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# ODONATA ASSOCIATED WITH WATER LETTUCE (*PISTIA STRATIOTES* L.) IN SOUTH FLORIDA

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Larval Odon. were identified from quantitative samples of water lettuce made from a single pond. 3 spp. of Zygoptera accounted for more individuals but less biomass than 4 spp. of Anisoptera. Numbers of larvae were highest in the winter when smallest size classes predominated, and lowest in the spring and summer when larger size classes were present. Size class data indicated a probable spring emergence for *Telebasis byersi* and *Pachydiplax longipennis* and an autumnal emergence for *Coryphaeschna adnexa*. Foregut dissections of freshly caught larvae revealed identifiable remains of certain prey, the commonest being larvae of *Mansonia* mosquitoes which attach to roots of *P. stratiotes*.

## INTRODUCTION

The cosmotropical macrophyte *Pistia stratiotes* L. is known to be an important nursery for aquatic insect life (DUNN, 1934; MACFIE & INGRAM, 1923). Among insect orders found on *P. stratiotes* in Volta Lake, Ghana, larval Odonata dominated in biomass and were second to Diptera in absolute numbers (PETR, 1968). Representatives of at least five genera of Anisoptera and three genera of Zygoptera were recovered during Petr's ten-month study. Larval Anisoptera accounted for approximately ten times more biomass than Zygoptera on Volta Lake, but DRAY et al. (1988) reported that dragonfly larvae were relatively uncommon on water lettuce in Florida.

The present paper represents a portion of a two-year study undertaken to identify the aquatic insect fauna on water lettuce at one locality and to describe the relationship between mosquitoes of the genus *Mansonia*, other members of the insect community, and growth of this host plant (LOUNIBOS & DEWALD,

1989; DEWALD & LOUNIBOS, 1990). Because we obtained accurate, specific identifications of Odonata and information on abundances, seasonality and, to a lesser extent, prey, these results are presented separately from a comprehensive publication (in preparation) which will deal with all the aquatic insect fauna.

## STUDY SITE AND METHODS

A monoculture of water lettuce was sampled monthly from an abandoned aquaculture pond (17x10 m) at Chinese Farm in St Lucie County, Florida (27°6′ N, 80°5′ W). Five quadrats each of 900 $cm^2$ were selected on each sample date and removed with a tool designed to cut through the *P. stratiotes* mat and trap the underlying water column (DEWALD & LOUNIBOS, 1990). Plant collections were returned in twenty-litre buckets to the laboratory where live invertebrates were separated in white enamel trays from plant tissue, counted and identified to order.

Larval Odonata were preserved in 70% alcohol, and lengths, excluding antennae and caudal lamellae, measured. Representatives of each morphotype were sent for identification to Drs M.J. Westfall and S. Dunkle of the International Odonata Research Institute. Identified specimens, larval keys (NEEDHAM & WESTFALL, 1955), and species descriptions (e.g. BYERS, 1930; WESTFALL, 1953, 1957), were used to make species determinations on all remaining material. We did not attempt to distinguish between *Ischnura posita* Needham and *I. ramburi* Calvert, both of which were recognized among material identified by Drs Westfall and Dunkle.

Odonate biomasses were estimated from lengths by application of a power equation ($r=0.94$, $n=43$) derived by SMOCK (1980) from data on *Argia* spp., *Boyeria vinosa* Say and *Gomphus* spp. For describing seasonal abundances of total larvae (Fig. 1), numbers in each quadrat were converted to a $m^2$ basis; for abundances of size classes separated by species and sample dates (Figs 2-4), the total numbers on a given sample date were divided by the total area to obtain a $m^2$ value.

From four collections during 1986-87, foreguts were dissected from larvae preserved immediately after capture and examined for exoskeletal remains of invertebrate prey. Guts with no identifiable remains were classified as "empty"(PRITCHARD, 1964). Larval exoskeletons of the mosquito genus *Mansonia* (s.l.), which include three species in Florida (SLAFF & HAEFNER, 1985), were recognized by their serrated siphons.

## RESULTS

Four species of Anisoptera and three species of Zygoptera were recognized during thirteen months of samples from which 3,912 larvae were identified to species. The zygopteran *Telebasis byersi* Westfall was by far the most abundant species followed by the anisopterans *Erythemis simplicicollis* Say and *Pachydiplax longipennis* Burmeister (Tab. I). In terms of larval biomass, *T. byersi* and *P. longipennis* were the dominant species, followed by *Coryphaeschna adnexa* Hagen, even though the latter accounted for only 1.8% of individuals identified. *Miathyria marcella* Selys and *Ischnura* spp. collectively accounted for 7.1% of the odonate biomass, even though the two *Ischnura* species were nearly five times as abundant as *C. adnexa.*

Numbers of odonate larvae were highest in winter samples, decreased in the spring, and were lowest in late spring, early summer and early autumn (Fig. 1).

Table I
Abundance and biomasses of larval Odonata recovered from water lettuce on thirteen collection dates, five samples per collection

| Species | Mean no./m² | SE | Mean biomass (mg/m²) | SE |
|---|---|---|---|---|
| *E. simplicicollis* | 33.78 | 3.68 | 244.42 | 31.00 |
| *P. longipennis* | 27.30 | 3.09 | 590.17 | 92.88 |
| *C. adnexa* | 4.45 | 0.91 | 426.68 | 87.48 |
| *M. marcella* | 2.79 | 0.60 | 49.30 | 13.98 |
| *T. byersi* | 156.95 | 19.14 | 497.50 | 86.78 |
| *Ischnura* (2 spp.) | 20.13 | 4.68 | 86.88 | 16.93 |

For *T. byersi,* individuals less than 5.0 mm in length dominated samples from October to early March (Fig. 2). The largest size class of *T. byersi* (12.1-14.9 mm) was recovered only between March and May.

The largest larvae of *P. longipennis* occurred only in winter and early spring collections (Fig. 3), and the maxima in absolute numbers of this species were collected in the winter. The largest numbers of *E. simplicicollis* larvae were found in a mid-summer collection, preceded by a spring sample which contained the two largest size classes of this species (Fig. 4). Whereas the largest individuals of *P. longipennis* and *E. simplicicollis* did not exceed 24.0 and 21.0 mm in length, *C. adnexa* up to 39.0 mm were recovered (Fig. 4). Total numbers of *C. adnexa* or *M. marcella* were too few to resolve any seasonal trends in size class frequencies.

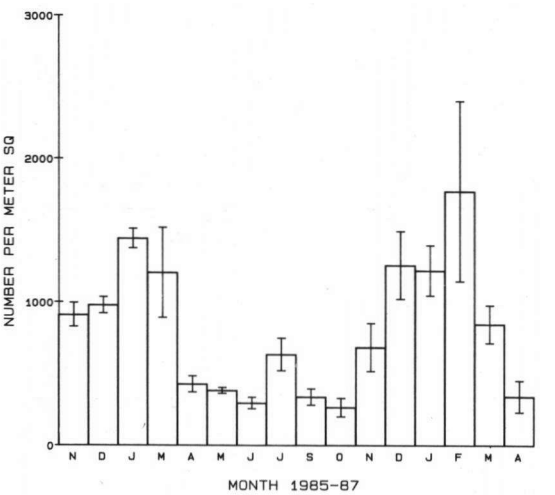


Fig. 1. Seasonal densities of larval Odonata from quadrat samples made approximately monthly at Chinese Farm. Values are means and SE of each sample converted to a m² basis. No samples were taken in February or August of 1986.

From 149 larvae dissected to examine foregut contents, 51.7% contained identifiable invertebrate exoskeletal parts (Tab. II). The incidence of "non-empty" foreguts varied among collection dates and was usually higher for Anisoptera than for Zygoptera. From the 77 foreguts with

Table II
Dissections of larval Odonata from water lettuce for identification of invertebrate prey

| Collection date | Pond* no. | No. dissec. | Median length (range) | No. with inverts | No. with *Mansonia* |
|---|---|---|---|---|---|
| Jan. 29, 1986 | A8 | 10 zyg | 12 (10-15) | 10 | 1 |
| | | 10 ani | 7.5 (5-26.5) | 10 | 3 |
| Jan. 31, 1986 | A10 | 7 zyg | 9.5 (8-10) | 3 | 1 |
| | | 7 ani | 9 (7-15.5) | 6 | 0 |
| Nov. 17, 1986 | A8 | 16 zyg | 6 (4-11) | 6 | 1 |
| | | 13 ani | 9.5 (5-18) | 10 | 2 |
| Jan. 5, 1987 | A8 | 77 zyg | 7 (3-13) | 24 | 6 |
| | | 9 ani | 9 (4-19) | 8 | 2 |

* A8 is the pond used in most of the study; A10 is a neighboring water lettuce pond of the same dimensions.

invertebrate remains, 20.7% contained exoskeletons of *Mansonia,* a higher frequency than for any other taxon recognized. Other identifiable remains in order of frequency were: mites, Crustacea, midge (Chironomidae) larvae, Zygoptera larvae, adult beetles and larvae of other species of mosquitoes.

## DISCUSSION

The relative importance of Odonata to the insect community on water lettuce in Florida appears comparable to that on Volta Lake (PETR, 1968). However, the odonate community on *P.stratiotes* Ghana was more diverse and Anisoptera accounted for a greater proportion of the odonate biomass. Petr's estimate of odonate standing crop was 46.9 gm/ $m^2$ of water lettuce, a value more than twenty times greater than mean odonate biomass in Florida (Tab. I). Some of this difference may be attributable to the prominent seasonality in Florida where winter cold maintains larvae in smaller instars and reduces host plant availability (DEWALD & LOUNIBOS, 1990).

We are surprised that DRAY et al. (1988) reported dragonfly larvae to be uncommon on water lettuce elsewhere in Florida. Moreover, the only Odonata identified to genus by these authors were *Enallagma* sp. and *Nehalennia* sp., two zygopterans not recognized in our study.

Previous work in Florida has shown that *T. byersi, M. marcella* and *E. simplicicollis* have particular associations with aquatic plants (WESTFALL, 1957; PAULSON, 1966; DUNKLE, 1989). Although *P. longipennis* has a greater habitat breadth, it is frequently found co-occurring with *E. simplicicollis* and *I. ramburi* (PAULSON, 1966). *Coryphaeschna adnexa* was only recently discovered in Florida (DUNKLE, 1989), but its frequency may be facilitated by the recent spread of floating aquatic macrophytes, as has been documented to

account for the increase of *M. marcella* associated with the proliferation of water hyacinth in Florida (PAULSON, 1966).

Among Old World Odonata favoring aquatic plants, larvae of *Urothemis assignata* Selys are known to live amongst the roots of floating macrophytes in Nigeria (HASSAN, 1975). Females of the libellulids *Aethriamantha aethra* and *A. rezia* (Kirby) oviposit preferentially among water lettuce in Malaysia (LIEFTINCK, 1954) and in Nigeria (HASSAN, 1981).

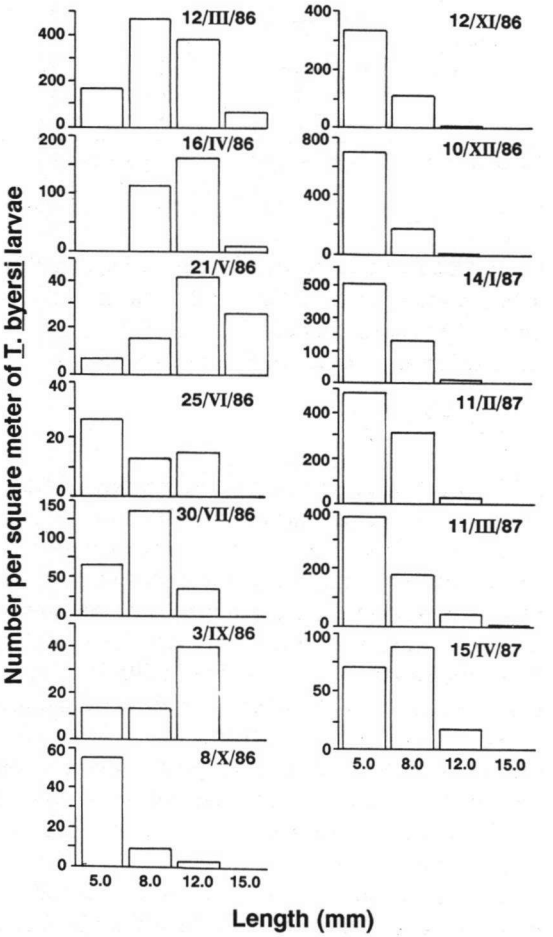


Fig. 2. Densities of *T. byersi* in monthly quadrat samples, the total numbers in each size class adjusted to a $m^2$ basis. Lengths on the independent axis represent the upper limit of each size class.

The decrease in numbers of odonate larvae observed in the springs of 1986 and 1987 (Fig. 1), coincided with increases in the average age of samples of some species (Figs 2-4). These data suggest a substantial loss of larvae in the spring. In Florida there is annual dieback of *P. stratiotes* due to winter cold (DEWALD & LOUNIBOS, 1990), and some loss of insect inhabitants may occur from immigration to alternative refuges in the pond.

Our inferences about emergence times based on larval size class frequencies agree with PAULSON's (1966) observations on the occurrence of adult *P. longipennis* and *E. simplicicollis* in south Florida, both of which appear in February. Among *P. longipennis*, PAULSON (1966) noted a seasonal decrease in the length of final instar larvae, from 18--20 mm in winter to 15-18 mm in summer. Thus, inferences about growth

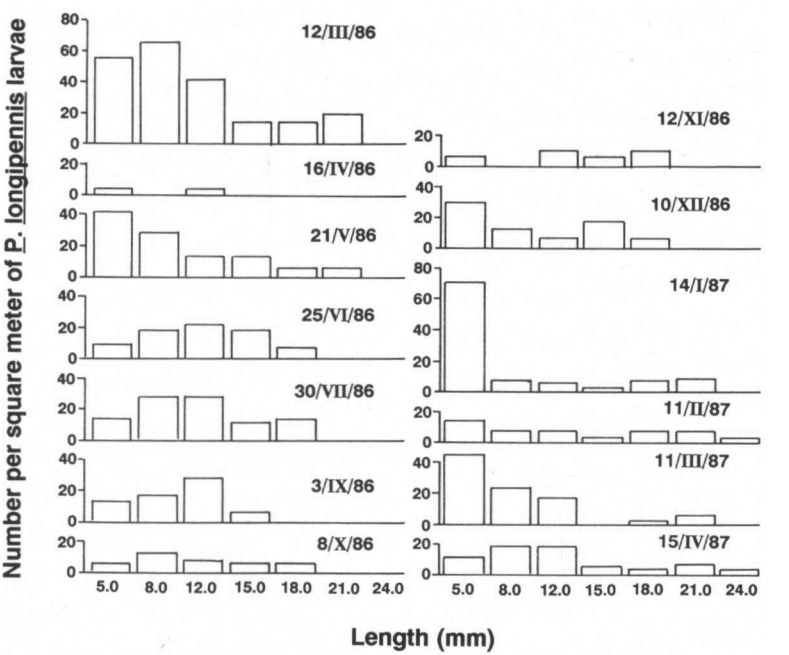


Fig. 3. Densities of *P. longipennis* in monthly quadrat samples, the total numbers of each size class adjusted to a $m^2$ basis. Lengths represent the upper limit for each size class.

stage based on larval length alone must be approached with caution, and the summer presence of larvae in the 15-18 mm class (Fig. 3) may indicate emergence throughout that season.

For *T. byersi* in early winter, when *P. stratiotes* biomass was high (DEWALD & LOUNIBOS, 1990), there was little evidence of mortality or immigration. Assuming that no oviposition occurs during the coldest months of December through February, then decreases in numbers of *T. byersi* in the smallest size class could be accounted for solely by increases in the next largest class (Fig. 2), occurring presumably through growth and molting.

The common presence of remains of *Mansonia* mosquitoes in odonate foreguts is provocative because it has been assumed that the larvae and pupae of this genus are relatively immune to predation while attached to plant roots (ASSEM, 1958). BAILEY (1984) proposed that *Mansonia* larvae detach from roots at night, and our own unpublished data have confirmed interplant movement, albeit not necessarily nocturnal. Swimming *Mansonia* would be more vulnerable to odonate predation during their mobile phase, although it is plausible that odonates can detect prey attached to roots.

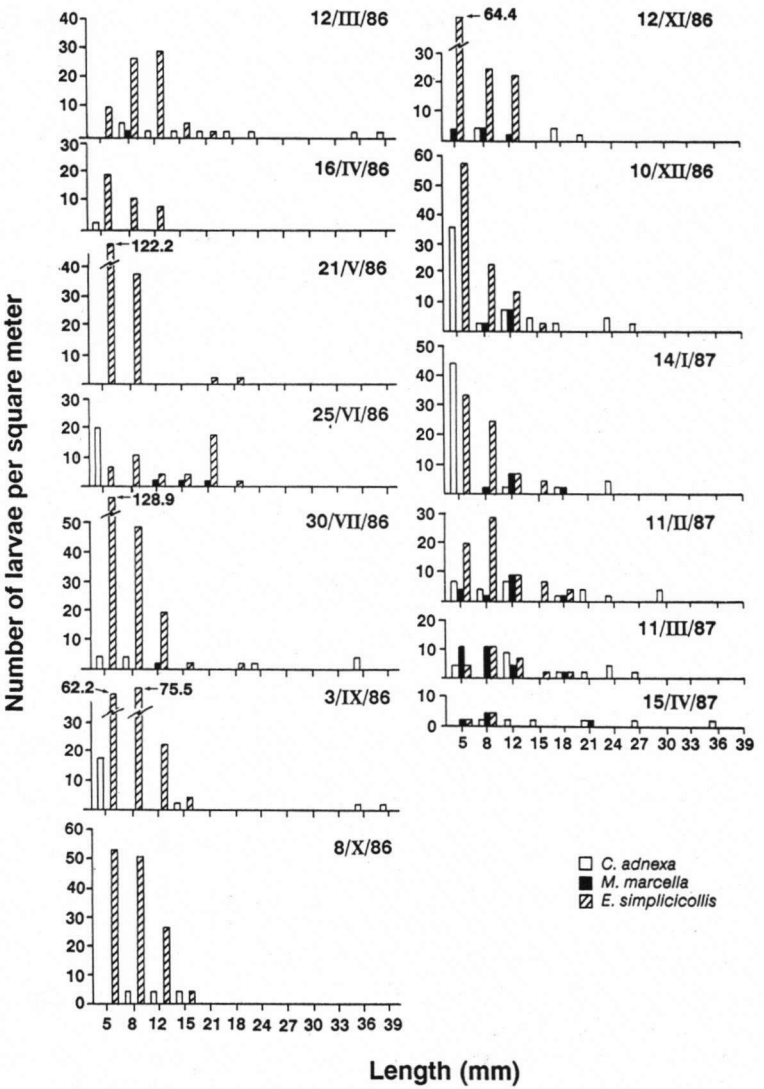


Fig. 4. Densities of three species of Anisoptera in quadrat samples, the total numbers of each size class adjusted to a $m^2$ basis. Lengths represent the upper limit for each size class.

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