



Studies on the Reproductive Behaviour of Dragonfly, *Pantala flavescens* (Fabricius, 1798) (Odonata: Insecta: Arthropoda) in Aravalli Range and Desert Ecosystem of Rajasthan, India

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ABSTRACT: The reproductive behaviour of *Pantala flavescens* (Fabricius) was studied in different localities of Aravalli Range and Desert Ecosystem of Rajasthan during 2008-15. Courtship is well marked and male demonstrate a circular territory with a radius of about 4-6 meters and defended it from the intruding intra or some inter specific male by chasing it away or by warning signals like wing vibration or abdomen raising. As female entered into the territory, the male starts following her and forms a tandem link, catching hold of her prothorax by his anal appendages. The before wheel tandem lasted for 10-40 seconds and during this period intramale sperm translocation is not observed. The male forced female to form courtship wheel. The courtship wheel lasts for about 70 seconds to 3 minutes and is performed in air above water body. The courtship wheel breaks and in tandem position the female oviposit exoptically on the surface of water and it lasts for 60 seconds to 2 minutes. During oviposition the male in tandem and after release of grip hovers around the female, to defend her from intruding intra or inter specific males. The total duration of reproductive behaviour lasts for 3-6 minutes.

Key words: *Pantala flavescens*, Reproductive behaviour, Rajasthan, India.

INTRODUCTION

For 270 million years, dragonflies with their four long independent membranous wings and long bodies have remained unchanged in their essential form. Dragonflies were the first creatures to truly command the air of this earth. They are the fighter planes of the insect world, hovering easily, flying fast, and manoeuvring seemingly instantly. They are flying dragons only to flies and mosquitoes, however, they cannot bite or sting us. 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. Hence, in this paper an attempt has been made to provide the detailed information on Reproductive behaviour of dragonfly, *Pantala flavescens* (Fabricius).

The different aspects of Reproductive behaviours on different species of dragonflies studied throughout the world by various workers such as Williamson (1906), Williams (1936), Hodgkin and Watson (1958), Eriksen (1960), Ito (1960), Moore (1960), Johnson (1961, 1962a & b), Corbet (1962), Pajunen (1962, 1963), Kiauta (1964), Bick and Hornuff (1966), Bick and Sulback (1966), Higashi (1969), Waage (1979), Arai

(1972), Bick (1972), Bick and Bick (1972), Furtado (1972), Heymer (1972, 1973), Consiglio (1974), Furtado (1974), Green (1974), Jurzitza (1974), Kumar and Prasad (1977), Mizuta (1974), Parr and Parr (1974), Sakagami *et al.* (1974), Arai (1975), Gossum (1999), Gossum *et al.* (2001), Cordero (2000), Switzer (2002), Cordola-Anguilar *et al.* (2003), Begum *et al.* (1982b), Prasad and Ghosh (1982), Srivastava and Babu (1984, 1985a & 1985b), Prasad (1986), Mitra (1987), Begum *et al.* (1990a), Prasad (1990, 1991), Chowdhury and Karim (1994), Srivastava *et al.* (1994), Sangal *et al.* (1994), Mitra (1996), Mitra (1998), Sharma (2005, 2009, 2010a & b, 2011), Sharma *et al.* (2008), Sharma and Vashistha (2011).

MATERIALS AND METHODS

The reproductive behaviour of *Pantala flavescens* (Fabricius) was studied in different localities of Aravalli Range (*i.e.* Jodhpur, Mount Abu and Udaipur) and Desert Ecosystem (*i.e.* Bikaner, Barmer and Jaisalmer) of Rajasthan during April, 2008 to March, 2015 (Fig. 1). The observation on reproductive behaviours of *Pantala flavescens* has been conducted in the field from morning 7:00 am to evening 6:00 pm for about 52 days in the different localities in the months of June to October during study period and observation were also recorded by taking photographs in the field by using Nikon SLR D70, D90, D7000 Cameras with closeup and telelens 80-400mm attachments.

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. As a result of south western monsoon, the swarms of adults of *Pantala flavescens* (Fabricius) appeared in June in the study area and disappeared with the decline of monsoon in November. The 52 different observations on the reproductive behaviour of *Pantala flavescens* (Fabricius) has been studied during 2008-15, out of which 24 cases happened without interference.

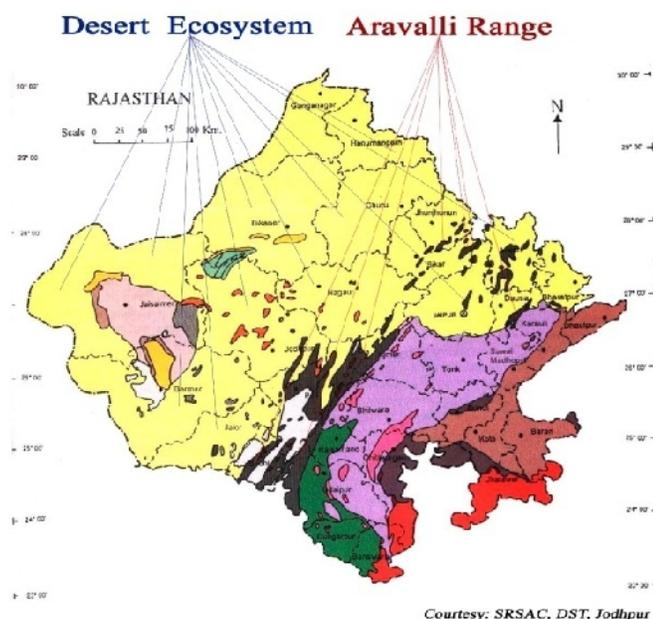


Fig. 1. Showing the area Rajasthan state: Desert ecosystem and Aravalli Range.

Reproductive behaviour of Dragonfly, *Pantala flavescens* (Fabricius)



Fig. 2.

The different aspects of Reproductive behaviour of *Pantala flavescens* (Fabricius) studied in the field were as given below:

(a). Territoriality: The males showed a strong territorial behaviour. The activity and appearance of males and females at the reservoir site depended on the sunlight. Generally the males arrive at the rendezvous during 7:00-8:30 a.m. The females appear from the surrounding vegetation late at about 9:00-10:30 a.m. Males, after arrival choose a base perch on the stem of vegetations or on some dry plants, stones etc., no particular preference for perch was observed. The perch formed the centre of a circular territory with a radius of about 4-6 meters, which was defended by the resident male from the inter and intraspecific invasions.

(b). Before wheel tandem: When the female entered into the territory of a resident male, the later tried to catch her prothorax by its anal appendages. Then the male in air caught the female and form the tandem. The before wheel tandem lasted for 10-40 seconds in the air.

(c). Courtship and wheel formation: After this the pair in tandem formed the wheel position in the air, in which the vulvar region of the female get

interlocked with the secondary copulatory apparatus of the male. The duration of the wheel position varied from 70 seconds to 3 minutes. Generally the formation of wheel does not need any support and occurs during flight and also the pair in courtship remains in the air without any perching till end. However, in some cases supports was used as a hiding place to avoid interference by other males. Intramale sperm translocation was not witnessed before wheel position and hence can be predicted to occur before the males arrive at the rendezvous.

(d). After wheel tandem: Just after breaking of the wheel, the male lowered the female and in tandem took flight in air. The after wheel tandem last for 20-30 seconds.

(e). Oviposition: After this the female in tandem oviposit moving repeatedly forward and backward along a straight line in less dense areas without interference towards the water surface or sometime by mistake on a shining surface of boundary walls of reservoir, on roads and on vehicles. The males in tandem aggressively guarded their females during oviposition. The females after oviposition took some rest hiding at the surrounding vegetation. Females generally takes 60 seconds to 2 minutes for completing the oviposition without interference. The total duration of reproductive behaviour of *Pantala flavescens* (Fabricius) lasts for 3-6 minutes.

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). Williamson (1906) noted the reproductive behaviour in some Zygoptera. Williams (1936) observed the oviposition of *Megalagrion oahuense*. Moore (1952a & 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) and Ito (1960) worked on the oviposition of *Enallagma exsultans* and territoriality of *Orthetrum albistylum speciosum* respectively, while Moore (1960) again described the behaviour of adult dragonflies in detail. The breeding behaviour and oviposition of *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. exsultans*, while *Hetaerina americana* was dealt by Bick and Sulback (1966). Higashi (1969) observed the territoriality of *Crocothemis servilia*. Waage (1979) worked on some aspects of the reproductive behaviour and ecology of *Calopteryx maculata*, and also studied its reproductive isolation from *C. aequabilis*. 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*. Gossum (1999) studied the male choice for female colour morphs in *Ischnura elegans*. Gossum *et al.* (2001) studied the frequency-dependent male mate harassment and intra-specific variations in its avoidance by females of the *Ischnura elegans*. Cordero (2000) made an analysis of multivariate selection in a non-territorial damselfly. Schultz *et al.* (2001) studied pursuit of heterospecific targets by territorial amberwing dragonfly *Perithemis tenera*. Switzer (2002) studied the individual variations in the duration of territory occupation by males of *Perithemis tenera*. Cordola-Anguilar *et al.* (2003) studied the sperm competition in Odonata, the evolution of female sperm storage and rivals sperm displacement. Kumar and Prasad (1977) made an excellent study on the different aspects of reproductive

behaviour of *Neurobasis chinensis*. Begum *et al.* (1982) commented on the sexual behaviour and oviposition of *Zyxomma petiolatum*. Prasad and Ghosh (1982) recorded the reproductive behaviour of *Urothemis signata signata*. Studies on the reproductive behaviour of *Ischnura a. aurora*, *Ceriagrion coromandelianum* and *Chloroneura quadrimaculata* were carried out by Srivastava and Babu (1984, 1985a & b). Prasad (1986) worked on the reproductive behaviour of *Tholymis tillarga*, where as Mitra (1987) made some comments on its breeding habitats. Begum *et al.* (1990) shed light on the reproductive behaviour of *Rhodothermis rufa*. Prasad (1990, 1991) made some important observations on the reproductive behaviour of *Ceriagrion coromandelianum*, *Pseudagrion rubriceps* and *Brachythemis contaminata*. 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 in *Pseudagrion decorum*. *Orthetrum s. sabina* and *Neurothemis intermedia intermedia* were studied on account of the reproductive ethobiology by Sangal, Bhandari and Saxena (1994). Mitra (1996) dealt with the reproductive behaviour of *Pseudagrion rubriceps* and detailed studies on reproductive behaviour of *Ceriagrion coromandelianum*, *Ischnura aurora*, *Orthetrum neglectum*, *Orthetrum sabina* at Asan Reservoir (Mitra, 1998). The reproductive behaviour of *Anax parthenope*, *Ceriagrion coromandelianum*, *Disparoneura quadrimaculata*, *Ischnura aurora*, *Neurobasis chinensis*, *Orthetrum sabina*, *Orthetrum glaucum*, *Orthetrum pruinosum neglectum*, *Pantala flavescens* and *Pseudagrion rubriceps* has been studied in details at Dholbaha Dam, Punjab; Bangalore, Karnataka and Aravalli Range and Desert Ecosystem of Rajasthan by Sharma (2005, 2009, 2010a & b, 2011), Sharma *et al.* (2008), Sharma and Vashistha (2011).

Though, the generalised patterns of these reproductive behaviour are quite same among the world of dragonflies, till detailed study reveals that, they vary greatly from species to species. The present investigations has provided information on different aspects of reproductive behavioural patterns of *Pantala flavescens* (Fabricius) and duration taken during each activity, which will help in further studies to the researchers and it also highlighted the importance of dragonflies in nature and focus on immediate actions for conservations of odonates species and especially their habitats in India.

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