Terrestrial Riparian Arthropod Investigations In The Big Beaver Creek Research Natural Area, North Cascades National Park Service Complex, 1995-1996: Part III, Arachnida:Araneae

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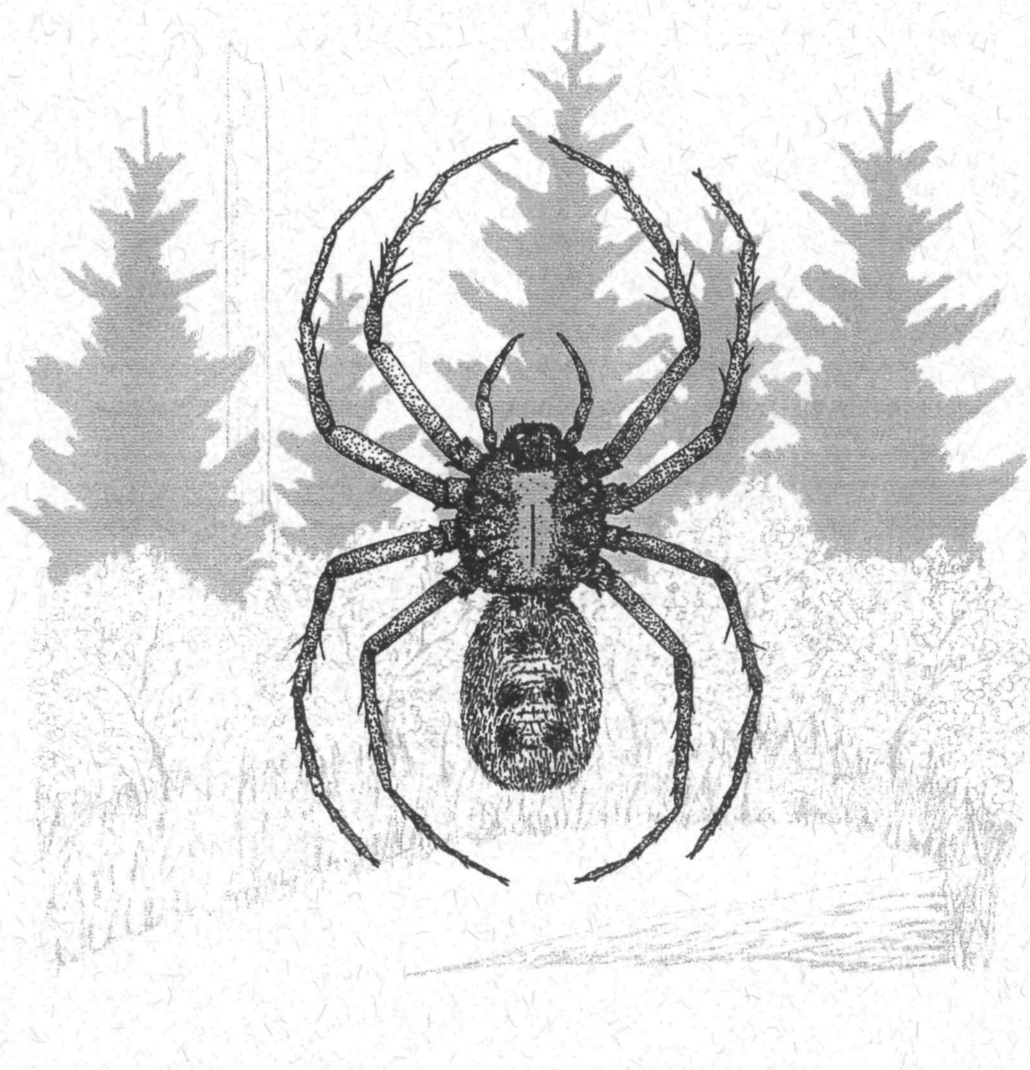

U.S. Department of Interior
National Park Service - Pacific West Region
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Technical Report NPS/NRNOCA/NRTR/98-03

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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

Ground-dwelling spider 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 1996 and 1997. This study was part of a comprehensive project to begin development of protocols for the assessment of biological integrity in the Park Complex. Specific objectives were to document the species, relative abundance, and habitat associations of ground-dwelling spider communities. Spiders represent a diverse and functionally important group of arthropods. They are frequently the dominant predators in arthropod communities. The assessment of their status can provide much information useful in monitoring the integrity of biotic communities.

Spiders were abundant in the study area. Pitfall captures of spiders were second to those of Coleoptera. A total of 8,922 spiders representing 10 families and 38 species are reported here. In addition, a few diverse families of small spiders, representing approximately 20% of all individuals collected, were not identified. Future efforts to identify these taxa and additional collections in the shrub and canopy layers should significantly increase the diversity of spiders found in the study area. In comparison, multi-layer sampling of spiders in the Western Cascades of Oregon at the H.J. Andrews Experimental Forest has resulted in the documentation of 30 families and 260 species (Parsons *et al*. 1991). Members of the family Lycosidae accounted for over 60% of all spiders collected. Agelenid spiders were second in abundance, representing greater than 20% of all individuals collected. The number of species collected varied little between the nine habitat types sampled. However, there were some major differences in individual species occurrence and abundance between habitat types. Both habitat generalists and habitat specialists were collected. Relative abundance of individuals collected exhibited greater variation among the habitat types than that observed for total species and habitat types. Capture rates were greater at habitats exhibiting low canopy closure and reflected the dominance of lycosid spiders in those samples. Agelenid spiders were the most abundant group of spiders collected at sites with closed canopies.

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 of Oregon State University and Greg Brenner, Ph.D. candidate at Oregon State University 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. Greg Brenner developed the sampling design and provided editorial assistance and technical guidance.

My sincere thanks to Juraj Halaj, Oregon State University, for his assistance with the identification of spider specimens and for his editorial review of the manuscript; 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 enthusiam, dedication, and skill is greatly appreciated.

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Introduction

Spiders (Araneae) represent a diverse group of arthropods that play a major role in invertebrate community dynamics (Moulder and Reichle 1972, Riechert 1974, Wise 1993). Spiders are ubiquitous and diverse predators in terrestrial ecosystems (Halaj *et al.* 1997), and are frequently the dominant predators found in arthropod communities (Turnbull 1973, Gertsch 1979). Although, many spiders are generalist predators, many species have strict habitat requirements. Species may segregate by habitat or be cryptically adapted to hunt on selected plant substrates (Johnson 1996). Spiders may be a significant enemy of forest insect pests (Mason 1992). For example, Spiders are known to prey on all stages of the western spruce budworm (*Choristoneura occidentalis* Freeman) (Mason *et al.* 1997). There is also evidence that the density, behavior, and population dynamics of spiders act to stabilize terrestrial arthropod populations (Breymeyer 1966, Turnbull 1973, Riechert 1974, Enders 1975).

There are approximately 3500 described species of spiders (Arachnida:Araneae) representing 515 genera in America north of Mexico. There are approximately 350 species that are not described residing in collections from the region (Roth 1993), While Schaefer and Kosztarab (1991) reported that there could be as many as 700 undescribed species found in America north of Mexico. Dondale and Redner (1978) stated that although there has been sporadic collecting in Canada for over a century, the spider fauna is not well known in any part of Canada.

Spiders are well suited for ecological studies. Sampling programs for spiders are uncomplicated by small sample sizes because both individuals and taxa are locally abundant and easy to collect. Their small size permits definition of communities within small areas (Coddington *et al.* 1996). Additionally, non-specialists can be quickly trained accurately distinguish morphospecies (Oliver and Beattie 1993). Spiders can be useful in monitoring levels of human disturbance, particularily for habitat related perturbations, because structural components of the habitat are important in structuring spider communities (Lowrie 1973, Uetz 1979, Hatley and MacMahon 1980, Greenstone 1984, Moring and Stewart 1994). Many authors have documented changes in spider abundance, species composition, and guild structure related to human disturbance such as: forest management practices (Huhta 1971, Mispagel and Rose 1978, Coyle 1981, Schowalter 1995, Docherty and Leather 1997), grazing (Turnbull 1966, Gibson *et al.* 1992, Edwards and Huryn 1996, Zulka et al. 1997), agriculture (Draney 1997, Thomas and Jepson 1997), and pesticides (Wisniewska and Prokopy 1997).

Spiders were chosen as one of four groups of epigeal arthropods considered for evaluation 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 spiders collected in the Big Beaver Creek Research Natural Area (BBCRNA) during 1995 and 1996.

Study Area

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).

The vegetation of this watershed can be divided roughly into three communities: wetlands, shrubs, and forests. 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, 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,*

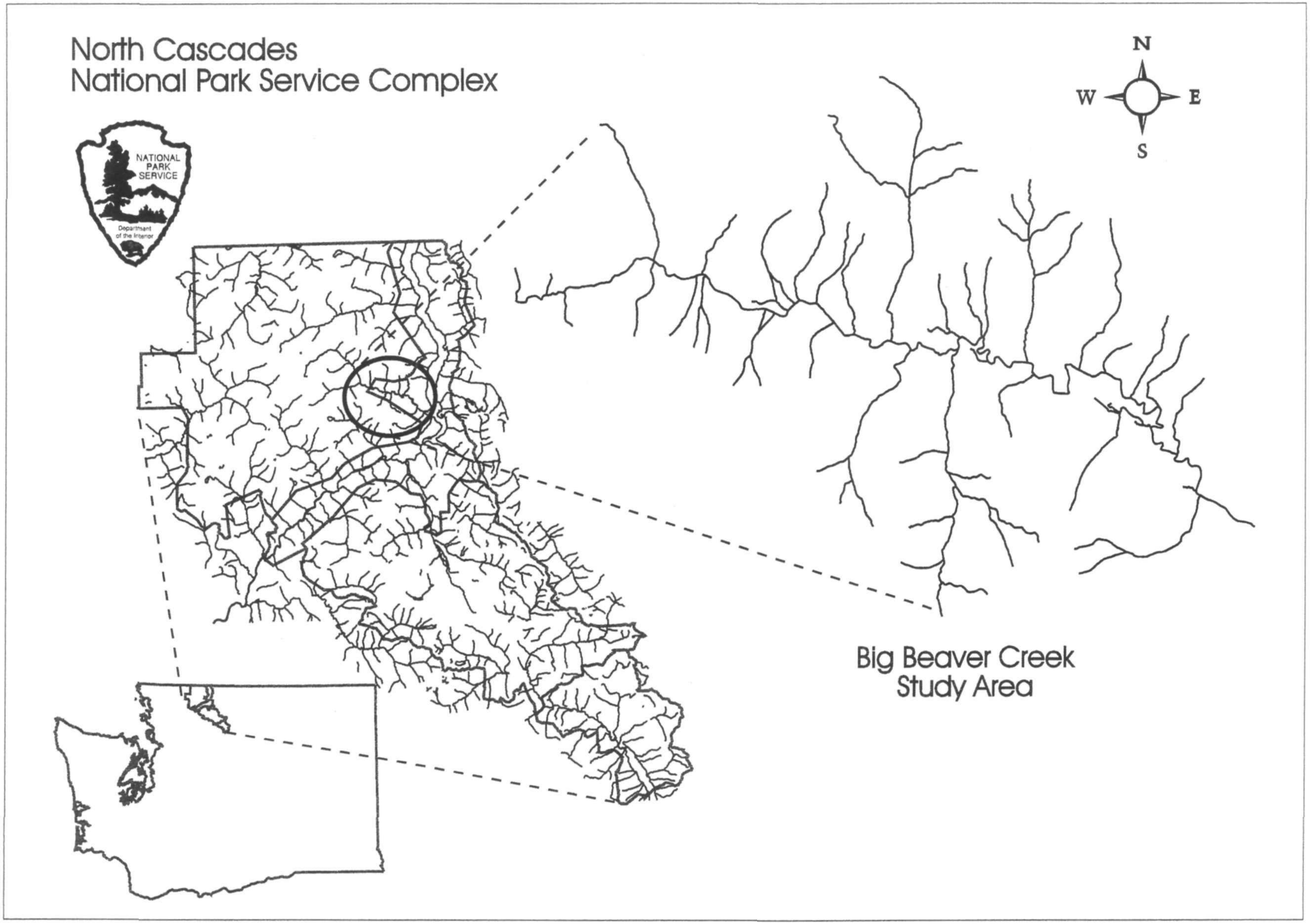

Figure 1. Location of the Big Beaver Creek study area in North Cascades National Park Service Complex, Washington.

Populus trichocarpa, and conifers, *Thuja plicata, Pseudotsuga menziesii, Tsuga heterophylla, Abies amabilis, Pinus contorta, Pinus monticola* and *Picea engelmanni.*

The vegetation and hydrography in the lower gradient sections of this valley 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.

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.

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. A summary description of each habitat follows, with all parameters averaged over all trap sites.

Alder swamp (AS) site soils were wet, predominantly sandy or loamy, with an average litter depth of 5.7 cm. The average coarse woody debris volume was 2.3 m^3 per plot. The sites were essentially flat, with an average slope of 0.6% canopy closure averaged 96%, with eight trees per plot, on average, and mean D.B.H. of 24 cm. The dominant herbs were *Athryium filix-femina* and *Lysichitum americanum*, herb cover averaged 53%, and species richness averaged 4.4 species per plot. The only common shrub was *Rubus spectabilis;* average shrub cover was 64%, with the average species richness of 4.5 species per plot. The only common tree was *Alnus rubra.*

Maple thickets (AT) had moist soils that were predominantly organic or loamy, with an average litter depth of 2.4 cm. Average coarse woody debris volume was 1.7 m^3 per plot. The average site slope was 5.4%. Canopy closure averaged 98%, with four trees per plot and a mean D.B.H. of 13 cm. The dominant herbs were mosses and *Athryium filix-femina*. Herb cover averaged 59%, with average species richness of 3.6 species per plot. The dominant shrubs were *Acer circinatum* and *Cornus stolenifera*. Average shrub cover was 107%, with average species richness of 2.6 species per plot. The dominant trees were *A. circinatum* and *Pyrus fusca*. Maple thickets had the greatest average shrub cover of all sampled habitats.

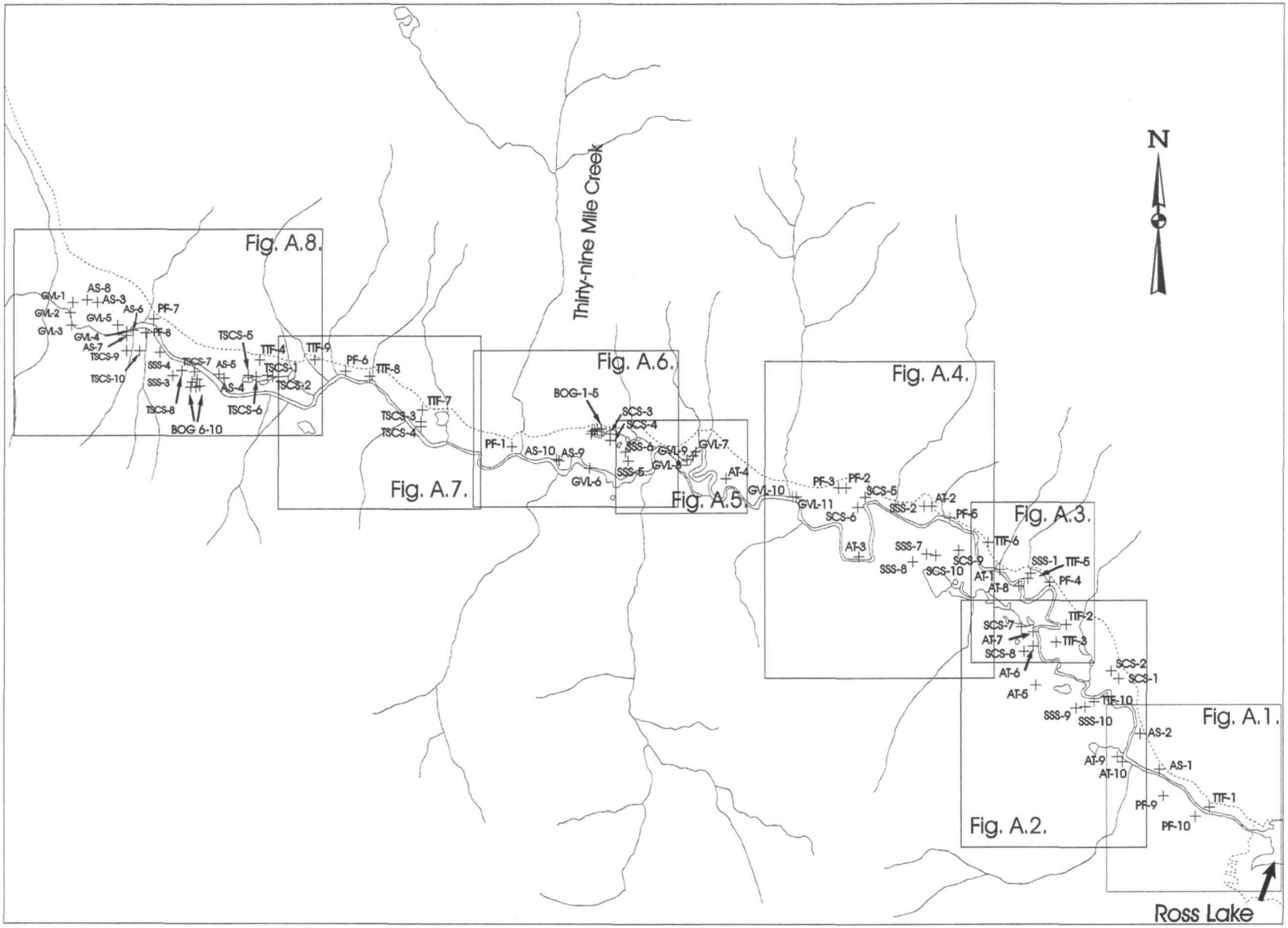

Figure 2. Arthropod pitfall trap locations, Big Beaver Creek, North Cascades National Park Service Complex, Washington, 1995-1996. (Boxes refer to aerial photos found in the Appendix, Figures A.1. - A.8.)

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. Canopy closure averaged 7%, with 0.2 trees per plot and a mean D.B.H. of 1.5 cm. The dominant herbs were *Sphagnum* spp., *Carex* spp., *Menyanthes trifoliata* and *Drosera rotundifolia;* herb cover averaged 242%, with the average species richness of 6.3 species per plot. Trees were rarely encountered at these sites. Bogs had the lowest average canopy closure and the greatest average herb cover.

Gravel bar (GVL) soils were dry, lacked litter and were composed of sand, gravel and cobbles. The average coarse woody debris volume was 1.5 m^3 per plot. The average slope was 3.2%. Canopy closure averaged 17%, with 0.2 trees per plot and mean D.B.H. of 27 cm. There were no dominant shrubs, and shrub cover averaged 11%, with an average species richness of 1.0 species per plot. No trees were dominant. Gravel bars had the lowest mean herb and shrub cover of sampled habitats, as well as the lowest species richness of herbs and shrubs. No shrubs were dominant, average shrub cover was 21%, with average of 2.5 species per plot.

Douglas-fir forest (PF) soils were dry, organic or loamy, with an average litter depth of 7.6 cm. The average coarse woody debris volume was 5.3 m^3 per plot. Slopes averaged 7.8%. Canopy closure averaged 99.5%, with 15 trees per plot and a mean D.B.H. of 17 cm. Mosses were the dominant herbs, with herb cover averaging 61% and average species richness of 2.6 species per plot. Average shrub cover was 26%, with an average species richness of 2.6 species per plot. Dominant trees included *Abies amabilis, Pseudotsuga menziesii* and *Tsuga heterophylla.* These forests were the steepest of all sampled habitats, had the greatest average canopy closure, the greatest average woody debris volume, the greatest number of trees per plot and the greatest average litter depth of all sampled habitats.

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%. Canopy closure averaged 4.5%, with no trees per plot. Dominant herbs were *Carex* spp. and *Equisetum* spp.; herb cover averaged 157%, with an average species richness of 6.1 species per plot. Dominant shrubs were *Salix sitchensis* and *Spiraea douglasii;* shrub cover averaged 40%, with an average species richness of 2.2 species per plot. There were no dominant trees.

Willow-spiraea swamp (SSS) soils were wet, organic and had an average litter depth of 5.3 cm. Average coarse woody debris volume was negligible, approximately 0.1 m^3 per plot. These sites were flat, with no discernable slope. Canopy closure averaged 19%. Dominant herbs were *Carex* spp., grasses and *Menyanthes trifoliata;* herb cover averaged 99%, with average species richness of 5.2 species per plot. Dominant shrubs were *Spiraea douglasii* and *Salix sitchensis*; shrub cover averaged 71%, with average species richness of 3.3 species per plot. There were no trees in any of the plots.

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. Canopy closure averaged 63%, with 0.6 trees per plot and a mean D.B.H. of 52 cm. Dominant herbs were *Carex* spp., *Athryium filix-femina* and *Equisetum* spp.; herb cover averaged 120%, with average species richness of 6.3 species per plot. Dominant shrubs were *Salix sitchensis* and *Spiraea douglasii*; shrub cover averaged 82%, with an average species richness of 4.7 species per plot. *Thuja plicata* was the dominant tree species. This habitat had the greatest species richness of both herbs and shrubs of all sampled habitats.

Cedar-hemlock forest (TTF) soils were dry, organic or loamy and had an average litter depth of 5.0 cm. Average coarse woody debris volume was 3.2 m^3 per plot. Average slope per plot was 4.8%. Canopy closure averaged 99.4%, with 6.3 trees per plot and a mean D.B.H. of 50 cm. Dominant herbs were mosses; herb cover averaged 49%, with average species richness of 6.0 species per plot. *Acer circinatum* was the dominant shrub; shrub cover averaged 41%, with average species richness of 2.7 species per plot. Dominant trees included *Thuja plicata, Acer circinatum* and *Abies amabilis*.

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. 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.

While not negating the utility of pitfalls or the information that can be gleaned from this method, it is essential to consider these biases and limitations when analyzing pitfall data. The above concerns will be addressed in following discussions and analyses.
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), tree species inventory (number of individuals and D.B.H.) 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 used for identification included: Chamberlin and Ivie (1941, 1947), Dondale and Redner (1978, 1982, 1990), Leech (1972), Platnick and Dondale (1992) and Roth (1952, 1993).

Results and Discussion

Species Richness and Abundance

Overall, spiders were the second most abundant group of arthropods collected from pitfall traps in the BBCRNA during 1995 and 1996. A total of 8,922 adult spiders were collected during the two sampling seasons. In contrast, a total of 18,766 beetles (LaBonte 1998) and 464 Heteroptera (Lattin 1997) were collected during the same period.

The number of spider taxa and individuals collected from the different habitat types during the study period are displayed in Table 1. Individual species capture data by habitat type, for 1995 and 1996, is shown in Tables 2 and 3. In any interpretation of numbers of families and species of spiders collected in this study, consideration must be given to the fact that the smaller spiders (Erigonidae, Linyphiidae, Theridiidae, and Uloboridae) were lumped together because of difficulty in identification. These taxa were labeled as 'miscellaneous small taxa'. Spider families in this group, particularly Linyphiidae, contributed significantly to the number of species collected in other studies (Coyle 1981, Zulka et al. 1995, Dobyns 1997, and Docherty and Leather 1997). Efforts to identify these species will be made in the future, and may contribute much to our understanding of spider communities and to spider species richness.

A total of 10 families and 38 species of spiders (excluding the previously described miscellaneous small taxa) were collected in the BBCRNA during 1995 and 1996. There were no additional species collected by resampling five of the nine habitat types during 1996. There was little variation in the number of species collected among the different habitat types. The total number of species collected per habitat type ranged from 11 species for the cedar-willow-sedge swamp (TSCS) sites to 15 species from the willow-sedge swamp (SCS) and gravel bar (GVL) sites (Table 1).

Species abundance for the pooled habitat data conformed to the lognormal distribution (May 1975, Ludwig and Reynolds 1988), where most of the species exhibit intermediate abundance and only a few species are represented by high and low abundance (Tables 2 and 3). 'Completeness of inventory" was defined by Coddington *et al.* (1996) as the percentage of species represented by singletons. Percentage of singletons from the BBCRNA was 15.8% for 1995, and 17.4% in the reduced subset of samples collected in 1996. Coddington *et al.* (1996) stated that inventory completeness, measured by the percentage of singletons, rarely goes to zero, but is likely to be low in well-sampled faunas and high from poorly sampled species rich communities.

Activity-density (no. of individuals/100 trap-days) exhibited greater variation between habitat types than that of the number of species and habitat types (Table 1). In 1995, activity-density values varied from 24 individuals/100 trap-days for the maple thicket sites (AT) to 110.5 individuals/100 trap-days for the willow-spiraea swamp sites (SSS) (Table 1). Habitat types resampled during 1996 exhibited activity-density values similar to those of 1995, with the

Table 1. Number of Spider (Araneae) 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 FAMILIES**	6	5	9	7	6	7	8	6	6	10
NO. OF SPECIES**	13	13	14	15	14	15	14	11	14	38
NO. OF INDIVIDUALS	532	289	870	795	450	1171	1558	715	312	6692
ACTIVITY-DENSITY (No./100 trap-days)	38.6	24	58	49.1	37.5	83	110.5	55.4	25.4	54.7

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 FAMILIES**	4			4	5	8			5	8
NO. OF SPECIES**	7			9	14	12			11	23
NO. OF INDIVIDUALS	433			247	256	989			305	2230
ACTIVITY-DENSITY (No./100 trap-days)	38			21.1	23.1	86.8			28.2	39.5

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

** Smaller miscellaneous spider taxa (Erigonidae, Linyphiidae, Theridiidae,and Uloboridae) have not been indentified, and were not included in the family and species richness counts.

Table 2. Spider 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=Cedar-Hemlock forest)

Taxa		Habitat								
		AS	AT	BOG	GVL	PF	SCS	SSS	TSCS	TTF
Agelenidae										
Agelenopsis	*oregonensis*	0	0	1	1	0	0	0	0	0
Cryphoeca	*exlinae*	2	3	0	1	16	0	1	0	12
Cybaeus	*eutypus*	13	17	4	7	55	3	2	12	38
Cybaeus	*exlinae*	0	3	0	0	0	0	0	0	0
Cybaeus	*reticulatus*	135	80	0	17	100	5	12	27	76
Cybaeus	*signifer*	0	0	0	0	1	0	0	0	0
Cybaeus	sp. 1	0	0	0	0	1	0	0	0	1
Cybaeus	sp. 2	20	0	0	0	1	0	0	13	6
Cybaeus	juvenile	30	17	0	2	15	2	3	5	15
Calymmaria	sp.	0	0	0	0	1	0	0	0	0
Novalena	*intermedia*	0	1	0	0	0	0	0	0	2
Amaurobidae										
Callobius	*nomeus*	0	0	0	0	0	0	0	0	2
Callobius	*pictus*	4	1	0	0	6	0	0	0	4
Callobius	*severus*	0	0	0	0	0	0	0	0	2
Callobius	juvenile	4	3	0	0	4	1	0	13	4
Callioplus	*wabritaskus*	1	0	5	5	0	14	14	12	1
Callioplus	*spenceri*	0	0	0	11	0	0	0	0	0
Callioplus	juvenile	1	0	13	5	0	8	19	0	2
Corrinidae										
Castianeira	*longipalpa*	0	0	0	1	0	0	0	0	0
Clubionidae										
Clubiona	*pacifica*	0	1	1	1	0	1	0	0	2
Clubiona	juvenile	0	0	0	0	0	0	0	1	0
Gnaphosidae										
Micaria	*pulicaria*	0	0	0	8	0	6	6	3	0
Zelotes	*fratris*	2	0	2	10	1	2	0	7	2
Zelotes	juvenile	0	0	2	0	0	0	0	2	0
Lycosidae										
Pardosa	*dorsalis*	0	9	0	2	0	0	0	0	0
Pardosa	*dorsuncata*	85	8	61	25	23	26	15	224	5
Pardosa	*lowriei*	0	0	0	272	0	0	0	0	0
Pardosa	*metlakatla*	0	0	0	0	0	22	9	0	0
Pardosa	*moesta*	0	0	13	0	0	409	560	3	0
Pardosa	*vancouveri*	0	0	0	0	0	4	1	0	0
Pardosa	*xerampelina*	0	0	0	7	0	0	0	2	0
Pardosa	juvenile	0	0	1	391	0	0	9	6	0
Pirata	*piraticus*	1	1	590	0	0	576	754	117	0
Pirata	juvenile	0	0	0	0	0	0	0	2	0
Trochosa	*terricola*	0	1	4	0	3	0	0	0	0
Philodromidae										
Tibellus	*oblongus*	0	0	2	0	0	0	3	0	0
Pisauridae										
Dolomedes	*triton*	0	0	1	0	0	0	6	0	0

Table 2. (Continued)

Taxa		Habitat								
		AS	AT	BOG	GVL	PF	SCS	SSS	TSCS	TTF
Salticidae										
Metaphidippus	*aeneolus*	0	0	0	0	1	1	0	0	0
Undetermined	sp. 1	1	0	0	0	0	0	0	0	0
Undetermined	sp. 2	0	0	1	0	0	1	1	0	0
Undetermined	sp. 3	0	0	0	0	0	1	0	0	0
Undetermined	juvenile	0	0	0	0	0	1	0	0	0
Thomisidae										
Coriarachne	*utahensis*	0	0	0	1	0	0	0	0	0
Ozyptila	*pacifica*	1	3	9	0	1	5	3	8	0
Ozyptila	juvenile	0	1	1	0	4	0	0	1	1
Xysticus	*luctuosus*	3	0	2	0	0	0	0	0	0
Xysticus	*pretiosus*	1	1	0	0	3	0	0	0	1
Xysticus	juvenile	2	0	0	0	0	0	0	0	0
Msc. small taxa		226	139	157	28	214	83	140	257	136

Table 3. Spider 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, GVL=Gravel bar, PF=Douglas-Fir forest, SCS=Willow-Carex swamp, TTF=Cedar-Hemlock forest)

Taxa			**Habitat**				
			AS	**GVL**	**PF**	**SCS**	**TTF**
Agelenidae							
Agelenopsis	*oregonensis*	Chamberlin & Ivie	0	0	2	0	0
Cryphoeca	*exlinae*	Roth	0	1	16	0	19
Cybaeus	*eutypus*	Chamberlin & Ivie	14	0	46	2	26
Cybaeus	*exlinae*	Chamberlin & Ivie	0	0	0	0	0
Cybaeus	*reticulatus*	Simon	110	1	26	3	102
Cybaeus	*signifer*	Simon	1	0	2	0	2
Cybaeus	sp. 1		0	0	0	0	0
Cybaeus	sp. 2		23	1	1	0	4
Cybaeus	juvenile		24	0	28	0	37
Calymmaria	sp.		0	0	1	0	1
Novalena	*intermedia*	(Chamberlin & Gertsch)	0	0	0	0	0
Amaurobidae							
Callobius	*nomeus*	(Chamberlin)	0	0	0	0	0
Callobius	*pictus*	(Simon)	0	0	0	0	2
Callobius	*severus*	(Simon)	0	0	0	0	1
Callobius	juvenile		1	0	0	0	3
Callioplus	*wabritaskus*	new sp.	6	1	0	8	1
Callioplus	*spenceri*	new sp.	0	1	0	0	0
Callioplus	juvenile		0	6	0	21	3
Corrinidae							
Castianeira	*longipalpa*	(Hentz)	0	0	0	1	0
Clubionidae							
Clubiona	*pacifica*	Banks	0	0	0	0	0
Clubiona	juvenile		0	0	0	0	0
Gnaphosidae							
Micaria	*pulicaria*	(Sundevall)	0	0	1	2	0
Zelotes	*fratris*	Chamberlin	3	1	2	0	0
Zelotes	juvenile		0	0	0	0	0
Lycosidae							
Pardosa	*dorsalis*	Banks	0	0	0	0	0
Pardosa	*dorsuncata*	Lowrie & Dondale	99	9	40	12	3
Pardosa	*lowriei*	Kronestedt	0	65	0	0	0
Pardosa	*metlakatla*	Emerton	0	0	0	12	0
Pardosa	*moesta*	Banks	0	0	0	334	0
Pardosa	*vancouveri*	Emerton	0	0	0	0	0
Pardosa	*xerampelina*	(Keyserling)	0	0	0	0	0
Pardosa	juvenile		1	148	0	19	0
Pirata	*piraticus*	(Clerck)	4	0	0	421	0
Pirata	juvenile		0	0	0	18	0
Trochosa	*terricola*	Thorell	0	1	2	0	0
Philodromidae							
Tibellus	*oblongus*	(Walckenaer)	0	0	0	0	0
Pisauridae							
Dolomedes	*triton*	(Walckenaer)	0	0	0	1	0

Table 3. (continued)

Taxa			Habitat				
			AS	GVL	PF	SCS	TTF
Salticidae							
Metaphidippus	*aeneolus*	Curtis	0	0	0	0	0
Undetermined	sp. 1		0	0	0	0	0
Undetermined	sp. 2		0	0	1	1	0
Undetermined	sp. 3		0	0	0	0	0
Undetermined	juvenile		0	0	0	0	1
Thomisidae							
Coriarachne	*utahensis*	(Gertsch)	0	0	0	0	0
Ozyptila	*pacifica*	Banks	0	0	1	4	0
Ozyptila	juvenile		0	0	0	0	0
Xysticus	*luctuosus*	(Blackwall)	0	0	0	0	0
Xysticus	*pretiosus*	Gertsch	0	0	1	0	2
Xysticus	juvenile		0	0	3	0	0
Msc. small taxa			147	12	83	130	98

exception of gravel bar sites. Both the numbers of species and activity-density at gravel bar sites were much lower in 1996. A similar pattern was shown for beetles collected in the study area during 1995 and 1996 (LaBonte 1998), and may be attributed to heavy flooding that occurred during the spring of 1996.

Percent composition of spider families, for all habitats combined during 1995 and 1996, is shown in Figure 3. There was very little difference in the composition of dominant families between the two years. Lycosids were the dominant family collected in both years, ranging from 53% (1995) to 63% (1995) of the total number of individuals. During 1996, agelenids were the second most abundant family representing 22% of the total number of individuals in the pooled sample. However during 1995, when all nine habitat types were sampled the Agelenidae represented only 11.6% of the total sample. The miscellaneous small taxa (as previously described) accounted for 20.6% in 1995, and 21.1% of the total number of taxa collected during 1996. Amaurobids represented less than 3% of the total number of individuals in each of the two years. The other seven families accounted for less than 2% of the individuals collected in each of the two years.

Family and Species Accounts

Agelenidae

The family Agelenidae (also known as the grass and funnel-web spiders) is a large group of common spiders that build sheetlike webs in the grass, under rocks, and in debris (Borror *et al.* 1992). Roth (1993) reported that there are 24 genera, 283 described species and more than 133 undescribed species in North America. Five genera represented by 10 species were collected in the BBCRNA. Members of the Agelenidae were the second most commonly collected group of spiders in the BBCRNA during both 1995 and 1996 (11.6% and 22.1% of all spiders collected, respectively). They were collected from all habitat types, but preferred sites with greater canopy cover (85% of all agelenids were captured from alder swamps, maple thickets, Douglas-fir and cedar-hemlock forest sites). Coyle (1981) found agelenid spiders common in both clear cut and forested sites.

Cybaeus was the most common genera of Agelenid spiders found in the study area. Six species were identified; including two left unnamed and treated as morphospecies (*Cybaeus* sp. 1 and *Cybaeus* sp. 2). A total of 29 species and 35 undescribed species are found in North America (Chamberlin and Ivie 1932, Roth 1952, and Bennett 1991). *Cybaeus reticulatus* Simon was collected from all but the bog habitat type. It was most commonly found in alder swamps, Douglas fir forest, maple thickets and cedar-hemlock forest sites. *Cybaeus eutypus* Chamberlin and Ivie exhibited a similar distribution but was collected in lower abundance than *C. reticulatus*. *Cybaeus* sp. 2 was collected in moderate abundance (13 to 23 individuals) from alder swamp and cedar-willow-carex swamp sites. A few individuals (1 to 6) of *Cybaeus* sp. 2 were also collected in forested sites. *Cybaeus* sp. 1, *Cybaeus exlinae* Chamberlin and Ivie, and *Cybaeus signifer* Simon were considered rare, as less than 5 representatives of each taxon were collected.

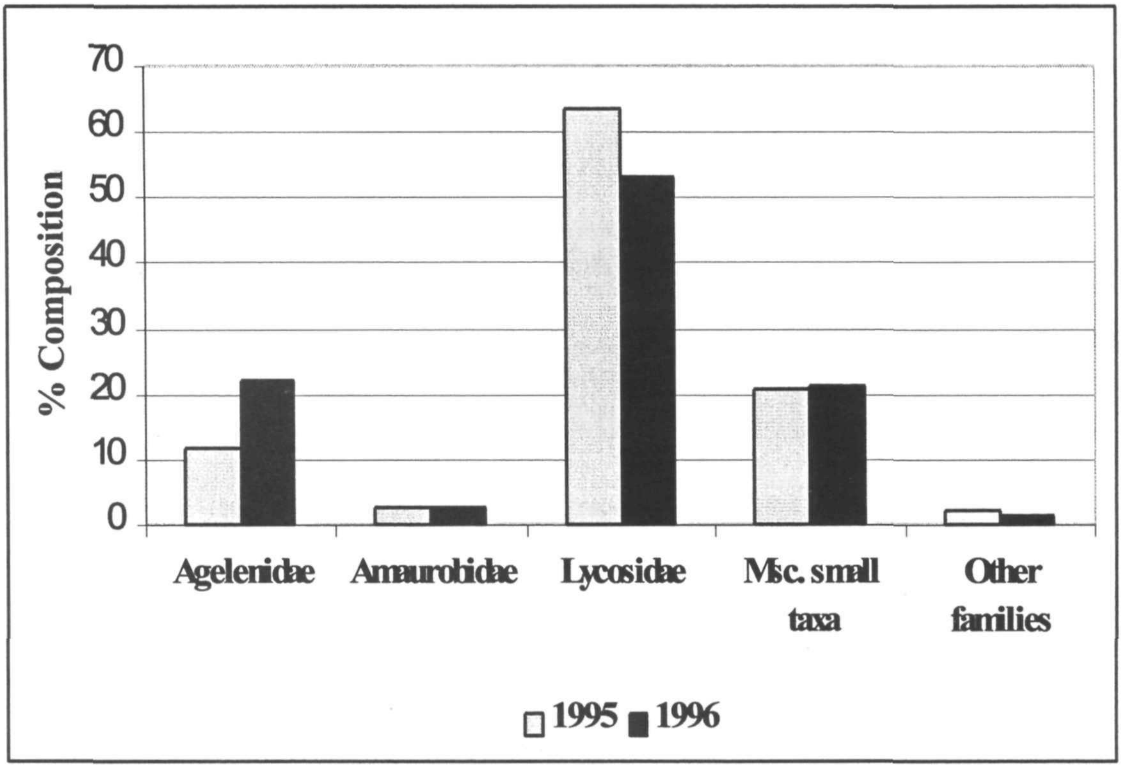

Figure 3. Percent composition of spider families collected in pitfall traps during 1995 and 1996, Big Beaver Creek Research Natural Area, North Cascades National Park Service Complex, Washington.

Cryphoeca exlinae Roth is one of two species found in North America (Roth and Brame 1972, Roth 1988). *Cryphoeca exlinae* was collected in moderate abundance (12-19 individuals) from the Douglas fir and cedar-hemlock forest sites. A few specimens were collected in four other habitat types. Other agelenids collected in the BBCRNA included members of the genera *Agelenopsis*, *Calymmaria*, and *Novalena intermedia* (Chamberlin and Gertsch). These taxa were represented by only a few specimens (<5 individuals for each taxon).

Amaurobiidae

The family Amaurobiidae is represented in North America by 83 species (two introduced species) from eight genera (Roth 1993). A comprehensive treatment of the family with keys to nearctic genera and species is provided by Leech (1972). Members of this family are largely ground dwelling, constructing irregular webs under stones, in rock crevices, and in debris (Borror *et al*. 1992). Two genera represented by five species were collected in the BBCRNA.

The genus *Callobius* is represented by 25 species in North America (Leech 1972). Three species (22 adults and 27 juveniles) were collected in the BBCRNA and included *C. nomeus* (Chamberlin), *C. pictus* (Simon), and *C. severus* (Simon). All three species were associated with either Douglas-fir or cedar-hemlock forest habitats. *Callobius pictus*, the most common of the three species, was also collected from the alder swamp and maple thicket habitat types. The distribution of *Callobius* spp. among forested habitats is consistent with habitat descriptions by Leech (1972), where woody debris and logs seem to be preferred by members of this genus.

Members of the genus *Callioplus* were collected in moderate abundance (76 adults and 78 juveniles) in the BBCRNA. Leech (1972) recognized nine species of *Callioplus* occurring in North America. Two species were collected in the BBCRNA, *Callioplus wabritaskus* new spp. and *Callioplus spenceri* new spp. *Callioplus. wabritaskus* was more widely distributed than *C. spenceri*, occurring primarily in swamp habitats and also found at gravel bar sites, bog sites, and at one cedar-hemlock forest site. *Callioplus spenceri* was only collected at gravel bar sites.

Corrinidae

Members of the family Corrinidae are closely related to the family Clubionidae. Dondale and Redner (1982) included corrinid taxa as part of their treatment of Clubionidae of Canada. This family was represented by only one species, *Castianeira longipalpus* (Hentz), in the BBCRNA. One individual was collected during each year of the two-year study period.

Spiders of the genus *Castianeira* have ant-like bodies and their movements are ant-like as well, exhibiting frequent jerky pauses and rapid changes in direction. They are commonly found in association with ants, and their mimicry is presumed to provide some survival advantage (Dondale and Redner 1982). Reiskind (1969) reported that some species of *Castianeira* feed on members of the ant genera *Camponotus*, which commonly occurs in the BBCRNA. The genus *Castianeira* was estimated by Reiskind (1969) to have 118 worldwide species of which 35 are found in North America.

Clubionidae

In North America the family Clubionidae is represented by 25 genera (two genera are undescribed and one genera is not satisfactorily placed), 191 species and at least an additional 47 undescribed (Roth 1993). Members of the family Clubionidae are referred to as the 'two-clawed hunting spiders'. They do not spin webs, but construct tubular retreats in the folds of grass, rolled up leaves, or under stones (Borror *et al.* 1992). The most complete coverage of the family in North America is presented by Dondale and Redner (1982).

Only one species, *Clubiona pacifica* Banks, was collected in the BBCRNA. Seven individuals were collected from maple thicket sites, bogs, gravel bars, willow-sedge swamp, and cedar-hemlock forest habitats during 1995, and none were collected during 1996. The genus *Clubiona* is a large group represented by approximately 320 described species worldwide, with 50 found in North America (Dondale and Redner 1982). Taxonomic references on *Clubiona* are presented by Edwards (1958), Roddy (1966,1973), and by Dondale and Redner (1976).

Gnaphosidae

Members of the family of Gnaphosidae have been referred to as the 'hunting spiders' (Borror *et al.* 1992) and are also known as the 'ground spiders' (Platnick and Dondale 1992). Platnick and Dondale describe this group as stealthy hunters living in plant litter, crevices among tree trunks, and under stones and logs. There are 141 genera and 1500 species distributed worldwide, with 30 genera and approximately 300 species found in North America (Platnick and Dondale 1992). Roth (1993) reported a total of 24 genera (one undescribed) and 243 species found in North America. A comprehensive key describing 16 genera and 100 species found in Canada and Alaska is provided by Platnick and Dondale (1992).

Individuals representing two species from two genera, *Micaria pulicaria* (Sundevall) and *Zelotes fratris* Chamberlin, were collected in low abundance (< 10 individuals per habitat) in the BBCRNA. In North America, the genus *Micaria* is represented by 43 species (Platnick and Shadab 1988). The genus *Zelotes* is represented in North America by 56 species, including four introduced species (Platnick and Shadab 1983). *Zelotes fratris* and *M. pulicaria* were primarily collected from gravel bar sites and swamp sites in the BBCRNA. Both species have been collected in a number of different habitats representing both wet and dry sites (Platnick and Dondale 1992). Grimm (1985) reported that most gnaphosid spiders are found in bright dry habitats, only a few taxa inhabit wet fields, meadows or bogs, and almost none live in dense shady forests. Mispagel and Rose (1978) found gnaphosid spiders much more abundant in clear cuts and younger growth forests than in mature and old growth forests.

Lycosidae

Members of the family Lycosidae (known as wolf spiders) are medium sized, ground dwelling hunters that rely on their vision and strong legs to chase down and capture a wide variety of ground-dwelling invertebrate prey (Gertsch 1979). The family includes nearly 2000 species worldwide. Approximately 300 species are found in North America (Dondale and Redner 1990). Members of the family are ubiquitous, and are often numerically dominant in epigeic spider communities (Mispagel and Rose 1978, Bardwell and Averill 1997, Dobyns 1997, Muzika and

Twery 1997, and Zulka *et al.* 1997). Lycosids were by far the most abundant spider taxon collected among the pitfall traps in the BBCRNA. They accounted for 63.4% of all spiders collected in 1995, and 53.3% of all spiders collected during 1996. They were found in all habitat types (Tables 2 and 3). Nine species from three genera (*Pardosa, Pirata,* and *Trochosa*) were collected.

Pirata piraticus (Clerck) was the most abundant species of lycosid collected and was found almost exclusively in bog and swamp habitats in the BBCRNA. Its distribution in the BBCRNA is consistent with that reported by Dondale and Redner (1990), which states that they prefer marshes, swamps, bogs and the moist margins of lakes and streams. *P. piraticus* occurs commonly throughout much of North America. *Pirata canadensis* Dondale and Redner and *Pirata insularis* Emerton may also occur in or near the Park (Dondale and Redner 1990).

Seven species of the genus *Pardosa* were collected from pitfall traps in the BBCRNA. *Pardosa* is one of the largest spider genera with an estimated 450 species worldwide. This genus is represented by approximately 100 species in North America (Dondale and Redner 1990). *Pardosa dorsuncata* Lowrie and Dondale, *P. lowriei* Kronestedt, and *P. moesta* Banks were commonly encountered in the study area (ranging from 3 to 560 individuals per habitat). Species collected less frequently included *P. dorsalis* Banks (11 individuals), *P. metlakatla* Emerton (43 individuals), *P. vancouveri* Emerton (5 individuals), and *P. xerampelina* (Keyserling) (9 individuals). An additional 13 species have been documented in the Pacific Northwest (Dondale and Redner 1990, Parsons *et al.* 1991).

Pardosa species have been described by Dondale and Redner (1990) as occupying a range of relatively open canopy habitats including marshes, meadows, bogs, grasslands and open forest. *Pardosa* species collected in the BBCRNA were predominantly from swamp habitat types, with the exception of *P. lowriei,* which was only found at gravel bar sites. This also is consistent with habitat use reported for *P. lowriei* by Dondale and Redner (1990). *Pardosa dorsuncata* was ubiquitous among the nine habitats sampled in the BBCRNA, but was collected in greatest abundance at alder swamp and cedar-willow-sedge swamp sites. *Pardosa moesta* was the most abundant species of *Pardosa* collected in the study area and primarily occupied willow- sedge and willow-spiraea swamp sites. A few specimens were also collected from a bog site.

Worldwide, the genus *Trochosa* is represented by approximately 60 species and *T. terricola* Thorell was the only species collected of this genus [*T. terricola* is monotypic in North America (Dondale and Redner 1990)]. During 1995, eight specimens of *T. terricola* were collected from maple thicket, bog, and Douglas fir forest habitats in the BBCRNA. Three individuals were also collected during 1996 in gravel bar and Douglas fir habitats.

Philodromidae

The Philodromidae are represented by a world fauna of 30 genera and 475 species. Five genera and 102 species occur in North America (Dondale and Redner 1978). Philodromid spiders are referred to as 'crab spiders' because of their crablike appearance, with flattened bodies and laterigrade legs. Pitfall traps were not very effective in capturing philodromids in the study area, because they commonly inhabit vegetation. Only five individuals from one species, *Tibellus oblongus* (Walckanaer), were collected in the BBCRNA. Seven of the thirty world species of *Tibellus* are found in North America. Members of this genus occur in tall grasses, sedges, ferns and similar herbs in fields, meadows and marshes. *Tibellus oblongus* is primarily found in tall grass habitat (Dondale and Redner 1978). Johnson (1996) commonly collected *T. oblongus* from gramminoid dominated early successional stages of barrier islands in Virginia. In the BBCRNA, two individuals were collected in pitfall traps located in the bog habitat and three individuals were collected in pitfall traps located in willow-spiraea habitat sites.

Pisauridae

The Pisauridae (also referred to as 'nurseryweb spiders') represent a group of semiaquatic spiders. Gertsch (1979) reported that they are capable of pursuing and capturing prey among submerged vegetation in ponds, lakes, and river backwaters. The common name for these spiders is derived from the tent-like web spun by females to enclose their egg sacs (Dondale and Redner 1990). The family is represented by three genera and 13 species in North America (Roth 1993). *Dolomedes triton* (Walckanaer) was the only species of Pisauridae collected in the BBCRNA. *Dolomedes triton* was also the largest spider collected in the study area, with a body size of males reaching ten mm and sixteen mm for females. Seven specimens were collected from bog and willow-spiraea swamp sites in 1995 and 1 specimen was collected from a willow-sedge swamp site in 1996. This genus is represented by nine species in North America (Carico 1973).

Salticidae

Approximately 46 genera and 294 species of Salticidae are found in North America (Roth 1993). Salticidae are referred to as the 'jumping spiders'. They hunt by day, locating their prey and capturing them with a sudden quick jump. Members of this family were rarely encountered in the samples from the BBCRNA, with only ten specimens collected during the two years of sampling. Two of the specimens were identified as *Metaphidippus aeneolus* Curtis and were collected from Douglas-fir forest and willow-sedge swamp sites. Mason *et al.* (1997) stated that *M. aneneolus* is a well known predator of defoliating insects, and this species accounted for almost half of the hunting spiders collected in arboreal samples from Douglas fir and grand fir trees. It is expected that arboreal samples from the BBCRNA would yield a greater number of salticids than that of the pitfall traps. Seven other specimens from the 1995 and 1996 samples were placed into three morphospecies groups. Efforts to identify these specimens will be made in the future.

Thomisidae

The Thomisidae, like the philodromid spiders, are referred to as 'crab spiders' because of their crab-like appearance. Worldwide there are 150 genera and 1450 species (Dondale and Redner 1978). Ten genera and 128 species are found in North America (Roth 1993). Thomisids are rather solitary. Some exhibit ambushing strategies for capturing prey. Most inhabit litter in grasslands and forests (Dondale and Redner 1978).

Three genera represented by four species were collected in the BBCRNA during 1995 and 1996. *Ozyptila pacifica* Banks was the most commonly collected species of Thomisidae. A total of 35 specimens were collected and they were found in all habitat types with the exceptions of gravel bars and cedar-hemlock forest sites. Five specimens of *Xysticus luctosus* (Blackwall) and nine specimens of *Xysticus pretiosus* Gertsch were collected. *Xysticus luctosus* was found in alder swamp and bog habitats, and *X. pretiosus* was found in alder swamp and maple thicket sites as well as Douglas fir and cedar-hemlock forested sites. One specimen of *Coriarachne utahensis* (Gertsch) was collected from a gravel bar site.

Summary and Conclusions

This work represents the first effort in the North Cascades National Park Complex to document taxonomic and life history information concerning spider 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 (LaBonte 1998). 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.

Results indicate that although there is little difference in species richness between the habitat types studied, there are important differences in the composition and abundance of spider taxa among the habitat types at both species and family levels. Spider species representing habitat-generalists and habitat-specialists were observed. Statistical analyses of species community and environmental attribute data will be treated in Part V of this series. However, in the absence of these analyses, there are some obvious differences in the occurrence of taxa among the habitat types related to gradients of canopy cover and moisture. At the species level habitat-specialists such as *Pardosa lowriei* and *Callioplus spenceri* were only found at gravel bar sites (open canopy and dry). *Pardosa moesta* Banks, *Pardosa metlakatla* and *Pirata piraticus* occurred only in open-wet habitat types. At the family level, agelenids were more abundant at sites with closed canopies while amaurobids and lycosids were more abundant at sites with open canopies. Much more can be learned from additional effort to identify and include the 'small miscellaneous taxa group', which accounted for approximately 20 % of all individuals collected during the two year study. This group includes the most speciose family of spiders in North America, the Linyphiidae, with 162 genera and 869 described species (including Erigoninae - Roth 1993). In addition, the Theridiidae (27 genera and 232 species in North America) and other families are also represented in this group of miscellaneous unidentified taxa.

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 section. Pitfall traps appeared to be effective for sampling those species that are vulnerable to this method. No additional species were collected in the reduced subset of habitats sampled during the second year of the study. In addition, the low percentage of singletons collected (see Coddington *et al.* 1996) indicated a relatively complete survey. Additional effort using other methods to sample herb, shrub, and canopy layers would significantly increase the number of species found and consequently provide a broader foundation for ecological monitoring and assessment.

A total of 38 species were collected in this study using only pitfall traps. 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. Thirty families of spiders, represented by 134 genera and 260 species have been recorded for the H.J. Andrews Forest during the last two decades (Parsons *et al.* 1991). It is expected that similar efforts in the Big Beaver Creek watershed would yield a similar richness of species. It is also interesting to note that 13 of the 38 species collected in the BBCRNA have not yet been found in the H.J. Andrews Forest. This may indicate a significant difference in species distributions along a latitudinal gradient in the Western Cascades and/or result from differences in habitats sampled at the two locations.

Future efforts should continue to document spider 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. Application of other methods of collection will prove useful in expanding our knowledge of the spider fauna from vegetation layers. This basic information combined with the examination of spider and other arthropod communities along gradients of human disturbance will provide diagnostic tools for future use in the assessment of 'Biological Integrity'.

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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.

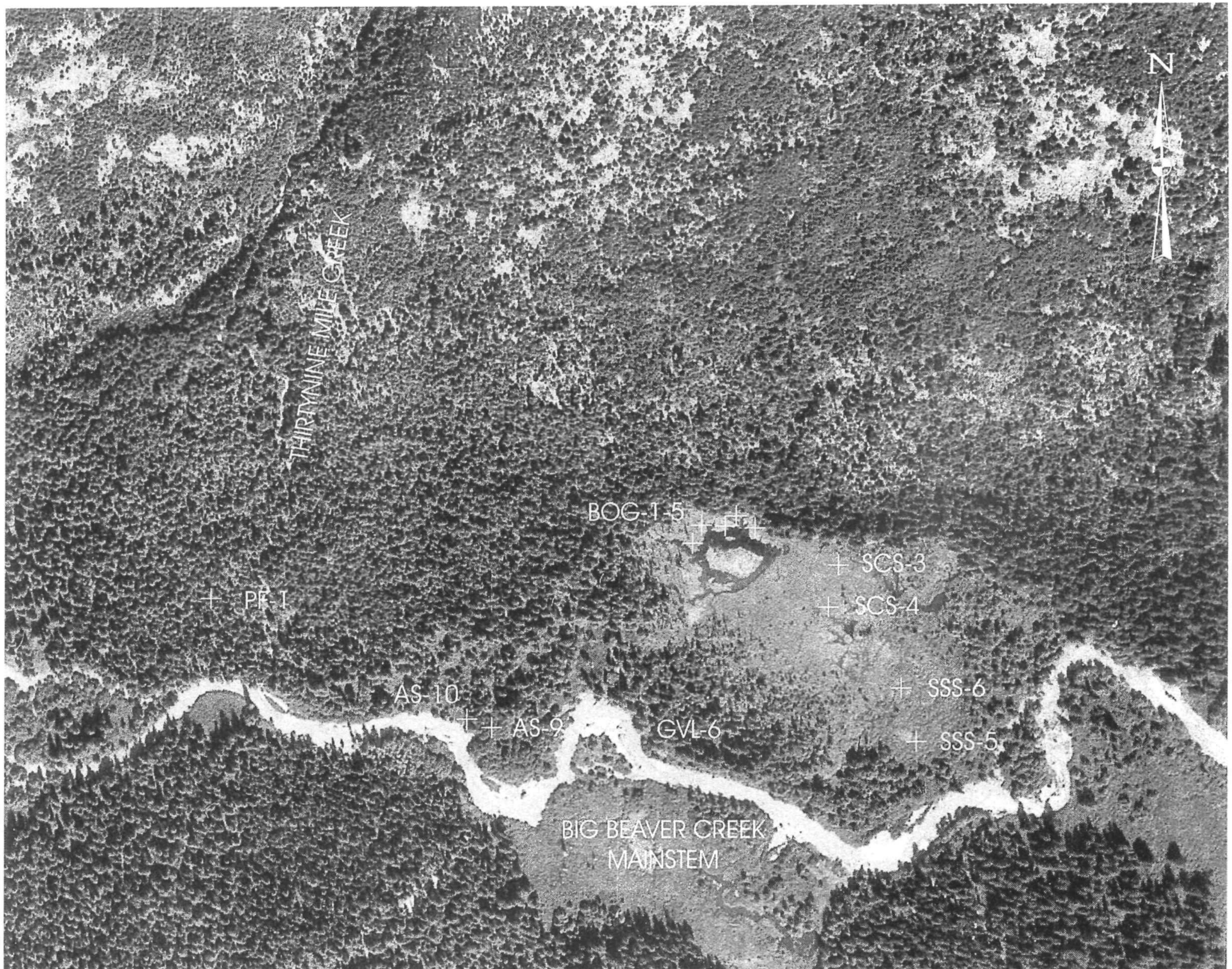

Figure A.6. Photo 6. Arthropod pitfall trap locations, Big Beaver Creek, North Cascades National Park Service Complex, 1995-1996.

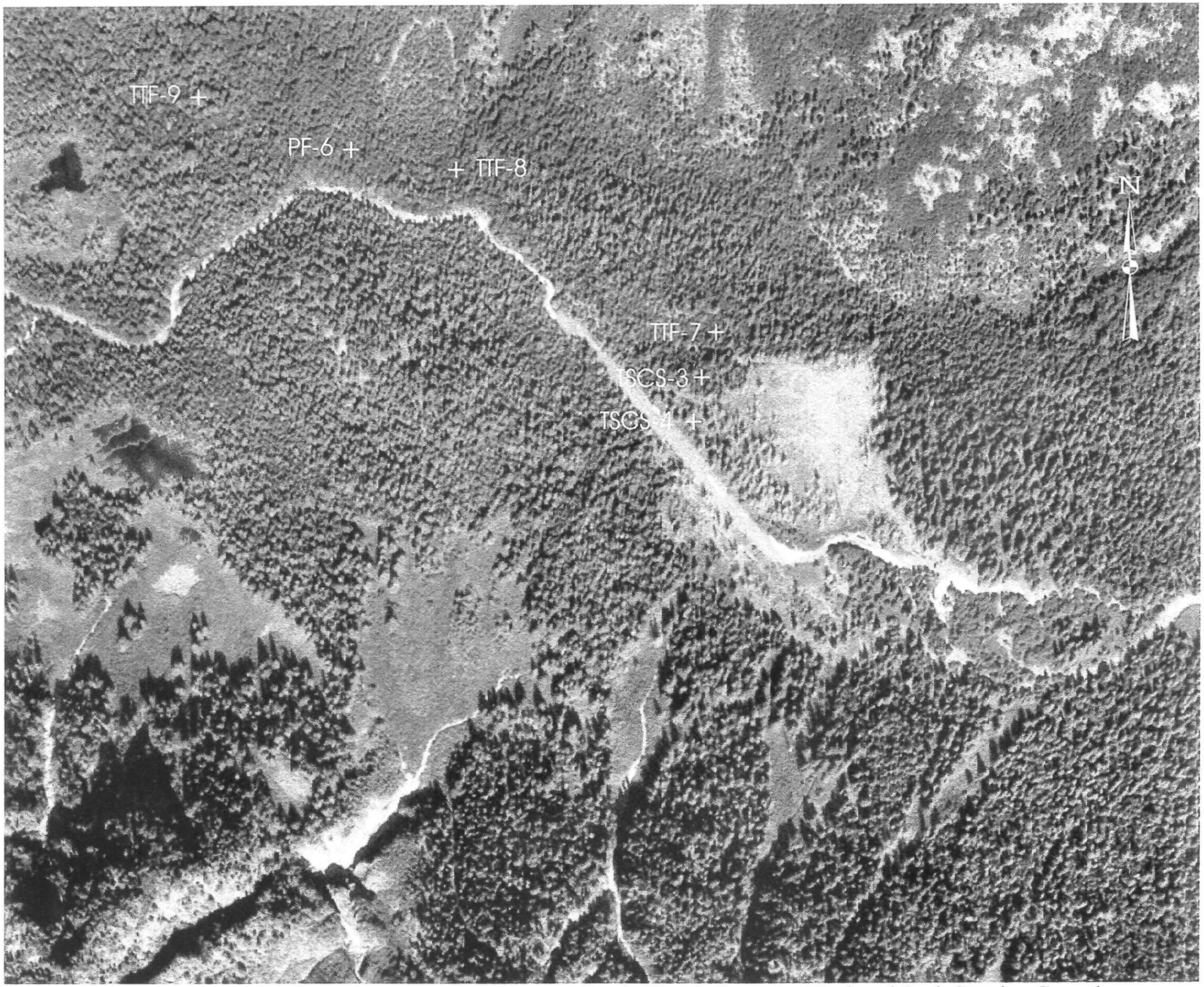

Figure A. 7. Arthropod pitfall trap locations, Big Beaver Creek, North Cascades National Park Service Complex, 1995-1996.

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

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.

(NPS D 234) (December 1996)