A years' study of the drifting organisms in a brown-water stream of Alberta, Canada

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Ten 24-h drift samples were taken from a brown-water stream of Alberta, Canada over a 1-year period with drift nets having a mesh size of 320 μ. Cladocerans, cyclopoids, and ostracods, collectively called entomostracans, made up a large part of the drift by numbers and contributed substantially to the total biomass of the drift. Drift densities of entomostracans tended to increase as the ice-free season progressed, but drift densities of immature insects remained relatively constant throughout the ice-free season. Total daily drift of both the entomostracans and non-entomostracan fractions tended to decrease as the ice-free season progressed, being dependent on water volume. Drift densities, total daily drift, and number of taxa in the drift were very low in winter. Most of the species exhibited nighttime behavioral drift. At the sampling site, the entomostracans and immature aquatic insects were found to be essentially evenly distributed throughout the water column. For part of the study period, drift densities of taxa caught in the 320-μ net were compared with drift densities of the same taxa caught in a 720-μ net. The 720-μ net caught a much smaller fraction of the aquatic insects than did the 320-μ net, and almost all the entomostracans passed through the 720-μ net. When compared with other regional drift studies, the large fraction of entomostracans in the brown-water stream seems to be a unique feature; there is evidence that most of the drifting entomostracans originate in the marshy area drained by the main stream.

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Pendant 1 an, on a procédé à l'étude de la dérive dans un ruisseau d'eau brune en Alberta, Canada. On a recueilli 10 échantillons de 24 h au moyen de filets à dérive à maille de 320 μ. Le nombre des entomostracés (cladocères, cyclopoïdes et ostracodes) est particulièrement abondant et forme une grande part de la biomasse totale. Alors que la densité des entomostracés tend à augmenter graduellement après la fonte des glaces, celle des larves d'insectes demeure relativement constante. La dérive est fonction du volume d'eau; c'est pourquoi la dérive quotidienne totale des entomostracés et des non-entomostracés tend à diminuer graduellement l'été. La densité de la dérive, la dérive quotidienne totale et le nombre d'espèces dans la dérive est très bas en hiver. La plupart des espèces dérivent la nuit. Au site d'échantillonnage, la répartition des entomostracés et des larves d'insectes aquatiques est homogène dans toute la colonne d'eau. Une partie de l'étude a été consacrée à la comparaison des densités de dérive d'espèces recueillies dans des filets à maille de 320 μ avec celles des mêmes espèces recueillies dans des filets à maille de 720 μ. Les filets à maille de 720 μ retiennent les insectes aquatiques en nombres beaucoup moindres que les filets de 320 μ et laissent passer presque tous les entomostracés. La comparaison de ces données avec celles d'études de dérive faites dans d'autres régions indique que la grande importance des entomostracés dans le ruisseau d'eau brune est probablement un phénomène particulier; il semble que la plupart des entomostracés qui dérivent proviennent de la région marécageuse que draine le cours d'eau principal.

Introduction

As part of a continuing limnological investigation of a brown-water stream in west-central Alberta, Canada, the drifting animals were studied for a 1-year period. The purpose of the drift work was to gather information that could be used to describe more fully the general limnological features of the stream. I was less interested in possible factors responsible for behavioral-type drift than in describing the magnitude of the drift and the various diel and seasonal patterns of the stream organisms in the drift.

Description of the Study Area

Physical and chemical features of the North Fork of the Bigoray River have been described (Clifford 1969) and only a brief account is given here. The stream (53°24′ N, 115°07′ W) is part of the Arctic Ocean drainage and drains extensive muskeg-type terrain, but the pH of the water is almost always above 7.0. Water temperatures are near 0°C for about 6 months of the year and the stream is completely ice-covered for about 5 months. Except in the headwater regions, there is little gradient, and the stream meanders in its lower reaches. At the sampling site, which includes one of the few fast areas of the stream, the stream is small, with maximum discharge usually occurring shortly after the ice goes out in April or early May. There is progressively less flow during the winter months. Since 1966, discharge at the sampling site has ranged from over 2 m^3/s during floods to about 0.05 m^3/s in late winter. During the ice-free season the water is dark brown, but the stream becomes quite clear in late winter. Dissolved oxygen content remains high throughout the year. The stream supports sparse fish populations, except for a short period after the ice goes out in the spring when a large population of white suckers, *Catostomus commersonii* (Lacépède), and a few longnose suckers, *C. catostomus* (Forster), make a spawning run into the Bigoray River from the Pembina River.

Methods

Ten 24-h drift samples were taken during the 1-year period in a relatively fast region of the stream. The drift nets were square-framed, 9 × 9 cm at the mouth. The nets were 50 cm long and each net had a pore size of 320 μ. Two nets, one on top of the other, were attached to a pair of steel rods, which were pushed into the substrate. The lower net was positioned so that its lower edge was 3 cm above the substrate; the upper net sampled the surface water to a depth of 5 cm. The arrangement was such that the nets sampled a partial slice of the water moving past a width transect. Depending on the water level, this partial slice represented anywhere from 20 to 80% of a total slice. A direct reading current meter was used to measure the water velocity in front of the mouth of each net. During the study period water velocities ranged from 13 to 74 cm/s.

Seven samples of 1-h duration were taken at evenly spaced intervals (i.e., 0800, 1200, 1600, . . . 0800 h) during the 24-h period. The nets were always placed in the stream at 30 min after the hour; for example, the 0800 sample represented the time between 0730 and 0830 h. With these short sampling intervals, there was neither clogging nor apparent backflow except for the near flood conditions of April 1971, at which time the nets became clogged with detritus before the end of each 1-h sampling interval; but no reliable estimate of the reduced filtering efficiency could be made. To avoid ice forming in and on the nets during the winter (the December and March samples), it was necessary to use dry nets for each 1-h sampling interval and to completely submerge the nets. Hence for the December and March periods the top 1 cm of water was not sampled.

The contents of each net was preserved in 80% alcohol. In the laboratory each sample was washed through a coarse net (pore size: 720 μ), and the filtrate was caught. The material retained by the coarse net was examined at × 16 magnification with the appropriate identifications and counts being made. The number of animals in the filtrate fraction was estimated by plankton counting techniques, i.e., identifying and counting all the animals in a Sedgwick–Rafter cell (the actual number of cells counted depended on the density of the organisms) at × 50 magnification and then making the appropriate correction for the volume of the filtrate. The animals caught in the nets during the first 0800 sampling period of each sampling date were measured to the nearest 0.5 mm. For presentation, except in one section, the data obtained from the lower and upper nets of each sampling period were combined and treated as one sample.

Results

Composition and Seasonal Changes

Taxonomic Groups

The drifting animals of the Bigoray River consisted of invertebrates and the fry of suckers (Table 1). Small crustaceans, hereafter collectively called "entomostracans," made up a large part of the drift. When compared with bottom fauna studies of the Bigoray River in previous years (Clifford 1969) and concurrent with the drift study (Clifford, in preparation), Trichoptera, which makes up a large fraction of the bottom fauna, was the most under-represented group in the drift. Entomostracans were a negligible part of the bottom fauna, even when a 320-μ net was used to collect the bottom samples.

TABLE 1

Total drift densities (number per 100 m^3) of the taxa caught in drift nets for the 10 sampling dates, May 21, 1970 to May 15, 1971

Taxa	Total drift densities
Ephemeroptera	
Baetis tricaudatus	5 959
Leptophlebia cupida	1 195
Siphloplecton basale	304
Callibaetis coloradensis	261
Caenis simulans	227
Paraleptophlebia debilis	181
Cloeon sp.	83
Other Ephemeroptera	10
Plecoptera	
Nemoura cinctipes	181
Other Plecoptera	12
Diptera	
Chironomidae (adults and pupae)	9 887
Chironomidae larvae	3 085
Simuliidae	9 160
Ceratopogonidae	345
Other Diptera	430
Hemiptera	
Corixidae	407
Trichoptera	844
Coleoptera (adults)	633
Other aquatic insect emergents	290
Terrestrial insects	1 207
Crustacea	
Ceriodaphnia reticulata	32 527
Scapholeberis kingi	5 851
Chydoridae	3 108
Cyclopoida	25 253
Ostracoda	22 066
Other Cladocera and Copepoda	197
Hydracarina	1 303
Collembola	999
Pisces	
Catostomus commersonii fry	1 828
Others	556

NOTE: The Crustacea and the Hydracarina include both adult and immature forms. Except where otherwise indicated, the insects are all larval forms.

Drift Densities and Total Daily Drift for the Fauna as a Whole

Total drift densities, i.e., the number of animals per unit volume of water, tended to increase throughout the summer as water volume decreased (Fig. 1 A and C). But this was due almost entirely to the entomostracan fraction of the drift. The drift densities of the non-entomostracans, mainly immature aquatic insects, remained relatively constant for most of the ice-free season, diminishing in autumn when *Baetis tricaudatus* and the simuliids were in the egg stage and the midge emergents were not so abundant. During winter, when the stream was completely ice-covered and water temperatures were near 0°C and constant, the drift densities were very low. The total drift density was also low during the high water of April 1971.

The total daily drift values (Fig. 1B) are crude approximations, since for purposes of calculations it was assumed that the drifting animals were equally distributed across the entire cross section of the stream and that the same number of drifting animals caught in the 1-h sampling period would have been caught in each of the three succeeding hours of the 4-h period. Although somewhat sporadic, total daily drift across a width transect tended to decrease throughout the summer, being dependent, as one would expect, on the total water volume, which in the Bigoray River generally decreased as summer progressed. The one exception was during the near flood conditions of April, at which time the total drift was not as high as would be expected from the flow values. But this was the one sampling date when, because of detritus, the nets tended to become clogged; hence the total drift estimate for this date was probably low. For the non-entomostracan fraction, total daily drift was greatest in late spring (May), then decreased and remained rather constant throughout the summer, decreased further in autumn and was very low during the winter. Total daily drift values of the entomostracans were sporadic during the ice-free season and very low in the winter.

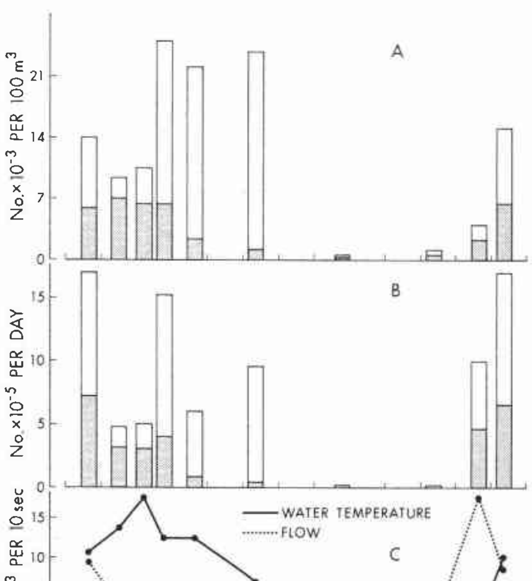

FIG. 1. A, total drift densities of the seven 1-h sampling intervals for each 24-h period; B, calculated total drift across a width transect per 24 h; C, average water temperature and flow. The unshaded areas indicate the entomostracan fraction of the samples.

Percentage Composition

By numbers, the drift fauna was composed of 13 abundant taxa, making up 95% of the year's total drift fauna (Table 2). The entomostracans collectively made up 50% or more of the total fauna on 7 of the 10 sampling dates; and for the October date, 90% of the total fauna was accounted for by one entomostracan, *Ceriodaphnia*. During most of the ice-free season, chironomid emergents (adults and pupae) and *Baetis* nymphs made up a large part of the non-entomostracan component. Terrestrial invertebrates were absent from the drift from October through March. Cyclopoids and *Leptophlebia cupida* nymphs accounted for most of the drifting animals during the winter.

During the ice-free season, May through October, the species composition fluctuated considerably from month to month. This was due to the appearance of species from the hatching of eggs and the disappearance of species because of emergence. In contrast, the species composition of the drift changed only slightly in the winter months.

Daily and Seasonal Drift Patterns

Twenty-four-hour Patterns for the Fauna as a Whole

The drift fauna as a whole was generally night-active, but there were seasonal variations (Fig.

2). During the long days of summer, there was only one nighttime sampling period and the nighttime peak was quite pronounced. By October and continuing through April, when the nights are much longer, the nighttime drift for the fauna as a whole tended to be evenly distributed over the dark period. Average daytime drift densities considerably exceeded average nighttime drift densities on only one occasion, the May 1970 sample. The large amount of daytime drift for this period was due to large numbers of emerging chironomids. In December, when the stream was completely covered with ice and snow and there were only 8 h of daylight, drift for the fauna as a whole was quite uniform throughout the 24-h period. However by March, when the stream was still completely ice and snow covered, average nighttime drift exceeded average daytime drift. The lack of diurnal fluctuations for the fauna as a whole in April is probably due to the high water, the behavioral drift being masked by catastrophic drift.

TABLE 2

Percentage composition of the taxa that made up by numbers at least 10% of the total drift on one date or 1% of the drift on at least four sampling dates, for the period May 21, 1970 to May 15, 1971

Taxa	May 21–22	June 11–12	July 3–4	July 28–29	August 18–19	October 2–3	December 30–31	March 13–14	April 23–24	May 14–15
Ceriodaphnia reticulata	0	1	T	30	11	90	0	0	1	T
Cyclopoida	3	12	18	18	62	3	57	27	18	5
Ostracoda	54	12	14	5	4	1	0	0	32	52
Chironomidae adults and pupae	24	7	23	11	2	0	0	0	0	1
Simuliidae larvae	8	8	10	1	2	1	0	0	1	33
Baetis tricaudatus	1	46	7	1	T	T	3	2	3	1
Scapholeberis kingi	0	0	0	20	4	0	0	0	0	T
Chydoridae	0	0	2	4	8	0	0	0	T	T
Chironomidae larvae	1	4	4	1	3	0	3	13	20	2
C. commersonii fry	0	5	13	T	0	0	0	0	0	0
Hydracarina	4	1	1	1	T	0	0	0	3	1
Terrestrial insects	2	1	1	2	T	0	0	0	1	T
Leptophlebia cupida	T	T	0	0	1	1	19	31	2	0
Others	3	3	9	6	3	3	18	27	19	5

NOTE: T indicates less than 1%.

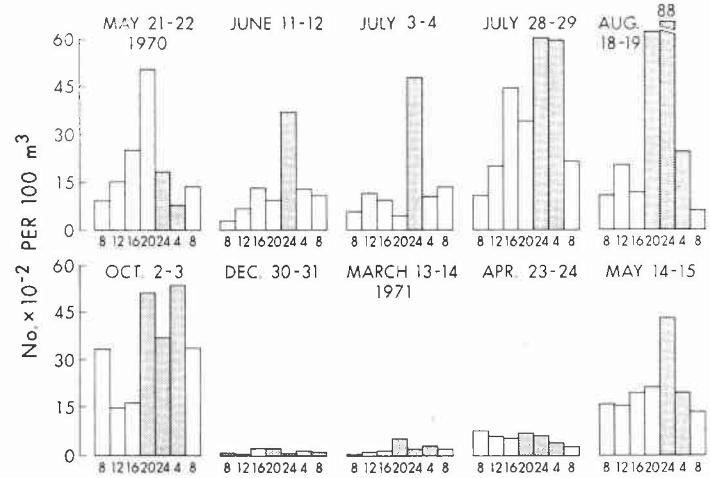

FIG. 2. Total drift densities per hourly sampling interval for the 10 sampling dates; the shaded bars indicate nighttime sampling intervals.

Daily and Seasonal Drift Patterns of Individual Taxa

Behavioral drift with a preponderance of night-active species has been well established for temperate streams, and most of the Bigoray River species have night-active patterns (Figs. 3 and 4). However for certain taxa there were indications of seasonal shifts in the activity patterns. For example, the ostracods were day-active in the spring of both years, but were found in greater number in the night samples of summer and autumn. Ostracoda as treated here is a heterogeneous taxon and it is possible that the species composition for the group was different in April and May from that of summer and autumn. For the winter sample of December when there were only 8 h of daylight, *L. cupida* maintained its night-active patterns; but *B. tricaudatus*, which was strongly night-active at other times, exhibited a day-active pattern. The high water of April tended to mask or "suppress" definite diurnal patterns for almost all species.

One should use caution when judging general activity patterns from pooled yearly day–night values, especially for heterogeneous taxa, since seasonal changes in activity patterns will influence the pooled values. To determine statistically whether drift densities over the entire study period were significantly greater at night for each of the taxa of Figs. 3 and 4, a paired variate t-test was used after log transformation of the data, using log $(x + 1)$ because there were zero values. For example: for simuliid larvae the paired values after log transformation of the average hourly daytime and nighttime drift values were 3.951 and 6.098 (May 21–22), 4.605 and 5.303 (June 11–12), 4.635 and 6.094 (July 3–4), 2.303 and 4.554 (July 28–29), 4.552 and 3.611 (August 18–19), 2.079 and 4.407 (October 2–3), and 5.587 and 7.555 (May 14–15); after computation $t = 3.195$ with six degrees of freedom. Hence simuliid larvae, considering the entire study period, drifted in significantly larger numbers at night ($P < 0.05$, one-sided test).

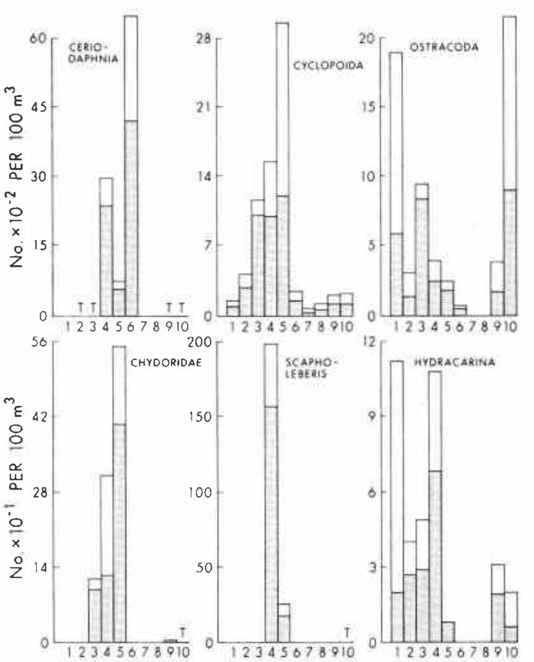

FIG. 3. Average daytime (unshaded) and nighttime (shaded) drift densities for each of the 10 sampling dates. Averages are total drift densities per daytime (or nighttime) sampling intervals divided by number of daytime (or nighttime) sampling intervals. Abscissa numbers are (1) May 21–22, (2) June 11–12, (3) July 3–4, (4) July 28–29, (5) August 18–19, (6) October 2–3, (7) December 30–31, (8) March 13–14, (9) April 23–24, (10) May 14–15. T's are trace values.

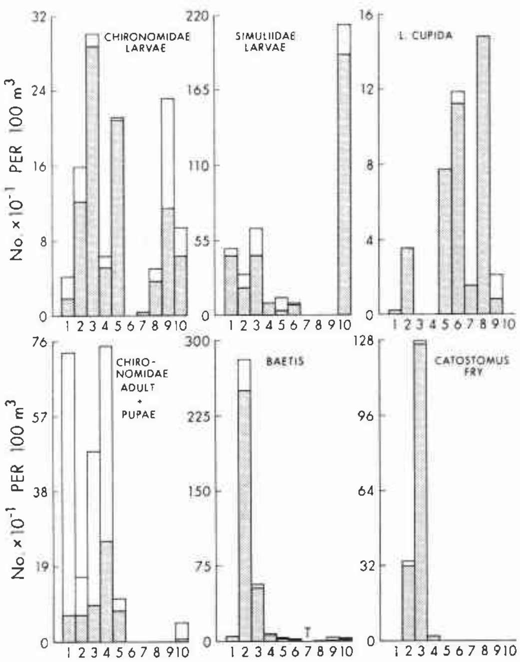

FIG. 4. Average daytime and nighttime drift densities for each of the 10 sampling dates. See Fig. 3 for explanation.

The following taxa of Figs. 3 and 4 had, when considering the entire study period, drift densities that were significantly greater at night: *Ceriodaphnia*, cyclopoids, simuliid larvae, *Baetis*, chironomid larvae, white sucker fry, and *L. cupida*. Only the emerging chironomids drifted in significantly larger numbers during the day.

The species with the most pronounced behavioral drift pattern was not an invertebrate, but the fry of white suckers. Ninety-eight percent of the suckers' drift occurred at night, with almost all of this during the 2400 period. Because the fry may actively swim downstream instead of being passively carried by the current, the fry should probably not be referred to strictly as drifting organisms, although clearly their pattern is night-active.

Vertical Distribution of Drift Densities

The drift nets were placed in the stream so that two regions of a vertical water column were sampled simultaneously. With this design, and treating the data as drift densities, it was possible to study the depth distribution of the drifting animals throughout the year. For each of the abundant taxa, the drift densities of the upper and lower nets were paired for each sampling interval, e.g., 0800, 1200, etc., of each sampling date for the entire study. After log transformation of the original values, using log $(x + 1)$ because there were zero values, possible differences in the drift densities between the upper and lower nets were analyzed by the paired variate t-test, the degrees of freedom $(n - 1)$ being the number of sampling intervals.

There was a statistically significant difference $(P < 0.05)$ between the upper and lower nets for only five groups, all being found in much larger numbers in the upper net (Table 3). Of these five groups, one was white sucker fry and the other four were invertebrate taxa that contained some adult specimens. None of the entomostracans or immature aquatic insect taxa was found in significantly larger numbers in either net, although there was a tendency for most groups to be caught in slightly greater numbers in the upper net. The three exceptions were the ostracods, simuliid larvae, and chydorids. In short, for the drift sampling site of the Bigoray River, which is fairly shallow and turbulent, the entomostracans and immature aquatic insects appear to be essentially evenly dispersed through the whole water column. This is different from that reported by Crisp and Gledhill (1970) for a slow-flowing chalk stream of southern England. They found a variety of depth distribution patterns for the drifting animals, with many of the taxa being more abundant near the stream bed. However the drift sampler of Crisp and Gledhill did not catch animals on the surface of the water; hence the data between the chalk and brown-water stream are not strictly comparable.

Drift Densities and Mesh Size

From May 1, 1970 through August 18, 1970 drifting animals were also collected with a

TABLE 3

Summary of paired variate t tests (after log transformation of data), comparing the surface drift net samples with the samples collected in a drift net close to the substrate for each sampling hour of the entire study period (see text for further explanation)

Taxa	Percentage of animals in surface net	Degrees of freedom	t values	P, 2-sided test
Terrestrial insects	92	33	6.499	.001
Chironomidae adults and pupae	94	33	6.169	.001
Corixidae	80	17	5.374	.001
Hydracarina	77	40	3.950	.001
C. commersonii fry	90	13	4.023	.01
Ostracoda	44	47	1.543	.20
Ceriodaphnia reticulata	67	30	1.285	.30
Simuliidae larvae	47	40	1.220	.30
Scapholeberis kingi	85	13	0.937	.40
Chydoridae	47	19	0.885	.40
Baetis tricaudatus	58	36	0.952	.40
Chironomidae larvae	59	47	0.534	.70
Cyclopoida	60	47	0.356	.80
Leptophlebia cupida	64	9	0.043	.95

coarser drift net having a pore size of 720 μ. This size net is one size smaller than the standard netting (pore size: 1024 μ) of most Surber samplers. The 720-μ drift net sampler was modified from a standard Surber sampler, 30 × 30 cm at the mouth. It was placed alongside the 320-μ nets. The 720-μ net filtered surface water to a depth of 22 cm. Although several factors other than mesh size per se are important for a precise analysis of mesh size efficiencies, the magnitude of the catch in the 320-μ nets was so much larger than in the 720-μ net that useful generalizations can be drawn from this comparison (Table 4). If one used only the 720-μ net, the composition of the drift would have been interpreted quite differently, seriously underestimating the aquatic insect groups and almost completely missing the large entomostracan component. Only corixids were taken in about equal numbers by both nets. Fourteen of the 17 abundant taxa were taken in much larger numbers by the 320-μ net. But white sucker fry and Collembola were taken in larger numbers by the 720-μ net. Apparently the coarser net functioned as a gill-net to capture large numbers of fry. The average size of the Collembola was 1.7 mm, and the presence of large numbers of Collembola in the coarser net is a mystery.

TABLE 4

Total number of animals per 100 m^3 of water caught in the fine mesh drift nets (pore size 320 μ) and the coarse mesh drift net (pore size 720 μ) for the period May 21 through August 19, 1970

Taxa	Fine net	Coarse net
Cyclopoida	22 235	1
Ostracoda	12 395	1
Ceriodaphnia reticulata	10 159	55
Chironomidae adults and pupae	9 671	1306
Scapholeberis kingi	5 847	0
Baetis tricaudatus	5 626	747
Simuliidae larvae	3 702	456
Chydoridae	3 092	1
C. commersonii fry	1 828	2863
Chironomidae larvae	1 758	78
Terrestrial invertebrates	1 139	421
Hydracarina	1 112	18
Collembola	609	1101
Coleoptera adults	581	104
Trichoptera larvae	574	130
Leptophlebia cupida	262	60
Corixidae	184	106

Discussion

The drift features of this northern brown-water stream are in many respects similar to those reported by other workers for other streams. (1) The fauna is generally night-active, a phenomenon reported by almost all workers who have studied the whole fauna of temperate streams, e.g., Tanaka (1960) (Japan); Waters (1962) (U.S.A.); Elliott (1967) (England); and Bishop and Hynes (1969) (Canada). (2) Drifting aquatic insects (the non-entomostracan component) per unit volume of water remained relatively constant over extended periods, not varying with the flow. Elliott (1967) found this phenomenon for the drift of a Dartmoor stream. (3) The high water of April 1971, approaching flood conditions, tended to mask or suppress the behavioral drift patterns of some species. Anderson and Lehmkuhl (1968) found that daytime drift equaled nighttime drift in an Oregon stream during a period of high water, although the Ephemeroptera and Plecoptera retained their behavioral day–night periodicity.

TABLE 5

Calculated total daily biomass (g/24 h) of the abundant taxa moving past a width transect, for the 10 sampling dates

Taxa	May 21–22	June 11–12	July 3–4	July 28–29	August 18–19	October 2–3	December 30–31	March 13–14	April 23–24	May 14–15	Total
Simuliidae larvae	23.4	2.9	105.5	32.2	1.8	2.3	0	0	0.4	103.6	272.1
Chironomidae larvae	18.3	7.3	1.7	1.0	1.4	0	*t*	0.2	196.3	14.7	240.9
Total entomostraca	39.2	4.8	7.0	45.3	21.5	36.7	0.1	0.1	21.1	35.4	211.2
Baetis tricaudatus	1.4	58.6	26.6	16.7	2.5	11.5	*t*	*t*	3.3	1.5	122.3
Chironomidae adults and pupae	60.4	7.1	12.4	19.3	1.6	0	0	0	0	2.3	103.1
Leptophlebia cupida	3.9	24.2	0	0	1.4	11.4	2.7	9.5	8.2	0	61.3
C. commersonii fry	0	176.0	3077.0	346.0	0	0	0	0	0	0	3599.0
Totals minus *C. commersonii* fry	146.6	99.4	153.2	114.5	30.2	62.1	2.8	9.8	229.3	157.5	

NOTE: = less than 0.1 g.

Although some of the above drift features are common to most streams, every stream has its individual characteristics. The northern brown-water stream has the following two pertinent features.

(1) There is a large entomostracan component in the drift. Several workers, e.g., Cushing (1964) and Enăceanu (1964), have reported a large amount of zooplankton in rivers that drain lakes. But for drift studies of smaller streams that are not influenced by lakes, such as the Bigoray River, investigators have not found the small crustaceans in nearly as large numbers as that reported here for the Bigoray River. In the Bigoray River most of the entomostracan component of the drift originates in the extensive marshy, muskeg-type terrain drained by the stream. The standing water of these marshy areas drains into the Bigoray River via small intermittent tributaries, which flow for a time after the snow melts in spring. In certain years, some of the small tributaries may flow throughout the ice-free season, but the tributaries invariably dry up in winter. A 1-year study of one such tributary (see this issue) indicated large numbers of entomostracans entering the main stream via the tributary especially in June and July. The marshy regions account for most of the entomostracans in the main stream, but beaver dams and sluggish side arms, both prevalent along the entire Bigoray River course, probably permit the maintenance of entomostracan populations in the river during low flow of summer and autumn. Also, some of the ostracods and perhaps the chydorids are not planktonic; they originate and maintain populations in the main stream. And some of the cyclopoids at least can maintain a population in the main stream during the entire winter, when the water of the tributaries and most of the marsh is frozen into the substrate.

The entomostracan drift of the Bigoray River contributes substantially to the total animal biomass moving downstream (Table 5). To compute the weight values of *L. cupida* and *B. tricaudatus* nymphs, the length–weight formulas of Clifford (1970) were used, and for the *Catastomus* fry the length–weight formula of Bond (1972) was used. It was assumed that each entomostracan, regardless of taxon, weighed 40 μg, which was the wet weight of an adult *Mesocyclops* as reported by Patalas (1970). The mesh size of the drift nets was too large to retain many, if any, of the immature entomostracans. The weights of simuliid larvae, chironomid larvae, and chironomid adults and pupae were based on the cube law, with a 1-mm specimen taken as weighing 10 μg. Although the estimates are only rough approximations, it is evident that over the year the entomostracans make up a substantial part of the invertebrate biomass moving downstream. On a relative basis the small crustaceans make up an especially large percentage of the drifting biomass in autumn. Obviously the drifting entomostracans of this brown-water stream are a very important component of its trophic structure.

(2) There is very little drift during the long winter. There was progressively less flow in the winter and hence one would expect total drift across a width transect per unit time to decrease, but drift densities were also much smaller in the winter, as was daily drift biomass (Table 5). Disregarding the sucker fry drift, if one considers the average daily biomass of the drifting invertebrates in the winter to be about halfway between the December and March values, i.e., 6 g, the total biomass of the drift in the 5-month winter period, mid-November to mid-April, would be about equivalent to the biomass drifting in 1 week of May. On a relative basis these winter values for the brown-water stream are much lower than the total winter drift reported by Elliott (1967) for a Dartmoor stream and by Bishop and Hynes (1969) for a southern Ontario stream.

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