

**OBSERVATIONS ON THE BIOLOGY OF *AMETROPUS NEAVEI*
(EPHEMEROPTERA: AMETROPODIDAE) FROM A LARGE RIVER IN
NORTHERN ALBERTA, CANADA**

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Abstract

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Ametropus neavei McDunnough populations apparently inhabit only large rivers. In the Athabasca River of northeastern Alberta, Canada, the species has an univoltine life cycle, with some overlap of generations. There appears to be an extended emergence period (June and July), the nymphs are found in flowing water at depths greater than 0.5 m, and the population is almost entirely small-particle detritivores.

Introduction

Detailed life cycle information is rapidly accumulating for North American mayflies of small and moderate size streams. However, there are few quantitative life cycle data for mayflies restricted to large rivers. Amongst mayflies of large rivers are nymphs of *Ametropus*. Ametropodidae contains only a single genus, the Holarctic *Ametropus*. Of the five described species, three are found in North America: *A. albrighti* Traver from the Colorado River Drainage, U.S.A., *A. ammophilus* Allen and Edmunds from Montana, Oregon, and Washington, U.S.A., and *A. neavei* McDunnough from Alberta and Saskatchewan, Canada (Allen and Edmunds 1976).

Jażdżewski (1973) gives notes on the biology of the Palearctic *A. eatoni* Brodskij; Allen and Edmunds (1976) present information on nymphal habits, habitat, and emergence time of *A. albrighti* and *A. ammophilus*; and Lehmkuhl (1970) describes the habitat of *A. neavei*¹ nymphs in the South Saskatchewan River, Saskatchewan. This appears to be the extent of biological information available for *Ametropus*, which, because of distinctive nymphal features (e.g. reduced forelegs, coxal pads of forelegs, long claws of middle and hind legs), is well known in the taxonomic literature.

Nymphs of *A. neavei* are generally distributed in the Athabasca River, part of the Arctic Ocean drainage, of northern Alberta, Canada. Much limnological information is accumulating for this river and its tributaries in northeastern Alberta, because of studies related to the extensive development of the tar sands in the Fort McMurray area (56°44' N., 111°23' W.). In 1976 and 1977, we collected, using an airlift sampler, an Ekman dredge and dip nets (mesh size, 500 μ m), sufficient numbers of *A. neavei* nymphs in the Athabasca River to give an adequate picture of the species' life cycle, especially growth and feeding habits. At the study site, 65 km downstream from the town of McMurray, the river is about 300 m wide. In 1977, mean discharge was 773 m³/s, with a maximum daily discharge of 2830 m³/s in early June and a minimum daily discharge of 144 m³/s in late November (Inland Waters Directorate, Environment Canada). Turbidity values often exceeded 100 J.T.U. during the ice-free season (April-Nov.) and averaged about 5 J.T.U. in winter. Maximum water temperature in summer rarely exceeds 19°C.

¹Dr. Dennis Lehmkuhl, University of Saskatchewan, has examined our nymphal and adult material and reports that it is similar to his Saskatchewan River material, which does not agree in every respect with the type material of *A. neavei*. Perhaps further study will dictate a revision, but until then we will call our material *A. neavei*.

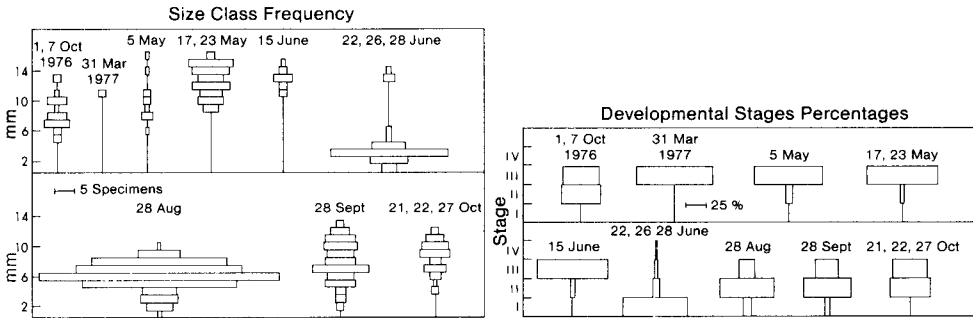


FIG. 1. Number of *Ametropus neavei* nymphs in mm size classes (based on total length, excluding caudal filaments and antennae) and in developmental stage percentages, 1976 and 1977. Developmental stages are defined in text.

Life Cycle

The *A. neavei* population had an univoltine cycle with some overlap of generations (Fig. 1). Nymphs of the new generation were first collected in late June. They grew rapidly during the remainder of the ice-free season and some appeared to be fully grown in October. However, there was an influx of small nymphs into the population throughout most of the summer. We could collect only two specimens under the ice in winter, and it was impossible to sample the river in April because of ice conditions. However, there are indications that at least some development continues during the long winter, re developmental stages (Fig. 1). Stage I nymphs lacked wing pads; stage II nymphs had mesothoracic wing pads whose lengths were shorter than the distance separating the two wing pads; stage III nymphs had wing pad lengths that were greater than the distance separating the two pads; stage IV nymphs had darkened wing pads, indicating the latter part of a discrete instar, the last nymphal instar.

We collected stage IV nymphs only in late June. But by this time considerable emergence must have already taken place because new generation nymphs were also present. We collected only two adults (two male imagoes). These were collected on 21 July from a group of about 20 to 30 adults that was swarming 1 h before sunset. The swarm was at a height of about 4 m over a backwater area of the river. The adult records and changes in the nymphal size class distribution indicate that emergence probably starts in late May and extends through most of July, a rather prolonged emergence period for an univoltine mayfly species.

Nymphs were found only in the Athabasca River despite extensive collecting in tributaries of the area. Most specimens were collected at the downstream end of sandbars where depth increased abruptly allowing the deposition of very fine sand (average particle size, 100 μm); nymphs were rarely found on coarse sand exposed to the full force of the current, and they seemed to avoid very shallow water. Most specimens were collected by wading as rapidly as possible while skimming the sand with the dip net at depths of 0.5 to 1 m. We could not wade fast enough to catch nymphs in deeper water. *Ametropus* nymphs are excellent swimmers, although not quite as strong as *Anaetris eximia* nymphs, a recently described (Edmunds and Koss 1972) predaceous mayfly (Lehmkuhl 1976), which is found in the same area of the Athabasca River as *Ametropus*.

In deeper water, the nymphs were found on a mud-sand substrate. Between 3 and 12 Ekman dredge samples were taken at depths of between 2 and 3 m on

Table I. Synopsis of ingestion data for *A. neavei* nymphs collected in May and June, 1977. Volumes and particle size classes were determined using a model TALL Coulter counter

Nymphal size class (mm):	3-4	9-10	12-13
Number of nymphs	16	5	4
Per cent diatoms/nymph	1.3	1.6	1.0
Per cent mineral matter/nymph	1.2	0.9	1.3
Per cent detritus/nymph	97.5	97.5	97.7
Average volume (mm ³) detritus/nymph	0.01	0.33	0.56
Per cent of ingested particles in:			
0-32 μ m particle size class	82	68	60
32-64 μ m particle size class	15	23	24
64-101 μ m particle size class	3	8	9
101-161 μ m particle size class	0	1	7

each sampling date of 1977. These samples yielded the following estimates of abundance (number of nymphs per m²): 26 June (4), 25 July (7), 28 August (42), 28 September (178), and 22 October (36). *Ametropus neavei* nymphs averaged 1.1% of the total macrobenthos fauna of the river, with a high value of 4.7% in June. These data were from an airlift sampling device that collected benthic animals from each of the principal substrates (course sand, mud-sand, and bedrock) on six dates between May and October 1977.

Ametropus nymphs are almost entirely detritivorous (Table I). In fact, there was almost as much sand in the gut contents as diatoms. The particle size of food items was usually less than 32 μ m for all three nymphal size classes, with indications that larger nymphs ingest slightly larger particles than smaller nymphs. We were able to maintain nymphs in the laboratory for months (although the nymphs never transformed in the laboratory), but we could not determine the exact feeding mechanism of *Ametropus*. Edmunds *et al.* (1976, p. 154) suggest that *Ametropus* nymphs feed on food items found interstitially in the sand; whereas Lehmkuhl (1970) believes that the reduced forelegs are specialized for a type of filter feeding. In our laboratory stream, *A. neavei* nymphs' behavior was similar to that observed for *A. albrighti* nymphs by Allen and Edmunds (1976). They would immediately bury themselves in the loose sand with only the eyes slightly projecting above the sand. They appeared to remain continually motionless. We never observed movements of the mouthparts that would indicate feeding, although the nymphs were supplied a variety of algal and detrital food items. We also observed no activity in the dark, when we could observe the nymphs for short periods by means of a red light. In Cummins's (1973) functional trophic categories, *A. neavei* nymphs would be small particle detritivores in the collector category; but whether they are filter or sediment feeders is unclear.

Discussion

Ametropus neavei populations apparently inhabit only large rivers. In the Athabasca River, the species is univoltine, with some overlap of generations. The population appears to have an extended emergence period (at least 2 months), the nymphs can be found in deep flowing water (up to 3 m), and the population is almost entirely small-particle detritivores.

Several mayfly species can maintain viable populations in both large rivers and smaller systems, but few mayflies are restricted to large rivers. As gathered from the literature, especially Edmunds *et al.* (1976), North American mayflies that appear to be restricted to large rivers include *Acanthametropus*, *Ametropus*, *Analetris*,

Anepeorus, *Pentagenia*, *Pseudiron*, *Spinadis*, and *Tortopus*. In the large Athabasca River, *A. neavei* nymphs are almost entirely detritivorous (ca. 98% detritus). Little is known about quantitative food habits of other mayflies restricted to large rivers, although there would appear to be an unusually large number of known or presumed carnivorous species, e.g. *Analetris* (Lehmkuhl 1976), *Acanthametropus*, *Anepeorus*, and *Pseudiron* (Edmunds 1957).

Harper and Magnin (1971) recognize two types of mayfly emergence patterns: a short synchronized type and a more prolonged, dispersed type. Emergence studies of mayflies from small and moderate-size streams (e.g. Leonard and Leonard 1962, Coleman and Hynes 1970, Harper and Magnin 1971, Boerger and Clifford 1975) indicate a large proportion of univoltine species exhibiting the short synchronized pattern, although the dispersed pattern is certainly not uncommon amongst univoltine species of small streams. In contrast, *Ametropus* appears to have an extended emergence period in the Athabasca River, and the few data available for other species, e.g. *Analetris* (Lehmkuhl 1976), *Anepeorus*, *Pentagenia* and *Tortopus* (Edmunds *et al.* 1976), also suggest prolonged emergence periods for some, if not all, univoltine mayfly species restricted to large rivers. Possibly prolonged emergence periods and either carnivorous or almost entirely detritivorous food habits are fairly common features of univoltine mayflies of large rivers. Of course, many more species from a variety of large rivers would have to be studied before there would be a valid basis for a generalization about these life cycle features.

Acknowledgments

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