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Aspects of the emergence ecology of the regionally endangered *Coenagrion mercuriale* (Odonata: Coenagrionidae) in Northeast Algeria

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ABSTRACT

Emergence is a critical phase in the life cycle of odonates because then they are highly susceptible to predation and damage. Thus the ecological understanding of this phenomenon is crucial, particularly for the conservation and management of threatened species. We studied the emergence ecology of the regionally endangered damselfly (*Coenagrion mercuriale*) in Northeast Algeria where the species produces two generations per year (spring and autumnal), focusing on the temporal emergence pattern, body size and vertical stratification of exuviae of the autumnal population. Emergence was synchronous with 50% of the population emerging within eight days. Sex ratio at emergence was slightly female biased. A seasonal decline was observed in the body size of the autumnal population like in that of the spring population. Vertical stratification of exuviae at ecdysis depended on the height of the support and vegetation density. These data are expected to be important for the management and conservation of this threatened species in Northeast Algeria and elsewhere within the distribution range.

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Introduction

The understanding of habitat utilization is a key to effective conservation of threatened species (Morris 2003; Stamps and Swaisgood 2007). Species live within complex habitats where they select specific microclimates maximizing their survival and reproductive success. The knowledge of intrinsic and extrinsic mechanisms underlying microhabitat selection in the wild should be integrated in order to ensure efficient management of threatened populations (Samways, McGeoch, and New 2010).

Freshwater ecosystems harbor very diverse fauna, particularly macroinvertebrates (Clarke et al. 2008). Yet, they are continually threatened with pollution and habitat degradation (Dudgeon et al. 2006). Odonates is a widespread group of insects, occurring in all continents except the Antarctic (Corbet 1999). In the Mediterranean region, 20% of species are threatened with extinction and about 2.5% are currently regionally extinct (Riservato et al. 2009). *Coenagrion mercuriale* Charpentier, 1840 is a damselfly that shows population decline in the region (Ferreira et al. 2015). However, several populations were reported in Northeast Algeria, of which some were relatively large (Khelifa et al. 2016). In this region, *C. mercuriale* produces two generations per year (Mahdjoub et al. 2015).The first generation emerges in spring and the second one in late summer and early autumn. The temporal pattern of emergence of the first generation has been studied already, and that of the second generation has not been investigated yet.

The emergence, when larvae choose a support (plant, rock, etc.) and remain static at a certain height, is a risky phase in the lifetime of odonates. The choice of the ecdysis height is variable within and among species (Cordero 1995). It can be hypothesized that selection of a particular stratum is not random, but is rather controlled by micro-abiotic (local temperature, exposure to sunlight, or humidity) and biotic factors (predation or competition) (Corbet 1957). Thus, the height of exuviae could be used as a surrogate for the microhabitat choice, and the understanding of microhabitat selection during ecdysis, especially for the species of conservation concern, is crucial for better management. Such data are not available for many dragonflies and damselflies, and particularly for the threatened populations of *C. mercuriale* in North Africa.

At the northern limit of its distribution range, this Atlanto-Mediterranean species has been studied thoroughly with investigations covering the species life history (Corbet 1955; Purse and Thompson 2002, 2003), its reproductive behavior (Purse and Thompson 2009), genetics (Watts et al. 2005; Watts and Thompson 2012), ecology (Rouquette and Thompson 2005; Watts et al. 2005) and conservation issues (Purse 2002; Thompson et al. 2015). The species is known to be

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