Proceedings of the Iowa Academy of Science

Volume 82 | Number 3-4

Article 10

1976

Observations of Invertebrate Drift in the Skunk River, Iowa

David W. Zimmer
Iowa State University

Observations of Invertebrate Drift in the Skunk River, Iowa[1]

DAVID W. ZIMMER[2]

ZIMMER, DAVID W. (Department of Animal Ecology, Iowa State University, Ames, Iowa 50011). Observations of Invertebrate Drift in the Skunk River, Iowa. *Proc. Iowa Acad. Sci.* 82(3-4): 175-178, 1976.
Invertebrate drift was collected weekly from four sites on the Skunk River in the summer of 1971. Drift was composed primarily of lotic insects. The composition and abundance of drift was related to predominant substrate types and water quality. There was a significant ($P = .05$) negative correlation between drift density and discharge at sites with sand bottom sediments, but drift density was not related to discharge at sampling areas with gravel and rubble substrates.
INDEX DESCRIPTORS: Skunk River Invertebrates, Drift Invertebrates, Lotic Insect Drift.

Downstream drift of benthic invertebrates has received a great deal of attention in recent years because of the role it may play in the dispersal (Muller, 1954) and regulation (Waters, 1961) of stream benthos populations. Studies by Waters (1965) and Elliott (1970) suggest that stream drift provides an opportunity to collect benthic invertebrates from a randomly distributed population. Because of the short distances that drifting organisms have been observed to travel (Waters, 1965; McLay, 1970; Elliott, 1971), drift collections should contain invertebrates originating from a wide range of benthic habitats (Larimore, 1974) within a particular stream segment of interest. This study was designed to determine what environmental factors influence the composition and abundance of invertebrate drift in the Skunk River.

THE STUDY AREA

The upper portion of the Skunk River basin (Figure 1) is located entirely within the Wisconsin drift area in north-central Iowa. Between Story City and Ames, the river meanders through a narrow, forested, bedrock valley. Substrates in this segment range from boulders and rubble in the riffles to silt at the bottom of deep pools. At Ames, the river flows into a wide preglacial valley; this segment of the stream was channelized about 1900 to improve drainage of agricultural land on the floodplain. Shifting sand is the predominant substrate in this reach of the stream.

The river receives effluent from municipal sewage treatment plants at Story City and Ames. Both facilities provide secondary treatment of wastes.

Volumes of flow in the Skunk River commonly fall to very low levels during late summer. Discharges north of Ames declined from 6.75 m^3/second on July 6 to 0.14 m^3/second by August 31, 1971 (U.S. Geological Survey, 1971). Pumping from adjacent aquifers at Ames further reduces natural flow in the river, and volumes of effluent from secondary treatment facilities at the Ames water pollution control plant exceed na'ural flow during periods of reduced discharge. Extensive background information detailing the fisheries and limnological characteristics of the river are available in Jones *et al.* (1974).

[1] Journal Paper No. J-8227 of the Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa. Project 1779.

[2] Department of Animal Ecology, Iowa State University, Ames, Iowa 50011.

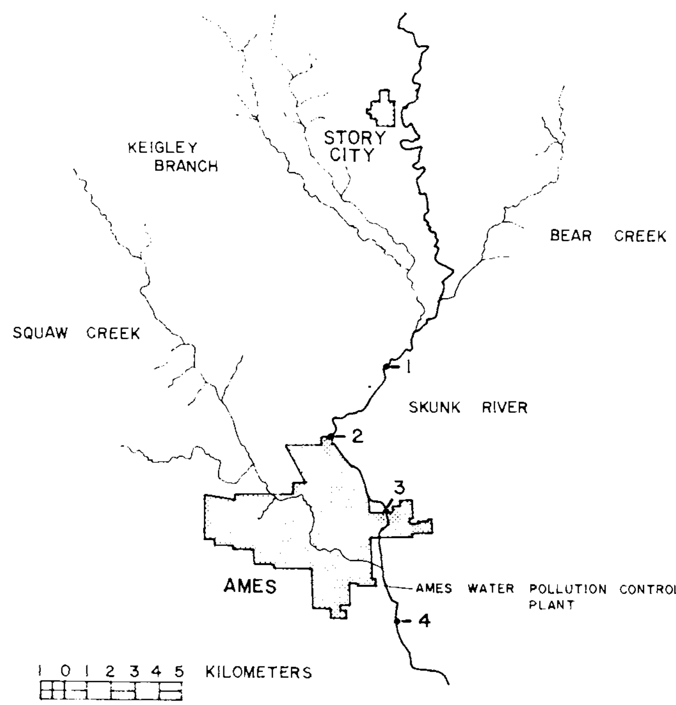

Figure 1. Location of sampling stations in the study area.

METHODS

Drifting organisms were captured in tapered nets similar to those used by Waters (1962). Nets were 30.5 cm^2 with mesh openings of 571 μm. Current velocities were measured in front of the net mouth with a pygmy current meter, and nets were left in the stream for the length of time needed to filter 13.6 m^3 of water (assuming 100% sampling efficiency). This relatively small sample size was adopted to minimize differences in sampling efficiency due to variable quantities of suspended organic materials clogging the net.

Hourly drift samples collected between dusk and midnight on June 8, 1971, and diurnal sampling (Figure 2) conducted July 27-29, 1971, indicated that total drift density increased rapidly after sunset. There was no evidence to suggest a day-active drift periodicity (Waters, 1968) for any invertebrates in the Skunk River. On the basis of these results, all drift samples were collected approximately two hours after sunset.

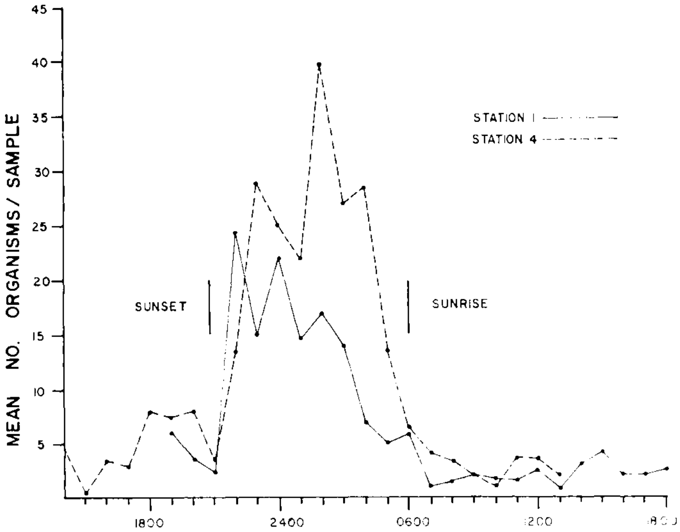

Figure 2. Diurnal fluctuations of invertebrate drift density at stations 1 (July 28-29, 1971) and 4 (July 27-28, 1971).

Two concurrent drift samples were collected weekly at four stations. Stations 1 and 2 were located in the stream segment with rock substrate; stations 3 and 4 were located above and below the Ames sewage treatment plant in the stream segment with predominantly shifting sand substrate. Sampling at stations 1 and 4 began in early June; stations 2 and 3 were established in mid-summer to determine if differences in drift at stations 1 and 4 were related to the substrate change or to the effluent from the Ames sewage treatment plant. Sampling at all stations was concluded in late August when current velocities were inadequate to distend the nets.

RESULTS

A total of 20 genera of invertebrates was identified from drift samples (Table 1). Some dead psychodid larvae were found in the drift at station 4 but were not included in Table 1 because it is probable that they originated in trickling filters at the Ames water pollution control plant.

Chironomid larvae and *Baetis* spp. nymphs were the most common organisms in drift during the summer of 1971, composing 42 and 21% of total collections. *Hyalella azteca, Hexagenia* sp., and *Pteronarcys* sp. were rarely found; combined they made up less than 1% of total drift.

Drift catches from two concurrent samples were combined for statistical analysis. Count data were normalized by transformation to the square root of the actual count plus one. The summer was arbitrarily divided into two periods to determine if the abundance of selected taxa changed during the period of low flow in late summer. Multiple-regression analysis (Steel and Torrie, 1960) was conducted by using period, weeks within period, station, and the period x station interaction as independent variables. A series of orthogonal comparisons was used to determine which means were significantly different.

Examination of mean counts for selected taxa at each sampling station (Table 2) suggests that taxa commonly associated with large substrate particles were less abundant in drift downstream from the transition to shifting sand substrates. Mean numbers of Baetidae, Heptgeniidae, Hydropsychidae, Simuliidae, and total individuals in samples at station 3 were significantly different (P = .05) from the mean of stations 1 and 2. In addition, the families Pteronarcidae and Rhyacophilidae, which were rare at stations 1 and 2, were not collected in drift at stations 3 and 4.

TABLE 1. COMPOSITION AND MEAN DENSITY (ORGANISMS/M^3) OF INVERTEBRATES IN DRIFT AT EACH SAMPLING STATION DURING SUMMER 1971

	Station			
Taxa	*1*	*2*	*3*	*4*
Amphipoda				
Talitridae				
Hyalella azteca	0.00+	0.00	0.00	0.00
Ephemeroptera				
Baetidae				
Baetis spp.	0.54	0.50	0.47	0.13
Pseudocleon sp.	0.01	0.02	0.02	0.00+
Caenidae				
Brachycercus sp.	0.03	0.03	0.02	0.01
Caenis sp.	0.06	0.01	0.04	0.03
Ephemeridae				
Hexagenia sp.	0.00+	0.00	0.00	0.00
Heptageniidae				
Heptagenia spp.	0.08	0.02	0.04	0.02
Stenonema spp.	0.09	0.13	0.08	0.04
Polymitarcidae				
Ephoron sp.	0.13	0.00	0.01	0.01
Siphlonuridae				
Isonychia sp.	0.05	0.02	0.02	0.01
Tricorythidae				
Tricorythodes sp.	0.06	0.01	0.02	0.02
Plecoptera				
Pteronarcidae				
Pteronarcys sp.	0.00+	0.01	0.00	0.00
Hemiptera				
Corixidae				
Trichocorixa sp.	0.05	0.00	0.00	0.01
Gerridae				
Metrobates sp.	0.01	0.02	0.00	0.00+
Trichoptera				
Hydropsychidae				
Cheumatopsyche sp.	0.10	0.09	0.02	0.00
Hydropsyche sp.	0.10	0.12	0.00	0.01
Leptoceridae				
Leptocella spp.	0.02	0.01	0.01	0.02
Rhyacophilidae	0.01	0.00	0.00	0.00
Coleoptera				
Elmidae				
Dubiraphia sp.	0.02	0.02	0.02	0.01
Stenelmis sp.	0.10	0.06	0.07	0.01
Diptera				
Simuliidae				
Simulium sp.	0.10	0.05	0.02	0.01
Chironomidae	0.58	0.21	0.36	1.53

TABLE 2. MEAN ABUNDANCE OF SELECTED TAXA IN DRIFT SAMPLES AT EACH SAMPLING SITE

	Station			
Taxa	*1*	*2*	*3*	*4*
Baetidae	12.5	11.7	8.9	2.7
Chironomidae	11.3	4.8	7.2	25.4
Heptageniidae	4.2	3.3	2.8	1.5
Hydropsychidae	4.2	3.0	0.4	0.2
Simuliidae	2.1	1.0	0.5	0.2
Total Individuals	55.1	33.3	29.5	37.4

TABLE 3. MEAN ABUNDANCE OF SELECTED TAXA IN DRIFT SAMPLES COLLECTED IN EARLY AND LATE SUMMER

Taxa	Time: Early Summer	Time: Late Summer
Baetidae	5.6	12.2
Chironomidae	4.6	29.1
Heptageniidae	3.5	2.1
Hydropsychidae	2.4	0.9
Simuliidae	1.1	0.7
Total Individuals	29.4	57.4

Mean numbers of selected taxa collected at stations 3 and 4 were compared to determine what effect the effluent of the Ames sewage treatment plant had on drift. Mean numbers of chironomid immatures were significantly different ($P = .05$) at stations 3 and 4. This may be due to the greater abundance of chironomids found in the benthic fauna of the river below the outfall of the Ames sewage treatment plant (Zimmer, 1972). Wastes from the Story City sewage treatment plant seemingly had little impact on drift in the study area.

Seasonal changes in the abundance of selected taxa are shown in Table 3. Season means were significantly different for all taxa tested with the exception of Simuliidae. Period x station interactions were not significant in any case. Abundance of various taxa in the drift did not exhibit a uniform trend in relation to the seasonal period of low discharge, but the total number of invertebrates per drift collection increased significantly ($P = .05$) in late summer.

The effect of low flow on total drift density was further examined by regressions of total drift density (organisms/m^3) on discharge at each station (Figure 3). Logarithmic transformations of drift density and discharge were used in this analysis. Correlation coefficients were −.18, +.04, −.80, and −.78 for stations 1 to 4. Regressions were not significant at stations 1 and 2, but were significant ($P = .05$) at stations 3 and 4.

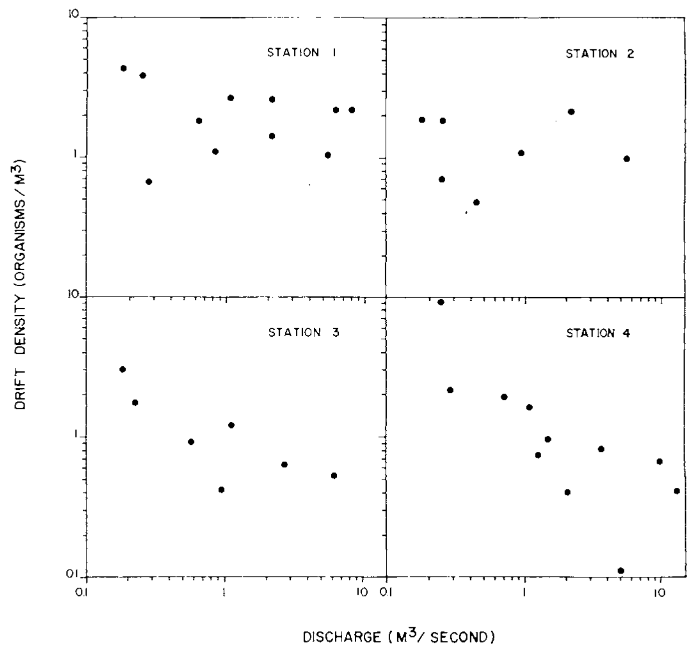

Figure 3. Relation between total drift density and discharge at each sampling site.

DISCUSSION

Drift of benthic invertebrates in the Skunk River was influenced by changes in channel morphology, water quality, and discharge. Morphological changes include the shift in substrates related to the geological history of the valley and to channelization of the lower part of the study area. Effects of the substrate transition and channelization were not separable because nearly all channel downstream of the bedrock valley has been dredged. Changes in water quality are related primarily to effluents from the Ames sewage treatment plant.

Few changes in drift composition were attributable to the effluent of the Ames sewage treatment plant. Mean numbers of drifting chironomids, however, increased below the outfall of the sewage treatment plant. Larimore (1974) found a similar increase in chironomids at polluted sites in central Illinois.

Substrate particle size seems to be a primary factor influencing the composition of drift within the study area. Taxa that are typically found associated with gravel and rubble substrates were most abundant at stations 1 and 2, and decreased downstream of the transition to shifting sand substrates.

The relationship between discharge and total drift density was significant only at stations with sand substrates. One possible explanation of this discrepancy is that sand substrates tend to stabilize with decreasing discharge and thereby become more favorable for establishment of a benthic community.

In conclusion, it seems that most differences in the composition and abundance of invertebrate drift above and below Ames are attributable to changes in the geologic character of the valley and/or channel dredging conducted below Ames. Drift abundance increases with decreasing discharges in the lower part of the study area, possibly because of stabilization of sand substrates. Municipal wastes from the city of Ames further influence the composition of drift, as evidenced by an increase in the abundance of chironomid immatures.

LITERATURE CITED

ELLIOTT, J. M. 1970. Methods of sampling invertebrate drift in running water. *Ann. Limnol.* 6:133-159.

———. 1971. The distances travelled by drifting invertebrates in a lake district stream. *Oecologia (Berl.)* 6:350-379.

JONES, J. R., D. M. COON, and R. W. BACHMANN. 1974. Limnological and fisheries survey of the upper Skunk River, Iowa. *Iowa State J. Res.* 48:255-266.

LARIMORE, W. R. 1974. Stream drift as an indication of water quality. *Trans. Am. Fish. Soc.* 103:507-517.

MCLAY, C. L. 1970. A theory concerning the distance travelled by animals entering the drift of a stream. *J. Fish. Res. Board Can.* 27:361-370.

MULLER, K. 1954. Investigations on the organic drift in north Swedish streams. *Inst. Freshwater Res. Drottningholm Rep.* 35: 133-148.

STEEL, R. G. D., and J. H. TORRIE. 1960. Principles and procedures of statistics. McGraw-Hill Book Co., Inc., New York.

U.S. GEOLOGICAL SURVEY. 1971. Water resources data for Iowa. Part I. Surface water records. U.S. Geological Survey, Iowa City.

WATERS, T. F. 1961. Standing crop and drift of stream bottom organisms. *Ecology* 42:532-537.

———. 1962. Diurnal periodicity in the drift of stream invertebrates. *Ecology* 43:316-320.

———. 1965. Interpretation of invertebrate drift in streams. *Ecology* 46:327-334.

———. 1968. Diurnal periodicity in the drift of a day-active stream invertebrate. *Ecology* 49:152-153.

ZIMMER, D. W. 1972. Evaluation of multiple-plate artifical substrate samplers. Unpublished M.S. thesis. Iowa State University Library, Ames.