

Note and Record

Long-range movements of an endangered endemic damselfly *Calopteryx exul* Selys, 1853 (Calopterygidae: Odonata)

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Introduction

Several anthropogenic factors usually affect continuous natural habitats and transform them to patchy environments, altering several ecological processes like animal movement patterns (Andreassen, Hertzberg & IMS, 1998). Within these fragmented habitats, a natural population is divided into different isolated subpopulations, which are usually linked by dispersal (Harrison, 1994; Hanski, 1999). Many insects have the ability to disperse over long distances to reach new suitable habitats (Zera & Denno, 1997). Besides butterflies, odonates are one of the most studied insect groups to assess dispersal pattern and colonization processes in the field (Corbet, 1999). Unlike most zygopterans, anisopterans are usually good fliers able to colonize different wetlands (Conrad *et al.*, 1999; Watts *et al.*, 2004). This asset is crucial to overcome problems related to habitat degradation and thus avoid extinction (Sternberg, 1998).

Calopterygids are river-dwelling zygopterans whose movements have long been studied throughout mark-recapture surveys revealing that some species travel long distances to reach their preferred habitats (e.g. Conrad & Herman, 1990; Cordero, 1991; Stettmer, 1996; Ward & Mill, 2007). *Calopteryx exul* Selys, 1853, is an endangered Maghreb endemic species that exists in isolated small

populations within its distribution range (Boudot, 2010). In Algeria, all of the seven known subpopulations are thought to be extinct due to habitat degradation. In 2007, a new subpopulation was discovered in the Seybouse River (north-east Algeria) presenting the largest population size ever recorded for the species (Khelifa *et al.*, 2011; Khelifa, 2013). Assessing movement capacities of this species is critical to understanding its dispersal habits, population structure and population dynamics. During our mark-resighting survey in a population of *C. exul* in the Seybouse River, we recorded that this species can undertake long-distance dispersals.

Materials and methods

The study was carried out in Salah Salah (36°27'41.37"N, 7°20'22.07"E) located upstream of the Seybouse River (north-east Algeria). It is a 20-m width watercourse with a mean depth of 70 cm and bank vegetation consisted of dense *Typha angustifolia* and *Nerium oleander*. This part of the river was affected by human activities like water pumping and throwing tons of rocks and gravelly soil coming from nearby building constructions into the river bed.

We conducted capture-mark-resightings on imagos during five days (20, 22, 25, 28 May and 01 June 2010) in the morning within a stretch of 200 m. The short sampling period was due to conflicts with local people. The current study stretch was isolated from other potential suitable ones by a distance of about 4 km. Adults were individually marked on the left and right wing, thorax and the abdomen using paint spots of different colours. SPSS 17.0 (SPSS Inc, Chicago, IL, USA) was used to perform Mann–Whitney *U*-test.

Results

The species flight period started in early May, and the first reproductive pair was observed on 25 May. A total of 141 imagos (64 males and 77 females) were marked, among which 33 (14 males and 19 females) were subsequently resighted giving a mean resighting rate of 23.40%

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(21.18% for males and 24.67% for females). All of the latter individuals were resighted only once.

Almost all resighted individuals (94%) displayed movements of less than 50 m with a mean of 9.35 ± 8.49 m (9.35 ± 8.49 for males and 9.56 ± 10.20 m for females). There was no significant difference in short-scale movements (<50 m) between males and females ($U = 94.5$, $P = 0.35$). However, 6% of resighted individuals carried out long-range movements. An individual male marked on 22 May was resighted two days after in a subpopulation 5.3 km downstream in a site where the species reproductive behaviour and biology were daily studied by our colleagues. Similarly, a female marked on 25 May was noted dead during the next day in another subpopulation 4.9 km downstream.

Discussion

The low resighting rate (23.40%) noted during this study was similar to that recorded for *C. splendens* (24.8%) in south-east Bavaria (Stettmer, 1996). Furthermore, 94% of resighted individuals of *C. exul* performed movements of less than 50 m with no significant differences between sexes. In the same way, Ward & Mill (2007) and Fuhrmann (1990) showed that 72% and 70% of *C. splendens* carried out such small-scale displacements of less than 50 m and 30 m, respectively. However, temporal limitation of this study may have affected our results regarding the number of resightings, which did not exceed one resighting per individual. It is also important to mention that we were not sure whether there was any likely dispersal prior to the initial marking. Therefore, dispersal could also be underestimated.

We showed through resightings far from the study site that both male and female of *C. exul* are long-distance dispersers. They carried out displacements of about 5 km downstream of the study site during a short period of time (two days for male and one day for female). Other congeneric species like *C. haemorrhoidalis*, *C. splendens* and *C. virgo* were recorded to perform long-distance movements of more than 1 km (Kiauta, 1963; Stettmer, 1996; Ward & Mill, 2007).

Studies have revealed that territoriality in some Calopterygids induces an exclusion pressure towards males and excludes some of them from high-quality reproductive sites or even from the population especially when the population density is high (e.g. Kiauta, 1963; Heymer, 1972; Stettmer, 1996). *C. exul* was a highly territorial

species; however, the fact that not only a male but also a female dispersed several kilometres downstream suggests that other factors probably contributed to this displacement decision. Waage (1972) stated that, unlike males, females are not territorial and thus should not displace to seek for mates or oviposition sites. Similarly to Stettmer (1996), we think that habitat quality was probably the most important factor inducing *C. exul* to conduct long-distance movements. In fact, the population of Salah Salah was under huge anthropogenic pressures that degraded the bank vegetation and destroyed potential territories and oviposition sites. The fact that both sexes have the opportunity to colonize quite distant habitats opens some conservation prospects at both the local and regional scale.

Acknowledgements

We are thankful to Khalil Mellal and Akram Belhout for field assistance. We are indebted to three anonymous reviewers for their instructive comments on an earlier version of the manuscript.

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- (Manuscript accepted 10 June 2013)
- doi: 10.1111/aje.12107