

## Notes on behaviour and morphology of some species of Odonata in the Maltese Islands

Godwin DEGABRIELE<sup>1</sup>

The Maltese Islands have limited availability of freshwater, so the local species of Odonata may adopt behavioural strategies which they may not use elsewhere where water is readily available. Moreover, since local species of Odonata tend to be the more common, hardy and adaptable species found in neighbouring countries, their behavioural strategies and morphological features may be relatively less studied than species which are rarer and perhaps more vulnerable. Between September 2012 and September 2013, behavioural strategies and morphological features of Odonata were observed along four valleys (Wied Qlejgħa, Fiddien, Wied ta' Ghajn Rihana, and Wied Hesri) and a saltmarsh (Is-Simar) in Malta. These observations are reported hereunder.

***Ichnura genei*:** A simple count of female types A, B and C as described by DEGABRIELE (2013) and others (e.g. DIJKSTRA & LEWINGTON, 2006) was carried out for the sites visited. Observations carried out in the five mentioned sites between September 2012 and September 2013 provided the following percentage occurrences for the three female types of this species as follows: andromorph type A: 45%, gynomorph type B: 37.5% and gynomorph type C: 17.5%

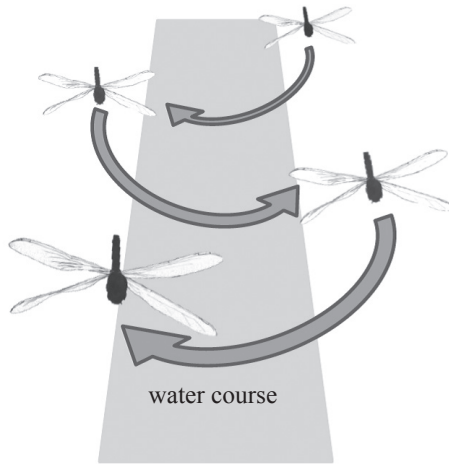
***Anax imperator*:** *Anax imperator* males have been observed to fly higher than those of *A. parthenope*, and they were also observed to occasionally dunk into the water and immerse the thorax following rapid flight patrols. This “splash-dunking” behaviour, (WALKER, 2011), typical of aeshnids, is considered to be a thermoregulatory strategy. WALKER (2011) states that in some cases individuals may not be able to fly out of the water and can drown. This may explain the presence of some drowned *Anax* individuals found in the localities where observations were carried out. *Crocothemis erythraea* males also exhibit similar behaviour, though they immerse the abdomen instead of the thorax. Tandem pairs were seen to perch high on trees and reeds close to, but not directly in, the area of water during early to mid-morning. *Anax imperator* females were observed to start ovipositing late in the morning at around 11.30 a.m. Ovipositing *A. imperator* females were also observed to show territorial behaviour, chasing away other conspecific females which choose to oviposit too close by.

***Anax parthenope*:** Males have been observed to fly at lower altitudes than those of *A. imperator*, sometimes swooping as low as a few centimetres above the ground. Male aggressive behaviour towards tandem pairs was observed at Wied ta' Ghajn Rihana in September 2013. In all but one of the cases, where the attacker managed to disengage the tandem pair, all aggressive attempts failed. This species was observed to adopt alternative ovipositing strategies depending on the resources available in the habitat. Females generally oviposit in tandem into aquatic vegetation, however, they have also been observed to oviposit in muddy deposits on rocks and stones when the water is very shallow. Moreover, females have been observed to oviposit unaccompanied in areas where the water body is very small or about to dry up. Similar cases of oviposition in soft mud and occasional unaccompanied oviposition have been described by D'AGUILAR *et al.* (1985). Females of this species have been observed to show aggressive behaviour towards other species patrolling nearby. An

<sup>1</sup> Department of Biology, Junior College, University of Malta, Msida MSD 1252, Malta. E-mail: godwin.degabriele@um.edu.mt

ovipositing female *Anax parthenope* was observed to suddenly chase and prey on a male *Orthetrum trinacria* which was keeping territory close by at Wied ta' Ghajn Rihana during August 2013.

***Orthetrum cancellatum*:** Males were observed to patrol an area or territory by flying across the width of the water body in “C” shaped swings from side to side (Fig. 1). This type of flight is described by CORBET & BROOKS (2009) as the “*libellulid partial flight of a dragonfly ... [which can be] ... directional or circular ...*”.



**Figure 1:** Patrolling flight of males of the genus *Orthetrum*.

***Orthetrum trinacria*:** Males of this aggressive species were also observed to patrol in the style described in figure 1 above when exploring a new habitat. However, once these males settled down and established territory, they were observed to fly rapidly, almost as if charging towards rival males in order to ward them off. GAUCI (2014) describes the oviposition of *Orthetrum trinacria* to involve non-contact guarding. This type of oviposition strategy has been described for this species by D'AGUILAR *et al.* (1985) and ASKEW (2004) amongst others. It was also the strategy adopted when *Orthetrum trinacria* males mated with similar species e.g. *Orthetrum cancellatum* (KUNZ, 2010). Nonetheless, ovipositing tandem pairs of both species were observed and described by the author (DEGABRIELE, 2013).

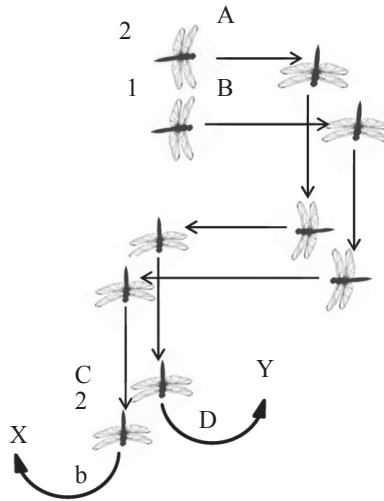
***Orthetrum coerulescens anceps*:** This fairly common subspecies was observed in rather large numbers at Fiddien, and at small, mostly slow moving, water bodies which were shaded by trees (particularly at Wied Qlejgha and Wied ta' Ghajn Rihana). Lotic water bodies are the described preferred habitat for this species locally (e.g. EBEJER *et al.*, 2007; BALZAN, 2012; DEGABRIELE, 2013; GAUCI, 2014), however this species was also occasionally observed to occur in sheltered sites where the water was static. Freshly emerged male adult specimens completely lack pruinosity and are of a light brown coloration (Fig. 2a). A number of male individuals were observed to lack pruinosity at the thorax region (Fig. 2b), showing prominent lightly coloured antehumeral stripes. This type of coloration is more typical of *Orthetrum coerulescens coerulescens*, since, in the *anceps* subspecies, the thorax is usually entirely pruinoso, with the powdery blue coloration covering the antehumeral stripes (Fig. 2c). DIJKSTRA & LEWINGTON (2006) and BOUDOT *et al.* (2009), claim that intermediate forms exist at overlapping geographical regions. Despite these claims, close examination of the laminar plate of the secondary genitalia of a number of individuals with brown thoraxes revealed

laminar plates typical in shape of the *anceps* subspecies (which almost tapers to a point when seen in profile), indicating that these individuals were in fact young males with very little pruinosity.



**Figures 2 a–c:** Different phases of pruinosity of *Orthetrum coerulescens anceps* males. **a:** teneral brown; **b:** blue form with brown thorax and visible antehumeral stripes similar to *O. coerulescens coerulescens*; **c:** all blue form typical of *O. coerulescens anceps*.

***Crocothemis erythraea*:** From observations of the species next to garden ponds, and artificial pools and reservoirs, it seems to show eurytopic tendencies; it did not appear to be deterred by floating vegetation covering the water surface, as observed at Wied ta' Ghajn Rihana. A range of territorial and reproductive behaviours has been observed in this species. According to CORBET (2004), odonates, including *C. erythraea*, use visual cues to communicate prior to taking action (e.g. attacking a rival) when defending territory and when recognizing a mate. The present author has observed that once male *C. erythraea* established their territories, they would attempt to ward off intruders, first by adopting a threatening posture, consisting of a short hop on the perch, followed by the sudden raising of the tensed abdomen at an angle of 45° with its natural position. This threatening posture has also been described for this species by FALCHETTI & UTZERI (1975) and by CORBET (2004). When this strategy did not deter the intruder, resident males were subsequently observed to ward off intruding males by means of a flight routine described in figure 3. In all cases observed, the intruder was effectively chased away from the territory. FALCHETTI & UTZERI (1975) state that, generally, rival males do not displace residents. Furthermore, they claim that territorial males take intermittent breaks from defending their territory. During these breaks, other males get a chance at occupying unguarded territories. Aggressive behaviour between males involving physical contact was not commonly observed; however, on a couple of occasions, following the ritual flight described, the resident and intruder males would soar up in a quick flight where the two would spiral round each other and attack. During such events the rustling of clashing wings could be heard even from some distance. The same flight was also observed to be occasionally used with females that were patrolling the territory. Males would approach females in the same way as rival males, and go over the same flight routine described in Figure 3. According to CORBET & BROOKS (2009) males would sometimes begin to attack a female and then proceed to mate with her. Observations during the current study showed that following the aforementioned flight routine, females would move away and hover with body axis held obliquely, a behaviour which is also described by WILDERMUTH (1994b, in CORBET, 2004). Males would then approach the female and copulate with her. Copulation would last a few seconds (which is typical for this species), and females would start ovipositing immediately after. Oviposition would usually be effected by the unaccompanied female, but occasionally, males would carry out non-contact guarding on the females at least for some time following copulation. On one occasion, the copulating female was observed to oviposit in tandem. The fact that this species occasionally uses alternative guarding strategies is also mentioned by D'AGUILAR *et al.* (1985). The behaviour described above did not occur in all cases. At times, territorial males would simply fly directly towards the approaching female and mate with her. It could be



**Figure 3:** Territorial flight in *Crocothemis erythraea*. 1 is the resident male and 2 is the female or intruding male. At point X, the resident male will resume patrolling his territory if threatening a male or fly to the female and attempt with her if courting a female. Flight sequences from points A – C, and from B – D are often repeated a number of times. If a resident male is chasing a male intruder, the resident changes direction of flight at point X while the intruder turns and flies away from the territory at point Y.

that, during the current study, aggressive behaviour and flight shown by males towards other males and females occurred in sites where a large number of males were concentrated in a relatively small area, resulting in tough competition to mate. CORBET (2004) explains that at ponds without perch sites and high incidences of females, males showed weak site attachment with rare male-male disputes, but at temporary marshes with perch sites and with low female arrival, males show high site attachment and more aggressive behaviour. As in the case of *Anax*, when a female *Crocothemis erythraea* attempted to oviposit too close to another of its kind, one female was observed to chase the other away. It was interesting to note that all attempted matings observed for this species in the current study were successful. This could imply that females may have been “coerced” to mate. According to FINCKE, (1997), “female mate choice ... [occurs]... only in insects with non-aggressive male signalling and whose males are subjected to high physiological stress, such as territorial odonates that court females, or Orthoptera that must call to attract females”. Males of this species tended to occasionally dip their abdomen into water, a thermoregulatory function. More specifically, they were observed to immerse the thorax, rather than the abdomen in water, as described earlier for *Anax imperator*. This was rather confusing as it was very similar to the oviposition behaviour of the usually unaccompanied female, even more so when the ovipositing female is of the andromorphic red type. As in the case of *Ischnura genei*, a simple count of red andromorphic females (described in DEGABRIELE, 2013) was also carried out. The percentage occurrence of observed andromorphic females in the five sites observed during the time of study was 11.3%.

***Trithemis annulata*:** Males of this fast-flying species were observed to show aggressive behaviour towards both conspecifics as well as larger species such as *Crocothemis erythraea*. This behaviour, as well as the persistent territory defence may have helped this species to establish itself in rather wide ranges in the islands since its first record by EBEJER *et al.* (2007). During the current study, males of

this species were observed to practice both contact as well as non-contact guarding, although GAUCI (2014) and others (e.g. KOCH, 2006) describe the oviposition of *Trithemis annulata* to involve non-contact guarding. However, because of the small number of ovipositing females observed, it was not possible to determine what factors influence choice of guarding strategy.

## REFERENCES

- ASKEW, R.R. (2004) *Dragonflies of Europe*. 2<sup>nd</sup> revised edition. Harley Books, Colchester. 308 pp.
- BALZAN, M.V. (2012) Associations of dragonflies (Odonata) to habitat variables within the Maltese Islands: A spatiotemporal approach. *Journal of Insect Science*, 12: 87.
- CORBET, P.S. (2004) *Dragonflies, Behaviour and Ecology of Odonata*. Harley Books, Colchester. 829 pp.
- CORBET, P.S. & BROOKS, S. (2008) *Dragonflies*. New Naturalist Library. Harper Collins, London. 456 pp.
- CRUMRINE, P.W., SWITZER, P.V. & CROWLEY P.H. (2008) Structure and dynamics of odonate communities: assessing habitat responding to risk, and enabling reproduction. In: CORDOBA-AGUILAR, A. [ed.] *Model organisms for ecological and evolutionary research*. Oxford University Press. 290 pp.
- D'AGUILAR, J., DOMMANGET, J-L. & PRECHAC, R. (1985) *A field guide to the Dragonflies of Britain, Northern Europe, and North Africa*. London - William Collins Sons & Company Ltd. 336 pp.
- DEGABRIELE, G. (2013) An overview of the dragonflies and damselflies of the Maltese Islands (Central Mediterranean) (Odonata). *Bulletin of the Entomological Society of Malta*, 6: 5–127.
- DIJKSTRA, K.D.B., & LEWINGTON, R. (2006) *A field guide to the Dragonflies of Britain and Europe*. Dorset, British Wildlife Publishing. 320 pp.
- EBEJER, M.J., DEGABRIELE, G. & SCIBERRAS, A. (2008) An annotated checklist of Odonata of the Maltese Islands, with evidence for a recent influx of species. *Libellula*, 27 (1/2): 133–145.
- FALCHETTI, E. & UTZERI, C. (1974) Preliminary observations on the territorial behavior of *Crocothemis erythraea* (Brulle) (Odonata: Libellulidae). *Fragmenta Entomologica*, 10: 295–300.
- GAUCI, C. (2014) A Review of the Odonata of the Maltese islands. *Journal of the British Dragonfly Society*, 30 (2): 1–31.
- KUNZ, B. (2010) Heterospecific copulation with subsequent oviposition in Libellulidae (Odonata). *Libellula*, 29 (3/4): 223–230.
- WALKER, J. S. (2012) Splash-Dunking Gone Bad: The Sticking Frequency. *Argia*, 24(1): 19–22.

Received: July 20, 2016

Accepted: August 30, 2016