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EMERGENCE TRAP COLLECTIONS OF LOTIC TRICHOPTERA IN THE CASCADE RANGE OF OREGON, U.S.A.

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SUMMARY

Emergence of caddisflies in three 3rd-order streams was monitored in 1982-83 using four traps, (each 3.34 m^2) per stream. Traps were placed over both riffle and depositional areas. A range of habitats was sampled because sites extended from 490 to 880 m in elevation and included areas with old-growth coniferous canopy, regrowth deciduous canopy and clearcut with no canopy. Although trapping efforts censused only limited reaches within each stream system, 65% of all caddis species known from the drainage were obtained.

More than 5200 specimens were collected. Rhyacophilidae (23 species) and Limnephilidae (14 species) were the most diverse families, but Lepidostomatidae accounted for 46% of the individuals, followed by Philopotamidae (14%), and Rhyacophilidae (13%). When partitioned into functional feeding groups, scrapers were the most diverse group; whereas collectors were poorly represented.

INTRODUCTION

This project is part of a comprehensive study of the impact of riparian vegetation on the structure and function of stream ecosystems in the Western Coniferous Forest Biome. Emergence trap collections of aquatic insects are being used as an index of secondary production to compare the biota of streams flowing through old-growth coniferous forest, a recent clearcut, and a regrowth deciduous forest. We present data for one flight season (1982-83) on species composition, abundance, functional feeding groups and seasonal occurrence of caddisflies. In a subsequent paper, we will analyze differences among sites for the entire insect community.

COLLECTION AREA

The three sites are located on 3rd-order streams in the McKenzie River watershed, draining the western side of the Cascade Range (44°N, 122°W). According to Franklin and Dyrness (1971), the area is in the older Oligocene-Miocene segment of the Oregon Cascade Range. Rock formations are volcanic in origin. The climate is maritime with a dry summer; 90% of the precipitation occurs from October to April. Annual precipitation ranges from 230 cm at lower elevations to 380 cm or more on the ridges. Air temperatures are moderate; the mean July maximum is about 29°C and the January minimum about -3°C (weather station at 450 m).

The three sites, Mack Creek, Grasshopper Creek and Quartz Creek are compared in Table 1. Monthly water temperature is also given for Mack Creek.

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Table 1. Site characteristics of the emergence-trap locations, western Cascades, Oregon. Water temperature for Mack Creek is a mean for 1978 and 1979.

	Mack Cr.	Grasshopper Cr.	Quartz Cr.
Elevation (m)	800	880	490
Gradient (%)	10	9	5
Substrates	Cobble-boulder, some gravel; abundant wood debris	Boulder-cobble; very low wood debris	Cobble-gravel; low wood debris
Canopy	Conifer (ca. 450 yrs.)	None (clear-cut)	Deciduous (ca. 40 yrs.)

Mean Monthly Water Temperature, Mack Creek (°C)

J	F	M	A	M	J	J	A	S	O	N	D
2.1	2.2	3.2	2.7	5.0	8.1	10.2	10.8	9.0	7.6	3.0	2.3

Table 2. Trichoptera adults collected in emergence traps in three Oregon Cascade streams, 1982-83.

		Quartz Creek		Mack Creek		Grasshopper Creek	
		No.	Em. period	No.	Em. period	No.	Em. period
RHYACOPHILIDAE							
Himalopsyche phryganea (Ross)		-		4	15May - 15Jul	-	
Rhyacophila angelita	Banks	6	7Jun - 9Jul	6	3Aug - 17Aug	5	22Jul
R. arnaudi	Denning	-		1	3Jun	17	2May - 7Jun
R. blarina	Ross	2	5May - 15May	-		-	
R. ecosa	Ross	4	5May - 20Jun	4	23May - 28Jun	-	
R. jewetti	Denning	-		29	15Jul - 1Sep	53	26Jun - 20Oct
R. narvae	Navas	6	26May - 26Jun	63	20Jun - 15Jul	1	2Jul
R. norcuta	Ross	-		4	15Apr - 31May	-	
R. oreta	Ross	1	13Jun	1	18Apr	-	
R. perda	Ross	2	26May - 20Jun	3	29Jun - 1Sep	-	
R. tucula	Ross	-		15	1Sep - 30Sep	4	15Sep - 1Oct
R. vaccua	Milne	58	12Aug - 21Oct	42	17Aug - 20Oct	26	11Aug - 7Oct
R. vaefes	Milne	26	31May - 15Sep	1	8Sep	1	22Sep
R. vagrita	Milne	-		3	15Sep - 30Sep	-	
R. valuma	Milne	28	19May - 4Aug	15	2Jul - 28Jul	1	9Jul
R. vao	Milne	57	18Apr - 3Sep	2	20Jul - 7Aug	1	6Jul
R. vedra	Milne	9	20Jun - 21Oct	-		-	
R. velora	Denning	1	12Aug	-		-	
R. verrula	Milne	32	15Sep - 27Oct	31	1Sep - 4Nov	70	2Sep - 20Oct
R. vocala	Milne	1	20Jun	7	3Jun - 9Jul	4	17Jun - 9Jul
R. vuzana	Milne	12	12Aug - 30Sep	1	30Sep	26	2Sep - 14Oct
R. willametta	Ross	-		-		1	11Aug
R. sp. nov.		-		2	20Oct	7	22Sep - 26Oct
GLOSSOSOMATIDAE							
Anagapetus bernea	Ross	33	5May - 13Jun	73	14Jun - 3Aug	24	3Jun - 6Jul
Glossosoma penitum	Banks	321	25Mar - 20Oct	2	23May - 6Jul	15	29Apr - 15Jul
Glossosoma sp.		1	27Aug	-		-	

Table 2. Cont.

		Quartz Creek No.	Quartz Creek Em. period	Mack Creek No.	Mack Creek Em. period	Grasshopper Creek No.	Grasshopper Creek Em. period
HYDROPTILIDAE							
Ochrotrichia sp.		5	22Sep	-		-	
Agraylea sp.		-		-		1	2Jul
Palaeagapetus sp.		-		2	28Jul - 7Aug	1	9Jul
PHILOPOTAMIDAE							
Dolophilodes aequalis	(Banks)	-		-		4	14Jun - 6Jul
D. dorcus	(Ross)	202	9May - 11Aug	181	29Jun - 11Aug	65	11Jun - 18Aug
D. novusamericanus	(Ling)	-		13	25Mar - 29Jun	3	18Apr - 4Jun
D. pallidipes	(Banks)	-		76	17Aug - 4Nov	2	22Sep - 30Sep
D. sisko	(Ross)	45	15Jul - 17Aug	1	15Jul	-	
Wormaldia anilla	(Ross)	9	17Aug - 15Oct	2	14May - 11Aug	1	17May
W. gabriella	(Banks)	103	17Aug - 15Oct	-		-	
W. occidea	(Ross)	*		2	7Aug - 22Sep	-	
PSYCHOMYIIDAE							
Psychomyia lumina	(Ross)	87	7Jun - 20Jul	-		-	
POLYCENTROPODIDAE							
Polycentropus halidus	Milne	45	6Jul - 8Sep	19	3Aug - 1Sep	1	11Aug
HYDROPSYCHIDAE							
Arctopsyche grandis	(Banks)	8	23May - 7Jun	*		*	
Hydropsyche sp.		21	10Jun - 17Aug	-		-	
Parapsyche elsis	Milne	7	31May - 6Jul	7	9Jul - 7Aug	4	6Jul - 20Jul
LIMNEPHILIDAE							
Allocosmoecus partitus	Banks	-		4	1Sep - 22Sep	26	1Sep - 22Sep
Apatania sorex	(Ross)	-		11	9Apr - 14Jun	69	25Mar - 14Jun
Cryptochia pilosa	(Banks)	-		1	20Jun	-	
Ecclisomyia conspersa	Banks	-		1	15May	3	23May - 1Jun
E. maculosa	Banks	-		16	23Jun - 9Jul	6	29Jun - 9Jul
Hydatophylax hesperus	(Banks)	1	20Jul	-		1	22Jul
Limnephilus nogus	Ross	2	31May - 15Sep	2	15May - 4Jun	-	
Neophylax occidentis	Banks	-		13	20Jun - 9Jul	4	24Jun - 29Jun
N. rickeri	Milne	1	21Oct	-		-	
N. splendens	Denning	73	22Sep - 21Oct	38	15Sep - 4Nov	49	15Sep - 30Sep
Oligophlebodes spp. **		-		74	17Jun - 15Jul	5	29Jun - 28Jul
Psychoglypha bella	(Banks)	2	21Oct - 27Oct	-		-	
P. browni	Denning	-		10	30Sep - 27Oct	6	30Sep - 15Oct
UENOIDAE							
Neothremma didactyla	Ross	-		429	9Jul - 1Sep	-	
LEPIDOSTOMATIDAE							
Lepidostoma cascadense	(Milne)	247	26May - 20Jul	857	24Jun - 18Aug	53	29Jun - 3Aug
L. hoodi	Ross	-		7	3Aug - 17Aug		
L. roafi	(Milne)	448	6Jul - 15Oct	225	3Aug - 22Sep	22	3Aug - 22Sep
L. unicolor	(Banks)	75	6Jul - 17Aug	45	28Jul - 27Aug	17	20Jul - 15Sep
L. veroda	Ross	-		2	28Jul - 3Aug	-	
BRACHYCENTRIDAE							
Micrasema bactro	Ross	221	26May - 18Aug	23	29Jun - 2Sep	23	29Jun - 18Aug
CALAMOCERATIDAE							
Heteroplectron californicum	McLachlan	7	13Jun - 6Jul	*		5	15Jul - 22Jul

* Known to be present at site from qualitative collections.

** O. minuta (Banks), O. sierra Ross, and probably O. ruthae Ross present in collections, but not separated.

The major difference between sites, in addition to riparian effects, is the lower elevation of Quartz Creek, where water temperature averages about 2°C warmer than Mack Creek, and emergence of most species is about a month earlier.

METHODS

Four large emergence traps were placed at each site. Two were placed over riffles and two over pools or drop zones. The traps were screen cages (mesh size = 536 μm) supported on frames of plastic pipe. Each trap covered 3.34 m^2. Traps were placed so that one edge included the stream bank. About 30% of the sampled area was emergent rocks in the riffle traps. This fluctuated somewhat with water level, but was controlled to some extent by addition or removal of large rocks. Traps were relocated when the enclosed substrates began to dry up.

Traps were installed at Mack and Grasshopper Creeks in early May, 1982 and at Quartz Creek in mid-June. They were taken out in late October or early November after winter freshets knocked them down. They were re-installed in March, 1983, and operated long enough to obtain a complete year of emergence. The traps were serviced every three to four days during most of the season and about weekly in the fall when emergence began to decline. Most of the adults were collected with a modified car vacuum cleaner, powered by a 12-volt motorcycle battery.

We consider that this method is a useful way of comparing emergence between sites. The large size allowed the traps to encompass the mosaic of substrates and microhabitats that are characteristic of mountain streams. Our collections are underestimates of total density, because some adults drop into the water and drift out of the traps. Small collections during rainy weather and on a few very hot days may be due to weather-related mortality between collection intervals.

RESULTS

The total emergence from the three sites was 5200 specimens, representing 64 species, 38 genera and 12 families (Table 2). The number of species ranged from 39 at Quartz Creek to 50 at Mack Creek. It is unlikely that many more species would have been collected by extending the trapping interval since the characteristic early-season species (*Dolophilodes novusamericanus* and *Apatania sorex*) and the late fall species (*D. pallidipes, Neophylax* spp. and *Psychoglypha* spp.) were all recorded.

Table 2 includes 65% of the total caddis fauna known from the entire Lookout Creek drainage, a 5th-order tributary of the McKenzie River (Anderson et al., 1982). Rhyacophilidae (23 species) and Limnephilidae (14 species) accounted for almost 60% of the species, but only 21% of individuals collected from the three sites. Lepidostomatidae adults were the most abundant (38%), followed by Philopotamidae (14%), Rhyacophilidae (13%), and Uenoidae (8%).

A striking pattern in the emergence-trap data is the limited occurrence of the Hydropsychoidea in these mountain streams. Only the Philopotamidae were well represented at all sites (8 species, 709 specimens). The Psychomyiidae were only collected at the low-elevation site, and polycentropodids were also more abundant there than at the colder sites. Hydropsychids were scarce in all collections and were primarily represented by *Arctopsyche* and *Parapsyche*.

In general, the caddis fauna of these streams may be characterized as rich in species but low in individuals for most taxa. Although the total area trapped was 40 m^2, over 40% of the species were represented by <10 individuals and only 12 species by >100 specimens.

The generic categories of functional feeding groups used by Wiggins and Mackay (1978) are modified slightly to emphasize probable differences in autochthonous or allochthonous origin of the food source (Table 3). Following Hawkins et al. (1982), we include a category of herbivore-shredders and piercers (herb.-shred.) for species that feed on macrophytes, including macroalgae and mosses, by either chewing or piercing. Taxa included in this group are *Micrasema* (moss-associated), *Rhyacophila verrula* (a moss and algal feeder), and the Hydroptilidae.

Although the shredders were dominant in abundance, scrapers were the most diverse functional group (Table 3). Two species of *Lepidostoma, cascadense* and *roafi*, accounted for over one third of all individuals collected and 91% of the shredders. Limnephilid shredders are underrepresented in these sites because the Limnephilinae are more common in seeps and 1st-2nd-order streams. Grazers were represented by nine genera in four families. When the five genera of herbivore-shredders are also included, 50% of all genera exploit food of autochthonous origin.

Table 3. Diversity and abundance of functional feeding groups in western Cascade streams, 1982-83.

	No. of Genera	Number of Adults	%
SHREDDERS	6	2035	39
Lepidostoma		1998	
Limnephilidae	(4)	25	
Heteroplectron		12	
HERB.-SHRED.	5	409	8
Micrasema		267	
Rhyacophila verrula		133	
Hydroptilidae	(3)	9	
SCRAPERS	9	1378	27
Glossosomatidae	(2)	469	
Neothremma		429	
Limnephilidae	(5)	393	
Psychomyia		87	
COLLECTORS	5	742	14
Philopotamidae	(2)	709	
Hydropsychidae	(3)	33	
PREDATORS	5	642	12
Rhyacophilidae	(2)	563	
Polycentropus		65	
Hydropsychidae	(2)	14	

Emergence intervals for all species are given in Table 2 and compared for 12 species common to all sites in Figure 1. Emergence began about a month earlier at Quartz Creek than at the higher sites for spring and summer species. There appears to be a trend for longer emergence periods at the low-elevation site. However, with widely different numbers of emergents at each site, the data for this relationship are tenuous. The late-season species, *Rhyacophila vaccua, R. verrula* and *Neophylax splendens*, had similar emergence patterns at all sites.

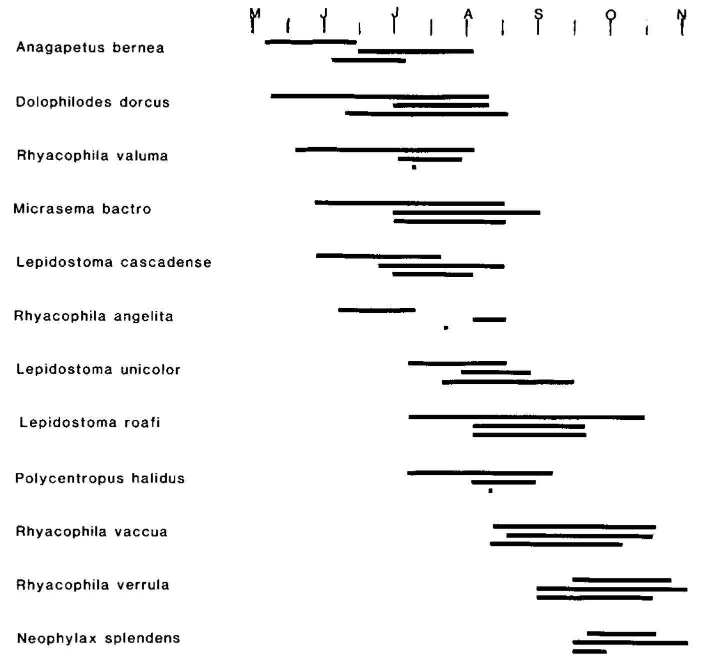

Figure 1. Emergence periods of 12 species of Trichoptera at three sites in the western Cascades, Oregon, 1982-83. Bars for each species are Quartz Cr. (top), Mack Cr. (middle), and Grasshopper Cr. (bottom).

DISCUSSION

The caddis community of western Cascade Range streams may be characterized as rich in species but low in density. Collections from 40 m^2 yielded 5200 adults of 64 species, or an average for each species of two adults/m^2/year. Three species, *Lepidostoma cascadense*, *L. roafi*, and *Dolophilodes dorcus*, accounted for 44% of the individuals. As these are all small species (<3 mg dry wt/individual), the biomass yield is low.

About 20% of the North American species of Rhyacophilidae and Philopotamidae were collected from the three sites. Although both families are characteristic of cool montane streams (Ross 1956), it is perhaps unusual to have this diversity in so limited an area of a watershed as was sampled. Species replacement typically occurs along gradients of altitude and stream order. Our sites apparently spanned the zones of overlap between several species.

Wiggins and Mackay (1978) proposed that the type of food resources in western montane forest streams limited the radiation of certain genera of Trichoptera. Their model helps to explain the underrepresentation of Hydropsychidae in our sites. Organic matter transport is high during fall-winter freshets, but low during spring-summer when temperature is optimum for larval growth. The philopotamids filter very fine particles that are retained within the substrates, so they are well represented in these streams.

Our data for the diversity of scrapers supports the suggestion of Wiggins and Mackay (1978) that periphyton is capable of supporting a higher degree of partitioning in the West than in the East. When the herbivore-shredders and piercers are included in the comparison, the differences between trophic categories are even more marked (Table 3).

The species composition at Quartz Creek is quite different from that at the other sites: six species were dominant or only collected at this site, while 12 species represented by 15 specimens at Mack and Grasshopper Creeks were absent at Quartz Creek. We initially attributed most of the differences to an altitude-temperature effect. However, seven of the 12 species that are absent at Quartz occur in Coast Range streams at 300 m, where mean annual water temperature is 5°C higher than at Mack Creek (Wisseman, 1984). The ongoing study is attempting to elucidate whether physical habitat requirements and/or food relations explain differences in community composition.

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