0	0	0	3	10
Tiarella trifoliata	5.1	30	0.6	40.0	0	0	0	0	0.1	10.0	0	0	0	0	0	0	5.3	50
Tolmeia menziesii	0	0	1	10	0	0	0	0	0	0	0	0	0	0	0	0	1.5	20
Trientalis latifolia	0	0	0	0	8.9	50	0	0	0.1	10	0	0	0	0	0	0	0	0
Trillium ovatum	0	0	0.1	10.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Urtica dioica	0.1	10	3.1	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Veronica americana	0	0	0	0	0	0	0	0	0	0	0.5	10	0	0	0	0	0	0
Viola palustris	0.2	20	0	0	9	20	0	0	0	0	1	10	0	0	1.1	30	0	0

Table A2. Average percent cover and relative frequency of occurrence (RF) of shrub species by habitat type at arthropod pitfall trap sites, Big Beaver Creek Research Natural Area, North Cascades National Park Complex, Washington, 1995.

	Habitat																	
	AS		AT		BOG		GVL		PF		SCS		SSS		TSCS		TTF	
	%	RF	%	RF	%	RF	%	RF	%	RF	%	RF	%	RF	%	RF	%	RF
Abies amabilis	0.3	10	0	0	0	0	0	0	5	10	0	0	0	0	0	0	0.5	10
Abies grandis	0	0	0	0	0	0	0	0	0.5	10	0	0	0	0	0	0	0	0
Acer circinatum	3	30	70	80	0	0	0	0	6.2	50	0	0	0.2	10	5.1	30	10	60
Alnus rubra	1.9	20	0	0	0.1	10	6.1	36	0	0	0	0	0	0	4	10	0	0
Alnus sinuata	0.9	20	5	10	1.5	10	2.4	18	0	0	0	0	0	0	6.2	40	0	0
Amelanchier alnifolia	0	0	1.5	10	0	0	0	0	0	0	0	0	0	0	0.1	10	0	0
Berberis repens	0	0	0	0	0	0	0	0	0.7	30	0	0	0	0	0	0	7.3	30
Cornus stolenifera	18	60	22	40	0	0	0.1	9	0	0	1.6	30	4.1	50	5.6	70	8	10
Corylus cornuta	0	0	0.5	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gaultheria humifusa	0	0	0	0	0.1	10	0	0	0	0	0	0	0	0	0	0	0	0
Lonicera involucrata	0.5	10	0	0	0	0	0.1	9	0	0	0	0	0.2	10	4	40	0	0
Menziesia ferruginea	0	0	2	10	5.2	30	0	0	0	0	0	0	0	0	2	10	0	0
Oplopanax horridum	17	40	0.1	10	0	0	0	0	0	0	0	0	0	0	0	0	4.5	20
Pachystima myrsinites	0	0	0	0	0	0	0	0	1.2	20	0	0	0	0	0	0	0.5	10
Populus trichocarpa	0	0	0	0	0	0	0.2	9	0	0	0	0	0	0	0	0	0	0
Pyrus fusca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	10	0	0
Rhamnus purshiana	0	0	0	0	0.5	10	0	0	0	0	0.1	10	0.8	30	0.6	20	0	0
Ribes bracteosum	1.5	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ribes sanguineum	0.1	10	0.2	20	0	0	0	0	0.1	10	0	0	0	0	0.5	10	0	0
Rosa gymnocarpa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	10
Rosa nutkana	0	0	0.2	10	0	0	0	0	0.1	10	0	0	0.1	10	0	0	0	0
Rubus leucodermis	0	0	0	0	0	0	0.2	18	0	0	0	0	0	0	0	0	0	0
Rubus parviflorus	2.3	40	0.15	20	0	0	0.5	9	0	0	0	0	0.5	10	0.8	20	0.1	10
Rubus spectabilis	10.4	90	0.1	10	0	0	0	0	0	0	0	0	0	0	0.6	20	1	10
Salix lasiandra	0	0	0	0	0	0	0	0	0	0	3.2	30	0	0	2.5	10	0	0
Salix sitchensis	1	10	0	0	3.3	20	1.5	55	0	0	25.2	90	21	70	34.5	80	0	0
Sambucus racemosa	2.8	60	5.5	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spiraea douglasii	3	10	0	0	5.9	60	0	0	0	0	9.8	60	40.7	100	12.5	60	0	0
Taxus brevifolius	0	0	0	0	0	0	0	0	5	10	0	0	0	0	0	0	3	20
Thuja plicata	0.5	10	0	0	3.8	90	0.3	9	2.7	40	0	0	0	0	0	0	2.5	20
Tsuga heterophylla	0.4	10	0	0	0	0	0	0	3.2	50	0	0	0	0	0.5	10	1.5	20
Vaccinium ovalifolium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	20	1.5	10
Vaccinium parvifolium	0	0	0	0	0	0	0	0	1.2	30	0	0	0	0	0	0	0.3	30
Viburnum edule	0	0	0	0	0.5	10	0	0	0	0	0	0	3.8	40	0.5	10	0	0

Table A3. Relative frequency of occurrence (RF) of tree species by habitat type at arthropod pitfall trap sites, Big Beaver Creek Research Natural Area, North Cascades National Park Complex, Washington, 1995.

	Habitat								
Tree Species	**AS**	**AT**	**BOG**	**GVL**	**PF**	**SCS**	**SSS**	**TSCS**	**TTF**
Abies amabilis	0	0	0	0	40	0	0	10	40
Abies grandis	0	0	0	0	10	0	0	0	0
Acer circinatum	20	30	0	0	40	0	0	0	30
Acer macrophyllum	0	10	0	0	10	0	0	0	0
Alnus rubra	90	0	0	0	0	0	0	0	20
Alnus sinuata	10	10	0	0	0	0	0	0	0
Picea engelmannii	10	0	0	0	0	0	0	0	0
Pseudotsuga menziesii	0	0	0	0	30	0	0	0	10
Pyrus fusca	0	20	0	0	0	0	0	0	0
Taxus brevifolia	0	0	0	0	20	0	0	0	10
Thuja plicata	10	10	10	0	70	0	0	40	70
Tsuga heterophylla	10	0	0	0	70	0	0	10	40

As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural and cultural resources. This includes fostering wise use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interest of all our people. The department also promotes the goals of the Take Pride in America campaign by encouraging stewardship and citizen responsibility for the public lands and promoting citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

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