Short communication

First report of underwater oviposition by the island bluetail damselfly, *Ischnura genei* (Zygoptera, Coenagrionidae)

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Abstract - Among odonates that exhibit endophytic oviposition, a few, mostly damselflies, are known to be able to perform underwater oviposition. Among them, just a few species do so very frequently. Here I report the first observation of underwater oviposition for the damselfly *Ischnura genei*, which becomes the eighth species of its genus known to adopt this strategy after *I. asiatica*, *I. aurora, I. elegans*, *I. graellsii, I. hastata, I. nursei*, and *I. verticalis*. The reasons why these species or other odonates choose this particular mode of oviposition on rare occasions are not yet known, although a number of possible costs and benefits have been proposed.

Key words: egg-laying, forktails, island endemic, Mediterranean basin, reproductive strategies, Sicily, Tyrrhenian species.

Riassunto - Prima osservazione di ovodeposizione subacquea da parte della codazzura insulare *Ischnura genei* (Zygoptera, Coenagrionidae).

Fra gli odonati che praticano ovideposizione endofitica, alcuni, soprattutto damigelle, sono in grado di ovideporre sott'acqua. Fra questi, poche specie lo fanno in modo molto frequente. Qui riporto la prima osservazione di ovideposizione subacquea per la damigella *Ischnura genei*, che diviene l'ottava specie del suo genere nota per utilizzare questa strategia dopo *I. asiatica, I. aurora, I. elegans*, *I. graellsii, I. hastata*, *I. nursei* e *I. verticalis*. Le ragioni che spingono queste o altre specie odonati a scegliere in rare occasioni questa particolare modalità di ovideposizione non sono ancora note, sebbene siano stati proposti una serie di possibili costi e benefici.

Parole chiave: bacino del Mediterraneo, damigelle, endemismo insulare, ovodeposizione, strategie riproduttive, Sicilia, specie tirreniche.

Oviposition is a key moment in the life of female odonates, which normally exposes them to an increased predation risk and, at the same time, to harassment by interfering males (Martens & Rehfeldt, 1989; Corbet, 1999; Rüppell *et al.*, 2020). Different groups of odonates developed a remarkable variety of countermeasure strategies and behaviours to contrast these threats to oviposition: for example, by performing it either solitarily or in tandem (both behaviours may often coexist in the same species) and by laying their eggs in various manners, either endophytically or exophytically, but in most cases directly into water (Corbet, 1999). While endophytic oviposition normally implies that females have to stand still close to the water, exophytic oviposition may reduce the time of exposure to predators and harassers (Corbet, 1999).

All damselflies (Zygoptera) perform endophytic oviposition either in tandem or solitarily, and sometimes form groups of conspecifics (Corbet, 1999). Females normally lay their eggs immediately below the water surface, often submerging part of the abdomen in the process, but usually keeping their thorax and wings out of water. However, a number of damselflies is also capable of egg laying underwater, a strategy almost absent in dragonflies (Anisoptera) (Corbet, 1999). Underwater oviposition is rarely the most frequent strategy, with the exception of a few species of the genera *Calopteryx* (Calopterygidae), *Coenagrion* and *Enallagma* (Coenagrionidae). However, females of several other species and genera may perform it as a facultative or rare behaviour, sometimes accompanied by the male: this has been documented in species of the families Calopterygidae, Chlorocyphidae, Coenagrionidae, Euphaeidae, Lestidae, and Platycnemididae. In the genus *Ischnura* (Coenagrionidae), this behaviour is considered a rare event, and it was so far documented in just 7 out of the over 70 valid species (Corbet, 1999; Paulson & Schorr, 2017): *I. asiatica* (Brauer 1865), *I. aurora* (Brauer 1865), *I. elegans* (Vander Linden 1820), *I. graellsii* (Rambur 1842), *I. hastata* (Say 1840), *I. nursei* (Morton 1907) (without submerging the wings), and *I. verticalis* (Say 1840) (Matsuki, 1969; Jurtitza, 1986; Fincke, 1987; Cordero, 1994; Yu, 2008; Sharma, 2019). Here, I report on the first observation of underwater oviposition by the island bluetail damselfly *I. genei* (Rambur 1842), a species of Mediterranean distribution present in Corsica, Sardinia, Sicily as well as in the Maltese and Tuscan archipelagos.

A female *I. genei* was observed performing underwater oviposition on 09.VI.2021 in Palermo (Sicily, Italy), at about 4:00 pm. Oviposition occurred in a small open

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Received for publication: 16 July 2021
Accepted for publication: 31 October 2021
Online publication: 9 March 2022

water tank used for irrigation (traditionally known as "*gebbia*" in Sicilian) sited in a private garden. The female perched on a yellow iris *Iris pseudacorus* L., a few centimetres above water and started to lay eggs on the emerged part of a leaf. Then, it moved downwards in a rapid series of steps following the margin of the leaf and submerged completely with its body about 5 cm below the water surface. There, it resumed laying eggs on the leaf (Fig. 1). While underwater, it kept its wings closed and had a silvery appearance due to the air bubble covering its body, as described by Corbet (1999). The female continued to lay its eggs underwater, moving slightly up or down on the leaf for about 10 min, after which it finally ascended the leaf emerging a few centimetres above the water surface (Fig. 1). After flapping its wings and resting for a while, it took a short flight to perch atop the iris. This female showed the very common androchrome pattern (see Cordero *et al.*, 1998; Sanmartín-Villar & Cordero-Rivera, 2016) and performed the entire oviposition process in the absence of a guarding male, which is a typical condition for *I. genei* as well as for other Mediterranean congeners, such as *I. elegans* (Parr, 1973). Furthermore, no odonates of the same or other species occurred in the area during the observation, ruling out intra- or interspecific interactions such as male interference (see Corbet, 1999) as a possible cause of the observed behaviour.

According to Corbet (1999), underwater oviposition implies risks of waterlogging and impaired vigour when surfacing. The risk of an emerging female becoming trapped by surface tension is frequently lowered by rescue actions performed by its own mate or by foreign males attempting to force copulations (Andoh, 1969; Fincke, 1986; Miller 1990). In addition, ovipositing underwater certainly exposes the damselfly to strictly aquatic predators that would otherwise have little chance to catch it (*Notonecta* sp. and larvae of *Anax imperator* (Leach 1815) are present in the observation site). On the other hand, advantages may be thermoregulation by evaporative cooling without relying on the body's water content (see Prange, 1996; Corbet, 1999), protection from male interference, reduced risk of egg desiccation should the water level fall markedly during the season (Corbet, 1999), and reduced parasitism of the eggs (Harabiš *et al*., 2015).

As in other Mediterranean *Ischnura* known to perform underwater oviposition (i.e. *I. elegans* and *I. graellsii*, see Jurzitza, 1986; Cordero, 1994), this behaviour appears remarkably rare in *I. genei*. Even at the study site, I personally observed *I. genei* during oviposition at least several dozen times during the last 6 years, without ever submerging their body. Behavioural similarity with *I. elegans* and *I. graellsii* could be expected due to the close phylogenetic relationships between these species (see Dumont, 2013; Sánchez-Guillén *et al.*, 2014a; 2014b; 2020; Galimberti *et al.*, 2020). However, the reasons why several damselfly species, including *Ischnura* spp., perform underwater oviposition and specifically why they do so only rarely, remain unknown.

Acknowledgments

This paper would not have been possible if not for Melania Messina and Giorgio Schifani, who supported the construction of ponds or tanks hosting freshwater invertebrates and amphibians in the garden where the observation was conducted.

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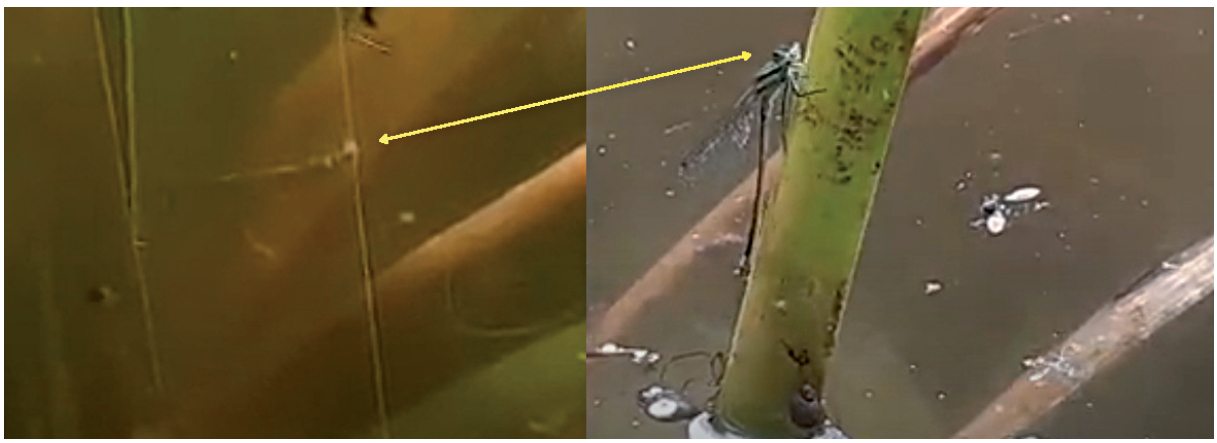

Fig. 1 - Female *Ischnura genei* photographed during underwater oviposition (left) and immediately after climbing out of the water (right). / Femmina di *Ischnura genei* fotografata durante l'ovodeposizione subacquea (a sinistra) e immediatamente dopo essersi arrampicata fuori dall'acqua (a destra).

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