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ABSTRACT

The arthropod community in a Douglas-fir forest near Blue River, Lane County, Oregon was investigated from March through August 1973. Five stands of Douglas-fir were sampled: two clearcuttings, a young-growth (20 years old), a midgrowth (125 years old), and an old-growth (450 years old) plot. A pole pruner was used to sample the foliar fauna on the trees in the young-growth plot. The ground fauna was sampled by pitfall traps, and the aerial fauna by rotary nets in each of the stand types. Relative abundances and general trophic categories and species lists for each strata are presented with comment. Trapping method efficiencies are discussed in light of the results of this study and data presented in the literature.

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INTRODUCTION

The terrestrial arthropod investigation of the Coniferous Forest Biome in 1973 was a generalized survey of the major arthropod groups associated with various age stands of Douglas-fir, Pseudotsuga menziesii (Mirb.) Franco. Surveys in the clearcut stands, 20, 125, and 450 years old, were standardized to obtain relative abundances.

Three methods were used to sample numbers of macroarthropods in selected forest strata.

1. Branches of young Douglas-fir trees were captured and pruned, and their attendant fauna collected.
2. Pitfall traps sampled the ground macroarthropod fauna.
3. Rotary nets sampled the aerial fauna 1.83 m aboveground.

Sampling was carried out weekly from March 27 to August 10, 1973. Each arthropod collected by the various sampling methods was stored in alcohol and identified later in the laboratory. Each sample received both a standardized sample number designating sampling method and plot, and a standardized week number following the scheme of Lewis and Taylor (1967). Original identifications were usually to family level, but generic or species determinations were obtained for most of the Coleoptera, Homoptera, and Hemiptera. The arthropods collected during this study are now located in the Entomology Collection, Department of Entomology, Oregon State University and work is presently underway to curate and further identify the arthropods.

Trophic Categories

The general trophic categories are based on the presumed mode of feeding of the life stage in which an arthropod was captured. An exception to this classification occurred with many wasp families, such as Ichneumonidae and Chalcididae. These were captured in the adult stage and classified as parasitic, although the adult was likely a nonfeeder, a nectar feeder, or perhaps a partial feeder on the juices of the insect on which it oviposits. Among particular groups of flies whose feeding habits differ according to sex, a 1:1 sex ratio was assumed for purposes of trophic tabulation. Thus, half the numbers might be assigned to parasites (as in blood feeders) and the other half to phytophages (nectar feeders) or unknown feeders. The trophic tabulation, then, is preliminary and often based on presumed feeding habits of whole families. The general categories recognized are:

Phytophages: Defoliators, sapsucking forms, and nectarivores feed chiefly on any portion of a plant.

Carnivores: Feeders on live animal material. This category was subdivided into predators and parasites. Parasitoids, ectoparasites, and bloodsuckers were considered parasites.

Scavengers: Fungivores, omnivores, and opportunistic feeders, feeding on dead or decaying plants or animals.

Ants: Many species of ants are specific to a particular food source. Because of their often unique community position and inadequate species indentifications, however, they are treated separately.

Nonfeeders or Unknown Feeders: This includes arthropods that are characterized by one or more of the following conditions: They appear not to feed in the life stage sampled; their feeding habits are unknown; they belong to families with such diverse feeding habits (depending on the actual species involved) that no attempt was made to place it in an arbitrary category.

Site Description

Sampling was conducted in the H. J. Andrews Experimental Forest (recently established as an Experimental Ecological Reserve) in Oregon's western Cascade Mountains (lat. 44°13' N; long. 122°10' W.). Five plots, representing four stand ages of Douglas-fir, were sampled.

Plot 1, a 20-year-old stand at 610-m elevation, was the young-growth plot in this study. It is a low, flat, parkland area that gradually sloped northward from 0 to 25°, along the southern bank of Lookout Creek. The site was clearcut in 1951 and reforested in 1953. When sampled, tree density was estimated as 720 trees/ha. Trees were about 10 m tall. Tree density on steeper slopes averaged 916/ha, and density on the lower, more open area was about 532/ha. This plot was crisscrossed with burned slash, and the understory was dominated by *Ribes sanguineum* Pursh and *Epilobium angustifolium* L.

Plot 2, a 125-year-old stand of pole-size second-growth Douglas-fir (Dyrness and Hawk 1972), was the midgrowth plot. It was located on a hill at a higher elevation (975 m) than the other plots and was not affected by climate associated with creekside proximity and valley-floor air movement. Trees were about 30 m tall with an open understory, except for patches of *Rhododendron macrophyllum* G. Don, *Vaccinium parvifolium* Smith, *Rubus ursinus* Cham. and Schlect., and *Berberis nervosa* Pursh. The litter layer on the forest floor was thin and composed primarily of needles, small twigs, and branches broken from the trees. Snow cover was more persistent because of the higher elevation. The site was clearcut in 1974, the year after sampling.

Plot 3, a 450-year-old stand along the southern bank of Lookout Creek at 474-m elevation, was the old-growth plot. *Tsuga heterophylla* (Raf.) Sarg. trees were scattered in the clearings. *Acer circinatum* Pursh, *Gaultheria shallon* Pursh, *Berberis nervosa* Pursh, and *Rhododendron macrophyllum* G. Don were the dominant shrubs and *Linnaea borealis* L., *Achlys triphylla* (Smith) DC., *Oxalis oregona* Nutt., and *Polystichum munitum* (Kaulf.) Presl the dominant herbs. Much moisture was retained by the thick litter and moss layer in this plot.

Plot 4, along the southern bank of Lookout Creek, and Plot 5, along the northern bank of McRae Creek, at 610-m elevation, were level clearcut plots. Despite reforestation, few replanted Douglas-fir trees survived. *Acer circinatum* Pursh, *Epilobium angustifolium* L., and *Rubus ursinus* Cham. and Schlecht., trailed over burned slash, bareground, and protruding rocks.

The open and exposed nature of these plots resulted in higher temperatures and lower humidity than in the more forested plots.

Air temperatures were recorded in Plots 1, 2, and 4 with a sheltered Yellow Springs hygrothermograph located 1 m aboveground. Plot 4 showed the greatest extremes in mean weekly maximum and minimum temperatures, followed by Plot 1 and Plot 2 (Figure 1). Lack of cover in Plot 4 allowed a great deal of reradiation. The low maximum temperatures in Plot 2 were due to the higher elevation and greater cover from the tall midgrowth trees. The minimum temperatures at the lower elevation of Plots 1 and 4 were affected by cover (or lack of it) and the effects of cold-air drainage associated with the location in the Lookout Creek canyon bottom. Thus, the minimum temperatures experienced in the young-growth and clearcut plots were usually lower than those of the midgrowth plot at a higher elevation. The temperatures recorded in the three plots responded similarly to cloud cover and precipitation (Figures 1 and 2).

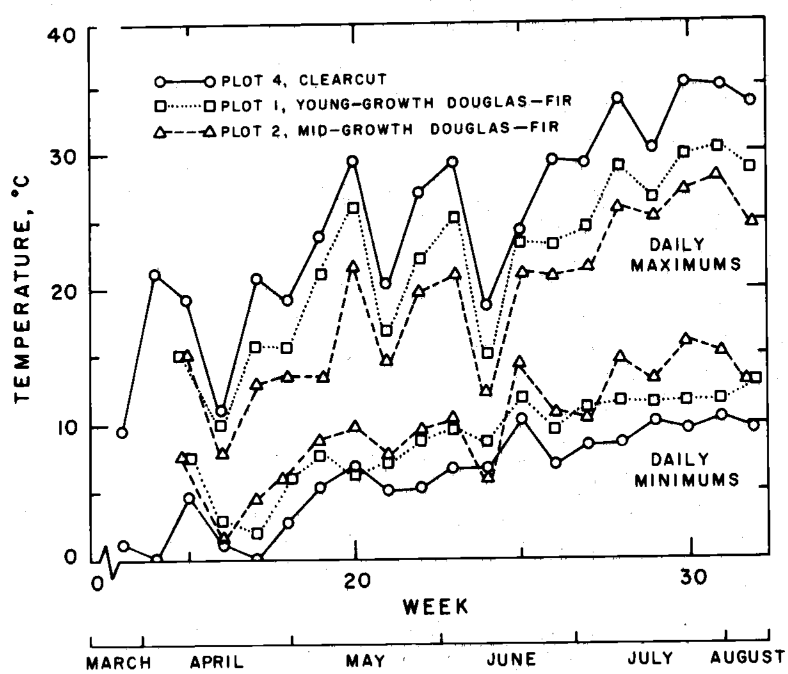

Figure 1. Mean maximum and mean minimum air temperatures 1 m aboveground in Plots 1, 2, and 4 from March through August 1973 in the H. J. Andrews Experimental Forest, Oregon.

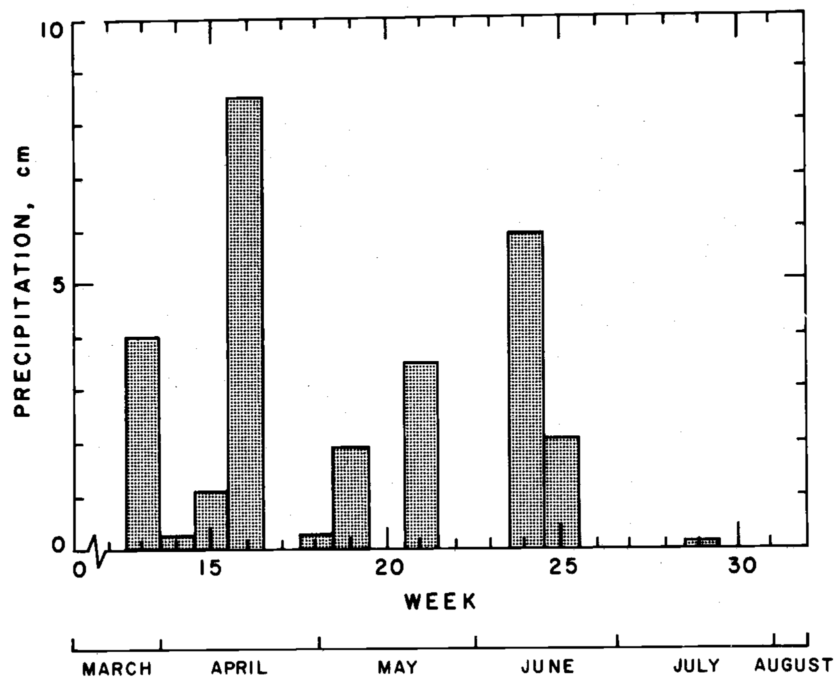

Figure 2. Weekly precipitation (cm) recorded from March through August 1973 by the U.S. Forest Service at a station adjacent to old-growth Plot 3 in the H. J. Andrews Experimental Forest, Oregon.

Precipitation was recorded by the U.S. Forest Service at a station adjacent to Plot 3 above Lookout Creek. The amount of precipitation in 1973 was lower than normal for this area. Only 167 cm of precipitation were recorded from October 1972 to September 1973 compared to 307 cm the previous year and 271 cm the year before. Nevertheless, the month of June 1973 received twice as much precipitation as usual (8.6 cm compared to an average of 4.3 cm).

DOUGLAS-FIR ARTHROPODS

Methods

A pole pruner was constructed to sample crown branches from 20-year-old trees. It was used only in Plot 1 because the 10-m tree height was within the range of the pruner assembly. Sampling was performed in open areas to facilitate use of the topheavy device (Mason 1969). Attached to the 4-m pole pruner was a horizontal net 1 m in diameter and 1.3 m long that could be closed by a drawstring from the ground level of the assembly.

Three branch samples about 1 m long were sampled each from five different trees each week. Weekly densities of arthropods captured were estimated from the 15 branch samples. Each branch was weighed and measured as an indication of live weight and swept or surface area of the foliage (Mason 1970). Sample sites on each tree were located 3.5-6.0 m aboveground, a height limitation imposed by the operating capabilities of the pruner assembly. Lower branches were sampled first to prevent disturbance of the foliage and arthropods higher in the tree. The three samples from each tree were representative of all sides of the tree and were assumed to be characteristic of the arthropod populations at the midcanopy level (I. W. Varty, personal communication). Once the selected branch had been caught in the net, the net was closed, the branch clipped, and the device lowered to the ground. The enclosed branch was vigorously beaten and shaken inside the net to dislodge clinging arthropods before the branch was removed, weighed, and measured. No search was made for internal branch or needle arthropods. Many of the smaller arthropods, such as Collembola, mites, and smaller adelgids, probably fell through the 0.5-mm^2 mesh, causing underestimated densities of smaller arthropods.

Densities of arthropod populations on the Douglas-fir branches were estimated by determining the number of arthropods collected per weight and per swept or surface area of sampled branches. Wet weight was recorded in grams, but foliage area was determined by multiplication of length by maximum width of each branch sampled. Based on the destructive sampling of two trees in Plot 1 and the estimated density of 720 trees/ha, the live weight of foliage in this plot was estimated at 50.34×10^6 g/ha, and the total foliage area was estimated at 1056.35×10^6 cm^2/ha. The ratio of the total foliage weight/ha to the total weight of the fifteen sampled branches each week yielded a weekly foliage weight multiplier. This multiplier times the number of arthropods of each species or taxon collected each week gave the population density estimates. Likewise, a weekly foliage area multiplier was derived, which was multiplied by the number of arthropods collected, to yield a population density estimated from foliage area sampled rather than weight. The mean of the two estimates based on foliage weight and foliage area was used as the density estimate in this study.

Results and Discussion

Species Composition. Appendix 1 lists the number of specimens of each species or taxon collected on Douglas-fir. The total of 3,767 arthropods collected over the 20-week sampling period was composed mainly of Hemiptera (Heteroptera and Homoptera), which made up 57.5% of the arthropods (Table 1). Coleoptera made up nearly 11%, and spiders (Araneida) 13.5%. The composition of captures on young Douglas-fir are compared with those from a red pine plantation in Ontario (Martin 1966) (Table 1). Considering that the pruning method did not effectively sample smaller arthropods and that Martin's insecticidal technique possibly overestimated the Diptera actually on the trees, the faunal compositions are relatively similar. Exceptions are the low number of Psocoptera and higher relative numbers of Hemiptera on Douglas-fir as compared to red pine.

Table 1. Comparison of arthropods collected on 20-year-old Douglas-fir by pole pruner, and arthropods collected on red pine by Martin (1966) with an insecticidal spray technique.

	Douglas-fir				Red pine	
	No.		% of total		% of total	% of total[a]
Noninsecta						
Araneida	510		13.5		4.3	6.9
Acarina	16		0.4		30.8	-
Insecta						
Collembola	7		0.2		10.1	-
Hemiptera	2,165		57.5		22.7	36.1
Heteroptera		74		2.0		
Homoptera		2,091		55.5		
Psocoptera	174		4.6		9.9	15.8
Coleoptera	399		10.6		2.3	3.7
Neuroptera	63		1.7		1.1	1.8
Lepidoptera	19		0.5		0.5	0.8
Diptera	232		6.2		14.2	22.6
Hymenoptera	172		4.6		3.5	5.6
Others	10		0.3		0.9	1.4
Total Arthropods	3,767					

[a]Percentage without inclusion of Acarina and Collembola.

Table 2 shows a preliminary trophic composition for the arthropods found on Douglas-fir. Phytophagous species accounted for 67% of the arthropods captured, and most of these were sapsucking Homoptera. The Cooley spruce gall aphid, *Adelges cooleyi* (Gillette) accounted for about 81% of the phytophagous numbers. Population numbers of adelgids may reach outbreak proportions in particular Douglas-fir stands, but this did not happen in Plot 1 during 1973, even though the estimated abundance was at least 2.5 million/ha during late July (Figure 3). This number is underestimated because of the insect's tenacity in the early instars and its small size in relation to the capture equipment method.

Table 2. General trophic composition of arthropods collected on Douglas-fir.[a]

Category	No.	% of total	Major taxa and % of trophic category
Phytophages	2,537	67.3	Adelges cooleyi (Adelgidae) 81% Scythropus ferrugineus (Curculionidae) 4.6% Diprionidae 1.9%
Carnivores	842	22.4	
Predators	827	22.0	Araneida (spiders) 61.6% Syrphid larvae 10.4% Podabrus sp. (Cantharidae) 9.3% Neuroptera 7.6%
Parasites	15	0.4	
Scavengers	223	5.9	Psocoptera 78.0%
Ants	115	3.1	
Unknown and nonfeeding	50	1.3	
Total	3,767	100.0	

[a]Trophic categories explained in Introduction.

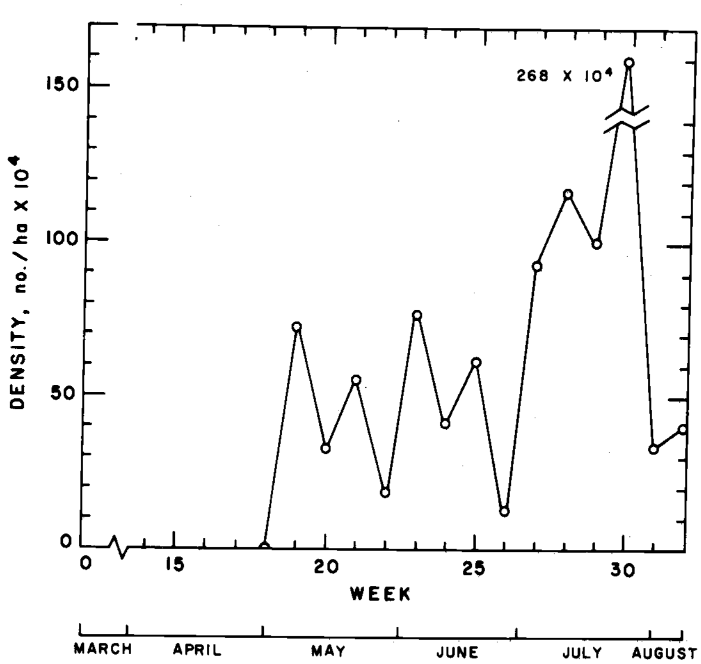

Figure 3. Weekly density estimates of the Cooley spruce gall aphid, Adelges cooleyi (Gillette), on 20-year-old Douglas-fir from pole-pruning samples, March through August 1973, H. J. Andrews Experimental Forest, Oregon.

The phytophagous weevil, Scythropus ferrugineus Casey, was most abundant in early spring when sampling began and the population was already on the decline (Figure 4). These weevils comprised about 5% of the phytophagous forms present on the trees and attained a relative abundance of at least 166,000/ha in late March.

Sawfly larvae of the Diprionidae accounted for about 2% of the phytophagous insects on Douglas-fir. Infestation was minimal, and no diprionid adults were collected by this method or by rotary net sampling. Most larvae were collected in late May and late June, and numbers declined thereafter. The maximum abundance was estimated to be about 70,000/ha in late May (Figure 4).

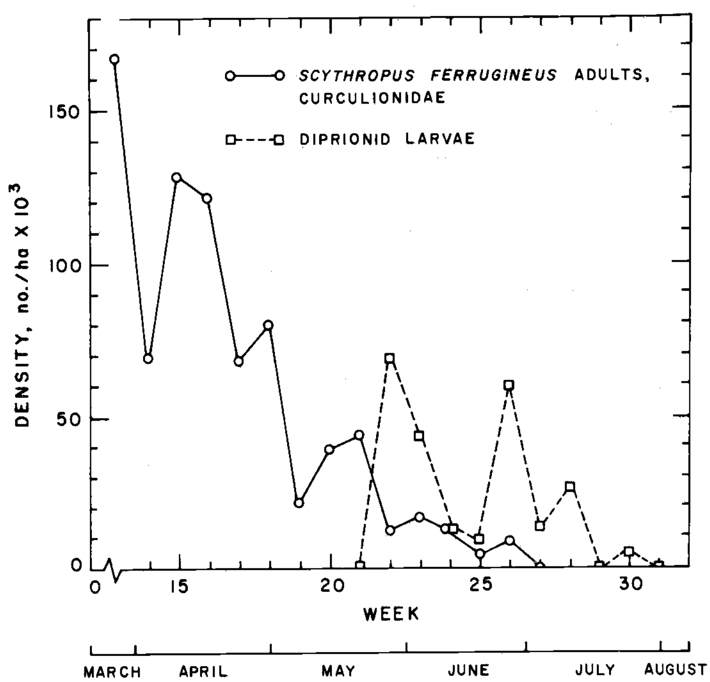

Figure 4. Weekly density estimates of the weevil, Scythropus ferrugineus Casey and diprionid larvae on 20-year-old Douglas-fir from pole-pruning samples, March through August 1973, H. J. Andrews Experimental Forest, Oregon.

Predaceous species made up about 22% of the arthropods collected (Table 2). The 3:1 ratio of phytophages to predators on the trees is similar to the ratio of (2.8-3.2):1 observed by Martin (1966) on red pine. Hunting spiders of the Salticidae and Thomisidae were the most abundant spiders. Predaceous cantharid beetles, syrphid fly larvae, and Neuroptera also were prominent. Adelgids were probably the most abundant and accessible prey, but to what extent predators utilized these prey is unknown. Cumming (1959) stated that, in spite of high mortality in adelgids, predatory effects seemed to be minimal in the population she studied. In our study, spiders reached combined densities of over 250,000/ha in mid-May (Figure 5), and syrphid larvae and cantharid adults (Podabrus sp.) reached densities of 92,000/ha and 136,000/ha in early June (Figure 6).

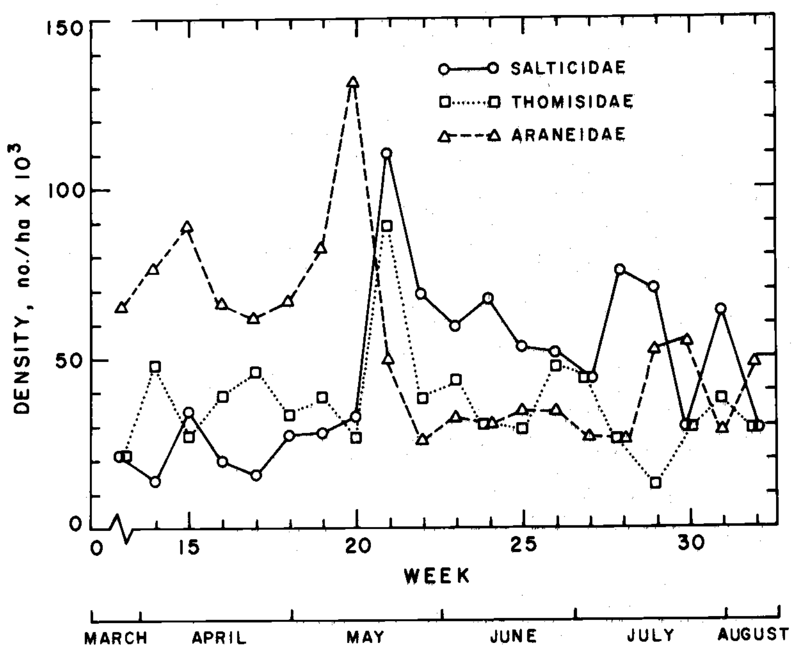

Figure 5. Weekly density estimates of spiders of the Araneidae, Salticidae, and Thomisidae on 20-year-old Douglas-fir from pole-pruning samples, March through August 1973, H. J. Andrews Experimental Forest, Oregon

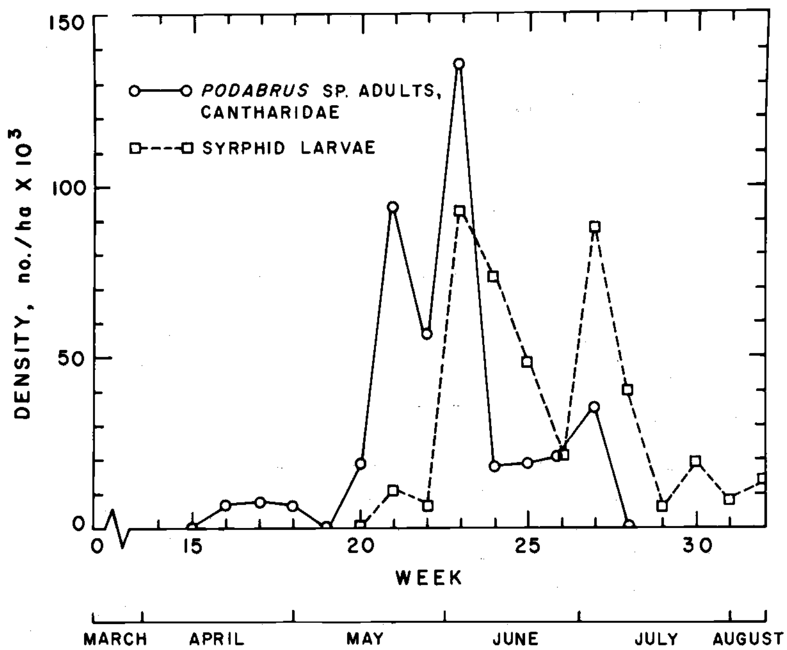

Figure 6. Weekly density estimates of cantharid beetles, Podabrus sp., and syrphid fly larvae on 20-year-old Douglas-fir from pole-pruning samples, March through August 1973, H. J. Andrews Experimental Forest, Oregon.

Scavengers were represented mainly by Psocoptera (Table 2). Depending on exact species present, however, some or all of these might actually be phytophagous. For lack of species identifications, whether ants collected were scavengers, phytophages, or predators was impossible to ascertain.

Capture Efficiency. Whether 15 branch samples per week from only five trees adequately sampled the arthropod fauna present on Douglas-fir branches is debatable. Varty (personal communication) mentioned, in connection with sampling techniques for the balsam twig aphid, that single branch samples from 40 trees per collection date would yield less than 20% standard error. Mason (1970) calculated that to sample larval populations of the tussock moth, three branch samples each from 11 or 12 trees would give a density estimate with a standard error within 20% for medium to heavy populations of larvae. Interpolation from his Table IV (p. 843) shows that the sampling technique followed in our study might be within 30% standard error if we were sampling for tussock moth larvae. The error factor for other taxa is not known.

GROUND-DWELLING ARTHROPODS

Average densities of ground-dwelling arthropods in forest soils have been enumerated elsewhere (Gill 1969, Huhta et al. 1967, Wallwork 1976). However, little investigation has been conducted on the wandering macroarthropod fauna of forest floors as collected by pitfalls (Huhta 1971, Uetz 1975).

Methods

The pitfall traps were No. 10 steel cans, 15 cm in diameter and 18 cm deep. Each can was buried below the litter, flush with the soil surface. Square pieces of 1/3-inch hardware cloth, placed about 5-8 cm below the rim of the can, prevented both the capture of small mammals and reptiles and their consumption of the trapped arthropods. An aspirator was used to collect the smaller arthropods. Rainwater and debris, which had accumulated between sampling periods, was removed with a sponge before and after each collecting period.

Pitfall locations sampled the previous year were re-used in Plots 2, 3, and 5. Each plot contained 15 pitfalls, spaced 10 m apart and radiating from a central trap along the four compass coordinates. Plots 1 and 4 each contained 25 traps arranged in a 5 x 5 grid, each trap 10 m apart. The increased number of traps in these plots was an attempt to more intensively trap the ground-dwelling arthropods in these specific stands.

All pitfall traps were left open for 48 consecutive hours each week, resulting in 30 trap nights per week (1 trap night = 24 hours) for Plots 2, 3, and 5, and 50 trap nights per week for Plots 1 and 4. As thorough collection of Collembola and Acarina was not possible with this trapping method, no attempt was made to assess these populations. However, preliminary counts indicated that these two groups would have been the most numerous arthropods in most of the sampling periods and plots.

To compare the numbers of arthropods collected in each of the stands and to compensate for the greater number of traps in plots 1 and 4, the numbers collected in these two plots had to be reduced by multiplying by a factor of 0.6. For purposes of this analysis, we assumed that use of either the grid pattern or radiating pattern in the plots did not significantly affect number or pattern of arthropod captures.

Results and Discussion

Species Composition. Appendix 2 lists the number of specimens of each species or taxon collected in the pitfall traps. Table 3 summarizes the numbers of arthropods collected by taxonomic order. The greatest numbers of arthropods were collected from the clearcut Plots 4 and 5, where large populations of wandering spiders and ants were encountered. Young-growth Plot 1 retained much of the clearcut fauna, but had additional species inhabiting the young understory. Despite the more intensive sampling in Plots 1 and 4, data suggest that clearcut Plots 4 and 5 and young-growth Plot 1 had a greater species diversity than mid- and old-growth Plots 2 and 3 (Appendix 2).

Table 3. Arthropods collected in pitfall traps.[a]

Order	Plot[b] 1 Young growth No.	1 Young growth No.[c]	1 Young growth % of total	2 Midgrowth No.	2 Midgrowth % of total	3 Old growth No.	3 Old growth % of total	4 Clearcut No.	4 Clearcut No.[c]	4 Clearcut % of total	5 Clearcut No.	5 Clearcut % of total
Noninsecta												
Isopoda	52	31	3.1	0	-	2	0.4	0		-	0	-
Chilopoda (Class)	25	15	1.5	5	1.0	12	2.2	25	15	0.9	11	0.7
Diplopoda (Class)	77	46	4.6	59	11.6	51	9.4	20	12	0.7	66	3.9
Chelonethida	17	10	1.0	3	0.6	18	3.3	2	1	0.0	5	0.3
Phalangida	14	8	0.8	2	0.4	13	2.4	11	7	0.4	3	0.2
Araneida	103	62	6.2	51	10.1	36	6.7	645	387	22.2	353	20.9
Acarina	p	p		p		p		p	p		p	
Insecta												
Collembola	p	p		p		p		p	p		p	
Heteroptera	47	28	2.8	3	0.6	0	-	87	52	3.0	84	5.0
Homoptera	16	10	1.0	2	0.4	13	2.4	61	37	2.1	156	9.2
Coleoptera	614	368	37.1	299	58.7	220	40.7	339	203	11.7	357	21.2
Diptera	47	28	2.8	22	4.3	37	6.9	46	28	1.6	14	0.8
Hymenoptera	625	375	37.8	56	11.0	115	21.3	1,647	988	56.7	611	36.2
Others	19	11	1.1	7	1.4	23	4.3	23	14	0.8	28	1.7
Total arthropods	1,656	992		509		540		2,906	1,744		1,688	

[a]Data for Plots 1 and 4 include columns listing the numbers reduced (times 0.6) for interplot comparisons because Plots 1 and 4 were more intensively sampled than Plots 2 and 3 (1,000 compared to 600 trap nights).

[b]"p" = present in great numbers, but not counted.

[c]Numbers in previous column times 0.6.

Clearcut Plots 4 and 5, with their high temperatures and burned slash, were ideally suited to wandering spiders of the Lycosidae and Gnaphosidae. Large populations of ants, mostly Camponotus spp. (carpenter ants), occurred within the slash. The carabid beetles, Harpalus sp., were relatively common ground dwellers in these clearcuttings and were not found in the forested stands.

Young-growth Plot 1 had a thick growth of secondary shrubs and trees, and concomitant with this undergrowth was a large phytophagous arthropod population. Large numbers of the phytophages, such as chrysomelid beetles, Pyrrhalta carbo LeConte, and the weevils, Dyslobus sp., were collected in this plot. Ants were common, but not as abundant as in the clearcuttings. Isopods were found almost exclusively in this plot. The carabids, Promecognathus crassus LeConte and Pterostichus herculaneus Mann., also were common in Plot 1.

Midgrowth Plot 2 had increased numbers of curculionids, mostly Steremnius carinatus Boh., and decreased numbers of Heteroptera and Homoptera, especially ants, compared to the other plots. The carabid, Pterostichus herculaneus Mann., was especially numerous in this plot.

Old-growth Plot 3 had a large unestimated population of Collembola and Acarina in its thick, damp layer of litter and mosses. The predaceous carabid, Promecognathus crassus LeConte, which feeds on slugs and snails, was abundant in this habitat. The number of wandering spiders, however, was less than in the other habitats sampled.

When the sampled populations are divided into trophic categories, habitat variation is expressed by the faunal composition. The composition of the ground-dwelling arthropods is related to the herbaceous vegetation and available litter and, at least indirectly, to the climate that produced that habitat. Table 4 describes the trophic composition of the various habitats as a percentage of the collected population. This trophic classification is preliminary and generalized, often based at the family level. Presentation of accurate Collembola and Acarina counts would have changed Table 4 substantially.

The greatest numbers of predators were collected in clearcut Plots 4 and 5. They composed only 30%-36% of the epigeal arthropods captured in these two plots, compared to 48% and 40% in Plots 2 and 3 (Table 4). The heavy litter and moss layer in Plot 3 supported large populations of scavengers and detritivores, which composed about 24% of the arthropods in this plot, compared to 4%-15% for the other four plots. As light intensity, temperature, and humidity changed in the litter layer with increased stand age (Figure 1), the population of detritivores and scavengers inhabiting that niche increased proportionately (Table 4) (Gill 1969, Pedigo 1970).

Table 4. General trophic composition of arthropods collected in pitfall traps.[a]

	Plot									
	1 Young growth		2 Midgrowth		3 Old growth		4 Clearcut		5 Clearcut	
Category	No.	% of total	No.	% of total	No.	% of total	No.	% of total	No.	% of total
Phytophages	435	26.3	118	23.2	68	12.6	231	7.9	334	19.8
Carnivores	367	22.2	254	49.9	217	40.2	925	31.8	655	38.8
Predators	356	21.5	247	48.5	214	39.6	876	30.1	612	36.3
Parasites	11	0.7	7	1.4	3	0.6	49	1.7	43	2.5
Scavengers	211	12.7	76	14.9	128	23.7	124	4.3	126	7.5
Ants	610	36.8	51	10.0	112	20.7	1,600	55.1	558	33.1
Unknown and nonfeeding	33	2.0	10	2.0	15	2.8	26	0.9	15	0.9
Total	1,656	100.0	509	100.0	540	100.0	2,906	100.0	1,688	100.1

[a]Trophic categories explained in Introduction.

Table 3 indicates some large differences in the compositon by Order in clearcut PLots 4 and 5. For example, Hymenoptera (mostly ants, Appendix 2) were 56.7% and 36.2%, and Coleoptera were 11.7% and 21.2% in Plots 4 and 5. It is difficult to ascertain if these numbers reflect physical variation within stand type, such as vegetational or slope variability or both, or variation in pitfall trap spacing, i.e., grid pattern compared to radiating pattern. Acceptance of the second possibility would only justify comparisons between the grid traps on Plots 1 and 4 and, separately, among the radiating traps of Plots, 2, 3, and 5.

Martin's (1965) 4-year pitfall study of the ground-dwelling arthropods in a red pine plantation showed an increase in the number of spiders collected with increasing stand age. His mean values ranged from 31% to 54% of the fauna, excluding Acarina and Collembola, in the "establishment" to "young forest" stage. In our study, however, the greatest number of spiders comprised about 22% and 21% of the fauna in clearcut Plots 4 and 5, but forested Plots 1, 2, and 3 had only about 6%, 10%, and 7% spiders (Table 3).

Midgrowth Plot 2 showed the greatest percentage of Coleoptera, 59%, and clearcut Plots 4 and 5 showed the least, 12%-21% (Table 3). The large numbers of Carabidae and Curculionidae in most plots, and Chrysomelidae in Plot 1, resulted in larger populations of Coleoptera than the 22%-27% reported by Martin (1965) in red pine stands. Ants also were more abundant in our study sites than in plantations Martin investigated.

Capture Efficiency. The effectiveness of pitfall traps has been debated in the literature. Greenslade (1964) and Southwood (1966) criticized this method to quantify populations, and Luff (1975) discussed some factors that make pitfall traps unacceptable for population quantification. Banerjee (1970) concluded that "a direct relationship does not exist between densities and number trapped...for sample surveys designed to assess relative population densities in different habitats". When practical, mark-recapture techniques, used in conjunction with pitfall trapping, appear to be useful, but a small number of recaptures and the problems Luff (1975) describes present sources of error. Thomas and Sleeper (1977) discussed this problem and the equations used for estimating densities of tenebrionid beetle populations in a desert community.

Gist and Crossley (1973) described the use of fenced extinction plots and the quantifications possible. Mispagel (1977) extensively followed the extinction plot concept in a desert community for larger beetles with excellent results. Nevertheless, to totally eradicate all ground-dwelling arthropods in a 100-m^2 plot within a single year's time, was extremely difficult, if not impossible. With adequate maintenance and the use of drifts or attractants for quick capture, extinction plot trapping was considered an adequate method to quantify epigeal arthropods.

In this study, pitfalls were widely scattered in Plots 2, 3, and 5 and concentrated in a grid pattern in Plots 1 and 4. Among other factors, captures can be influenced by slope exposure (Tolbert 1975) and the low probability of sampling an adequate proportion of the area utilized by the existing populations because of the number or location of traps, or both. Assuming the same error factors in each study plot, a knowledge of the number of individuals and the biologies of the species groups captured in each plot can be used to describe the differences in vegetation, cover, and climate of those plots as reflected by the arthropod fauna adapted to those conditions.

AERIAL ARTHROPODS

Little work has been done to describe aerial populations or their diversity through various strata of a community (Duviard and Pollet 1973). We used a rotary net to describe the aerial component of the forest arthropod fauna at a single height in different age stands of Douglas-fir. This method has been followed primarily to estimate the population structure and flight patterns of scolytid bark beetles (Daterman et al. 1965, Gara and Vite 1962).

Methods

Arthropods were sampled by a rotary net device developed by Gara and Vite (1962). It consisted of a nylon mesh net, 38 cm in diameter and 70 cm long, rotated in a horizontal plane 1.83 m aboveground. The net was rotated at 60 rpm by a 0.25 horsepower electric motor, powered by a portable gasoline generator, located at least 15 m from the net assembly.

Sampling was continuous for a single 2-hour period each week in Plots 2 and 3, and for two 2-hour sampling periods on different days each week in Plots 1 and 4. The majority of samples were taken between 10:00 A.M. and 4:00 P.M. To standardize the sampling time, we excluded early morning and late evening crepuscular flying insects. Limited manpower and equipment made impossible standardization of sampling time to a particular 2-hour period of the day.

Results and Discussion

Species Composition. Appendix 3 lists the numbers of specimens of each species or taxon collected by rotary net during the sampling periods in each stand type. Table 5 summarizes the totals by taxonomic order. The greatest numbers were collected in clearcut Plot 4 followed by young-growth Plot 1. Although the sampling effort was twice as great in these two plots as in the older stands, the greater numbers of arthropods possibly reflect the greater diversity of the herbaceous understory and the vertical limitation of habitat. In other words, stands with tall trees, as Plots 2 and 3, probably have more vertically dispersed aerial fauna than a stand with short trees or a clearcut plot. Plots 2 and 3 contain arthropods in the canopy that might not be expected to be present at the lower 1.83-m level of sampling.

Diptera were the most commonly captured insects and composed 63%-82% of the aerial fauna captured in all stand types (Table 5). Flies of the families Mycetophilidae, Chironomidae, Empididae, and Cecidomyiidae were most numerous, comprising 56% of all flies and about 41% of all arthropods found in all stands (Appendix 3).

Table 5. Arthropods collected in rotary net traps over 20 weeks in 1973.

	Plot							
	1 Young growth		2 Midgrowth		3 Old growth		4 Clearcut	
	No.[a]	% of total	No.	% of total	No.	% of total	No.[a]	% of total
Noninsecta								
Araneida	34	0.7	1	0.0	4	0.1	16	0.3
Acarina	37	0.8	6	0.2	2	0.1	6	0.1
Others	0	-	1	0.0	0	-	1	0.0
Insecta								
Plecoptera	3	0.1	0	-	1	0.0	8	0.1
Thysanoptera	0	-	19	0.5	1	0.0	307	5.4
Heteroptera	12	0.2	10	0.3	4	0.1	33	0.6
Homoptera	122	2.5	334	9.5	208	6.6	801	14.0
Psocoptera	11	0.2	0	-	3	0.1	1	0.0
Coleoptera	192	4.0	298	8.5	270	8.6	166	2.9
Neuroptera	3	0.1	8	0.2	2	0.1	3	0.1
Lepidoptera	15	0.3	14	0.4	13	0.4	56	1.0
Diptera	3,926	81.9	2,625	74.9	2,456	78.3	3,611	63.0
Hymenoptera	438	9.1	189	5.4	160	5.1	713	12.4
Others	2	0.0	2	0.1	11	0.4	6	0.1
Total arthropods	4,795		3,507		3,135		5,728	

[a]Because of the increased sampling effort in Plots 1 and 4, the numbers collected are halved to simulate trapping intensity equal to Plots 2 and 3.

Coleoptera comprised 3%-9% of the aerial fauna and were more abundant in the forested areas (Table 5). Members of the Scolytidae, Scraptiidae, Elateridae, and Cantharidae were most numerous. In spite of the more intensive sampling in Plots 1 and 4, indications were that Coleoptera species composition was more diverse in clearcut Plot 4 than the other three plots (Appendix 3).

Homoptera were most plentiful in clearcut Plot 4 where over 65% were Adelges cooleyi and 24% were aphids (Table 5). In contrast, aphids composed about 70%-90% of the Homoptera collected in the three forested plots. Aerial Thysanoptera were collected almost exclusively in the clearcut plot.

The spiders collected by rotary net (Table 5, Appendix 3) were usually immature forms that may have dropped from the trees and were ballooning on the wind.

Hymenoptera were somewhat more abundant in Plots 1 and 4, 9%-12% of the totals, than the 5% in Plots 2 and 3 (Table 5). The parasitic Braconidae and Ichneumonidae comprised 60%, 41%, and 49% of the Hymenoptera in Plots 1, 2, and 3. Miscellaneous Chalcidoidea and Proctotrupoidea were the most abundant Hymenoptera in clearcut Plot 4, comprising about 41% of the total compared to only 2%-14% in the other three plots. The apoid bees, such as the Andrenidae, Apidae, and Megachilidae, comprised 20%-23% of the Hymenoptera found in the midgrowth and clearcut plots and only 11%-14% in the young- and old-growth plots. High numbers would have been expected in the clearcut and young-growth plots if one considers only the availability of nectar and pollen sources. If some of the bees were inquilines, however, host and nest requirements must be considered when explaining the numbers of pollinators.

Ants collected in the clearcutting by aerial net further verifies the large formicid population previously indicated by pitfall trapping.

Table 6 shows the habitat variation indicated by the trophic composition of the aerial arthropod fauna. Many of the most common flies do not feed in the adult stage, have unknown feeding habits, or belong to a family with variable feeding habits. Chironomids, mycetophilids, cecidomyiids, phorids, and sciarids are examples. Therefore, between 48%-67% of the arthropods in each plot were categorized as Unknown/Nonfeeding. Doubtless, many of these actually belong to the Scavenger/Detritivore or Phytophage categories. Because of the substantial numbers of rotary net arthropods classified as Unknown/Nonfeeding, we reserve any comments about the trophic composition of the aerial fauna. A shift of part or most of the Unknown/Nonfeeding category of Table 6 into the other categories would drastically change the numbers and the percentages relative to the different stand types, possibly contradicting any preliminary remarks that relate stand structure to faunal composition.

Table 6. General trophic composition of arthropods collected in rotary nets.[a]

	Plot							
	1 Young growth		2 Midgrowth		3 Old growth		4 Clearcut	
Category	No.	% of total	No.	% of total	No.	% of total	No.	% of total
Phytophages	885	9.2	627	17.9	410	13.1	3,057	26.7
Carnivores	3,156	32.9	575	16.4	540	17.2	2,696	23.5
Predators	2,148	22.4	340	9.7	264	8.4	1,297	11.3
Parasites	1,008	10.5	235	6.7	276	8.8	1,399	12.2
Scavengers	75	0.8	63	1.8	87	2.8	98	0.9
Ants	3	0.0	3	0.1	2	0.1	70	0.6
Unknown and nonfeeding	5,462	57.0	2,239	63.8	2,096	66.9	5,529	48.3
Total	9,581	99.9	3,507	100.0	3,135	100.1	11,450	100.0

[a]Trophic categories explained in Introduction.

Capture Efficiency. Although primarily limited to qualitative analysés, we feel that the rotary net sampling device can be effective in determining faunal composition and relative abundance of adult forms of flying insects if care is used in standardization of sample timing and equipment. Nevertheless, its effectiveness for particular species is debatable. For example, the motion of the net easily distracts adult Lepidoptera, which may avoid the swinging net. Furthermore, the mesh of the net may be too large to adequately sample the smallest arthropods. Therefore, a solid piece of material sewn in the bottom of the net is advisable. The assumption that the proportion of the fauna flying one day is the same as that flying the next day is not necessarily valid in detailed analyses of rotary net data. Insect flight activity is dependent upon prevailing climatic and microclimatic factors in addition to season and time of day. Wind velocity, cloud cover, precipitation, and barometric pressure can all affect the flight response of certain insects (Johnson 1969).

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APPENDIX 1. Arthropods of each species or taxon collected from 20-year-old Douglas-fir by pole-pruning sampling in young-growth Plot 1 in the H. J. Andrews Experimental Forest, Oregon, March 27 to August 7, 1973.

Species	Total No.[a]
Arachnida[b]	
Acarina	16
Araneida	
Amaurobiidae	4
Anyphaenidae	9
Araneidae	184
Clubionidae	5
Gnaphosidae	1
Oxyopidae	2
Salticidae	172
Thomisidae	133
Insecta	
Coleoptera	
Alleculidae	
Hymenophorus sinuatus Fall	1
Bruchidae	
Acanthoscelides pauperculus LeC.	6
Buprestidae	
Anthaxia deleta LeC.	3
Cantharidae	
Malthodes dorothae Fend.	7
M. flexuosus Fend.	1
Malthodes sp.	1
Podabrus cavicollis LeC.	66
P. conspiratus Fall	1
P. piniphilus Dej.	9
Podabrus sp.	1
Silis insperata Green	6
Cephaloidae	
Cephaloon tenuicornis LeC.	2

Species	Total No.[a]
Coleoptera	
Cerambycidae	
Anoplodera crassipes LeC.	1
Chrysomelidae	
Pyrrhalta carbo LeC.	3i,60a
Cleridae	
Enoclerus sphegeus F.	1
Hydnocera scaber LeC.	1
Coccinellidae	
Anatis rathvoni LeC.	1
Cycloneda polita Csy.	1
Hyperaspis sp.	1
Mulsantina picta Rand.	3
Psyllobora 20-maculata Say	1
Scymnillus aterrimus Horn	1
Scymnus ardelio Horn	2
S. lacustris LeC.	1
Unknown	6i
Curculionidae	
Cylindrocopturus furnissi Buch.	5
Dyslobus segnis LeC.	5
Dyslobus sp.	1
Lechriops californica LeC.	1
Pissodes fasciatus LeC.	7
Rynchaenus parvicollis LeC.	2
Scythropus ferrugineus Csy.	118
Dascillidae	
Macropogon piceus LeC.	5
Derodontidae	
Laricobius laticollis Fall	1

APPENDIX 1. (Continued)

Species	Total No.[a]
Coleoptera	
Elateridae	
Ampedus oregonus Schaef.	1
Ctenicera columbiana Brown	1
C. umbripennis LeC.	1
Megapenthes caprellus LeC.	14
Unknown	5
Helodidae	
Elodes sp.	1
Hydrophilidae	
Cercyon sp.	1
Melyridae	
Anthocomus mixtus Horn	12
Eurelymus atra Csy.	1
Oedemeridae	
Oxacis bicolor LeC.	1
Xanthochroa testacea Horn	1
Ostomidae	
Eronyxa pallidus Mots.	3
Scolytidae	
Hylastes nigrinus Mann.	1
Pityophthorus sp.	1
Pseudohylesinus nebulosus LeC.	4
Scolytus unispinosus LeC.	2
Scraptiidae	
Anaspis sp.	1
Staphylinidae	
Amphiroum maculatum Horn	3
Medon shastanicum Csy.	1
Pelecomalium opaculum Csy.	2
Coleoptera	
Staphylinidae	
P. testaceum Mann.	1
Xylodromus concinnus Marsh	1
Unknown family	1i
Collembola[b]	
Sminthuridae	7
Diptera	
Anthomyiidae	2
Cecidomyiidae	7
Ceratopogonidae	3
Chironomidae	62
Chloropidae	2
Culicidae	2
Empididae	24
Lauxaniidae	
Minettia flaveola (Coq.)	1
Lonchaeidae	1
Lonchopteridae	1
Muscidae	5
Mycetophilidae	4
Phoridae	2
Sciaridae	9
Simuliidae	5
Sphaeroceridae	1
Syrphidae	86i,1a
Tephritidae	
Pericantha sp.	1
Unknown family	13i
Ephemeroptera	
Ephemerellidae	1

APPENDIX 1. (Continued)

Species	Total No.[a]
Ephemeroptera	
Unknown family	1
Hemiptera	
Lygaeidae	
Kleidocerys sp.	1
Miridae	
Deraeocoris sp.	2
Dicyphus sp.	1i
Phytocoris sp.	1
Pilophorus sp.	2
Plagiognathus	11i,17a
Psallus sp.	15i,14a
Unknown	4
Pentatomidae	
Euschistus sp.	1
Peribalus sp.	1
Podisus sp.	1
Reduviidae	
Zelus sp.	1i
Tingidae	
Corythuca sp.	1
Unknown family	1i
Homoptera	
Achilidae	7
Adelgidae[b]	
Adelges cooleyi (Gillette)	2056
Aphididae[b]	8
Cercopidae	
Aphrophora sp.	2
Philaenus sp.	1

Species	Total No.[a]
Homoptera	
Cicadellidae	
Ballana sp.	2
Erythroneura sp.	1
Scaphytopius sp.	1
Unknown	2i,5a
Psyllidae	6
Hymenoptera	
Braconidae	3
Cynipidae	1
Diprionidae	47i
Eucharitidae	1
Figitidae	1
Formicidae	115
Ichneumonidae	2
Misc. Chalcidoidea and Proctotrupoidea	2
Lepidoptera	
Geometridae	3i
Noctuidae	3i
Nymphalidae	
Limenitis archippus (Cramer)	1i
Misc. microlepidoptera	6
Unknown	6i
Neuroptera	
Chrysopidae	25i,2a
Coniopterygidae	1
Hemerobiidae	22i,11a
Raphidiidae	
Agulla sp.	2

APPENDIX 1. (Continued)

Species	Total No.[a]	Species	Total No.[a]
Orthoptera		Plecoptera	
Acrididae	1	Chloroperlidae	
Gryllidae	1i	*Alloperla* sp.	1
Tettigoniidae		Leuctridae	
Insara sp.	1	*Leuctra* sp.	1
Plecoptera		Psocoptera[b]	174
Capniidae		Thysanoptera[b]	1
Capnia sp.	1	Unknown Order	1i

[a] "i" indicates immature form captured; all other numbers refer to adult captures (sometimes "a" is used to avoid confusion).

[b] All numbers were recorded as adults; no attempt was made to differentiate between adult and immature life stages.

APPENDIX 2. Total numbers of arthropods of each species or taxon collected from 5 different Douglas-fir stands by pitfall trapping in the H. J. Andrews Experimental Forest, Oregon, March 27 to August 7, 1973.[a]

Species	Plot[b]				
	1 Young growth	2 Midgrowth	3 Old growth	4 Clearcut	5 Clearcut
Isopoda[c]	52		2		
Diplopoda[c]					
Chordeumida	13	9	9	6	5
Polydesmida					
Chonaphe sp.	17		2		19
Harpaphe haydeniana	32	49	36	5	4
Unknown	8	1	3	3	38
Polyxenida					
Polyxenus sp.				2	
Spirobolida	1				
Unknown	6		1	4	
Chilopoda[c]					
Geophilomorpha	2	1	1	1	2
Lithobiomorpha	12	2	7	10	5
Scolopendromorpha	7	2	4	13	4
Unknown	4			1	
Arachnida[c]					
Acarina	p	p	p	p	p
Araneida					
Agelenidae	4		1	2	
Amaurobiidae	8	2	2	1	1
Antrodiaetidae	7	4	4	6	6
Anyphaenidae	1	1	1		
Araneidae	28	9	8	4	2
Clubionidae	2	2	1		
Ctenizidae				1	

APPENDIX 2. (Continued)

Species	Plot[b]				
	1 Young growth	2 Midgrowth	3 Old growth	4 Clearcut	5 Clearcut
Arachnida[c]					
Araneida					
Dipluridae		1			1
Gnaphosidae	8	4	1	48	28
Hypochilidae				1	
Lycosidae					
Lycosa sp.	21	15	3	499	283
Unknown	1	3	4		
Oxyopidae				1	
Salticidae				5	1
Thomisidae	2	2	3	5	1
Unknown	21	8	8	72	30
Chelonethida	17	3	18	2	5
Phalangida	14	2	13	11	3
Insecta					
Coleoptera					
Alleculidae					
Mycetochara malkini Hatch				1	
Byrrhidae					
Byrrhus stolidus Csy.				6	
Byrrhus sp.				1	
Lioon simplicipes Mann.			1		
Listemus formosus Csy.	7	1		9	4
Listemus sp.	3			1	
Morychus oblongus LeC.					5
Unknown				2	
Cantharidae					
Malthodes dorothae Fend.	1				
M. oregonus Fend.					1
Malthodes sp.			1		

APPENDIX 2. (Continued)

Species	Plot[b] 1 Young growth	2 Midgrowth	3 Old growth	4 Clearcut	5 Clearcut
Coleoptera					
Cantharidae					
Podabrus piniphilus Dej.	1				
Silis insperata Green	1				
Unknown				1i,4a	1i,2a
Carabidae					
Amara littoralis Mann.					4
A. sinuosa				3	2
Amara sp.				1	2
Apristus constrictus Csy.				7	
Bembidion osculans Csy.	1				5
Cychrus tuberculatus Harr.	1	2	2	2	3
Harpalus sp.				17	95
Microlestes sp.	1			10	14
Notiophilus sylvaticus Esch.	2i		1i	1	1i
Promecognathus crassus LeC.	80	15	79	24	5
Pterostichus amethystinus	2		2		
P. castaneus Dej.	2		3	2	2
P. herculaneus Mann.	70	107	32	25	9
P. inopinus Csy.	5		1	2	3
P. lama Men.	2	6	4	7	4
Scaphinotus angulatus Harr.	1	4	5	1	
S. marginatus Fisch.	2		1	1	1
S. rugiceps Horn		5			
Zacotus matthewsii LeC.		3	1		
Unknown					1
Cephaloidae					
Cephaloon tenuicornis LeC.					1
Cerambycidae					
Anoplodera crassipes LeC.		1		1	
Dicentrus bluthneri LeC.		1			

APPENDIX 2. (Continued)

Species	Plot[b] 1 Young growth	2 Midgrowth	3 Old growth	4 Clearcut	5 Clearcut
Coleoptera					
Chrysomelidae					
Altica tombacina Mann.	1				2
Bromius obscurus L.	1			8	
Monoxia angularis LeC.				6	2
Pachybrachis melanostictus				2	1
Pyrrhalta carbo LeC.	209i,2a				
Scelolyperus varipes LeC.					1
Syneta hamata Horn	1				
S. simplex LeC.			1		
Timarcha intricata Hald.	21	1		7	5
Unknown				1i	
Cicindelidae					
Omus dejeani Reiche	19	18	4	28	3
Clambidae					
Empelus brunnipennis Mann.			1	1	
Coccinellidae					
Coccinella trifasciata L.				1	1
Cryptophagidae					
Atomaria vespertina Makl.	1				
Curculionidae					
Cnemogonus lecontei Dietz				8	2
Dyslobus granicollis LeC.	41			1	5
D. segnis LeC.	10	32	3	5	1
Dyslobus sp.	2		1		
Geodercodes latipennis Csy.	14		1	1	3
Lobosoma horridum Mann.			1		
Nemocestes incomptus Horn	4				
N. puncticollis Csy.	1				17
Nemocestes sp.	3				
Plinthodes taeniatus LeC.	6	1			7

APPENDIX 2. (Continued)

Species	Plot[b] 1 Young growth	2 Midgrowth	3 Old growth	4 Clearcut	5 Clearcut
Coleoptera					
Curculionidae					
Rynchaenus rufipes LeC.					1
Scythropus ferrugineus Csy.	1			1	
Sitona californicus Fahr.				2	5
Steremnius carinatus Boh.	16	60	35	1	6
Unknown				1	
Dascillidae					
Macropogon sp. ?				2	
Elateridae					
Athous varius Lane				1	
Ctenicera suckleyi LeC.		1			
Hemicrepidius morio LeC.	2	1			
Megapenthes caprellus LeC.				2	
Negastrius sp.	1				3
Unknown	1	1i,1a			1i,1a
Endomychidae					
Stethorhanis borealis Blais.	1			1	
Xenomycetes laversi Hatch					1
Helodidae					
Cyphon concinnus LeC.	1				
Elodes sp.	1				
Lampyridae					
Ellychnia hatchi Fend.		4			
Unknown	4i	16i	10i	29i	10i
Leiodidae					
Agathidium jasperinum Fall	2				
Agathidium sp.				1	
Catopocerus capizzii Hatch					1
Catops basilaris Say			6		
Colon sp.					4

APPENDIX 2. (Continued)

Species	Plot[b] 1 Young growth	2 Midgrowth	3 Old growth	4 Clearcut	5 Clearcut
Coleoptera					
Leiodidae					
Hydnobius sp.				2	1
Leiodes curvata Mann.				2	
Leiodes sp.	2			4	4
Neocyrtusa sternita Hatch				1	
Platycholeus opacellus Fall	5				
Unknown					1i,1a
Lucanidae					
Platyceroides laticollis Csy.	6			3	1
Meloidae					
Lytta stygica LeC.					1
Melyridae					
Dasytes cruralis LeC.					2
Mycetophagidae					
Mycetophagus pluriguttatus LeC.	1				
Oedemeridae					
Ditylus gracilus LeC.	10	1	5	15	
D. quadricollis LeC.					2
Ostomidae					
Eronyxa pallidus Mots.				1	
Phenogodidae					
Zarhipis integripennis LeC.		1i			
Unknown		5i			
Pselaphidae					
Abdiunguis fenderi Park and Wag.			1		
Actium microphthalmum Park and Wag.			1		
Batrisodes albionicus (Aube)	2	1		2	13
Batrisodes sp.	2		1		
Cupila clavicornis (Makl.)		1	1		
Lucifotychus impellus Park and Wag.			1		1

APPENDIX 2. (Continued)

Species	Plot[b]				
	1 Young growth	2 Midgrowth	3 Old growth	4 Clearcut	5 Clearcut
Coleoptera					
Pselaphidae					
Lucifotychus sp.	3		1	2	4
Megarafonus sp.		1			
Oropodes sp.				1	1
Pselaptrichus proprius Sch. and Marsh.			1		
P. vanus Schuster and Marsh	3				
Pselaptrichus sp.			2	1	1
Unknown	1		1	8	2
Ptilidae					
Acratrichis sp.	1				
Rhysodidae					
Clinidium calcaratum LeC.				1	1
Scarabaeidae					
Aphodius opacus LeC.	2			3	
Aphodius sp.					1
Bolboceras obesus LeC.				4	2
Dichelonyx backii Rby.		1			
D. valida LeC.			1		
Serica sp.					2
Scolytidae					
Hylastes nigrinus Mann.	1			1	
Scraptiidae					
Anaspis sp.				1	
Scydmaenidae					
Eutheia scitula Makl.	1	1	1		1
Lophioderus similis Marsh.	2			4	2
Lophioderus sp.	1				
Unknown				1	
Silphidae					
Nicrophorus vesilloides Hbst.			2		

APPENDIX 2. (Continued)

Species	Plot[b]				
	1 Young growth	2 Midgrowth	3 Old growth	4 Clearcut	5 Clearcut
Coleoptera					
Sphaeritidae					
Sphaerites politus Mann.				1	
Staphylinidae					
Anthobium subcostatum Makl.	2		1	1	
Astenus longiusculus Mann.					1
Atrecus quadripennis Csy.	1				
Ischnopoda sp.	3			2	21
Lithocharis obsoleta Nordm.				1	
Megarthrus pictus Mots.	1				
Mycetoporus sp.	3				
Ocypus rutilicauda Horn				5	
Orus pugetanus Csy.				2	1
Orus punctatus Csy.					1
Orus sp.					1
Philonthus picicornis Horn					1
Proteinus basalis Makl.			1		
Stictolinus franciscanus Csy.					1
Sunius fenderi Hatch				3	2
Xestolinus frontalis Hatch					2
Unknown	3		1	1i,2a	5i,16a
Tenebrionidae					
Coelocnemis californicus Mann.		3		3	2
Helops edwardsii Horn				2	
Iphthimus serratus Mann.				2	1
Phellopsis porcata LeC.		3	1	7	2
Usechus nucleatus Csy.	1				
Trixagidae					
Aulonothroscus validus LeC.	4			1	
Pactopus hornii LeC.				2	
Trixagus sericeus LeC.				1	

APPENDIX 2. (Continued)

Species	Plot[b] 1 Young growth	2 Midgrowth	3 Old growth	4 Clearcut	5 Clearcut
Coleoptera					
Trixagidae					
Unknown				1	
Unknown family	3i,2a		1	3i,3a	7i,1a
Collembola[c]					
Entomobryidae	p	p	p	p	p
Isotomidae	p	p	p	p	p
Poduridae	p	p	p	p	p
Sminthuridae	p	p	p	p	p
Diptera					
Bibionidae					
Bibio sp.	1	1			
Bombyliidae				1	
Cecidomyiidae	6	7	1	6	3
Ceratopogonidae				1	
Chironomidae	9	1i,1a	2	10	2
Empididae	2			10	1
Lonchaeidae				1	
Milichiidae				5	
Muscidae	1				
Mycetophilidae	2		1		
Phoridae	6		9		1
Sciaridae	9	4	4	7	2
Sphaeroceridae					
Leptocera sp.	3		1		
Sphaerocera sp.	2				
Unknown			12		
Syrphidae		1i			1
Tachinidae		1		1	

APPENDIX 2. (Continued)

Species	Plot[b]				
	1 Young growth	2 Midgrowth	3 Old growth	4 Clearcut	5 Clearcut
Diptera					
Tipulidae	2	2i	1		
Unknown	4i	2i,2a	5i,1a	3i,1a	1i,2a
Hemiptera					
Aradidae	3			9	3
Berytidae					
Acanthophysa sp.					7
Unknown				2	12
Cydnidae					
Amnestus sp.					2
Unknown					1
Lygaeidae					
Geocoris sp.				2	7i,3a
Scolopostethus sp.	14			11	4
Unknown	17	2		1i,24a	8
Miridae					
Phytocoris sp.				2i	1i
Unknown	2i,2a			5i	
Nabidae					
Pagasa sp.					1
Unknown					3i
Pentatomidae					
Podisus sp.		1			
Unknown				1i	1i
Reduviidae					
Zelus sp.					1
Tingidae					
Acalypta sp.				17	5
Corythuca sp.				1	
Unknown family	9i			10i,2a	23i,2a

APPENDIX 2. (Continued)

Species	Plot[b] 1 Young growth	2 Midgrowth	3 Old growth	4 Clearcut	5 Clearcut
Homoptera					
Achilidae			1		1i
Adelgidae[c]					
Adelges cooleyi (Gillette)			2		2
Aphididae[c]	10		9	10	22
Cicadellidae					
Aceratagallia sp.				1	2
Cuerna hasbrouki Nielson				2i,15a	10i,11a
Scaphytopius sp.				1	
Unknown	3i,1a	1i,1a	1i	13i,4a	90i,10a
Cicadidae					
Okanagana sp.					3
Psyllidae	1			3	2
Unknown family	1i			12i	2i,1a
Hymenoptera					
Apidae					
Apis mellifera L.	1				1
Braconidae	1			5	2
Diapriidae				9	12
Eucharitidae	1				
Formicidae	610	51	112	1,600	558
Halictidae					2
Ichneumonidae	3	1	2	2	3
Misc. Chalcidoidea and Proctotrupoidea	6	4	1	29	25
Mymaridae					1
Pompilidae				2	3
Scelionidae	1				
Sphecidae					1
Tenthredinidae					2i,1a
Unknown family	2i				

APPENDIX 2. (Continued)

Species	Plot[b] 1 Young growth	2 Midgrowth	3 Old growth	4 Clearcut	5 Clearcut
Isoptera					
Hodotermitidae					
Zootermopsis sp.	1			2	
Lepidoptera					
Geometridae	2i				1i
Noctuidae				2i	5i
Microlepidoptera				1i	1i
Unknown		1i,1a	1i	2i	12i
Mallophaga[c]					
Trichodectidae		1			
Orthoptera					
Acrididae				3i,1a	3i
Gryllacrididae	2i,4a	1i	1	2	1
Plecoptera					
Nemouridae					
Nemoura sp.	1				
Psocoptera[c]	1		1		
Siphonaptera					
Ceratophyllidae				1	
Pulicidae				1	
Thysanoptera[c]		2	2	6	5

APPENDIX 2. (Continued)

Species	Plot[b]				
	1 Young growth	2 Midgrowth	3 Old growth	4 Clearcut	5 Clearcut
Thysanura[c]					
Machilidae	1	1	17	1	
Unknown Order	7i		1i	1i	

[a] Numbers for Plots 1 and 4 represent 1000 trap nights of sampling each (25 traps per plot open for 48 consecutive hours each week for 20 weeks) and numbers for Plots 2, 3, and 5 represent 600 trap nights (15 traps per plot open for 48 consecutive hours each week for 20 weeks).

[b] "i" indicates immature life stage collected. All other numbers refer to the numbers of adults collected (the most common life stage found). "p" indicates present in great numbers, but not counted because collection methods were inconsistent.

[c] Groups that were all recorded as adults; no attempt was made to differentiate between immature and adult life stages.

APPENDIX 3. Total numbers of arthropods of each species or taxon collected by rotary nets (1.83 m aboveground) from 4 different Douglas-fir stands in the H. J. Andrews Experimental Forest, Oregon from March 27 to August 7, 1973.[a]

Species	Plot[b] 1 Young growth	2 Midgrowth	3 Old growth	4 Clearcut
Arachnida[c]				
Acarina	73	6	2	12
Araneida				
Araneidae	3	1	1	3
Gnaphosidae			1	
Lycosidae	1			1
Micryphantidae				1
Salticidae	1			3
Thomisidae	1		1	1
Unknown family	61		1	22
Chelonethida		1		1
Insecta				
Coleoptera				
Alleculidae				
Mycetochara procera Csy.			1	
Anobiidae				
Ernobius gentilis Fall		1		
Ptilinus basalis LeC.	1			
Bruchidae				
Acanthoscelides pauperculus LeC.				2
Buprestidae				
Agrilus politus Say				1
Anthaxia expansa LeC.				2
Chrysobothris grandis Chamb.				1
Melanophila drummondi Kby.				1
Cantharidae				
Malthodes dorothae Fend.	2			
M. flexuosus Fend.		7		
M. oregonus Fend.				1
Malthodes sp.			1	1

APPENDIX 3. (Continued)

Species	Plot[b] 1 Young growth	2 Midgrowth	3 Old growth	4 Clearcut
Coleoptera				
Cantharidae				
Podabrus cavicollis LeC.	41			2
P. conspiratus Fall	1		1	
P. hackerae Fend.	1			
P. macer LeC.	1			
P. piniphilus Dej.	16	1	2	3
P. pruinosus LeC.				1
Podabrus sp.		1		
Silis insperata Green	25	1	2	9
Troglomethes oregonensis Witt.		1	2	
Unknown	1	1	1	
Carabidae				
Bembidion iridescens LeC.	1	4		1
B. osculans Csy.	4			3
Bradycellus nigrinus Dej.				1
B. politus Fall				1
Lebia viridis Say				1
Cephaloidae				
Cephaloon tenuicornis LeC.	12			
Cerambycidae				
Anoplodera amabilis LeC.	1			
A. aspera LeC.	1			
A. canadensis Ol.				1
A. crassipes LeC.	10	2	7	5
A. dehiscens LeC.				3
A. dolorosa LeC.	5		1	11
A. laetifica LeC.				2
Dicentrus bluthneri LeC.		2		
Evodina vancouveri Csy.		2		1
Leptura obliterata Hald.				2

APPENDIX 3. (Continued)

Species	Plot[b] 1 Young growth	2 Midgrowth	3 Old growth	4 Clearcut
Coleoptera				
Cerambycidae				
Opsimus quadrilineatus Mann.		1		
Pidonia quadrata Hop.				2
P. scripta LeC.			1	
Chrysomelidae				
Altica tombacina Mann.	1			13
Bromius obscurus L.	1			1
Orsodacne atra Ahr.				1
Pachybrachis circumcinctus Cr.				2
Pyrrhalta carbo LeC.	10i,6a			
Scelolyperus varipes Lec.	1	3	1	9
Unknown	1i			
Cicindelidae				
Cicindela oregona LeC.				1
Clambidae				
Empelus brunnipennis Mann.		1		
Coccinellidae				
Hippodamia convergens Guer.				12
Mulsantina picta Rand.	1			
Scymnillus aterrimus Horn			1	
Scymnus caurinus Horn				5
S. lacustris LeC.				1
S. maculatus Hatch				1
Scymnus sp.				3
Stethorus punctillum Ws.				2
Colydiidae				
Lasconotus schwarzi Kraus		3	1	
Unknown			1i	
Cryptophagidae				
Anchicera gonodera Csy.	2			

APPENDIX 3. (Continued)

Species	Plot[b] 1 Young growth	2 Midgrowth	3 Old growth	4 Clearcut
Coleoptera				
Cucujidae				
Pediacus depressus Hbst.		31	43	2
Curculionidae				
Cylindrocopturus furnissi Buch.		1		
Deporaus glastinus LeC.	1	1		1
Gymnaetron pascuorum Gyll.	1			
Lechriops californica LeC.				1
Miccotrogus picirostris F.				1
Pissodes fasciatus LeC.				1
Rhyncolus brunneus Mann.	1			
R. cylindricollis Woll.		2		
Rynchaenus parvicollis LeC.	4			
R. rufipes LeC.	1			1
Scythropus ferrugineus Csy.	2			
Sitona californicus Fahr.	1			
Dascillidae				
Araeopidius monachus LeC.	1			
Macropogon piceus LeC.				39
Derodontidae				
Peltastica tuberculata Mann.	1		2	
Dermestidae				
Anthrenus lepidus LeC.				1
Megatoma perversa Fall	1		1	4
Orphilus niger Rossi				10
Trogoderma sp.				1
Elateridae				
Ampedus apicatus Say				2
A. cordifer LeC.				1
A. varipilis Van D.				6
Athous rufiventris Esch.	1			

APPENDIX 3. (Continued)

Species	Plot[b]			
	1 Young growth	2 Midgrowth	3 Old growth	4 Clearcut
Coleoptera				
Elateridae				
Athous varius Lane	2			
Cardiophorus sp.				1
Ctenicera columbiana Brown	2			
C. nebraskensis Bland		1		
C. suckleyi LeC.	1			
C. umbripennis LeC.	2	2		
Megapenthes caprellus LeC.	52	3	15	24
Negastrius sp.				1
Unknown	4	10	7	2
Erotylidae				
Triplax californicus LeC.		1		
Eucnemidae				
Epiphanis cornutus Esch.	1			
Helodidae				
Elodes angusta Hatch	1			
Elodes sp.			1	
Histeridae				
Isolomalus mancus Csy.	2			
Hydrophilidae				
Crenitis snoqualmie Mil.		1		3
Megasternum posticatum Mann.	7	7	12	
Lampyridae				
Ellychnia hatchi Fend.	1			
Lathridiidae				
Melanophthalma distinguenda C.				1
M. pumila LeC.			1	
Stephostethus liratus LeC.	1			
Leiodidae				
Agathidium maculosum Brown			1	

APPENDIX 3. (Continued)

Species	Plot[b] 1 Young growth	2 Midgrowth	3 Old growth	4 Clearcut
Coleoptera				
Leiodidae				
Agathidium pulchrum LeC.			1	
Agathidium sp.			2	
Catops basilaris Csy.			2	
Hydnobius longulus LeC.			1	
Leiodes curvata Mann.				1
Platycholeus opacellus Fall	2			
Limnichidae				
Limnichus tenuicornis Csy.	1			
Lucanidae				
Platyceroides laticollis Csy.				1
Melandryidae				
Prothalpia holmbergii Mann.	1			
Xylita livida Sahlb.		2		
Meloidae				
Lytta stygica LeC.				5
Melyridae				
Amecocerus provincialis Blais				3
Amecocerus sp.				2
Anthocomus mixtus Horn				1
Dasyrhadus impressicollis Fall			1	
Dasytes cruralis LeC.				2
Eurelymis atra Csy.	1	3		24
Hoppingiana hudsonica LeC.		1		6
Hypebaeus bicolor LeC.				1
Unknown			1	
Mordellidae				
Mordella atrata Melsh.				3

APPENDIX 3. (Continued)

Species	Plot[b] 1 Young growth	2 Midgrowth	3 Old growth	4 Clearcut
Coleoptera				
Nitidulidae				
Epuraea aestiva L.	2		8	
E. ambigua Mann.		1		
E. avara Rand.		36	6	
Meligethes nigrescens Steph.				2
Omosita discoidea F.	1		4	
Pocadius fulvipennis Er.		1		1
Oedemeridae				
Asclera nigra LeC.		1		
Ostomidae				
Eronyxa pallidus Mots.		2		20
Nemozoma punctatum Van D.		1		
Temnochila virescens F.		2		
Ptilidae				
Acratrichis sp.			13	1
Scarabaeidae				
Aphodius haemorrhoidalis L.				1
A. opacus LeC.	1			
A. pectoralis LeC.			1	2
Aphodius sp.				2
Dichelonyx valida LeC.	1			
Scolytidae				
Carphoborus vandykei Bruck.		1		
Cryphalus sp.		1		
Dendroctonus pseudotsugae Hopk.	2	2	1	
Dolurgus pumilus Mann.		1		
Gnathotrichus retusus LeC.			1	
Hylastes longicollis Sw.		1		
H. nigrinus Mann.		3	2	
Ips latidens LeC.		7		

APPENDIX 3. (Continued)

Species	Plot[b] 1 Young growth	2 Midgrowth	3 Old growth	4 Clearcut
Coleoptera				
Scolytidae				
Leperisinus californicus Sw.		1	1	
Phloesinus sp.			1	
Pityophthorus sp.	1			
Pseudohylesinus granulatus		2		
P. nebulosus LeC.	58	23	46	
P. nobilis Sw.		2		
Scolytus tsugae Sw.		9		1
S. unispinosus LeC.	3	19		
Trypodendron lineatum Ol.	4	7	3	
Scraptiidae				
Anaspis sp.	32	54	19	16
Sphaeritidae				
Sphaerites politus Mann.	1		1	
Staphylinidae				
Amphicroum maculatum Horn		4	2	1
Anthobium fimetarium Mann.			2	1
A. subcostatum Makl.	5		6	
Coprophilus sexualis Leech			1	
Eusphalerum ferrarae Hatch			1	
E. minskae Hatch	2	3		
Hapalaraea floralis Payk.	5		1	1
Ischnopoda sp.		2		2
Lordithon pygmaeus F.			1	
Lordithon sp.				1
Medon sp.				1
Megarthrus pictus Mots.			2	
Pelecomalium opaculum Csy.	4		5	2
P. puberulum Fauv.		1		1
P. testaceum Mann.	8	7	3	5

APPENDIX 3. (Continued)

Species	Plot[b] 1 Young growth	2 Midgrowth	3 Old growth	4 Clearcut
Coleoptera				
Staphylinidae				
Philonthus concinnus Grav.		2		
P. cruentatus Gmel.				2
P. picicornis Horn		1	6	
Philonthus sp.			1	
Phaeopterus lagrandeuri Hatch	1		1	
Platystethus americanus Er.				2
Proteinus sp.	1			
Quedius aenescens Makl.	1	2	10	2
Q. capucinus Grav.			1	
Q. laevigatus Gyll.		1		
Q. marginalis Makl.	1			
Q. oculeus Csy.	1			
Quedius sp.			2	
Stenus maritimus Mots.		3	3	
Tachinus contortus Hatch	1			
T. semirufus Horn	1			
Tachyporus chrysomelinus L.				1
Trigonurus dilaticollis Van D.		1		
Xestolinus frontalis Hatch				1
Unknown		1	1	1
Tenebrionidae				
Phthora americanum Horn	1			
Trixagidae				
Aulonothroscus validus LeC.	1			
Unknown family	2i,1a	1		1
Collembola[c]			4	10
Diptera				
Acarthophthalmidae	2		1	

APPENDIX 3. (Continued)

Species	Plot[b] 1 Young growth	2 Midgrowth	3 Old growth	4 Clearcut
Diptera				
Acroceridae				
Eulonchus sp.	6	2		2
Agromyzidae	54	11	3	77
Anisopodidae				
Mycetobia sp.	1			
Unknown		1		1
Anthomyiidae	129	303	10	67
Asilidae	16	1		1
Aulacigastridae				
Aulacigaster leucopeza Meigen	2			
Bibionidae				
Bibio sp.				2
Unknown		1		1
Bombyliidae				
Anthrax sp.				3
Villa sp.				2
Unknown				41
Calliphoridae	29	9	3	28
Cecidomyiidae	886	485	655	483
Ceratopogonidae	40	39	67	195
Chamaemyiidae				
Leucopsis sp.	2			
Unknown	4	2	1	171
Chironomidae	638	137	291	1,780
Chloropidae				
Thaumatomyia sp.		1		10
Unknown	18	4	1	143
Conopidae				1
Culicidae	19	1	4	

APPENDIX 3. (Continued)

Species	Plot[b] 1 Young growth	2 Midgrowth	3 Old growth	4 Clearcut
Diptera				
Dolichopodidae	17	1	2	3
Drosophilidae				
Amiota sp.				2
Scaptomyza sp.		1		
Unknown	8	1		2
Empididae	1,535	216	102	958
Ephydridae				
Ditricophora argyrostoma C.				1
Ditricophora sp.	5			22
Hydrellia griseola (Fallen)	1			
Hydrellia sp.	10			
Parydra sp.	4	1		
Psilopa compta (Meigen)				1
Unknown	7		1	14
Heleomyzidae				
Amoebaleria infuscata Gill	1			
Borboropsis steyskali Mathis	12	2	1	7
Suillia sp.	1	2		
Unknown	3			
Lauxaniidae				
Minettia lupulina (Fab.)	1			
Minettia sp.		2		
Unknown	5			
Lonchopteridae				6
Lonchaeidae	111	3	12	32
Milichiidae	27	22	3	913
Muscidae				
Schoenomyza sp.				2
Unknown	178	24	15	102

APPENDIX 3. (Continued)

Species	Plot[b] 1 Young growth	2 Midgrowth	3 Old growth	4 Clearcut
Diptera				
Mycetophilidae	1,685	766	580	119
Odiniidae	3			
Otitidae	10	7	2	1
Pallopteridae				
Palloptera sp.	5			
Unknown	9			
Periscelididae				
Periscelis sp.	2			
Phoridae	735	184	39	745
Piophilidae	4	5		1
Pipunculidae	15		1	10
Platypezidae	4			1
Psilidae	2			
Psychodidae	99	18	127	17
Rhagionidae				
Symphoromyia sp.	222	3	10	25
Unknown	138	7	3	6
Sarcophagidae	14	1	7	28
Scatopsidae		1	1	13
Scenopinidae				4
Sciaridae	466	136	201	368
Sciomyzidae				
Limnia sp.		1		
Unknown	1			
Sepsidae				
Sepsis sp.	1	3		11
Unknown	1		1	7
Simuliidae	104	60	182	250
Sphaeroceridae				
Leptocera sp.		6		

APPENDIX 3. (Continued)

Species	Plot[b] 1 Young growth	2 Midgrowth	3 Old growth	4 Clearcut
Diptera				
Sphaeroceridae				
Scatophora sp.		2		
Sphaerocera sp.		6		
Unknown	55	12	5	44
Stratiomyidae	2			
Syrphidae	108	69	47	2i,174a
Tabanidae				
Chrysops sp.	37		1	11
Hybomitra sp.	18	10	7	7
Tabanus sp.	12	1	1	3
Unknown	14		4	4
Tachinidae	231	18	15	138
Tephritidae	7			2
Therevidae		1		4
Tipulidae	18	6	13	14
Trichoceridae	5		4	
Trixoscelididae	2	1		5
Unknown family	50	29	33	135
Ephemeroptera	1		1	
Hemiptera				
Anthocoridae				6
Aradidae	1	2	2	2
Berytidae	1			3
Cydnidae				
Amnestrus sp.				1
Lygaeidae				
Geocoris sp.				11
Scolopostethus sp.	7			5
Unknown	5	4		12

APPENDIX 3. (Continued)

Species	Plot[b] 1 Young growth	2 Midgrowth	3 Old growth	4 Clearcut
Hemiptera				
Miridae				
Lygus sp.	1			1
Unknown	1i,4a	3	1	8
Pentatomidae				
Cosmopepla sp.				1
Peribalus sp.				1
Unknown	1			
Tingidae				
Corythuca sp.	2			12
Derephysia sp.				2
Unknown family		1i	1	1
Homoptera				
Achilidae	1		3	
Adelgidae[c]				
Adelges cooleyi (Gillette)	10	12	34	387
Aleyrodidae		1		3
Aphididae[c]	173	303	160	1,046
Cicadellidae				
Cuerna hasbrouki Nielson				6
Unknown	28	17	2	42
Delphacidae			1	8
Psyllidae	28		8	108
Unknown family	1i,2a	1i		1
Hymenoptera				
Andrenidae	11	2		81
Anthophoridae				
Nomada sp.	1			2
Unknown	1			2
Apidae				
Apis mellifera L.	3	1		84

APPENDIX 3. (Continued)

Species	Plot[b] 1 Young growth	2 Midgrowth	3 Old growth	4 Clearcut
Hymenoptera				
Apidae				
Bombus bifarius Cresson		1		1
B. occidentalis Greene				1
B. vosnesenskii Rad.				1
Bombus sp.	35	11	8	16
Unknown		1		
Argidae				3
Aulacidae	2			4
Braconidae	109	26	20	286
Chalcididae				3
Chrysididae	4		1	8
Cimbicidae				
Zaraea americana Cresson			1	
Colletidae	3			13
Cynipidae	3	2		4
Diapriidae	7	6	7	5
Eucharitidae	1	1		17
Formicidae	3	3	2	70
Gasteruptiidae			9	
Halictidae	67	21	9	95
Ichneumonidae	414	52	59	78
Megachilidae				
Anthidium sp.				2
Heriades sp.				1
Unknown	2	1	1	27
Misc. Chalcidoidea and Proctotrupoidea	20	27	12	588
Orussidae		1		1
Platygasteridae				
Inostemma sp.				2
Pompilidae	2	1	1	

APPENDIX 3. (Continued)

Species	Plot[b] 1 Young growth	2 Midgrowth	3 Old growth	4 Clearcut
Hymenoptera				
Sphecidae	27	3	6	15
Tenthredinidae	110	3	10	7
Vespidae	50	26	14	8
Lepidoptera				
Aegeriidae				18
Hesperiidae				1
Lycaenidae				3
Noctuidae				4
Misc. microlepidoptera	27	8	12	37
Nymphalidae				
Boloria sp.				1
Nymphalis californica (Bois.)		4		15
Unknown			1	18
Unknown family	2	1i,1a		15
Neuroptera				
Chrysopidae		1	1i	
Coniopterygidae	2	3	1	
Hemerobiidae	2			
Inocelliidae				
Inocellia sp.		4		2
Raphidiidae				
Agulla sp.				3
Sialidae	1			
Pleocptera				
Capniidae				
Capnia sp.				1
Eucapnopsis sp.	1			
Chloroperlidae				
Alloperla sp.	1		1	

APPENDIX 3. (Continued)

Species	Plot[b] 1 Young growth	2 Midgrowth	3 Old growth	4 Clearcut
Pleocptera				
Leuctridae				
Leuctra sp.	2			9
Nemouridae				
Nemoura sp.	2			6
Psocoptera[c]	22		3	2
Strepsiptera				
Stylopidae				1
Thysanoptera[c]		19	1	613
Trichoptera				
Rhyacophilidae			1	
Unknown	2	2		1
Unknown Order	1i		6i	

[a] A net was run for 2 consecutive hours once a week each in Plots 2 and 3 and run for 2 consecutive hours each on two days weekly in Plots 1 and 4.

[b] "i" indicates that the immature stage was collected; all other unmarked numbers represent the adult stage captured. Sometimes "a" is used to indicate adult stage to avoid confusion.

[c] No attempt was made with these groups to distinguish immature from adult stages, and all were recorded as adult.