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**VOLTINISM AND LABORATORY REARING OF *MICROVELIA HINEI*
(HETEROPTERA: GERROMORPHA: VELIIDAE)**Steven J. Taylor¹ and J. E. McPherson²**ABSTRACT**

Voltinism in *Microvelia hinei* was studied in southern Illinois during 1989 and 1990. This species apparently overwintered as adults, which became active in late April; adults were last collected in late September. First instars were found from mid-May to late June, second instars from early-May to late October, third instars from mid-May to mid-July, fourth instars from mid-May to mid-August, and fifth instars from mid-May to mid-August. The sequences of peaks of nymphal instars and adults indicate that this species is at least bivoltine in southern Illinois. This species was reared from egg to adult at $26.7 \pm 0.6^\circ\text{C}$ and under a 14L:10D photoperiod. The incubation period averaged 6.41 days; and the five nymphal stadia, 4.28, 2.76, 2.52, 3.00, and 4.08 days, respectively. Total developmental time averaged 25.00 days.

Key Words: *Microvelia hinei*, voltinism, southern Illinois, life history, laboratory rearing.

The broadshouldered water strider *Microvelia hinei* Drake occurs from Massachusetts and New York south to Florida, and west to Oregon and California; it also has been reported from the West Indies, Mexico to Argentina (Smith 1988), and Ontario (Scudder 1987, Maw et al. 2000) and Nova Scotia (Maw et al. 2000), Canada. Illinois records are from southern Illinois and Iroquois County (Taylor 1996). Based on its presence in Michigan, Minnesota, Iowa (Smith 1988), and Wisconsin (Hilsenhoff 1986), it probably occurs in northern Illinois.

This species is found in a wide range of aquatic habitats. It has been collected from lakes and ponds where duckweed and emergent vegetation are abundant in southern Illinois (Taylor 1996). It also has been collected from "seepage pools" adjacent to a river and at the swampy margin of a farm pond in the Carolinas (Sanderson 1982); lake, pond, swamp, and impoundment habitats in New Jersey (Chapman 1959); primarily from ponds and marshes, but also from creeks and lakes, in Minnesota (Bennett and Cook 1981); lentic habitats throughout Wisconsin (Hilsenhoff 1986); ponds and quiet streams in Missouri (Froeschner 1962); "cattail pools" and at a spring-fed stream in California (Polhemus and Chapman 1979); and "mats of sphagnum moss in the quite-acid swamp and bog streams" in Florida (Herring 1950). It has been found with *Hebrus burmeisteri* Lethierry and Severin in Minnesota (Bennett and Cook 1981) and with *Microvelia americana* (Uhler) and *Microvelia pulchella* Westwood in Virginia (Bobb 1974).

Little is known about the life cycle of this insect. Specimens, presumably or actually listed as adults, have been collected in March and April in Virginia (Bobb 1974); in April, May, and September in New Jersey (Chapman 1959); from late May to late October in Missouri (Froeschner 1962); and in February, March, and September in northern Florida (Herring 1950). Overwintering adults have been found in November in detritus below leaf litter near a pond in Minnesota (Bennett and Cook 1981). This species has five nymphal instars (Hoffmann 1925).

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During 1989 and 1990, we studied voltinism in a population of *M. hinei* at President's Pond on the Southern Illinois University at Carbondale campus, Jackson County (see Taylor [1996] for detailed description of pond). The roughly triangular 0.29 hectare (0.71 acre) pond is connected at its northern end to an adjacent lake by a narrow channel (approximately 2-5 m wide, 2 m deep). Water depth along the eastern margin (where the present study was conducted) increased sharply between 1 and 2 m from shore and commonly exceeded 2 m at 2.5 m from shore.

Floating, emergent, and shoreline vegetation associated with the pond was diverse (Taylor 1996). The western margin was bordered by a narrow, dense band of cattails (*Typha angustifolia* L.). The southern border consisted of a riprap dam covered with soil and crossed by a paved road. The eastern margin was bordered by overhanging trees and other vegetation. During the summer, the pond filled with a dense growth of aquatic vascular plants and filamentous algae. Near the shoreline and wherever aquatic plants reached the water surface, duckweeds built up into dense mats. The duckweeds [i.e., *Lemna minor* L., *Spirodela polyrrhiza* (L.) Scheiden, and *Wolffia papulifera* Thompson] tended to move around the pond because of air currents unless they were partially anchored in the underlying aquatic vegetation.

Presented here is information on voltinism in *M. hinei*, including times of occurrence of the adults and nymphal instars in the field. We also discuss our method for distinguishing instars and present the results of our rearing of this insect under controlled photoperiod and temperature.

MATERIALS AND METHODS

Field life history. Samples were collected weekly from 18 March to 25 November 1989 and biweekly from 11 February to 2 December 1990, dates that encompassed seasonal activity. Sampling was limited to an area along the eastern shore because (1) the cattails along the western shoreline prevented use of the quadrat sampler (see below); (2) the riprap shoreline of the southern border was unnatural and, often, disturbed by fishermen; and (3) the water surface along the eastern shore, which was a mosaic of open water, duckweeds, and emergent stems, supported a diverse gerromorphan fauna.

Four 60 m transects were made parallel to a relatively uniform section of the eastern margin at 0, 0.5, 1.0, and 1.5 m from the shoreline. Each sample was collected with a floating quadrat sampler (0.25 x 0.25 x 0.05 m), with four replicates placed randomly along each transect; the resulting 16 quadrat samples were pooled, providing a broad sampling of the habitat. The pooled data from each of the 16 quadrat samples were used for the life-history analysis. Prior to each sample, the collector (SJT) stood for approximately 3 min. to allow the insects to acclimate to the disturbance; then, the sampler was placed on the surface of the water. Specimens were removed with a fine mesh nylon net, preserved in alcohol, and sorted in the laboratory.

Distinguishing instars. Ability to distinguish nymphal instars and adults was based on field and laboratory data. It was difficult to find characters to distinguish instars because of small sample sizes of some instars, small body size of early instars, and the lack of readily discernible characters. However, we found the third through fifth instars could be distinguished by mesotibial length, the method used by Taylor and McPherson (1999) for *M. pulchella*. The gap between the first and second instars was not complete and, thus, separation of these instars was somewhat subjective (Fig. 1). Adults were primarily apterous but some macropterous individuals were collected. They were distinguished from nymphal instars by the external genitalia or the presence of wings.

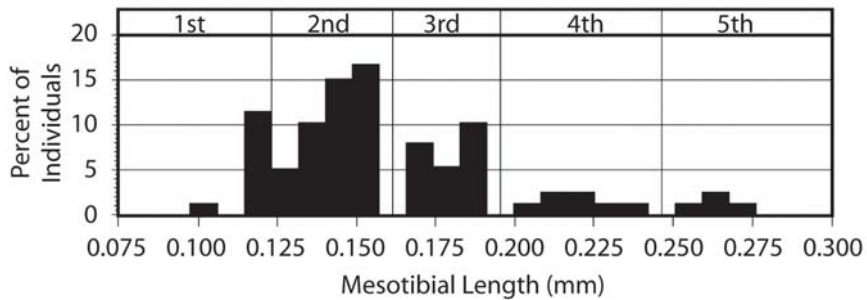


Figure 1. Approximate instars of *Microvelia hinei* (n = 78) as delineated by mesotibial length (mm). Based on 1989 and 1990 collections from President's Pond, SIU Campus, Carbondale, Illinois.

Laboratory Rearing. Twenty-five adults (14 males, 11 females) were collected from a small pond in Jackson Co. on 3 July 1991 (N 37° 39' 18.4", W 89° 17' 47.9", altitude 135 m), brought to the laboratory, and placed in plastic containers (1 male, 1 female/container). Each plastic container (3.5 cm deep x 5.4 cm diam. [top] and 3.7 cm diam. [bottom]) was half-filled with deionized water. A plastic disk (3.5 cm diam., with seven 0.6 cm diam. holes) was placed on the surface. The holes were made to create a longer intersection line (Hess and Hall 1943) between the "land" (plastic disk) and water. Two paper strips of cardstock (approximately 1.25 x 2.5 cm) were angled against opposite sides of each plastic container with the tops above the water. These strips served as oviposition sites and allowed individuals to leave the water.

Containers were checked daily for eggs. Plastic disks or paper strips with attached eggs were transferred to new containers. If eggs were deposited on the walls of the container, adults were transferred to a new container. As eggs hatched, the newly emerged first instars were transferred to new containers prepared similarly to those for adults but without the strips. Nymphs of the same instar molting to the subsequent instar on the same day were transferred to new containers if other nymphs in the container had not molted. The water level was maintained just above (1-3 mm) the eggs. Maximum numbers of individuals reared per container were six first instars, four second instars, three third instars, and one fourth or fifth instar. Adults reared from these eggs were preserved in 70% ethanol.

Each adult was fed one, and each nymph one-half, frozen adult fruit fly (*Drosophila melanogaster* Meigen) per day. Flies were crushed or torn slightly for nymphs to facilitate feeding. Flies were replaced daily.

All individuals were maintained in incubators at $26.7 \pm 0.6^\circ\text{C}$ under a 14L:10D photoperiod. All containers were changed at least once per week but more frequently when water became cloudy or bacterial growth was observed.

Data were analyzed with the SAS (SAS Institute 1988) TTEST procedure. Level of significance was set at 0.05.

RESULTS AND DISCUSSION

Field life history. In southern Illinois, *M. hinei* apparently overwintered as adults, which became active in late April; adults were last collected in late September (Figs. 2-5). First instars were found from mid-May to late June, second instars from early-May to late October, third instars from mid-May to mid-July, fourth instars from mid-May to mid-August, and fifth instars from mid-May to mid-August. The

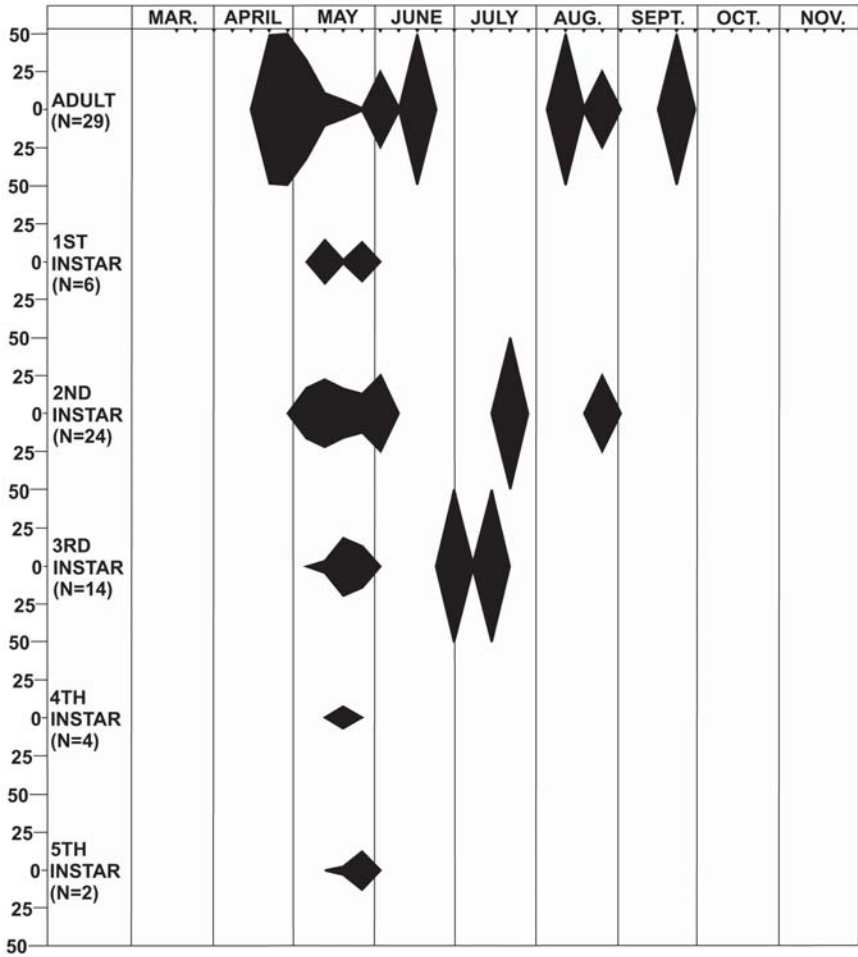


Figure 2. Percent of individuals in each stage per sample of *Microvelia hinei* collected at President's Pond, SIU Campus, Carbondale, Illinois, during 1989. Beginning and end points of each shaded area represent sample dates preceding and following collection of specimens, respectively.

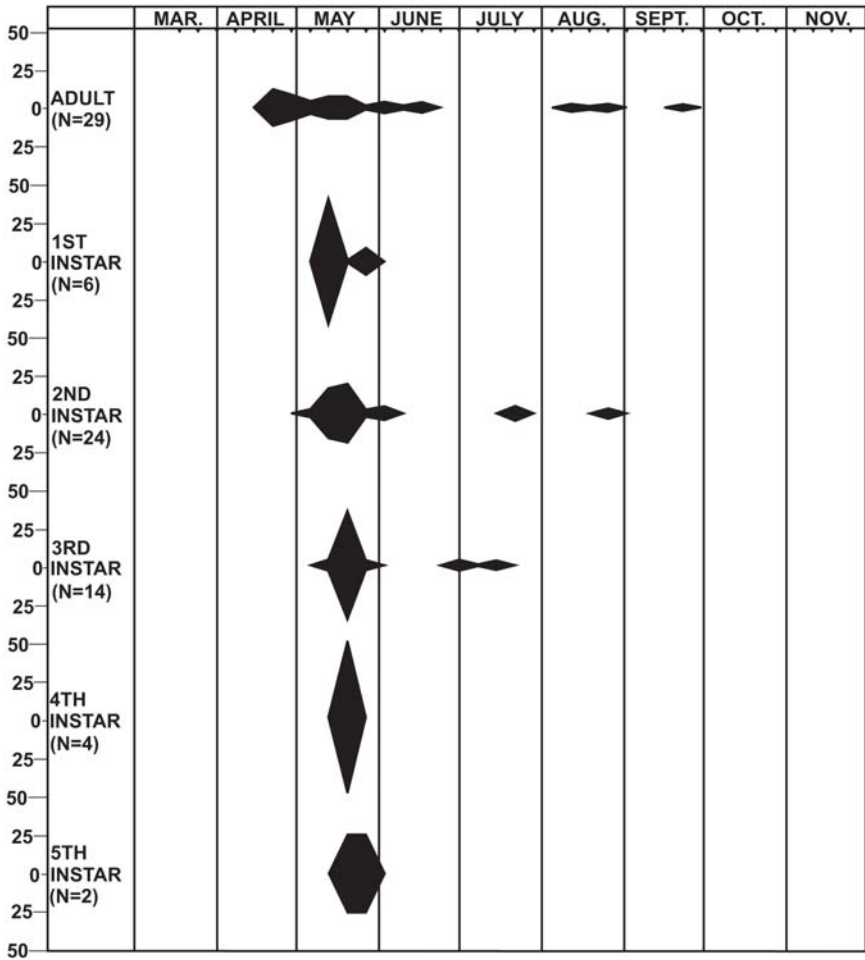


Figure 3. Percent in each sample of total individuals of same stage of *Microvelia hinei* collected at President's Pond, SIU Campus, Carbondale, Illinois, during 1989. Beginning and end points of each shaded area represent sample dates preceding and following collection of specimens, respectively.

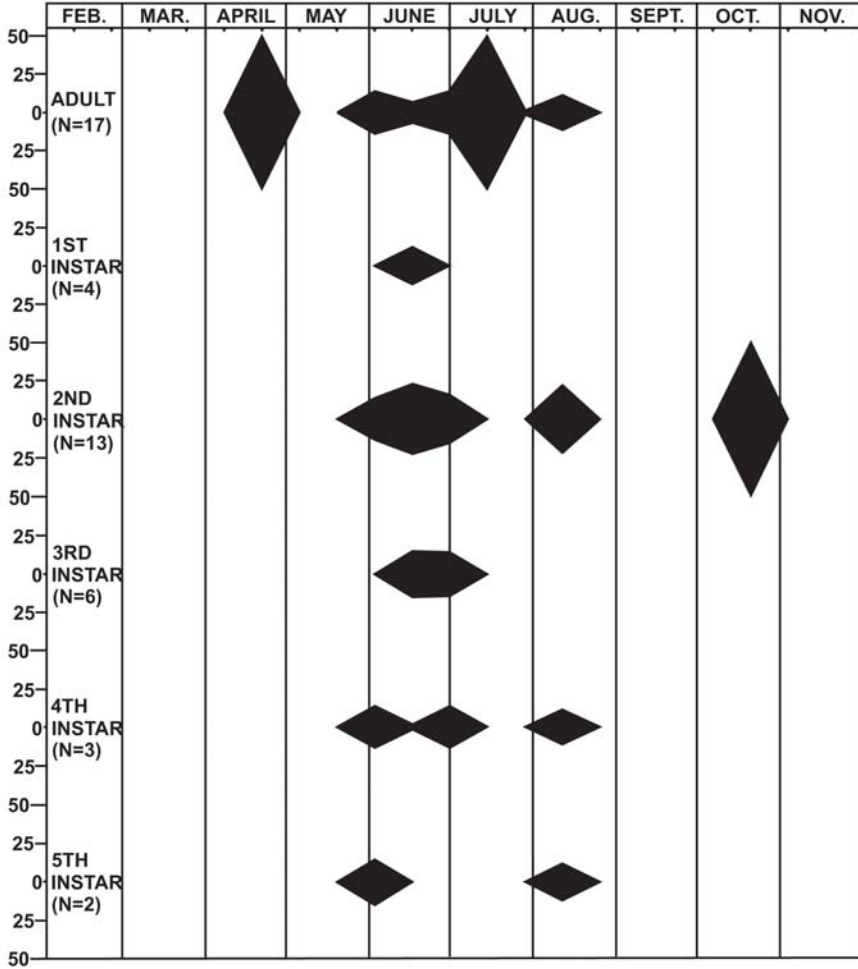


Figure 4. Percent of individuals in each stage per sample of *Microvelia hinei* collected at President's Pond, SIU Campus, Carbondale, Illinois, during 1990. Beginning and end points of each shaded area represent sample dates preceding and following collection of specimens, respectively.

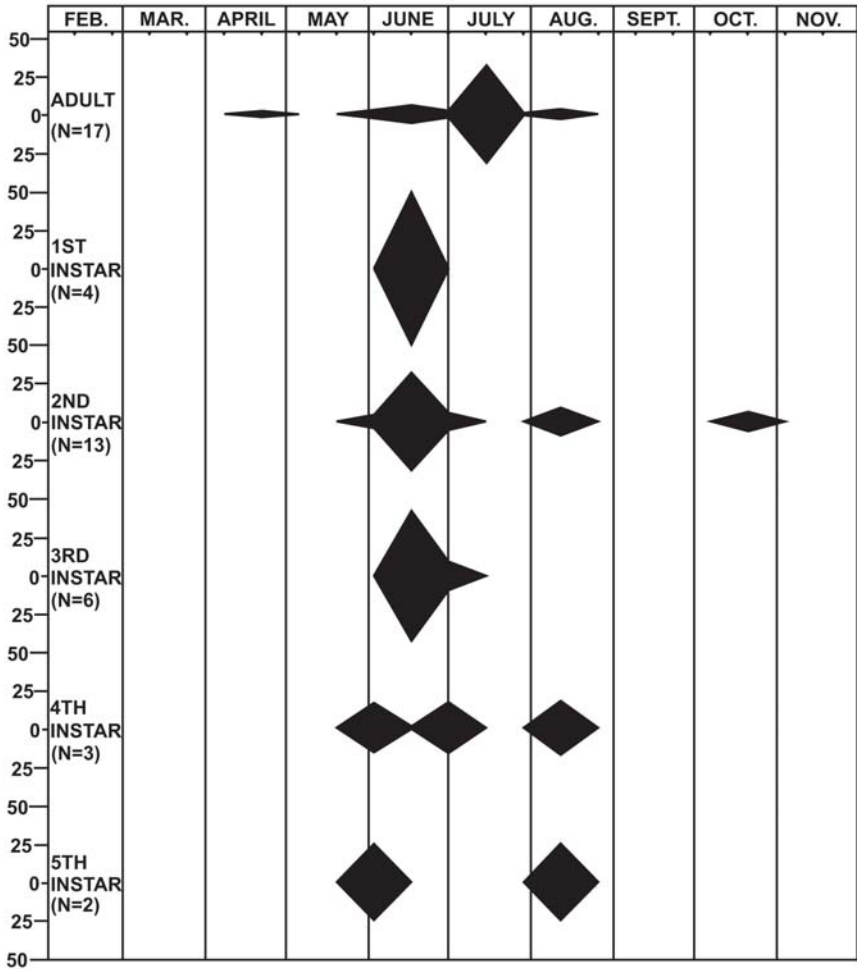


Figure 5. Percent in each sample of total individuals of same stage of *Microvelia hinei* collected at President's Pond, SIU Campus, Carbondale, Illinois, during 1990. Beginning and end points of each shaded area represent sample dates preceding and following collection of specimens, respectively.

sequences of peaks of nymphal instars and adults suggest that this species is at least bivoltine in southern Illinois. Because of the low numbers collected during this study (1989, $n = 79$; 1990, $n = 45$), it is possible that additional generations were missed.

We also examined Illinois specimens housed in various collections (see Acknowledgments). These specimens had been collected from 20 March to 19 October (122 adults, 25 nymphs) (Taylor 1996). Most adults had been taken from late March through April ($n = 15$, 12.3%), from mid-June through July ($n = 51$, 41.8%), and in October ($n = 52$, 42.6%). The remainder, two females and two males, had been collected in May and September, respectively. The nymphs had been collected in June ($n = 4$), July ($n = 17$), and October ($n = 4$). These data also suggest two generations per year, with adults overwintering, thus supporting the results of our study.

Laboratory rearing. Eggs ($n = 71$) generally were deposited on paper strips in the rearing containers. The incubation period averaged 6.41 days (Table 1). The first through fifth stadia averaged 4.28, 2.76, 2.52, 3.00, and 4.08 days, respectively; mean of the fifth stadium was identical for both sexes (Table 1). Total developmental time averaged 25.00 days; no sexual difference was detected ($t = 1.3583$, $df = 11$, $P = 0.2016$).

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Table 1. Durations (in days) of immature stages of laboratory-reared *Microvelia hinei*.

Stage	Sex	Number completing stadium	Mean \pm Std. Err.	Range
Egg ^a		70	6.41 \pm 0.19	5-12
First instar		46	4.28 \pm 0.18	2-7
Second instar		33	2.76 \pm 0.12	1-4
Third instar		29	2.52 \pm 0.12	2-4
Fourth instar		17	3.00 \pm 0.17	2-5
Fifth instar	Males + Females ^b	13	4.08 \pm 0.24	3-6
	Males	2	4.00 \pm 1.00	3-5
	Females	10	4.00 \pm 0.26	3-6
Egg through fifth instar	Males + Females	14	25.00 \pm 0.48	22-28
	Males	2	26.50 \pm 0.50	26-27
	Females	11	24.64 \pm 0.56	22-28

^a71 eggs were laid.

^bOne individual died during molting and was not sexed.

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