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Life Cycles, Standing Stocks, and Drift of Some Megaloptera, Ephemeroptera, and Diptera from Streams in Minnesota, U.S.A.

by

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From analyses of monthly length frequency distributions, univoltine life cycles were described for *Sialis dreisbachi, Stenonema vicarium,* and *Dicranota* sp. from stream riffles. Stream drift of immature *S. dreisbachi* and *S. vicarium* peaked near the ends of their life cycles in the spring. Drift of these two species was not related to standing stocks. *Dicranota* larvae exhibited negligible drift rates.

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INTRODUCTION

The present study describes the life cycles for *Sialis dreisbachi, Stenonema vicarium,* and *Dicranota* sp. from Minnesota streams. In addition, standing stock and daily drift estimates are compared with the seasonal patterns in the life cycle. This paper is part of a larger investigation on the secondary production of invertebrates for which it was necessary to determine the length of life for immature stages (Krueger 1979; Krueger and Cook 1981, in press.; Krueger and Waters 1983).

MATERIALS AND METHODS

Benthic samples were collected approximately once per month from February 1977 to February 1978 from a single riffle in North Branch Creek (43° 38′ N, 92° 14′ W) and in the Caribou River (47° 32′ N, 91° 04′ W). Collections were made with a modified Surber sampler (0.1 m^2) fitted with 471 μ netting (Krueger and Cook 1981). Duplicate invertebrate drift samples (24 hour) were collected by drift nets (15 x 30 x 180 cm) constructed of 471 μ mesh. Discharge through the nets was measured at the end of the 24 hour period. Stream discharge was at base flow on each of the dates sampled. Daily drift rates by month were calculated in the manner described by Waters (1972). Samples were preserved in 10% formalin. Larvae and nymphs were separated into size classes based on head widths or body lengths. Species identifications were based on adults captured at the streamside and on nymphs collected in the bottom samples (Flint 1964; Bednarik and McCafferty 1979; Byers 1978). Larvae and nymphs that were in good condition when measured were set aside by size class for later weighing. Mean individual wet weight was measured to the nearest 0.1 mg for each size class after centrifugation to remove excess water. Further information on the site locations and sampling procedures has been reported elsewhere (Krueger and Cook 1981; Krueger and Waters 1983).

RESULTS AND DISCUSSION

Sialis dreisbachi Flint (Megaloptera: Sialidae)

Monthly size class distributions for larval *S. dreisbachi* from North Branch Creek indicated a univoltine life cycle with larvae occurring for approximately ten months from July to April or May (Fig. 1). Larvae in the large size classes collected in early spring (March and April) had nearly disappeared by May, probably because of pupation and emergence. Adults were collected on streamside vegetation in May. Small larvae of the new generation dominated the samples in July and grew rapidly through October. During the winter months, larvae were present in a wide range of sizes and little growth occurred.

Stream drift of these larvae occurred principally in the spring and may have been related to movements associated with pupation (Fig. 2a). Standing stocks clearly reflected the life cycle; the decline of standing stocks in the spring was related to pupation and the increase in the summer and autumn months was coincident with recruitment of the new cohort and growth (Fig. 2b).

Previous descriptions of the life cycle of *S. dreisbachi* were not found in the literature. Univoltinism has been described for *S. aequalis* and *S. itasca* from West Virginia (Woodrum and Tartar 1973; Lilly et al. 1978) and *S. rotunda* from Oregon (Azam and Anderson 1969). *S. californica* has been reported to be either univoltine or hemivoltine dependent on the availability of food in an Oregon stream (Azam and Anderson 1969). Semivoltinism of two or three years has also been described for this genus and noted in the species that follow: *cornuta* in Alberta (Pritchard and Leischner 1973), *fuliginosa* in England (Elliott 1977),

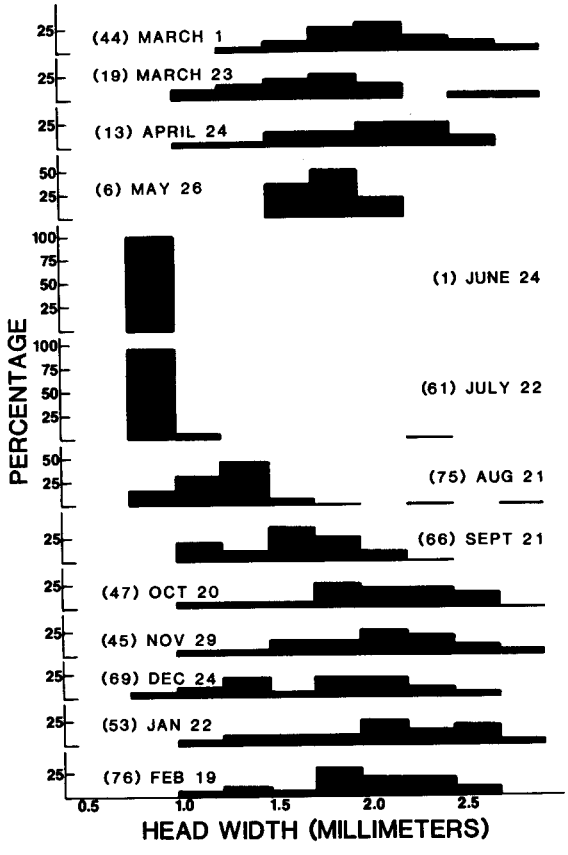

Fig. 1. Head width frequency histograms of larval *Sialis dreisbachi* collected in bottom samples from North Branch Creek. The number enclosed in parentheses to the left of the date is the number of individuals collected on that date.

lutaria in France and England (Giani and Laville 1973; Elliott 1977; Brooker 1979) and *mitsuhashii* in Japan (Yamamoto 1972).

Stenonema vicarium (Walker) (Ephemeroptera: Heptageniidae)

Size frequency histograms of nymphs collected in the Caribou River indicated a univoltine life cycle (Fig. 3). Nymphs of *S. vicarium* were present in the stream for approximately ten months, from the middle of July to early May. Nymphs in large size classes were observed in the spring and probably emerged from late April through May. In June, no nymphs were collected and eggs were probably incubating. The new cohort first appeared in July and grew rapidly until December. Daily drift of nymphs was highest in April and May near the end of the life cycle and did not appear to be related to standing stocks (Fig. 4a, b).

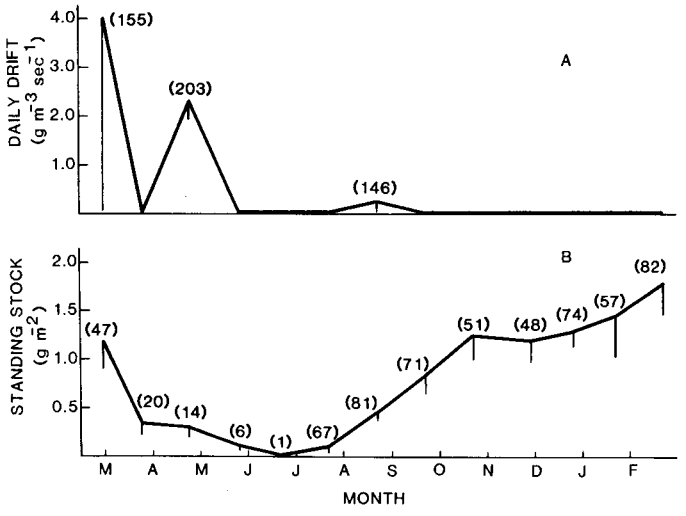

Fig. 2. Daily drift (A) and standing stock estimates (B) in wet weights for *Sialis dreisbachi* larvae from North Branch Creek. Vertical lines represent one standard error of the estimates. The number enclosed in parentheses is the estimated number of individuals. Abscissa tick marks represent the start of each month.

Similar univoltine cycles have been described for *S. vicarium* from West Virginia (Richardson and Tartar 1976), Wisconsin (Flowers and Hilsenhoff 1978), and Ontario (Ide 1939, Coleman and Hynes 1970). Barton (1980) classified the life cycle of this species as univoltine slow seasonal based on collections from Alberta. Other species of *Stenonema* have also been described as univoltine and this is apparently typical for the genus (Lyman 1955; Flowers and Hilsenhoff 1978; Richardson and Tartar 1976; Lamp and Britt 1981). Bivoltinism has been described for two species, *S. femoratum*, from Wisconsin (Flowers and Hilsenhoff 1978) and *S. modestum* from Virginia (Kondratieff and Voshell 1980).

Dicranota sp. (Diptera: Tipulidae)

A univoltine cycle for *Dicranota* was revealed by the temporal distribution of length classes of larvae collected from North Branch Creek (Fig. 5). The larval life stage extended for approximately eleven months, from May through March. Large larvae were collected in March and appeared to grow little between the beginning and end of this month. The absence of larvae in April suggests that pupation and emergence was occurring at this time. Small larvae of the new generation were first observed in May. Growth was slow from June through September for these tipulids. In October and following months, a regular pattern of growth into larger size classes was observed so that by February, the size class distribution approximated the March sample from the year before.

Stream drift during the year for this genus was virtually nonexistent with only one larva captured in the April drift net collections (Fig. 6a). Standing stocks of

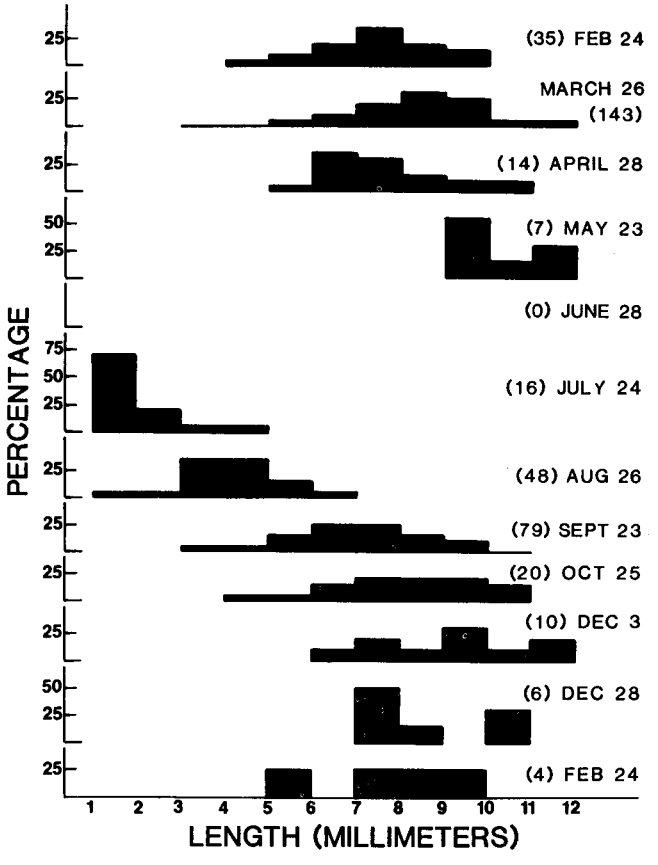

Fig. 3. Body length frequency histograms of *Stenonema vicarium* nymphs collected in bottom samples from the Caribou River. The number enclosed in parentheses to the left of the date is the number of individuals collected on that date.

Dicranota exhibited a sharp decline in April at the end of the life cycle and gradually increased in the months that followed (Fig. 6b).

Prior to this study, data from life cycle investigations of *Dicranota* generally have been difficult to interpret. In the Bigoray River, Alberta, *D. montana* clearly grew during the winter months; however, the life cyle became difficult to distinguish in the summer (Clifford 1969). Interpretation was also difficult for *Dicranota* size frequency distributions from Afon Hirnant, Wales (Hynes 1961). In Salem Creek, Ontario, *D. currani* was designated as univoltine based on the observance of a single flight period in the spring of the year (LeSage and Harrison 1981).

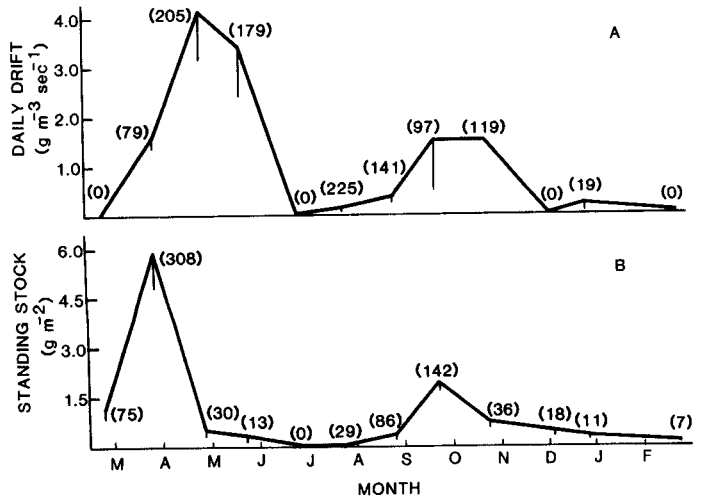

Fig. 4. Daily drift (A) and standing stock estimates (B) in wet weights for *Stenonema vicarium* nymphs from the Caribou River. Vertical lines represent one standard error of the estimates. The number enclosed in parentheses is the estimated number of individuals. Abscissa tick marks represent the start of each month.

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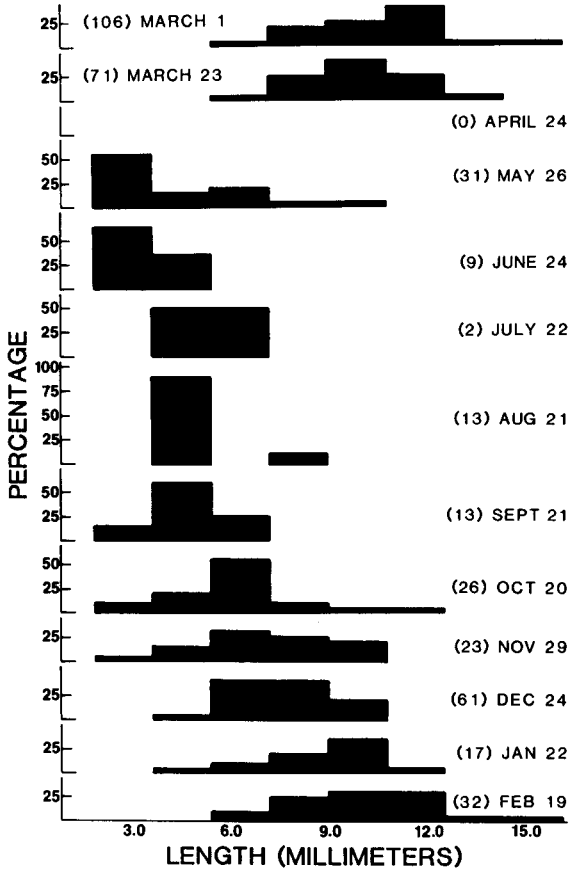

Fig. 5. Body length frequency histograms of larval *Dicranota* sp. collected in bottom samples from North Branch Creek. The number enclosed in parentheses to the left of the date is the number of individuals collected on that date.

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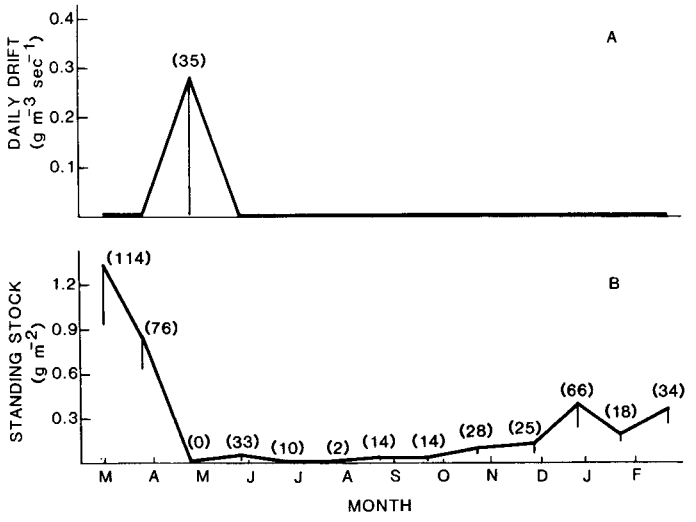

Fig. 6. Daily drift (A) and standig stock estimates (B) in wet weights for *Dicranota* sp. larvae from North Branch Creek. Vertical lines represent one standard error of the estimates. The number enclosed in parentheses is the estimated number of individuals. Abscissa tick marks represent the start of each month.

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