



Studies on the Reproductive Behaviour of *Orthetrum sabina* (Drury, 1770) (Odonata: Insecta) at Asan Conservation Reserve-RAMSAR site, Uttarakhand, India

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ABSTRACT: The reproductive behaviour of *Orthetrum sabina* (Drury, 1770) was studied at Asan Conservation Reserve-RAMSAR site, Uttarakhand, India during 2022-2025. The Courtship is well marked and male demonstrate a circular territory with a radius of about 1-4 meters. Before Wheel tandem lasted for a 6-20 seconds in the air. The copulatory wheel formed in the air during chase by male to the female in the territory and is performed on perching the vegetation, which lasts for about 8-10 minutes. In the air copulatory wheel break, the After Wheel tandum lasted for about 10-15 seconds, the male release the grip on female in the territory and female freely laid eggs by dripping the tip of the abdomen 25-32 times on the surface of the water among the aquatic vegetation exophytically. The male hovers continuously in the air and guarded the female during oviposition from inter or intra specific males. After laying the first batch of the eggs, the female along with male took rest of 10-20 seconds on the twig of vegetation, before going for the next batch. The oviposition completed within 2-4 minutes. The complete reproductive behavior duration varies from 12-20 minutes.

Keywords: Odonata, *Orthetrum Sabina*, Reproductive behaviour, Asan Conservation Reserve, RAMSAR site Uttarakhand, India.

INTRODUCTION

The order Odonata includes some of the most ancient and beautiful insects that ever roamed the earth and were the first creatures to truly command the air of this earth. For about 270 million years, dragonflies with their four long independent membranous wings and long bodies have remained unchanged in their essential form. They are amphibious hemi-metabolan insects having the aquatic egg and larval (nymph) stages, while the adults are terrestrial. Dragonflies possess well diversified behavioral patterns, including larval and adults feeding behaviour, emergence pattern, post-emergence dispersal and the reproductive behaviour, of which, the last one is the most significant. Though, the generalised patterns of these behaviours are quite same among the world of dragonflies, till detailed study reveals that, they vary greatly from species to species.

Williamson (1906) noted the reproductive behaviour in some Zygopterans. Williams (1936) observed the oviposition of *Megalagrion oahuense*. Moore (1952 a&b) described the oviposition of *Sympetrum striolatum* as well as the territoriality in some dragonflies. Hodgkin and Watson (1958) recorded the breeding of some dragonflies in temperate water. Eriksen (1960) worked on the oviposition of *Enallagma exsulsans*, the breeding behaviour and oviposition of

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Hetaerina americana, *H. titia*, *Calopteryx maculatum* and *Pachydiplax longipennis* were studied by Johnson (1961, 1962a & b) respectively. Corbet (1962) in his book "A Biology of Dragonflies" gave an account on the *Reproductive behaviour* of different dragonflies from different parts of the world. Pajunen (1962, 1963) worked out the reproductive behaviour of *Leucorrhinia dubia* and *L. rebicunda* as well as the influence of population density on the territorial behaviour of the later one.

Kiauta (1964) made some important field observations on the adult behaviour of *Leucorrhinia pectoralis*. Bick and Hornuff (1966) studied the reproductive behaviour of *Enallagma aspersum* and *E. exsulsans*, while *Hetaerina americana* was dealt by Bick and Sulback (1966). Higashi (1969) observed the territoriality of *Crocothemis s. servilia*. Reproductive behaviours of *Orthetrum albistylum speciosum* and *O. triangulare melania* were studied by Arai (1972). Bick (1972) gave a review of the territorial and reproductive behaviour in Zygopteran, whereas the substrate utilization during reproduction by *Argia plana* and *A. moesta* was studied by Bick and Bick (1972). Furtado (1972) highlighted the reproductive ethobiology of *Ischnura senegalensis* and *Pseudagrion microcephalum*, while Heymer (1972 & 1973) made exhaustive studies on the reproductive

behaviour of the genus *Calopteryx* in Palaearctic region. Consiglio (1974) studied the behaviour of reproduction of *Platycyphs caligata*, while *Copera marginipes* and *C. vittata acutimargo* were dealt by Furtado (1974). Green (1974) observed territoriality of some Nigerian dragonflies.

Jurzitza (1974); Mizuta (1974); Parr and Parr (1974); Sakagami *et al.* (1974) also worked on different aspects of the reproductive ethobiology of dragonflies. Arai (1975) studied the adult behavioural patterns of *Onychogomphus viridicostus* and Gossum *et al.* (2001) studied the frequency-dependent male mate harassment and intra-specific variations in its avoidance by females of the *Ischnura elegans*. Cordola-Anguilar *et al.* (2003) studied the sperm competition in Odonata, the evolution of female sperm storage and rivals sperm displacement. Considerable studies have been done in the Indian subcontinent concerning reproductive behaviour of dragonflies. Begum *et al.* (1982) commented on the sexual behaviour and oviposition of *Zyxomma petiolatum*. Prasad and Ghosh (1982) recorded the reproductive behaviour of *Urothemis s. signata*. Studies on the reproductive behaviour of *Ischnura a. aurora*, *Ceragrion coromandelianum* and *Chloroneura quadrimaculata* were carried out by Srivastava and Babu (1984, 1985a & 1985b). Prasad (1986) worked on the reproductive behaviour of *Tholymis tillarga*, whereas Mitra (1987) made some comments on its breeding habitats. Begum *et al.* (1990a) shed light on the reproductive behaviour of *Rhodothemis rufa*. Prasad (1990 & 1991) made some observations on the reproductive behaviour of *Brachythemis contaminata*, *Ceragrion coromandelianum* and *Pseudagrion r. rubriceps*. Chowdhury and Karim (1994) observed the reproductive behaviour of *Copera annulata*, while Srivastava *et al.* (1994) made a detailed study on the behaviour of reproduction and oviposition also in *Pseudagrion decorum*. The reproductive ethobiology of *Orthetrum s. sabina* and *Neurothemis i. intermedia* have been studied by Sangal *et al.* (1994). Sharma (2009a&b, 2011, 2014, 2015, 2017, 2018, 2019a&b, 2022), Sharma and Joshi (2007), Sharma and Kumar (2008) and Sharma *et al.* (2007, 2008) studied the species diversity of Odonates in different parts of the India including the reproductive behavior of different odonates species. The present studies made a modest attempt on the reproductive behaviour of *Orthetrum sabina* (Drury, 1770) at Asan Conservation Reserve-RAMSAR site, Uttarakhand, India.

MATERIAL AND METHODS

The detailed study on the reproductive behaviour of *Orthetrum sabina* (Drury, 1770) has been made in and around the Asan Conservation Reserve and Ramsar site, District Dehradun, Uttarakhand, India having coordinates 30°26'09"N, 77°39'56"E during May, 2022 to August, 2025. The Asan Wetland, Conservation Reserve or also known as Dhalipur Lake was constructed in 1967 at union of two rivers Asan and Yamuna, is small wetland of about 4 Km² and now also famous tourist attraction for observation of migratory

waterbirds from October to March every year. A large number of animal and plant species are restricted only to wetlands, their survival depending totally on the existence of this habitats. The observations on the reproductive behaviour of *Orthetrum sabina* (Drury, 1770) was made by using stop watch to record the duration of before tandem position, copulatory wheel, after tandem position and oviposition; Nikon DSLR with telelens 80-500mm was used for photography and continuous observations were made by three members team in the two selected areas of wetland having vegetation and easily visibility of male and female of the *Orthetrum sabina*.

RESULTS AND DISCUSSION

The Odonata exhibit two periods during their entire life *i.e.* The pre-reproductive period and the reproductive period. The pre-reproductive period is the period in between emergence and reproduction. The main behaviour of a dragonfly during this period is dispersal after emergence and feeding to help the teneral adults in becoming fully mature adults within a few days. Hence, the pre-reproductive period is also called maturation period. It does not mean that in the reproductive period, the dragonfly remains on fast. But together with the feeding behaviour the most spectacular phenomenon of this period are the different types of reproductive behaviour, which comprises territoriality, pre-copulatory tandem or before wheel tandem position, copulatory wheel formation, post copulatory tandem or after wheel tandem position and oviposition. The reproductive behaviour of Odonata comprises adult behaviour, which leads to successful mating and oviposition.

Reproductive Behaviour of *Orthetrum sabina* (Drury)

The twelve different observations on the reproductive behaviour of *Orthetrum sabina* was recorded on dated (21.05.22, 16.07.22, 30.07.22, 27.05.23, 8.07.23, 22.07.23, 15.05.24, 20.07.24, 27.07.24, 17.05.25, 24.05.25 and 19.07.25) at Asan Conservation Reserve-RAMSAR site, Uttarakhand, India during 2022-25, out of which eight cases happened without interference on dated (21.05.22, 30.07.22, 27.05.23, 22.07.23, 15.05.24, 27.07.24, 24.05.25 and 19.07.25).

(a). Territoriality: *Orthetrum sabina* males demonstrate strong territoriality and the number of wandering males are very few in the population. The males would arrive at the rendezvous during 8:00-8:30 a.m (Fig. 1). The females appeared little late from the surrounding vegetation at about 8:45-9:00 a.m (Fig. 2). The appearance of males and females at the reservoir site depends totally on the availability of the sunlight. Males, just after arrival choose a base perch on the stems of *Lantana camara*, *Ipomoea* sp., *Eupatorium* sp. etc. or on the nearby stones. The perch formed the centre of a circular territory with a radius of about 1-4 meters, which was defended by the resident male from the intra and interspecific invasions. The resident male showed aggressive behaviour and chase display against the intruding males of same or other species (Fig. 3).

Sometimes they fed on intruding male Zygopterans of the genus *Ischnura*, *Ceriagrion*, *Pseudagrion*, etc. The changing of the base perch by the male was also noticed.

(b). Before wheel tandem: The female when entered into the territory of a resident male, the later chased her to catch her prothorax by its anal appendages. When

they got success, the pair formed tandem in the air. The before wheel tandem lasted for 6-20 seconds.

(c). Courtship and wheel formation: After this immediately, the courtship wheel was formed in the air by the interlocking of the vulvar region of the female with the secondary copulatory apparatus of the male present beneath the second abdominal segment (Fig. 4-6).



Reproductive Behaviour of *Orthetrum sabina* (Drury): Fig. 1. Male, Fig. 2. Female, Fig. 3. Territorial male, Fig. 4-6. copulatory wheel, Fig. 7. Male hovering around female during Oviposition, Fig. 8-9. Female ovipositing on the surface of water among the vegetation.

The pair in wheel position settled on nearby vegetation by changing the perch, sometime on getting disturbance by intruding males of same or other species. The duration of the wheel position generally varied from 8-10 minutes, but during May-July when the population density reached its peak, the wheel may lasts for 2-4 minutes only due to interference.

(d). After wheel tandem: On completion of copulation, the male release the abdomen of the female from its secondary abdominal segment and in tandem taken the female in the territory at the selected ovipositing site. The After Wheel tandum lasted for about 10-15 seconds.

(e). Oviposition: After breaking of the copulatory wheel in the air near the territory, the male also release the anal appendages grip on the female thorax. The released female freely laid eggs by dripping the tip of the abdomen about 25-32 times on the surface of the water exophytically without being assisted by the males (Fig. 7-9). During heavy interference, the female, sometimes, before completing the oviposition was caught by another male in tandem and was forced to make the wheel again. Though this didn't last long. During oviposition the female after releasing her first batch of eggs sometimes took a rest of 10-20 seconds and then again came to the oviposition site for the next

batch of egg laying. During the process of oviposition the male continuously hovers around and guards the female from intruding males of same or other species. The oviposition completed within 2-6 minutes.

Charles Darwin (1859) stated in the "Origin of Species", that sexual selection, "depends, not on a struggle for existence, but on a struggle between the males for possession of females; the result is not death to the unsuccessful competitors, but few or no offspring". In Odonata, the primary goal of an adult male is to secure mates and therefore in the polygynous mating system, competition for mating opportunities exists. Many different reproductive tactics have evolved to optimize the number of opportunities to successfully reproduce with females. In the Odonata, the territorial behaviour is exhibited in order to gain access to the female. Territorial behaviour is defined to be a defended area used exclusively by an individual (Brown & Orians 1970). In Odonata species that exhibit territorial behaviour, copulation and oviposition are carried out within or near the territory (Conrad & Pritchard 1992). Since the acquisition of a territory is correlated to the number of mating opportunities, the territorial behaviour is extremely important to the sexual selection of the Odonata.

In both damselflies and dragonflies the rendezvous is at or near the oviposition site. In every case mature males arrive at the rendezvous earlier in the season and in the day than females, and form the territory before the females arrive which agree with the observation of Corbet (1980). The resident males of *Orthetrum sabina* shows aggressive behaviour and chase display against the conspecific male intruders and chase the intruding male of other species also. The before wheel tandem position in *Orthetrum sabina* it can last 6-20 seconds which is quite shorter than the observation (8-13 minutes) made by Sangal *et al.* (1994). In *Orthetrum sabina*, the duration of copulatory wheel position generally varies from 8-10 minutes, but during overcrowding it may also lasts for 2-3 minutes. Sangal *et al.* (1994) have, although, mentioned the general range of duration of wheel position of *Orthetrum sabina* (12-18 minutes) they did not study the same during high population density.

The observation of Sangal *et al.* (1994) on the duration of oviposition of *Orthetrum sabina* (2-6 minutes) also coincides with the present study. The duration to complete reproductive behavior of *Orthetrum sabina* (Drury, 1770) during present study varies from 12-20 minutes.

CONCLUSIONS

The reproductive behaviour of *Orthetrum sabina* (Drury, 1770) was studied at Asan Conservation Reserve-RAMSAR site, Uttarakhand, India. The Courtship is well marked and male demonstrate a circular territory with a radius of about 1-4 meters. The complete reproductive behavior duration varies from 12-20 minutes.

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