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Early stadium damselfly larvae (Odonata: Coenagrionidae) as prey of an aquatic plant, *Utricularia australis*

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Two third stadium larvae of Coenagrionidae (probably *Coenagrion puella* or *Ischnura elegans*) were recorded in the bladders of *U. australis* sampled from a garden pond in Karlsruhe, Germany, in June 2010. These are the first records of odonate larvae as prey of carnivorous aquatic macrophytes.

Keywords: Odonata; dragonfly; bladderwort; carnivorous plants; macrophytes; predation

Introduction

In Odonata larvae the presence of macrophytes can reduce the risk of predation (Corbet, 1999, p. 164). However, there may be an exception, when the plant itself is a predator. Since Darwin (1875, p. 2) it has been well known that terrestrial carnivorous plants may capture odonate imagines. In the genus *Drosera* especially there are many examples of predation on larger insect imagines, including odonates (e.g. Achterberg, 1973; Thum, 1986).

The capture chambers of aquatic carnivorous plants such as *Utricularia* spp. are very small. They prey mainly on very small aquatic arthropods, including planktonic micro-crustaceans such as copepods, cladocerans and ostracods (Harms, 2002), as well as small dipteran larvae and mites (Baumgartner, 1987; Sanabria-Aranda et al., 2006). However, the question of whether odonate larvae could fall prey to these plants has long remained unclear, and only after several years of searching for direct evidence, as well as an exhaustive literature survey, has the issue finally been resolved.

Material and methods

On 21 June 2010, several specimens of the bladderwort *Utricularia australis* R. Brown were collected from an artificial pond lined with polythene sheets in the former ecological garden of the University of Education Karlsruhe (49.0143° N, 8.3851° E; 119 m a.s.l.). The pond was

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approx. 20 m^2 in size and with a maximum depth of 1.4 m. The plant material of *U. australis* was collected and stored for 7 days in two buckets in a green house of the university. On 28 June 2010 the bladders were examined during a practical class associated with a biodiversity course at the university.

For closer examination, the plants were put into white dishes, leaves were cut with fine scissors, put in petri dishes and dissected under a microscope (10–100×). For the green, nearly transparent bladders the check for prey was mostly possible by external visual inspection; the opaque violet bladders however were punctured and opened using a sharp needle. The records of the contents of the bladders of both colours were documented with an electronic camera integrated in the microscope (Leica EZ4 D).

Results

On 28 June 2010 two very small coenagrionid larvae were recorded in the bladders. One larva was dead (Figure 1). The second was found captured but still alive with the tips of the anal appendages protruding from the door of the bladder (Figure 2). Both larvae had a head width of 0.375 mm (body lenght 1.5 mm, anal appendages 1.2 mm) and four antenna segments. Other prey items recorded included larvae of Chironomidae and imagines of *Plea minutissima* Leach (Heteroptera), as well as various species of Ostracoda, Cladocera, Copepoda and aquatic Acari.

Discussion

In *Utricularia* the bladders are water-filled suction traps generating a negative pressure in their interiors. When an animal touches one of the trigger bristles at the bladder door, this causes the door to open, and to suck water and prey into the interior (Barthlott, Porembski, Seine & Theisen, 2007, p. 142; Reifenrath, Theisen, Schnitzler, Porembski & Barthlott, 2006). *Utricularia* spp. are well-known predators of small crustaceans such as Copepoda, Phyllopoda and Ostracoda (Harms, 2002). Small insects, such as larvae of Ceratopogonidae, Chironomidae, Culicidae and Ephemeroptera, as well as Corixidae (Heteroptera) are also known fall prey to them (Andrikovics,

Figure 1. Coenagrionid larva (head width 0.375 mm) found dead in a bladder of *Utricularia australis*.

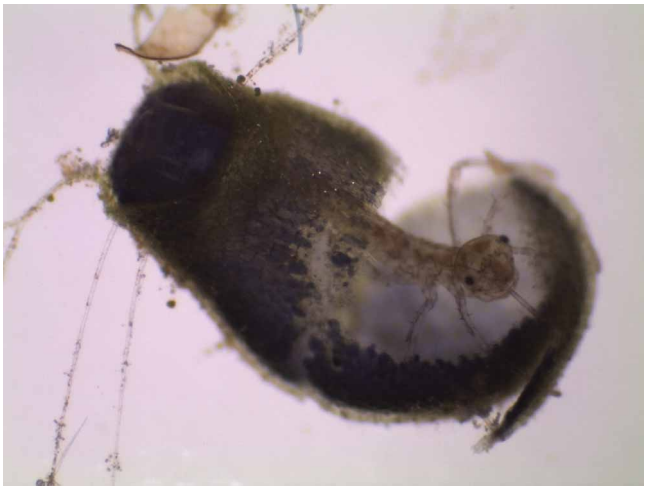

Figure 2. Living coenagrionid larva (head width 0.375 mm) found in a dissected bladder of *Utricularia australis* (diameter 2 mm).

Forró & Zsunics, 1988; Baumgartner, 1987; Mette, Wilbert & Barthlott, 2000; Sanabria-Aranda et al., 2006). It is no surprise that odonate larvae should be among the insect groups preyed on. However, until now there has been no evidence for this.

Based on long-term data of the pond in Karlsruhe (pers. obs.) the larvae observed might belong either to *Coenagrion puella* (L.) and/or *Ischnura elegans* (Vander Linden). Based on body measurements and the number of antenna segments the specimens belong to the second larval stadium (after the prolarva) (c.f. Gardner, 1951, 1954; Robert, 1959, p. 368). For the majority of European Odonata the specific identification of early larval stages is not yet possible from morphological characters.

So far, there is no evidence of any ecological relevance of these records. However, when one regards the small window of opportunity – the temporary presence of first stadia of Odonata within the vegetation related to the presence of permanently small organisms, there is the possibility that carnivorous plants could be a relevant regulator of odonate populations in the more or less unknown first stadia.

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