14 Emergence of Ephemeroptera from some lakes and streams in the experimental lakes area (ELA), northwestern Ontario, Canada

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In emergence studies in three lakes and two streams in ELA, 18 species of mayflies were collected. The lakes produced two to nine species. The total number of species was ten. Seven species were recorded in the lake outflow, whereas only two species were recorded from the groundwater-fed stream. There were no species in common between the streams and only two species in common between the streams and the lakes. The streams were different in source, size, temperature and other physical characteristics, perhaps accounting for the difference in species composition. Differences in the observed species composition among the lakes may be partly attributed to the different limitations of the emergence samplers used. The wide variation in species composition among the five waterbodies sampled suggests that many more species will be recorded when other waterbodies at ELA are sampled.

Introduction

The mayfly fauna of the extreme southeastern portion of the Nelson River drainage basin, Canada, is largely unknown. Studies of aquatic insect emergence in three lakes and two streams conducted in 1968 and 1978 in the Experimental Lakes Area (ELA) of northwest Ontario have provided the opportunity to identify the fauna and to compare the species assemblages of this headwater area of the catchment, both with waterbodies in other parts of the catchment basin and with studies of the mayflies of other similar Canadian Shield waterbodies.

The lakes of ELA are generally small, chemically dilute, neutral or slightly acidic waterbodies. Armstrong and Schindler (1971) and Brunskill and Schindler (1971) describe the location, geography and limnology of these lakes.

Materials and Methods

The three lakes studied, L122, L132 and L382, are similar to each other in size and water chemistry (Brunskill and Schindler 1971). However, L122 and L132 have little shoreline development, whereas L382 has two relatively large, shallow bays. Stream A is a relatively warm (July water temperature 22.2°C) lake outflow while Stream B is a cooler (July water temperature 18.8°C) groundwater-fed stream.

A summary of physical characteristics and details of the sampling schedule, emergence trap type, trap number and year sampled for each of the waterbodies sampled is given in Table 1.

In L122 and L132 funnel traps were set over a variety of substrates and at depths >1 m, whereas in L382 the box traps were set only at depths <0.75 m, and their associated substrates, because of the inherent limitations of the different traps used.

Results

Eighteen species of mayflies representing 12 genera and eight families were collected during these studies (Table 2). Eight species were restricted to streams and eight to lakes; only two species were common to both lakes and streams. Each waterbody had a distinct mayfly species assemblage with the exception of L122, which had only two species, both of which occurred in the other two lakes. The two streams had no species in common and stream B had no species in common with any of the lakes. Stream A had seven species but had only one species in common with L382 and one with L132. Similarly, fewer than half of the species in L382 were shared with L132 (Table 2).

Siphloplecton basale and *Stenonema femoratum* were the first species to emerge and *Paraleptophlebia debilis* was the last. The other 15 species formed a temporal succession in between (Table 3). Most species were collected over large particle size substrates. A few, such as *Caenis latipennis*, *Leptophlebia cupida* and *Callibaetis ferrugineus* were restricted to substrates with vegetation or organic material (Table 3). The presence of "drowned" logs appear to provide a solid substrate for many species in areas of soft, flocculent substrates (Table 3).

Sex ratios were generally close to one when large numbers were collected. *Acerpenna macdunnoughi*, which is known to be parthenogenetic at northern latitudes, was an exception, since only females were collected.

Table 1. Summary of physical characteristics and details of sampling schedule, emergence trap type, trap number and year sampled for each of the waterbodies sampled.

	Lakes			Streams	
	122	132	382	A	B
Year sampled	1968	1968	1978	1968	1968
Sampling schedule[1]	W	W	D	W	W
Number of Traps	12	12	12	16	8
Trap type[2]	A	A	B	A, C	C
Watershed/Lake area (ha)	12.2	7.2	37.1	2250	<1
Max. Depth (m)	12.8	8.4	13.1	—	—
# mayfly species	2	5	9	7	3

[1] W = 2 or 3 times/week, D = daily

[2] A = Funnel trap; area sampled, 0.1 m^2 (Flannagan and Lawler 1972). B = Box trap; area sampled, 1 m^2 (Flannagan 1978). C = Hamilton stream trap, area sampled, 0.1 m^2 (Hamilton 1969).

Discussion

L382 produced almost twice as many species as L122 and L132 together (Table 2). This may result from the different habitats sampled by the different traps used. The negatively buoyant Funnel traps are designed to be suspended from a buoy and are therefore unusable in water of <1 m deep. The Box traps are designed to sit directly on the substrate, be emptied from within using an aspirator and thus are unusable in water deeper than 0.75 m. Alternatively, the differences in species numbers may result from the occurrence in L382 of large shallow bays. The other ELA lakes sampled had only very limited shallow water habitat.

The difference in species composition between the two streams is likely related to stream type. Stream A is expected to have a much more varied fauna than Stream B because it is fed by surface lake water, is much wider and deeper and has a much more varied substrate than Stream B.

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Table 2. Distribution, total numbers collected and mean density (total number of specimens/number of traps x 1/trap area) of mayflies in the various waterbodies of ELA.

Species	Waterbody				
	L 382	L 132	L 122	Stream A	Stream B
Stenonema	101	1	2		
femoratum (Say)	(8.42)	(0.83)	(1.67)		
Caenis	6	26	1		
latipennis Banks	(0.5)	(21.7)	(0.83)		
Siphlonurus	1	30			
phyllis McD.	(0.08)	not known[1]			
Hexagenia	6	1			
limbata Serville	(0.5)	(0.83)			
Procloeon	278			17	
rubropictum (McD.)	(23.17)			(10.6)	
Callibaetis		12		4	
ferrugineus (Walsh)		(10)		2.5	
Siphloplecton	7				
basale (Walk.)	(0.58)				
Stenacron	58				
candidum (Traver)	(4.83)				
S.	15				
interpunctatum (Walk.)	(1.25)				
Eurylophella	7				
temporalis (McD.)	(0.58)				
Baetis pluto McD.				6	
				(3.75)	
Stenonema				2	
vicarium (Walk.)				(1.25)	
S.				19	
mediopunctatum (McD.)				(11.9)	

Table 2. (continued)

Species	L 382	L 132	Waterbody L 122	Stream A	Stream B
Eurylophella				10	
prudentalis (McD.)				(6.25)	
Leptophlebia				13	
nebulosa (Walk.)				(8.13)	
L.					1
cupida (Say)					(1.25)
Paraleptophlebia					(12)
debilis (Walk.)					(15.0)
Acerpenna					76
macdunnoughi (Ide)					(95)
# species	9	5	2	7	3
# specimens·m^{-2}	39.9	33.4	2.5	44.4	111.3

[1] collected only on shore.

The only published emergence study of mayflies of a Canadian Shield lake in the Nelson River catchment basin is that of Flannagan and Lawler (1972) in which five species of mayflies were collected in Heming Lake. Their study is directly comparable with the L122 and L132 studies because the same traps were used by the same person, over the same season and all three lakes are very similar physically, chemically and zoogeographically. However, Heming Lake is five degrees of latitude further north than ELA and it is in the western part of the Nelson River catchment (Fig. 1)

Perhaps the most obvious difference in emergence results between Heming Lake and the ELA lakes is the length of the mayfly emergence period. In Heming Lake emergence was limited to July while at ELA emergence occurred from May to late September. This undoubtedly results from the change in length of open water season and water temperature resulting from the latitudinal differences. Although Heming Lake produced similar densities and had a similar mayfly fauna to some of the ELA lakes, it contained significant numbers of *Ephemera simulans*,

Table 3. Emergence times, peaks, substrate preference and sex ratio of Ephemeroptera from ELA.

Species	Emergence Dates	Emergence Peak	Substrate	Sex Ratio M:F
Siphloplecton basale	May 28-Jun. 12	May 30	cobble, boulder, logs[1]	0.29
Stenonema femoratum	May 28-Aug. 30	late June, early July	76% cobble 13% boulder 11% logs	1.02
Leptophlebia cupida	June 4	-[2]	pool, fine substrate	1 male
L. nebulosa	June 4	-	flowing water coarse substrate	1.17
Acerpenna macdunnoughi	June 6-Sept. 12	June 26-June 28	gravel, sand, logs	all female
Baetis pluto	June 20-Aug. 28	none	slow flow, fine organic substrate	0.5
Stenonema vicarium	June 24, July 26	-	flowing water, logs	1.0
Eurylophella prudentalis	June 26-July 22	-	flowing water, coarse substrate	2.33
E. temporalis	June 27-July 25	mid-July	cobble, logs	1.33
Hexagenia limbata	June 27-July 4	- -	boulder, cobble, logs	0.75
Caenis latipennis	June 27-Sept. 10	none	18% boulder 90% fine substrate with vegetation	0.94
Stenonema mediopunctatum	June 28-July 24	early July	flowing water, logs	1.0
Stenacron candidum	June 29-Aug. 1	mid-July	69% cobble 28% boulder 3% logs	1.15

Table 3. (continued)

S. interpunctatum	July 4- Aug. 24	none	94% cobble 6% logs	0.88
Procloeon rubropictum	July 4- Sept. 26	mid-July, early Sept.	52% cobble 41% boulder 6% sand	1.18
Callibaetis ferrugineus	July 12- Aug. 13	early Aug.	logs, sand with organic material	3.0
Siphlonurus phyllis	July 30, Aug. 8	-	mostly collected on shore, boulder	1.07
Paraleptophlebia debilis	Aug. 11- Sept. 23	- -	flowing water, coarse substrate	1.4

[1] substrate composed of a variety of, often flocculent, base substrates overlain with logs.

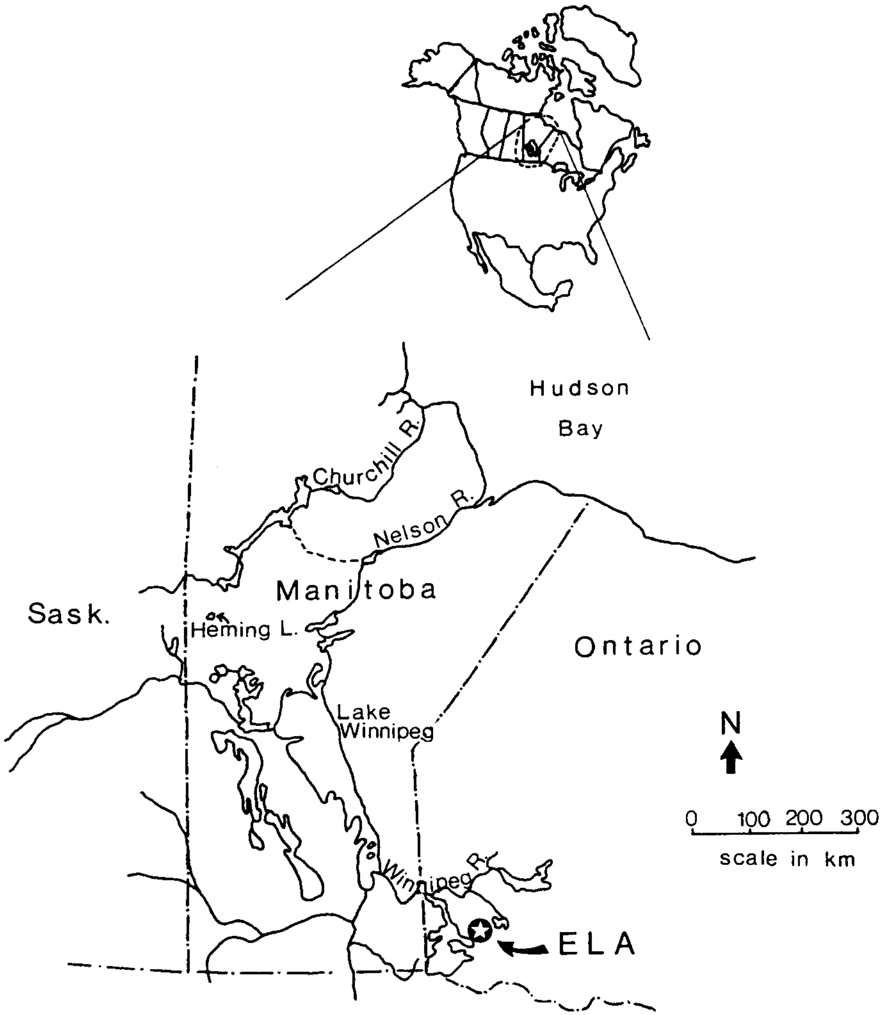
[2] "-" indicates insufficient specimens were caught to allow estimate of emergence peak.

a species not collected from the ELA lakes. *Ephemera simulans* is a lotic species that can only survive in highly oxygenated lentic situations, such as northern lakes (Edmunds et al. 1976). Four of the five species collected from ELA lakes and not from Heming were collected by the L382 Box samplers (Table 2) and, therefore, may not have been effectively sampled at Heming Lake. The remaining species, *Stenonema femoratum*, although widespread in the southern part of the drainage basin has not been collected north of latitude 52° (Flannagan and Flannagan 1982).

Although insect emergence has been widely studied in streams of the Nelson catchment basin (Friesen et al. 1980; Flannagan et al. 1990, 1991; Cobb et al. 1991; Flannagan and Cobb 1991), all of these published studies were on western streams that were much richer in nutrients, dissolved solids, diversity of riparian vegetation and diversity of aquatic insects than the ELA streams, thus comparisons are not meaningful.

Acerpenna macdunnoughi, *Eurylophella prudentalis* and *Stenonema candidum* were not previously collected from the Nelson catchment (Flannagan and Flannagan 1982). All of these are eastern species that have been recorded from the adjacent St. Lawrence River catchment and thus, may be in the process of colonizing the Nelson system.

Figure 1. Map of Nelson River catchment showing location of ELA.



The most comprehensive study suitable for comparison with our result is that of Harper and Harper (1982). Although their study was carried out outside the Nelson River catchment basin, it was an area on the edge of the Canadian Shield with waters of similar physical and chemical composition to those of ELA. Stream A is probably equivalent to their mainstreams, Stream B is equivalent to their tributary streams and the data from their lakes and ponds are equivalent to our lake data. A comparison of their results with ours shows that although they collected more species in total, individual lakes and streams of ELA produced numbers of species that lie within the range found in the Achigan River system. Similarly, the density of mayflies in ELA lakes and Stream B falls within the range found by Harper and Harper (1982). Their mainstream, however, contained densities of mayflies that varied from about 6 to 27 times the density collected in Stream A. This latter difference may be real or may result from the comparison of only one stream section, in our case, with the six sections in their system.

Conclusions

It appears that the mayfly faunas of ELA lakes are similar in species composition and density to that of the only other Canadian Shield waterbody of the Nelson River catchment studied.

Since the five ELA waterbodies each produced distinct species assemblages, it is to be expected that investigations of other ELA waterbodies will greatly expand the species list for the area. This later suggestion is supported by the finding of Harper and Harper (1982), who, in studying a similar number of Canadian Shield lakes, found a similar number of mayfly species, but who found many more stream species than we did when they studied six times as many stream sections.

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