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LIFE HISTORY OF *MESOVELIA MULSANTI* (HEMIPTERA: MESOVELIIDAE) IN SOUTHERN ILLINOIS

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ABSTRACT

The life history of *Mesovelia mulsanti* was studied during 1983-1986. This species was apparently trivoltine with a partial 4th generation at the end of the year. It overwintered as eggs. First instars appeared in mid-April followed by marked overlapping of the subsequent instars and generations. The first adults appeared in early May. No active individuals were found after November.

The water treader *Mesovelia mulsanti* White ranges from southern Canada through much (all?) of the United States to the West Indies and Argentina, and also occurs in Hawaii (Polhemus and Chapman 1979). It is very common in southern Illinois.

Scattered notes have been published on this bug's life history. It occurs in shaded and unshaded areas, generally on the surface of standing water covered with much vegetation (e.g., duckweeds, algae) (Andersen 1979; Andersen and Polhemus 1980; Bennett and Cook 1981; Bobb 1974; Brooks and Kelton 1967; Ellis 1952; Herring 1950; Hilsenhoff 1986; Hoffmann 1932; Hungerford 1917, 1919, 1924; Neering 1954; Polhemus and Chapman 1979; Torre-Bueno 1905, 1908, 1923; Uhler 1884; Williams 1944; Wilson 1958). It is predaceous, feeding chiefly on insects found on the water surface (Bennett and Cook 1981; Bobb 1974; Brooks and Kelton 1967; Hoffmann 1932; Hungerford 1917, 1919; Polhemus and Chapman 1979; Uhler 1884) and possibly small organisms (e.g., Crustacea) that come to the surface film from below (Brooks and Kelton 1967; Hungerford 1917, 1919).

The overwintering stage of this bug was unknown for many years. Early authors felt *M. mulsanti* overwintered as adults (Hungerford 1917, 1919; Uhler 1884); this belief occasionally appears in more recent literature (e.g., Brooks and Kelton 1967). However, it has become apparent that in northern parts of North America, it overwinters as eggs (Bennett and Cook 1981; Bobb 1974; Galbreath 1973, 1975; Hilsenhoff 1986; Hoffmann 1932); nymphs and adults do not survive hard freezes (Galbreath 1973). In the southern United States, it is active year around (Herring 1950, Polhemus and Chapman 1979); surprisingly, Froeschner (1949) reported adults had been found throughout the year in Missouri.

Females, at least in northern areas, are capable of laying both diapause and nondiapause eggs. Near the end of seasonal activity, they can lay only nondiapause, or diapause and nondiapause, or only diapause eggs with the transition from nondiapause to diapause occurring in early September (Galbreath 1973). Diapause eggs overwinter (Galbreath 1973, 1975) and cold exposure promotes development in these eggs (Galbreath 1973).

Eggs are inserted into plant tissue (Brooks and Kelton 1967; Galbreath 1973, 1975; Hoffmann 1932; Hungerford 1917, 1919, 1924).

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M. mulsanti has been reported to have several generations per year (Hilsenhoff 1986; Hungerford 1917, 1919; Torre-Bueno 1923); Galbreath (1973, 1975) stated five or more.

This bug has been reared in the laboratory under uncontrolled (Hoffmann 1932; Hungerford 1917, 1919; Neering 1954) and controlled (Galbreath 1975, Lanciani 1987) conditions and the egg (Cobben 1968; Hoffmann 1932; Hungerford 1917, 1919) and five nymphal instars (Hoffmann 1932; Hungerford 1917, 1919) have been briefly described.

For the past four years (i.e., 1983-1986), I have studied the life history of a population of *M. mulsanti* occurring in the La Rue-Pine Hills Ecological Area. This area, which is part of the Shawnee National Forest, is located in the northwest corner of Union County, Illinois, and is ca. 30 km northeast of Cape Girardeau, Missouri. It includes both heavily forested limestone bluffs, and moist forests at the base of these bluffs that surround La Rue Swamp and Winters Pond. These aquatic habitats are continuous and it is here where this mesoveliid occurs. Much of the study area is blanketed with duckweeds (i.e., *Lemna, Spirodela, Wolffia,* and *Wolffiella)* along the shoreline.

This paper presents the life history of this insect.

MATERIALS AND METHODS

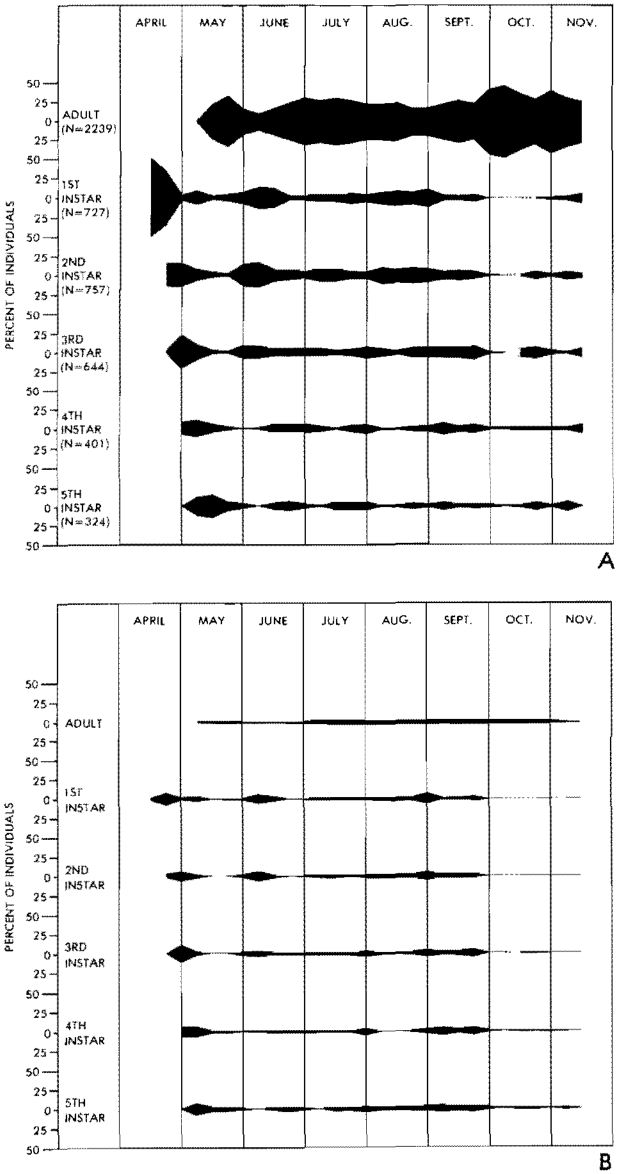
The study began in March 1983, before the bugs became active that year. Samples of adults and (or) nymphs were taken with an aquatic net at ca. weekly intervals at six sites along the edge of the study area into November when all nymphs and adults had disappeared. Sampling during the following three years was conducted similarly. All samples were preserved in 75% ethanol and subsequently examined in the laboratory to accurately determine the developmental stages present in each sample. Occasional samples were also taken during the winter to determine the overwintering stage(s). Data gathered during the four years of this study were combined to gain a better understanding of the annual life cycle.

RESULTS AND DISCUSSION

This insect overwintered as eggs and became active in mid-April (Fig. 1A-B). This statement is based on the following data, even though no eggs were found during the study. Adults and all nymphal instars were active into mid-November but had disappeared from samples by late November. However, the first individuals found the following spring were all 1st instars, and in much higher numbers than the previous fall. Although it is possible that some of the early spring 1st instars had successfully overwintered, it is highly unlikely that environmental conditions severe enough to kill older individuals, including adults, could have spared the 1st instars. Therefore, the most plausible explanation supports those authors (cited above) who have stated *M. mulsanti* overwinters as eggs.

This species generally has been considered to have several generations per year, perhaps exceeding five. My data do not support this contention for southern Illinois. There were three clearly defined peaks (April-May, June, and August-September) (Fig. 1B). The small peaks in July-August for the 3rd-5th instars resulted from a high number of these individuals collected at one site on the same date and do not represent a general trend. Thus, this insect appears to be trivoltine with a partial 4th generation at the end of the year. However, it is possible, as Dr. J. E. Galbreath has stated (pers. comm.), that additional generations may have been masked in the rather extended 3rd. The range of dates of seasonal activity for nymphs and adults (i.e., mid-April-mid-November) closely corresponds to that of Galbreath (1975).

The wide distribution of this species from southern Canada to the West Indies and Argentina, and even to Hawaii, exposes it to a wide range of annual temperatures and moisture; it is at the same time both a temperate and a tropical species. Although this insect's life history apparently has not been thoroughly studied in the southern parts of its range, it is known to be reproductively active throughout most of the year in Florida (Herring 1950) and year around at even lower latitudes (Polhemus, pers. comm.). Thus,



Figs. 1A-B. (A) Percent of individuals in each stage per sample of *M. mulsanti* during 1983–1986 combined seasons in Union County, Illinois. (B) Percent in each sample of total individuals of same stage of *M. mulsanti* during 1983–1986 combined seasons in Union County, Illinois. For both figures, bars extend to last date specimens were collected; dashed lines between first and last dates indicate no specimens were found.

it appears that diapause plays less of a role, if any, in the survival of this insect in subtropical and tropical areas and, conversely, more of a role in temperate areas.

According to Tauber et al. (1986), seasonal cycles are often influenced by photoperiod progression, the most predictable cue to future conditions. At least for temperate species, however, temperature and other environmental factors may modify the effects of photoperiod. For equatorial and tropical insects, effects of temperature and moisture may override the role of photoperiod.

Incorporation of diapause into the life cycle has several advantages, two of which are (1), enabling the insect to survive harsh seasonal conditions and (2), synchronizing development of postdiapause individuals. Production of a partial (i.e., nondiapause) generation at the end of a season (as occurs in *M. mulsanti)* would appear to be disadvantageous, as these offspring would not survive the winter. It would be disadvantageous if the final generation were never completed. However, if the length of favorable conditions in the fall is so variable that occasionally the last generation is completed, then it is advantageous to reproduce as long as possible even at the risk of losing the final generation.

An insect that produces nondiapause and diapause individuals late in the season in a variable climate is, to use Tauber et al.'s term, "bet-hedging." The population always is prepared to survive the rigors of winter because it produces at least some diapause individuals. In those years in which the final generation is not completed, the diapause individuals will be the only source of the next generation. However, in those years in which the final generation is completed, the potential number of offspring of these parents surviving the winter is increased as is, therefore, the probability that their particular genes will be passed on to subsequent generations.

M. mulsanti is trivoltine in southern Illinois with a final partial generation and, as Galbreath (1973) noted, produces an increasing number of diapause eggs toward the end of the season. This is the long-day type of response described by Tauber et al. (1986) (i.e., insect reproduces, grows, and develops during the long-day conditions of late spring and early summer and enters diapause during the short-days of late summer and fall). Tauber et al. (1986) also noted that low temperatures tend to enhance the diapause-inducing effects of short-days and, by implication, high temperatures tend to reduce these effects. Galbreath (1973) stated that daylengths of 13 hrs or less in southern Illinois apparently stimulate the development of diapause eggs and that high temperatures might block this. She also found (1976) that age is apparently important as females tend to lay a higher proportion of diapause eggs as they near senility. The advantage to this age effect is that during transition from nondiapause to diapause eggs, the same female may provide for a subsequent nondiapause generation and for an overwintering diapause generation.

I predict that this insect lays few or no nondiapause eggs late in the season in the most northern parts of its range. Likewise, tropical and, perhaps, subtropical populations either are unable to produce diapause eggs or, if able, are normally prevented from doing so by warmer temperatures.

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