

ANALYSIS OF THE GUT CONTENTS OF NAIADS OF *ENALLAGMA CIVILE* (ODONATA: COENAGRIONIDAE) FROM A TEXAS POND¹

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ABSTRACT. Foregut contents of naiads of the damselfly species, *Enallagma civile*, collected from a permanent pond, were analyzed to determine the natural prey for immatures of this species. The analyses revealed the naiads containing prey had fed predominantly on chironomid larvae. Corixid, cladoceran, ostracod and aquatic mite remains were found in some of the naiad specimens examined. However, no remains of mosquito larvae were detected in any of the specimens, even though mosquito larvae were observed as being continuously present in the pond sites where the naiad specimens were collected.

Analyses of the foregut contents (Chutter 1961, Macan 1964, Fisher 1967) and fecal pellets (Lawton 1970, Pearlstone 1973, Thompson 1978a, 1978b) of damselfly naiads have been used in studies to identify the selection of natural prey by these insects in the field. Generally, natural prey of the naiads of the damselfly species studied thus far suggest that prey composition broadly mirrors the prey available to the damselflies within their habitat (Chutter 1961, Thompson 1978a, 1978b). Studies of damselfly naiad aggressive behavior in response to prey density and prey size selection have largely led to the conclusion that damselflies take prey within the boundaries of the physical size they can handle, lacking a particular prey size preference within their maximum/minimum size constraints (Thompson 1978b, Lawton et al. 1980, McPeck and Crowley 1987). Thompson (1978b) also noted that, although minimum prey size over a number of different damselfly naiad instars remained fairly constant, the maximum prey size increased logarithmically with instar number.

In the current study, foregut contents of *Enallagma civile* (Hagen) naiads were analyzed to determine the natural prey for populations of these naiads occurring in a permanent pond where populations of mosquito larvae were known to be continually present so as to determine the importance of mosquito larvae in the diet of naiads of this particular damselfly species. The pond is located at the Texas A&M swine farm, approximately 2 km west of the Texas A&M campus near College Station, TX.

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The oval pond is approximately 60 × 40 m with sides gently sloping to a depth of about 5 m toward the center and with the banks overgrown with Bermuda grass, *Cynodon dactylon* (Linn.). During the study period, mosquito larvae of 5 genera (*Aedes*, *Culex*, *Culiseta*, *Mansonia* and *Psorophora*) were frequently found among submerged vegetation along the banks of the pond. Fish were not observed in the pond during the sampling period or at any other time.

Enallagma naiads were collected from shallow water along the banks of the pond using an aquatic D-sweep net at approximately 2.5-week intervals from October 13 to April 10 (10 sampling dates, $n = 68$). The naiads were returned to the laboratory immediately after capture, killed and dissected and the foregut contents mounted on slides. With the aid of a compound microscope, the fragments were identified to the lowest recognizable taxon.

The damselfly naiads sampled were penultimate or ante-penultimate instars measuring (from apex of head to apex of the gills) an average length of 18.5 mm (range 11–24 mm). Fifty percent of the foregut contents (34/68) examined contained no recognizable arthropod fragments. Of the 56 individual prey items found in the damselflies dissected ($n = 34$ naiads), there were 45 chironomoids, 7 corixids, 2 cladocerans, 1 ostracod and 1 aquatic mite. Of the 34 naiad foreguts containing prey, 70% contained fragments of chironomid larvae only (identifiable from intact head capsules, jaws, claws from the prolegs and tail tufts as per Thompson 1978a). The chitinized remains of corixids only were noted in 12%; and in 6% of the foreguts, only cladocerans were found as identified from their postabdominal tails. In 6% of the specimens, chironomid and corixid fragments were found together, while corixids and ostracods (with the valves from the carapace intact) were noted in 3%. One damselfly specimen (3%) contained the intact body of a mite.

The study by Thompson (1978a) on the natural prey of *Ischnura elegans* (van der Linden), a damselfly similar in size to *E. civile*, revealed that the damselfly naiads consumed different prey species in largely the same proportions as

the prey occurred in the field. Although only qualitative sampling was carried out simultaneously with the collection of naiads in our study, the data generally agrees with that of Thompson (1978a) within the confines of the habitat space we inferred as accessible to the damselflies, with the exception of mosquito larvae of which members of at least one of the 5 genera were present during the entire sampling period. Thompson (1978b) proposed that, within the minimum and maximum limits of the prey size available to the naiads, there was no preference toward any particular sized prey. However, chironomid larvae were common in the natural diets of *I. elegans* (Thompson 1978a), *Pyrrhosoma nymphula* (Sulz). (Lawton 1970), and *Enallagma boreale* Sleys (Pearlstone 1973), and were the major constituent of the diet of the damselfly species in our current study. Lawton (1970) found chironomid larvae to be the most important prey of *P. nymphula*, comprising about 60–75% of the food energy assimilated. Chironomid larvae have been found in many studies to be the dominant taxon of macroinvertebrates in freshwater ecosystems (Pennak 1978).

Bay (1974) stated that damselfly naiads tended to avoid utilizing corixids as prey. However, corixids were the second most prevalent damselfly prey found in this study, second only to the chironomids and taken significantly more than all the remaining prey species. In agreement with the present study, the consumption of cladocerans and ostracods by damselfly naiads is well documented (Thompson 1978a, 1978b; Lawton et al. 1980).

Thompson (1978a) found water mites to be a part of the diet in *I. elegans*, but thought it unlikely that the naiad had consumed the mites directly. It was suggested that the mites could have been consumed initially by a predacious chironomid before the insect was subsequently preyed upon by the damselfly. However, in our study, the single mite found was the only recognizable item found in the foregut of the naiad, indicating probable direct ingestion by the damselfly. Free-living mites were not uncommon in the swine farm pond, and were of a size range and swimming similar to that of cladocerans and ostracods, thus we see no prior reason that water mites cannot be prey items for the *E. civile* naiads.

Miura et al. (1981) noted that damselfly naiads were the most abundant insects found in rice fields of Fresno County, California, and

were consequently thought to be important predators of mosquito larvae in these rice fields (C. H. Schaefer, personal communication). In our study, at least as far as the pond involved is concerned, no evidence of predator-prey interaction between damselfly naiads and mosquito larvae was found. Although damselfly naiads might be important in mosquito larvae regulation in areas where large amounts of submerged aquatic vegetation are present, no evidence was uncovered in this study to support the hypothesis for *E. civile*.

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