



STUDY OF OPPORTUNISTIC SEXUAL BEHAVIOUR OF MALE IN GIANT WOOD SPIDER *NEPHILA PILIPES*.

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ABSTRACT: Giant wood spiders of *Nephila sp* also known as golden orb – web spiders are one of the largest known species of spiders showing wide distribution. They show marked sexual dimorphism, where the female is much larger than the male. Instances of cannibalism owing to different factors are commonly reported in spiders, especially in context to mating. Males, owing to their smaller size, are vulnerable to cannibalism by a female not ready for mating. Therefore, they have to find the correct opportunity for mating. They follow a complex mating ritual of courtship behaviour preceding the actual act of copulation which is time consuming, requires large amounts of energy and may often be fatal to them. In addition, there is competition from other males for mating. This mating ritual as well as the risk of cannibalism may be avoided if the male is able to take advantage of certain favourable circumstances such as when the female is feeding or moulting, in which he is at least risk of predation by her. Such conditions constitute opportunistic behaviour in which the progeny of the male gets ensured with least risk of being cannibalized.

In the present instance, a female of *Nephila pilipes* was observed while undergoing moulting. The female was in a torpid state just after moulting. A male in the proximity of the female, taking advantage of her weakened condition, showed opportunistic behaviour by mating with her. The phenomenon was observed and recorded photographically.

Key words: *Nephila*, cannibalism, opportunistic behaviour, moulting.


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INTRODUCTION

The Giant Wood Spider *Nephila* is found in arboreal habitats of tropical and subtropical regions. The female is large, dark brown to black in colour, with vivid patterning in orange, yellow or white on its opisthosoma and joints of the legs. The body is about 8-10 cm long, and the body along with its extended legs, may show a diameter of about 28-30 cm. The female is much larger than the male, who is lighter, reddish in colour and only about 1-2 cm long. This marked sexual dimorphism makes the male much vulnerable to being killed or eaten by the female during any interaction, of courtship or mating.

The female spins a giant, intricate, vertical web, about 1m in diameter, supported by tree trunks, thick parts of foliage or other solid structures. The female is found in the hub of the web, usually located in the upper third of the web. The web is used primarily for prey capture and also for supporting egg cases. Many organisms including spiders of other species, prey animals, kleptoparasites such as *Argyrodes argentatus* (Cambridge) and *Argyrodes miniaceus* (Dolleschall) [1] as well as males of the same species may venture into the web. Usually, two to three males, termed as 'waiting males', may be found on the web of the female. Vibrations of the web are the main cue for the female to become active and respond to different situations.

Typical courtship behaviour of the male involves approaching a mature female through tentative advances and frequent withdrawals along the web. Such approaches and withdrawals may indicate that the female may become aggressive and prey upon the male. On being allowed in the proximity of the female, the male taps the body of the female with his legs in rapid movements of his pedipalps, especially in the region of the epigyne. If the female is not aggressive, the male climbs on to the ventral portion of the female and deposits his silk rapidly at the joint between the prosoma and opisthosoma, probably to immobilise the female so that she is unable to bend in order to pick off or otherwise harm the male during insertion. Silk is also deposited at the base of the legs of the female and near her genitalia [1].

The male deposits the sperm embolus by using his pedipalps for inserting it into the genital orifice of the female. The time required to deposit the embolus of sperm may vary from one situation to another, and may last, through several repeated copulatory bouts, for as long as 1 -2 days. In species such as *N. plumipes*, the genital appendages of the male are broken off during insertion into female genitalia, in some cases effectively plugging the genital openings against entry of sperm of other males, thereby assuring paternity. Copulation in many sexually cannibalistic spiders is associated with a loss of function of the male reproductive organs. Sexual cannibalism is common in the Australian golden orb-web spider (*Nephila plumipes*) [2].

There is high probability of cannibalism of males by the female spiders, and cannibalism after copulation has been observed in many species. Different workers vary in their views on whether cannibalism exists in *Nephila*. Models predicting mechanisms driving sexual cannibalism in spiders with sexual size dimorphism, in general, often assume that spiders use post-copulatory food to channel nutrients into eggs and fecundity is altered through changes in clutch size or egg mass [3].

Literature reports that male golden orb-web spiders (*Nephila plumipes*) are frequent victims to sexual cannibalism^[4], and there are no obvious paternity benefits of sexual cannibalism to the male victim [5],[4],[2]. It has been found that aggressive *N. plumipes* females tend to engage in cannibalism more, grow faster and produce more eggs than less aggressive females^[4]. It is also thought that sexual cannibalism in *N. plumipes* more likely reflects a sexual conflict of interest over the duration of copulation^[2]. It is reported that males of *N. pilipes* may be subject to cannibalism prior to actual physical contact with the female for copulation [1].

Opportunistic sexual behaviour, reported sporadically (and anecdotally) for several spider species, is where the male takes advantage of different situations such as feeding or moulting, in order to copulate with the female, and escape both the elaborate courtship rituals as well as chances of cannibalism. Typically, the male waits on the hub of the web on the opposite side of the female. Males rarely move from this location unless the female captures a prey item [6]. It has been suggested that, because non virgin females are less receptive compared with virgins, male mating opportunity with non virgin females is limited to times when the female is eating [7].

The complicated structure of spider genitalia may make forced copulation difficult for males since mating requires a large degree of cooperation by the female. In order to transfer sperm, the male must ensure that the female's genital opening is accessible and that she remains still for the time he needs to insert his pedipalp [8]. Only during moulting might females be vulnerable and unable to resist a mating attempt.

In the case of a social spider, *Achaearanea wau*, a male that discovers a moulting female will attempt to mate with her before her exoskeleton has hardened and while she is incapable of reacting. If the female's cuticle hardens during copulation, he may become stuck, and this will result in the death of both members of the pair [9]. It has been reported that a male mating with a female shortly after she had ecdysed, at a stage, in fact, when she was still hanging from her cast exoskeleton [1].

In the present study, the male showed opportunistic sexual behaviour by copulating with a female in similar conditions just after moulting.

MATERIALS AND METHODS

The present work was carried out in Kanha, which is a National Park in the State of Madhya Pradesh, India. The Kanha National Park is located in the Banjar river valley, which support a mixed deciduous forest having a rich flora and fauna. The thick forest is an ideal habitat for the Giant wood spiders, both in terms of food and shelter.

A camera of Sony make (DSLR A-100) with zoom lens 70-300 was used to record the present work in Auto Focus Mode. The phenomenon was recorded from about 3.00 to 4.00 PM in the forest.

Observation

Fig 1 shows sexual dimorphism between adult male and female of *Nephila pilipes* highlighting the difference in their sizes. A female was observed hanging from a stabilimentum of a single thick strand of silk. The moult was seen just above this strand. The female appeared to be inactive, having just moulted and probably drained of all energy. The body proper of the female, as well as her legs, were hanging downward, probably still in the process of drying out after the process ecdysis or moulting. Only a solitary male was present in the vicinity.

The male approached the female when she was in such a weakened state. (Fig 2). The female, hanging from the ecdysed exoskeleton, showed only very slow and feeble movements, and could not, as such, react in any way to the advance of the male. The male did not make any tentative approaches and withdrawals which are an important part of courtship in normal circumstances. He moved on to her ventral surface and directly proceeded to copulate her. Thus, long and exhaustive courtship behaviour, otherwise seen in case of normal mating, was totally excluded. The male made a rapid approach from the anterior end (Fig 3) of the ventral portion of the hanging female to reach the genital orifice.

He then proceeded to insert the sperm embolus with his pedipalp into the genital orifice of the female (Fig 4).

The male was seen to repeat the act of copulation after an interval, moving away from the female and returning for another bout of copulation within an hour. No other competing males were present at the time.



Figure 1: Sexual dimorphism in *Nephila pilipes*

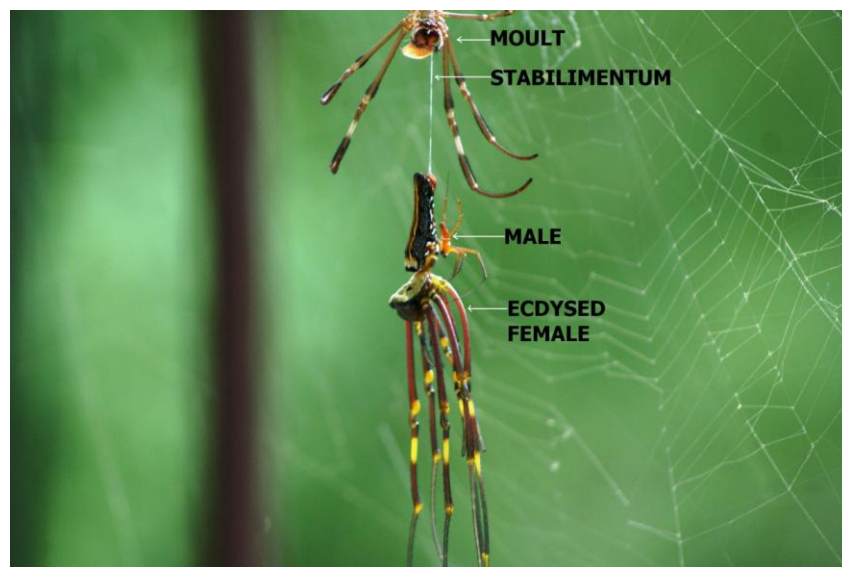


Figure 2: Male approaching freshly ecdysed female



Figure 3: Male ready to copulate (Ventral View)



Figure 4: Male copulating with inactive female (Lateral View)

CONCLUSION

In this study of the Giant Wood Spider *Nephila pilipes*, the male took advantage of the feeble state of the female, who was undergoing moulting. The male also had an added advantage of absence of competition due to lack of other males in the vicinity. The weakened state of the female did not pose any danger of the male being cannibalized by her. The male also benefited from his own proximity to the moulting female at that time, drastically reducing chances of any competition from other males, and avoiding the process of a long and complex courtship which would otherwise involve expenditure of many resources- energy, time and secretion of silk. The male was able to copulate with the female when she was wet just after ecdysis, before hardening of her cuticle was completed. Thus, such opportunistic behaviour of the male won for it the dual benefit of survival and ensuring his own paternity and continuation of his own genes through his sperm for propagation of the species.

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