

**'ACCOMPANYING' BEHAVIOUR OF
BRACHYTHEMIS LEUCOSTICTA (BURMEISTER) IN EUROPE
(ANISOPTERA: LIBELLULIDAE)**

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At a location in southern Spain (nr Vejer de la Frontera, Rio Barbate valley, Andalusia), observations were made on a local population of ca 40 *B. leucosticta* individuals, a sp. known for its inclination to accompany large mammals (the test subject was a human). The goal of the tests was to ascertain how far they are willing to accompany a large mammal, whether the size of the group has an influence on the distance for accompanying the subject and whether the accompaniment differs between sexes. Accompanying a person was recorded in 53 cases, involving 41 ♂ and 83 ♀ dragonflies. They generally flew at a height of 10-50 cm above the ground in front of the moving person, distributed in a semicircle with a radius of 1-2 m (the maximum observed group size was 11 dragonflies). Group size did not influence the flight range of the last individual or the detachment of the first individual from the group, as the dragonflies broke away at random. The average distance of accompaniment by ♀ ♀ (38.4 m) was further than that by ♂ ♂ (23.9 m). The maximum path of accompaniment was 89 m for ♂ ♂ and 111 m for ♀ ♀. After detaching from the person, the dragonflies returned to the shade. Only rarely did ♀ ♀ settle on open pasture, and then just for a brief period. In 3 cases (i.e. 1.6%), hunting of prey stirred up from the pasture by the person was observed.

INTRODUCTION

Dragonflies have various methods of hunting for their food (see CORBET, 1999). In general, they either search for food in flight (fliers) or wait for food when perched (perchers). The methods of obtaining food are often very interesting, as

dragonflies make use of various opportunities, and it appears that the method of hunting may be adaptable and the dragonflies react flexibly to the available food source. It depends on the characteristics of the habitat as well as the characteristics of the prey. In certain cases, however, prey in a given habitat is very scarce and thus certain species have developed methods to increase the probability of hunting success. A very specialized method serving to increase the probability of capturing food consists in accompanying a large mammal, such as cattle, a hippopotamus, antelope or a person, moving slowly through open grasslands. These mammals stir up small insects (CORBET, 1999). Such behaviour is referred to as 'accompanying' behaviour (CORBET & MILLER, 1991) and is known to occur in several sympetrine species, such as *Brachythemis leucosticta* (Burmeister) and *B. contaminata* (Fabricius), for which a tendency to accompany large objects is universally known (CORBET, 1962; CORBET & MILLER, 1991).

The goal of this work is to document the 'accompanying' behaviour of *B. leucosticta* at a site in southern Europe and to record (i) how far they are willing to accompany a large mammal, (ii) whether group size influences the distance of accompanying the subject and (iii) whether the accompaniment differs between sexes.

METHODS

The study was conducted at a location near Vejer de la Frontera in the valley of the River Barbate (36°15'34.41" N, 5°57' 33.12" W) in Andalusia, southern Spain. In the study area, the river's flood plain was situated at 5 m asl and was some 140 m wide. The banks of the river were lined with a belt of *Phragmites communis* L. and on the edge of the bank were scattered solitary *Eucalyptus globulus* Labill. (Fig. 1). The vegetation beyond the edge of the bank was very sparse (Fig. 2), and under the trees only dry leaves fallen from the *E. globulus*.

At this site, with an area of approximately 70 m², a population of *B. leucosticta* was discovered



Fig. 1. Location near Vejer de la Frontera in the valley of the River Barbate (36°15'34.41" N, 5°57' 33.12" W) in Andalusia, southern Spain.

on 6 July 2002. Tests were conducted on 11 and 13 July 2002 from 1 to 4 p.m. and at temperatures of 38–40°C with no wind (as measured by a Windmaster 2 hand anemometer).

Dragonflies remained predominantly in the shade under *E. globulus* trees or in locations near the bank edge (maximum 10 m from the river). Upon passing over the area where the dragonflies were perched, they "joined up" with the moving figure. After establishing contact, the person (two men of the same height 175 cm and wearing shorts and a white t-shirt)

set out at a right angle from the river, walking in easterly direction until reaching the bottom of a hill with a stand of *Olea europea* L. The walking speed was around 2 ms^{-1} . This distance from the edge of the shade to the olive stand was 120 m. The size of the group, sex of the individuals and point at which the dragonflies began to return to the shade were monitored. If the dragonflies returned after flying a distance of less than 5 m from the border of the shade, i.e. half the diameter of the shaded area, the attempt was considered as negative. Distances were measured by measuring tape with an accuracy of one metre. The dragonflies were not marked or otherwise trapped in order to ensure that they would not be alarmed and that their natural behaviour would not be influenced. Next walk did not start earlier than five minutes after the ending of the previous one. The person went back along a semicircle (30 m in diameter) from the studied transect.

Distances of flight were compared between males and females by a U Mann-Whitney' test, normality by the Shapiro-Wilk test, and sex ratio by a χ^2 -test which, like the regression analyses, were performed in the programme Statistica 8.0 for Windows.

RESULTS

A population of *B. leucosticta* numbering ca 40 individuals, was counted at the site. No other *B. leucosticta* group occurred within a distance of 200 m up- or downriver. Beyond 100 m upriver, the character of the habitat changed to ruderal growth with vegetation up to 1 m in height. The majority of individuals remained in the shade of the *E. globulus* tree. This shade was not continuous but was rather a patchwork of shaded places and sunny spots (Fig. 2). Perched females were recorded only in a few isolated cases in sunlit places beyond the border of the tree's shade but always in close proximity to the edge of the riverbank (a maximum distance of 6 m from the edge of the riverbank). No dragonflies were seen in the shade of other *E. globulus* trees on the riverbank standing 10 m from the monitored tree. The shade from these other trees covered an area of approximately 30 m^2 .

The dragonflies flew at a height of 10-50 cm above the ground in a semicircle with a radius of 1-2 m in front of the moving person. They most often flew in scattered formation. The maximum recorded group size was 11 individuals and, in total, 53 instances of accompanying the person were recorded (Fig. 3). Group size did not influence the flight range of the last individual or the detachment of the first individual from the group ($r = -0.19$, $p >$



Fig. 2. Detail of shaded area in which *Brachythemis leucosticta* remained perched on the pasture surface.

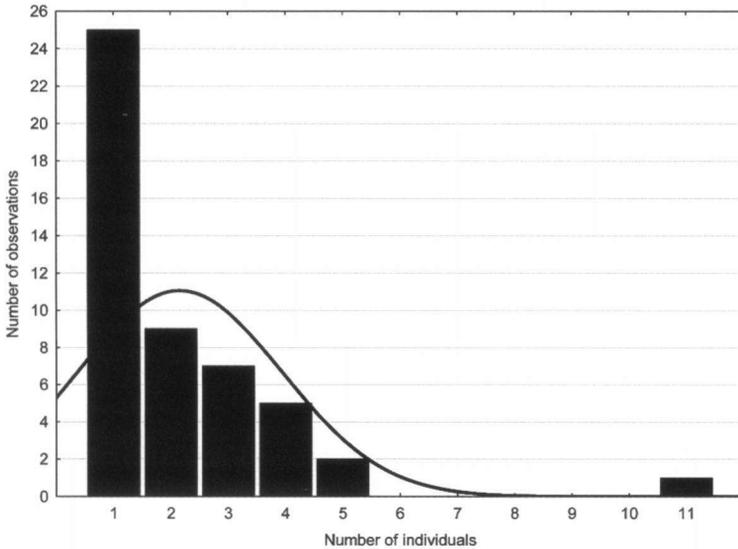


Fig. 3. Group size of *Brachythemis leucosticta* accompanying the person (line indicates normal distribution).

0.10), as the dragonflies broke away at random ($r = 0.09$, $p > 0.10$). During ‘accompanying’ behaviour, not a single case of mating behaviour or mutual attacks was observed among flying individuals, nor were individuals observed in tandem or in copula in the shaded area.

In total, 41 cases of following the person were positively noted for males and 83 cases for females ($\chi^2 = 13.3$, $p < 0.001$). In another 13 cases (i.e. 25% of the total), males returned to the shaded area after flying less than 5 m (i.e. negative case of contact), while females did so in 19 cases (i.e. 19%).

The median distance females accompanied the person (25 m) was longer than the median distance that males accompanied the person (14 m) ($z = -2.79053$, $p < 0.01$) (Fig. 4).

The maximum distance of accompaniment was 89 m for males and 111 m for females. However, the majority of individuals, both male (Fig. 5; $p < 0.001$) and female (Fig. 5; $p < 0.001$), travelled shorter distances. After detaching from the person, the dragonflies returned to the shade. Only rarely did females settle on open pasture (and then for a maximum of 10 s), after which they also returned to the shade. Upon the person’s return through the pasture, no dragonfly individuals were recorded within 5 m along the line of transect.

In three cases (i.e. 1.6%), hunting of prey roused from the pasture by the person was observed (the prey was comprised of insects ≤ 1 cm).

DISCUSSION

Brachythemis leucosticta is now one of the most widespread and numerous dragonfly species of open habitats in Africa (CORBET, 1999). In the western Palaearctic, its area is comprised of a large number of smaller areas. In Europe, it is found only in southern Portugal, south-western Spain, and in Sardinia and Sicily (cf. DIJKSTRA & LEWINGTON, 2006; BOUDOT *et al.*, 2009). The monitored location is part of the habitation in the western part of Mediterranean Europe and in the Maghreb, which is strongly disjunct from the main range of this species (BOUDOT *et al.*, 2009). The location thus lies in the northern periphery of the range, although this species has recently expanded in the Iberian Peninsula (BOUDOT *et al.*, 2009).

B. leucosticta is found in the vicinity of lakes, large ponds, water reservoirs and broad rivers, but is extremely uncommon or absent around bodies of water smaller than 20-30 m on average (ADETUNJI & PARR, 1974; CORBET & MILLER, 1991; SUHLING & MARTENS, 2007). It is found mostly in grasslands with less than 20 cm high vegetation, but also among bare rocks and sand (CORBET & MILLER, 1991). Individuals often perch on bare soil as well as rocks, mud and sand and less often on vegetation, except for emergent plants. They prefer sunlit parts of the riverbank and have a tendency to avoid places with many bushes and trees (CORBET & MILLER, 1991). The discovered habitat corresponds to these specifications, as the dragonflies were found in a dry pasture in close proximity to water.

This species tends to be gregarious (cf. ASKEW, 1988; SUHLING & MARTENS, 2007), especially where there is standing water such as a lake or rain-puddle (PINHEY, 1961). The large clusters stay in the shade during the midday heat (present study; DIJKSTRA & LEWINGTON, 2006). During 'accompanying' flights, regardless of wind, the dragonflies keep a distance of 1-2 m from the observer at a height of 10-30 cm (present study

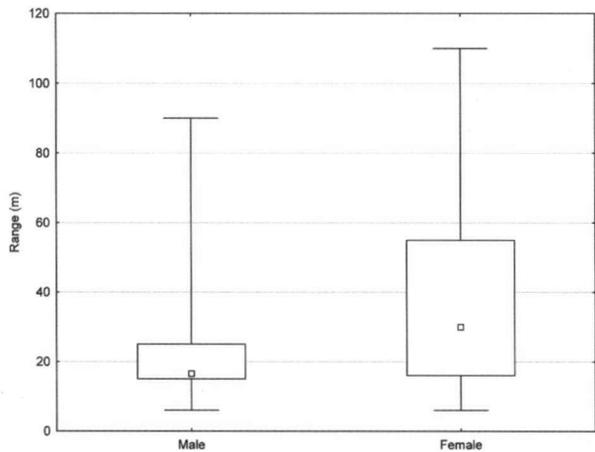


Fig. 4. Male and female *Brachythemis leucosticta* flight ranges (the inner square, the median; the rectangle, \pm 25% and 75% values; the bars, \pm minimum and maximum values).

10-50 cm) (CORBET & MILLER, 1990; ADETUNJI & PARR, 1974; WORTH, 1962) and show no signs of sexual activity (present study; CORBET & MILLER, 1990).

'Accompanying' behaviour did not occur among all individuals in the perched swarm. The dragonflies flew most often in scattered formation and the size of the group was irregular. The size of a swarm can be much greater—in the hundreds (DEJOUX, 1968) — depending on the size of the local population. Dragonflies do not tend flying in groups but rather act independently.

It appears that males have a lower tendency to show 'accompanying' behaviour (present study; CORBET & MILLER, 1990). Females fly farther, probably because they are lighter-coloured, and thus are not as noticeable, whereas the dark males quickly return to the shade. This could also be because the males heat up faster since they are darker.

The majority of individuals accompanied the person only 10-40 m (present study; ADETUNJI & PARR, 1974). However, *B. contaminata* has been recorded accompanying a bicycle 48-91 m (ACHARYA, 1961), so it is probable that the maximum distance over which it will show 'accompanying' is the width of the flood plain. In the trial, the walking speed of cattle (i.e. a very slow pace) was simulated. However, certain observations of following a fast-moving bicycle indicate that

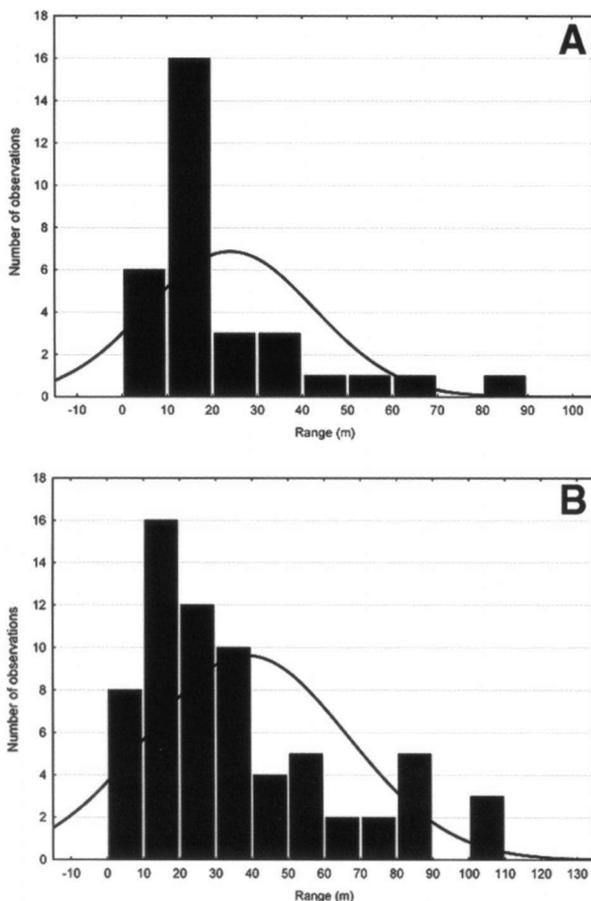


Fig. 5 Flight ranges in male (A) and female (B) *Brachythemis leucosticta* in intervals of 10 m (line indicates normal distribution).

speed of flight while accompanying can be high (WORTH, 1962). 'Accompanying' behaviour is not fixed to a particular time of day; it continues until the light intensity is too low for the dragonflies (CORBET & MILLER, 1991). For the present experiment, however, the warmest time of day was chosen, at which time dragonfly activity is high.

The diet of *B. leucosticta* is comprised of small insects. The dragonflies' ability to use large grazing mammals as beaters allows them to find food in otherwise barren habitats during daytime heat and also to benefit from relatively diffuse pasturage (CORBET, 1999). Therefore, methods that increase the probability of capturing food include (i) following larger mammals due to the attraction of parasitic insects, and (ii) taking advantage of the disturbance of insects that these large mammals cause (CORBET & MILLER, 1991; CORBET, 1999; SUHLING & MARTENS, 2007). Two percent of walks during which feeding was seen (the other walks did not disturb any insects) can be regarded as a relatively large success in these types of habitats where no spontaneous movement of insects was seen during observation. *B. leucosticta* is found mostly in grasslands but also among bare rocks and sand, where prey is not likely to settle. Moreover, open landscapes are exposed during the day to strong winds that inhibit the flight of potential prey (CORBET & MILLER, 1991). The records of dragonflies preying on blood-sucking Diptera that have been attracted to large vertebrates show that the 'accompanying' behaviour of *B. leucosticta* could result in acquisition of prey by means other than disturbance (CORBET & MILLER, 1991).

The incidence of this behaviour in an isolated population numbering several dozen individuals supports the common occurrence of 'accompanying' behaviour by *B. leucosticta* and the opinion that this behaviour is instinctive (see also CORBET & MILLER, 1991).

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REFERENCES

- ACHARYA, H.G., 1961. Strange behaviour of some dragonflies. *J. Bombay nat. Hist. Soc.* 58: 819-820.
- ADETUNJI, J.F. & M.J. PARR, 1974. Colour change and maturation in *Brachythemis leucosticta* (Burmeister) (Anisoptera: Libellulidae). *Odonatologica* 3: 13-20.
- ASKEW, R.R., 1988. *The dragonflies of Europe*. Harley Books, Colchester.
- BOUDOT, J.P., V. KALKMAN, M. AZPILICUETA AMORÍN, T. BOGDANOVIĆ, A.C. RIVERA, G. DEGABRIELE, J.L. DOMMANGET, S. FERREIRA, B. GARRIGÓS, M. JOVIĆ, M. KOTARAC, W. LOPAU, M. MARINOV, N. MIHOKOVIĆ, E. RISERVATO,

- B. SAMRAOUI & W. SCHNEIDER, 2009. Atlas of the Odonata of the Mediterranean and North Africa. *Libellula* (Suppl.) 9: 1-256.
- CORBET, P.S., 1962. *A biology of dragonflies*. Witherby, London.
- CORBET, P.S., 1999. *Dragonflies: behaviour and ecology of Odonata*. Harley Books, Colchester.
- CORBET, P.S. & P.L. MILLER, 1991. 'Accompanying' behaviour as a means of prey acquisition by *Brachythemis leucosticta* (Burmeister) and other Anisoptera, *Odonatologica* 20: 29-36.
- DEJOUX, C., 1968. Contribution à l'étude des insectes aquatiques du Tchad. Catalogue des Chironomidae, Chaoboridae, Odonates, Trichoptères, Hémiptères, Ephéméroptères. *Cah. ORSTOM* (Hydrobiol.) 2(2): 51-78.
- DIJKSTRA, K.-D. B. & R. LEWINGTON, 2006. *Field guide to dragonflies of Britain and Europe*. British Wildlife Publishing, Gillingham.
- PINHEY, E.C.G., 1961. *A survey of the dragonflies (order Odonata) of eastern Africa*. Brit. Mus. (nat. Hist.), London.
- SUHLING, F. & A. MARTENS, 2007. *Dragonflies and damselflies of Namibia*. Gamsberg Macmillan, Windhoek.
- WORTH, C.B., 1962. Dragonflies and bicycles. *J. Bombay nat. Hist. Soc.* 59: 676-677.