

**DROUGHT-INDUCED DISPERSAL
IN *CALOPTERYX HAEMORRHOIDALIS* (VANDER LINDEN)
(ODONATA: CALOPTERYGIDAE)**

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C. haemorrhoidalis is the dominant sp. of this genus in coastal streams and irrigation channels in NW Spain. It was confirmed that the adults disperse when the streams dry during summer. A male and a female of one population dispersed from a stream and were recaptured within another population at a distance of 1200 m, in Sept., 1985. This involved crossing an area with high human density and a motorway. The behaviour that allows the sp. to subsist in temporal environments is discussed.

INTRODUCTION

The mobility of adult Calopterygidae is clearly related to their territorial behaviour (JOHNSON, 1964; HEYMER, 1972; HIGASHI, 1981; HIGASHI & UEDA, 1982; NOMAKUCHI et al., 1984; NANTEL, 1986; CORDERO, 1989). The territorial males defend a place from conspecific individuals and, as a result of territorial interactions, there occurs a displacement along the stream.

In the case of *C. haemorrhoidalis*, HEYMER (1972) has demonstrated that the displacement of mature males along the water course depends clearly on the possession of a territory. Territorial males come to the same point day after day, while males without territories and young males fly over a greater distance (CORDERO, 1989).

However, unfavorable environmental conditions can also influence

dispersal from their habitat. The migration of dragonflies is related to two factors: overpopulation and habitat (CORBET, 1962). During 1985, when studying a small population of *C. haemorrhoidalis* with capture-recapture methods, I confirmed that drought induced a great dispersal of the individuals. Here I present an analysis of this dispersal and the consequences of this behaviour on population structure.

METHODS

The study was carried out during 1985, on a monospecific community of *C. haemorrhoidalis*. Adults were numbered on their wings with permanent ink, between 19 June and 14 September (52 days of sampling; daily from 9 July to 20 August). The population lives at a little channel 60 cm wide, with summer drought (population 1). The studied area included about 100 m of the channel, which usually had water. The remaining length of channel was not accessible and was already dry on 17 July. At the same locality *Cordulegaster boltonii* and *Lestes viridis* were present.

In order to find individuals coming from the first population, a second community of *C. haemorrhoidalis* (dominant) and *C. virgo* was visited (population 2) between 1 and 15 September. It was a permanent stream about 1 m wide, which was studied again in 1986. Both populations are in Salcedo (Pontevedra, Spain), at a distance of 1200 m from each other and less than 500 m from the coast (Fig. 1). The analysis of the population structure of both streams was made in a previous work (CORDERO, 1989).

The data from marking-recapture were analyzed with the methods of Jolly and Manly-Parr in order to obtain an estimate of the population size (SOUTHWOOD, 1978). Due to the small population size (76 ♂ and 67 ♀ marked), the estimates have been pooled, because the proportion of recaptures was the same in both sexes (29% for ♂ and 39% for ♀; $\chi^2 = 1.14$, $p = 0.285$).

RESULTS

The channel of population No. 1 was dry in mid July 1985 (as had been the case in 1984 and again in 1986 and 1987). A small depression held water at the place of study, but its level decreased slowly and was dry by 1 September. Simultaneously, the number of adult *Calopteryx* decreased, and after 11 August, in spite of daily samplings until 20 August and then every two days until 3 September, only 12 individuals could be marked (in contrast to 92 marked in July). The population dispersal was evidenced by isolated individuals at a nearby pond.

At population No. 2, samples were taken with the objective to determine whether the dispersed individuals reached an adequate environment for their reproduction. On 1 September, I found male 114, who had

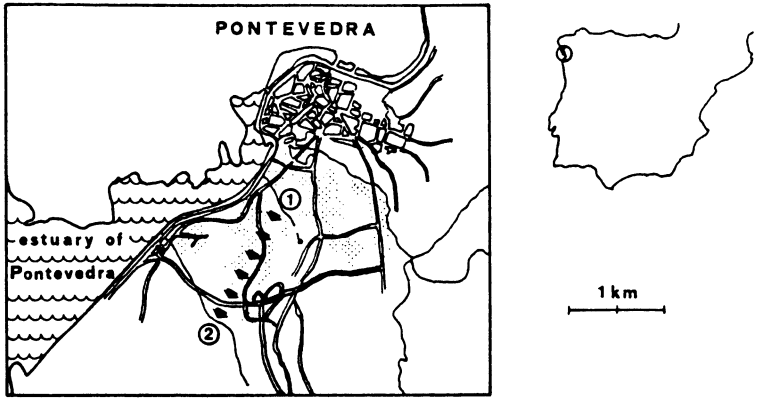


Fig. 1. Map of the study area and its location in the Iberian Peninsula. The two streams are indicated with numbers, and the possible route of migration of adult *C. haemorrhoidalis* with arrows. The points indicate the densely populated zone, and the lines roads and motorways.

been marked as a teneral on 6 August in population 1. This individual, now mature, was seen on 17 August at the place of its marking, and subsequently it was observed in population 2 on 1, 3, 5, 9, 12 and 15 September, always at the same point and as a territorial male. On 3 September I found female 136, marked when mature on 17 August in population 1. After 15 September no more individuals of *Calopteryx* were observed.

The estimates of population size after Jolly and Manly-Parr (Fig. 2), in spite of the error due to low proportion of recaptures, show that this population was decreasing, as a consequence of dispersal. The dispersal commenced at the end of July, and in the second half of August very few individuals of *C. haemorrhoidalis* were observed in population 1, even though population 2 remained until mid-September.

DISCUSSION

The channel drought caused the dispersal of the adult *C. haemorrhoidalis*. Probably most individuals wandered about the area and by chance a few of them came upon an environment adequate for reproduction. HEYMER (1972) displaced 50 males over a distance of 2 km,

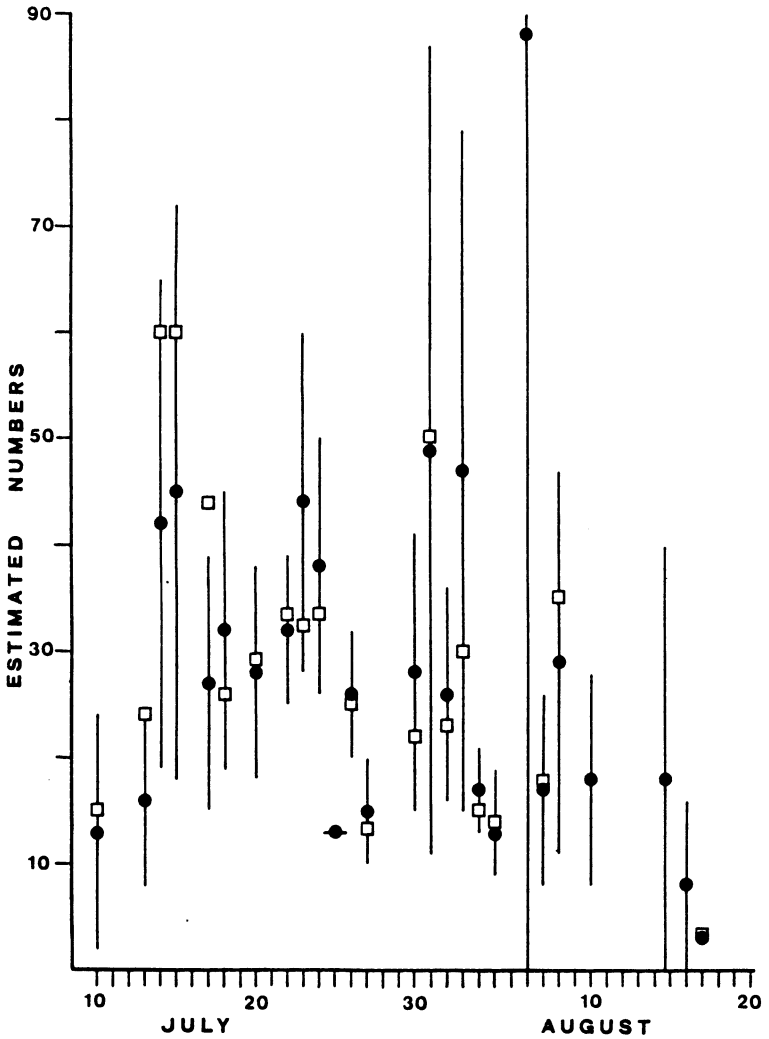


Fig. 2. Population size estimates for *C. haemorrhoidalis* (both sexes) after Jolly (circles) and Manly-Parr (squares). The vertical bars indicate standard errors. A decrease in population size, due to the dispersal of individuals because of channel drought from 25 July, is evident (given their great standard error, the estimates of 31 July, 1 and 6 August are probably not accurate).

and found that after 5 hours 27 of them had returned to the place of capture, using the course of the stream as a guide. In the present study, however, the emigrant individuals from population 1 to population 2 had no water course as a guide, and needed to cross a highly populated area (including a motorway) to reach the stream 2 (Fig. 1). Another possibility is that the male and female from the dried-up stream followed it to the estuary and then along the shore to the other stream.

Possibly more individuals of population 1 reached the second population since their dispersal began at the end of July while the first sampling in population 2 was not made until 1 September.

C. haemorrhoidalis is dominant in the coastal streams, and it excludes the congeners, *virgo* and *splendens xanthostoma* (CORDERO, 1989). This competitive capacity and the species's dispersal ability may allow its subsistence at habitats with summer drought (population 1 had a small number of individuals in 1986 and 1987), because as a consequence of drought, a great number of individuals of these temporal environments will disperse each year to the nearest populations.

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