NOTES ON THE LIFE HISTORY OF POTAMANTHUS MYOPS
IN SOUTHEASTERN MICHIGAN (EPHEMEROPTERA: POTAMANTHIDEA)

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ABSTRACT

Nymphs of the mayfly Potamantorhynchus myops were collected six times over a one year period from the Huron River to obtain some information on their natural history. Unlike other Ephemeridae, myops was never collected below the substrate surface, but was usually found on the underside of stones. The immature mayflies were measured and their length plotted for each collection period. The results support the hypothesis that the majority of myops requires two years to mature.

Potamantorhynchus myops (Walsh) is a spawling Ephemeridae of the family Potamantidae. It is an unusual member of this group because unlike its relatives, myops has not been found to burrow actively throughout its life cycle. Potamantorhynchus has retained many of the morphological characteristics of the fossorial habitat such as large mandibular teeth and feathery filamentous gills which are adaptations of Ephemeropera for burrowing and feeding in soft substrates. Potamantorhynchus has also acquired many morphological characteristics that are adaptive to its own habitat, such as flattened body form, reduced legs, lateral gills, and mouthparts for scraping rather than filter feeding.

Very little is known of the taxonomy, ecology or life history of the genus Potamantorhynchus. It is presently known of six species which are known in the aquatic form. Recent work by McCafferty (1975) and Lord (1975) has helped clarify the continuing taxonomy of the genus. Lord and Notes (1977) demonstrated the intra-specific variations of the species myops.

The ecology of Potamantorhynchus is even less understood than its taxonomy. The literature offers only brief descriptions of the habitat occupied by Potamantorhynchus. A description by Morgan (1913) typifies the early misconception that Potamantorhynchus occupied essentially the same habitat as other Ephemeridae. "(Potamantorhynchus?) occurs upon the muddy bottoms in the same locality as other ephemereids." Augs (1925) distinguished Potamantorhynchus from another Ephemeridae (Polycentropus) and described the Potamantorhynchus habitat as "found in the sand and gravel at the edges of riffles where current is not too swift." McCafferty (1975) took nymphs from "gravel substrate in a moderate current of medium size to large rivers, often times under rocks or logs." Lord (1975) described a similar habitat for myops in southeastern Michigan.

McCafferty (1975) postulated that nymphs of myops may burrow throughout their life cycle. He noted that very early instars of this mayfly were taken in the Tippecanoe River in the substrate at a depth of 11 cm.

Nearly all information on the life history of Potamantorhynchus is based on the collection of adults. Images have been collected from June through August. McCafferty (1975) found that in Indiana, this species emerges immediately after oviposition and overwinters as nymphs. He took young instars in October and middle instars in May. This information was interpreted by McCafferty to mean that Potamantorhynchus spends one year development cycle. Lord (1975) hypothesized from limited collections that myops in southeastern Michigan is an extreme.

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Immediate growth of many after hatching is substantially shown in various laboratory studies. Age (1927) described the hatching of Pseudephemurus in the laboratory in only 14 days. The effects of environmental factors such as temperature on hatching time should be taken into consideration.

DESCRIPTION OF STUDY AREA

This study was conducted at the Huron River in the vicinity of Zeeb Road Bridge, Washtenaw County, Michigan. The Huron River is a moderately warm, hard water river, which flows through mixed forest and agricultural land. The drainage basin, which is largely glacial till, covers about 1866 km². Water temperatures range between a warm minimum of 10°C and an average summer maximum of 25°C. Dissolved oxygen shows daily and seasonal variations, a maximum of 12.5 ppm and a minimum of 6.0 ppm were found during the study year. Discharge in early spring with a variability range of 0.32 (Reed and Gunter, 1961). The consistently good water quality of the Huron River supports a diverse benthic fauna as defined by Lounsbury (1958).

METHODS

A single population of Pseudephemurus pygmaeus delimited by only 100 m² sampling area on the Zeeb Road Bridge, was used throughout this entire study. As part of a larger study which dealt with the feeding behavior of animals, approximately 950 nymphs of this mayfly were taken from the sampling area on the following dates: 29 June, 1976, 22 July, 1976, 12 August, 1976, 9 October, 1976, 23 February, 1977, 6 May, 1977. Hand picking was used to avoid damaging the abdomen of the leaf during sampling. This procedure is used to sample standard or random sampling methods. Attempts were made to ensure consistency in sampling so that any animal located in the sampling area had an approximately equal probability of being sampled. This procedure permits, however, to assert random as certain rocks and animal interactions (i.e. leaf length) could be picked twice.

Animals were preserved in 70% ethanol until measurement. The body length was measured using a calibrated ocular micrometer on a dissecting microscope. Body length was defined as the distance between the posterior tip of the 11th abdominal segment and the anterior tip of the labrum. This body length excludes test length.

DESCRIPTION OF HABITAT

The population of nymphs in the Huron River's patchy wetland can be found in at least three distinct habitats. The preferred substrates of the nymphs are gravel and sand evenly distributed within this area. Areas which are seasonally dry and still remain available for the nymphs are located in the riparian areas near the river. These areas are characterized by low light availability and high moisture content.

An abundant periphyton community was also observed to be a critical requirement for the development of nymphs. Nymphs were not seen from what was otherwise normal for a perfectly sized habitat within a larger growth. Primarily of Chironomus, these nymphs were also present. The periphyton community of the Chaetopterus was composed of Chaetopterus (predominantly, diatoms, dinoflagellates, and algae variable concentrations). Analysis of gut contents for all species revealed that the major food source of this organism.

Pseudephemurus pygmaeus demonstrates a negative phototactic response which is common to most ephemeropters. During the photoperiod, nymphs were collected almost exclusively from the undersides of stones, with movement to the upper surface of stones periodically to feed on surface accumulations.
LIFE HISTORY

Size distributions of myops collected on 29 June, 22 July, 12 August, 9 October, 23 February, and 6 May were made to observe the population dynamics throughout the year. The percentage of individuals occurring in each of 0.32 mm body length intervals (0.2 mm with 0.1 mm) was graphed for each sampling date mentioned above (Fig. 11). The 29 June collection was characterized by having no peak or modal distribution; rather the population was extended with a nearly equal proportion of individuals throughout the middle size classes. The smallest individuals were 5.3 mm and the largest individuals were 14.9 mm in length. The distribution for this date did show some clumping into two size groups. The division of the two populations occurred approximately at 7.2 mm, which was made from mean=±SD of 102 individuals.

The 22 July data showed evidence for a possible bimodal peak in the population distribution. The mean size of individuals in the smaller group occurred at 8.2 mm while the mean size of the larger group was approximately 13.9 mm. The smaller size distribution was greatly reduced by the distribution of larger individuals. The size range of the 263 individuals taken on this date was from 7.5 mm to 16.5 mm.

The 12 August distribution showed a very strong divergence of the population into two size groups. The smaller group, which contained approximately the same number of individuals as the large group, ranged from 8.2 mm to 11.4 mm. The larger group ranged from 13.6 mm to 16.5 mm. Some individuals of intermediate sizes between these size groups were found. The mean size of the first group was 9.7 mm and the second occurred at 14.9 mm. The sample size for August 12 totaled 90 individuals.

The population of myops on 9 October showed an approximately normal distribution about a single mean. The mean value (also the model occurred) at 12.3 mm. The width of size classes on this date was from 7.5 mm to 15.2 mm. The sample size on 9 October was 191.

Two very distinct and widely separated size groups of myops were found on 23 February. The smaller group included the smallest individuals of this population found on any date. These individuals were less than 2.0 mm in length. The average size of this group was 3.4 mm. The other cohort concurrent with the younger group had a mean size of 12.0 mm. Individuals of this larger group ranged from 9.1 mm to 19.6 mm in length. A total of 69 males was measured for this date.

A less distinct bimodal distribution of this myops was found on 6 May, 1977. The smaller group indicated appreciable growth since 23 February while the larger group had shown little or no growth for this time period. The younger cohort ranged in size from 4.2 mm to 9.8 mm with a mean body length equal to 7.3 mm. The older cohort enveloped into the smaller generation, which ranged from 9.6 mm to 15.0 mm with a mean of 12.1 mm. A total of 296 males were measured for this date. The distribution of the younger cohort became wider still at this time. It is possible that a portion of this population achieved a growth rate which enabled some of them to emerge within one year.
Fig. 1. Size distribution of Petasatus myops for respective collection dates.

DISCUSSION AND CONCLUSION

The size distributions of the population shown here for 1976-1977 support an annual reproductive hypothesis, that myops in northeastern Michigan possesses a two-year, or C1, development cycle.
The life history results showed evidence of a dumped, extended distribution on 29 June, 1964. A reduced, bimodal distribution occurred on 22 July, 1976, and 6 May, 1977. A distinct, widely separated bimodal distribution was found for both dates of 12 August, 1976, and 23 February, 1977. All of these data substantiate the fact that on these dates three distinct, concurrently, two cohorts of the same population of myops were present in the area. However, a large percentage of the population may require two years to complete their life cycle.

Only the 9 October population showed a normal distribution about a mean body length value. The 9 October date corresponds to the time when the emergence of the older cohort was complete but development of the offspring of the emerging generation had not yet begun. Thus, this single cohort represented the emergent generation of the following summer.

The reduced size of the smaller cohort which is more apparent on the 22 July collection demonstrates the bias of hand picking toward larger individuals. When two size groups were present, the larger individuals were picked preferentially to the smaller. On 12 August, again two cohorts were present, however, the larger population was more scarce owing to emergence and the smaller individuals were closer in size to the larger. This caused less size selectivity of the cohort on this date. On 23 February the early instar could not be hand picked; rather they were found by kick-sampling with a fine mesh net. Thus, these data do not represent the actual population distributions of myops in the Hance River.

The major growth period for both generations appears to be the months from May through the time of emergence. The non-emergent generation continues a rapid growth rate until October when it reaches a mean body length of approximately 12.0 mm. The mean body length of the younger cohort was found to develop 1.5 mm from 22 July through 12 August. This represents the maximum growth rate found for this population. The development of mean body length of the larger cohort was only 1.0 mm for this time period. This reduced growth is owing to emergence of a portion of this population. The smaller cohort continued to increase mean body length at approximately the same rate until October. The time period from 12 August to 9 October showed a 2.6 mm growth. Thus, a similar increase in mean body length of 1.2 mm month$^{-1}$ was found for the younger instars up through October. The non-emergent instars were found to disperse at a 2.0 mm body length with no appreciable growth during the winter months from October to May, whereas the period from 23 February through 9 May indicated good development for the younger cohort. These animals would only have to continue growth to about 15 mm before reaching the ultimate instar by the month of July.

Because the first instar nauplii were not found, the hatching, or egg diapause time cannot be estimated for this species under natural conditions. The first instar of Potamopyrgus was reported by Argus (1929) to be 10.0 mm in length. The nauplii found on 22 January were as small as 1.9 mm representing more than the third instar of this species. There are two possibilities for the development of the early instars. First, that the eggs of myops hatch soon after oosorption and develop to about the third instar when they overwinter. Second, the eggs of myops are dispersed over the winter and development of first instars does not begin until early February. The fact that Argus (1927) reports hatching times for Potamopyrgus of only 14 days in the laboratory, has no bearing on which type of development does exist because egg hatching is dependent on in vivo control of temperature. Regardless of which type of development does exist the growth of the new cohort is not significant during the winter months.

McCaflrey (1975) hypothesized the early instars of myops might bivouac. However, all nauplii of myops found from the Hanie River were found spacially on the undersides of algal mats located on the sub-littoral surface. Even on 23 February the early instars were found only at the bottom of the water column. Thus, the first instars of myops were not found. Because the first instar does not seem capable of actively burrowing owing to its small size and lack of tentacles, we hypothesize that myops has completely lost this ancestral trait and does not burrow throughout any part of its life cycle.

The simultaneous migration of myops during the winter months was a curious phenomenon. Two theories for this change of habits are possible. The first is that because of
physical-environmental factors the near-shore habitat became very unstable causing the
maids to move out to midstream. The winter of 1976-1977 was a cold one as evidenced by
the Huron River in this section being frozen over throughout most of the winter. Tempera-
tures, the formation of ice, or the accompanied flow reduction could have caused the
migration. The second theory relates to the biological competition for available food and space
between {sp} and the midge population. The chironomid larvae were extremely dense in
this area during the winter months. Their production and numbers could have forced {sp}
to the midstream habitat.

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