



## Study on behaviours of different life stages of *Odontomantis planiceps* (Mantodea: Mantidae)

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### Abstract

Mantids (Class: Insecta; Order: Mantodea; Family: Mantidae), popularly called 'Praying mantids' are peculiar in respect of their body structure, prey capture, camouflage and reproductive behaviour. They control the potential in the fight against various insect pests in the environment and maintain the balance of tropic levels of the food chain. Both nymphs and adults are generalist predators that are mainly insectivorous and rarely consume small vertebrates. The reproductive behaviours of different life stages of *Odontomantis planiceps* (De Haan, 1842) were studied from April 2023 to September 2023 under laboratory conditions at 28 °C to 36 °C and 60% to 70% RH based on extensive preliminary observations. In addition, behaviour patterns such as head rotation, feeding, drinking, swaying movement, stretching forelegs, grooming foreleg, and grooming antenna have been observed.

**Keywords:** Mantids, reproductive behaviour, head rotation, grooming

### Introduction

Insects play an important role in their respective niches and are significant contributors to a variety of ecosystem processes (Chapman, 2012) [7] and help to perform various activities which are necessary for an ecological balance (Khadijah *et al.*, 2013) [20]. Mantids (Class: Insecta; Order: Mantodea; Family: Mantidae), popularly called 'Praying mantids' are peculiar in respect of their body structure, prey capture, camouflage and reproductive behaviour. They control the potential in the fight against various insect pests in the environment and maintain the balance of tropic levels of the food chain (Sathe, 2014) [26]. Both nymphs and adults are generalist predators that are mainly insectivorous and rarely consume small vertebrates from nature and captivity (Jehle *et al.*, 1996; Tomasinelli, 2000; Dale, 2005; Battiston *et al.*, 2018) [19, 31, 9, 5]. They play an important role in ecology and predatory behaviour (Frederick *et al.*, 1999) [15]. They act as indicators for biodiversity and environmental conservation (Ghate and Ranade, 2002; Battiston *et al.*, 2020; Dwari and Mondal, 2018) [16, 4, 10] and are used as biological control agents to control pest populations (Shar and Panhwar, 2020) [27] and ecosystem management (Hedric and Geden, 2001) [18].

There are around 2300 species of mantids under 434 genera all over the world (Ehrmann, 2002; Otte and Spearman, 2005) [11, 23]. There are 162 species of mantids under 68 genera of six families recorded in India of which 35 species and 24 genera of mantids in West Bengal (Mukherjee *et al.*, 1995) [22]. A Preliminary Study on the Mantid Fauna of Orissa, India was reported by Sureshan (2009) [30]. *Odontomantis planiceps* (De Haan, 1842) commonly known as the Asian Ant Mantis resembles a little black ant perfectly. *O. planiceps* was 1<sup>st</sup> recorded by Chanda (2017) [6] from district Paschim Medinipur, West Bengal and identified by a nymph stage of the mantis. *Odontomantis Saussure* was recorded in Kerala (Vyjayandi, 2007) [32]. No

detailed behaviour study of different life stages of *O. planiceps* has been recorded. Hence, efforts have been made to give detailed information on the behaviour of different life stages along with the photographs in the present communication.

### Materials and methods

As top-level predators in their ecological systems, they are not highly abundant in number. Still, their presence can be easily assessed with a sweeping net from the nymphal stages to the adults, a malaise trap or a light bait for the adult (Battiston *et al.*, 2010) [3]. A few mantids species were observed in the garden and were collected by a 30 cm diameter sweep net on 25<sup>th</sup> April 2023 at Shyamnagar, North 24 Parganas, West Bengal. Then the male and female were kept in separate plastic jars (20cm x 14cm x 12cm) for observation for a few days. "Identification of Mantid species was done with the help of this authentic literature (Ehrmann, 2002; Mukherjee *et al.*, 1995) [11, 22]. The adult male and female species of *O. planiceps* were put into the same size plastic jar on 29<sup>th</sup> April 2023 at 8 am. The nymph, sub-adult and adult stages of *O. planiceps* were used in this study. The reproductive behaviours of different life stages of *O. planiceps* were recorded from April 2023 to September 2023 under laboratory conditions at 28 °C to 36 °C and 60% to 70% RH based on extensive preliminary observations in the morning and afternoon. In addition, the following behaviour patterns have been observed. They were as follows: Head rotation, feeding, drinking, swaying movement, stretching forelegs, grooming foreleg, grooming antenna.

### Results and discussion

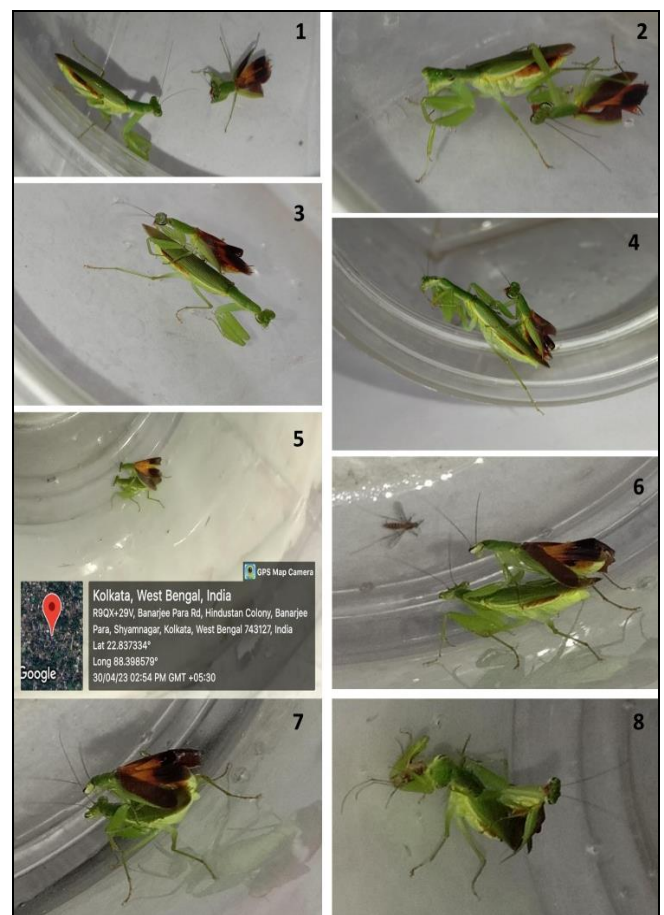
Mantids undergo incomplete metamorphosis and have three life stages: egg, a nymph stage which resembles smaller wingless sub-adult and adult. A list of reproductive

behaviour studies of *O planiceps* is shown in Figure A (Plate 1 to Plate 8). In addition, a list of different life-stage behaviours of *O planiceps* is shown in Figure B (Plate 9 to Plate 20). The mating behaviour of praying mantis was very well studied in other species. The female mantis is known for their sexual cannibalism. But all species of mantis do not show sexual cannibalism. In this case, sexual cannibalism was not observed. Elgar (1992) [12] and Wilder *et al.* (2009) [35] reported that females consume males before, during or after mating. For many species, the reality is that females may kill and consume males before they mate (Barry *et al.*, 2008; Fea *et al.*, 2013) [1, 14]. Pre-copulatory cannibalism has also been reported in praying mantids (Barry *et al.*, 2009; Walker and Holwell, 2016) [2, 33] and spiders (Elgar and Nash, 1988; Wilder and Rypstra, 2008) [13, 34].

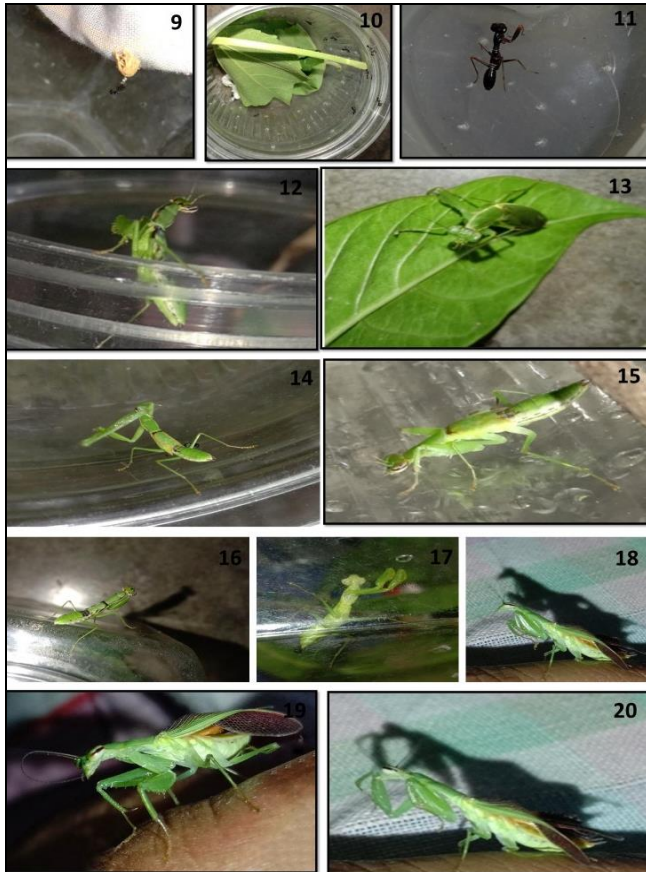
The male moves in a stalking fashion to a position three or four inches in front of the female, facing her (Figure A: Plate 1). At the same time, the tegmina are raised and spread apart slightly and the wings are expanded. During mating the male approaches the female from behind (Figure A: Plate 2 to Plate 4). The male leapt with the female from its back and grabbed its pronotum to hold the female with his first two pairs of legs. Immediately after that the male started to find the ovipositor of the female by curling its abdomen under the female's body. The female responds by opening her genital chamber whereupon the male inserts his claspers and effects copulation on 30<sup>th</sup> April 2023 (Figure A: Plate 5 to Plate 7). Events do not always run as smoothly as this, for several attempts may sometimes be needed to induce the female to open her genital chamber. The whole sequence of events from the courtship start might take one to two hours. The female was eating a mosquito after copulation and the male was still on her back (Figure A: Plate 8). Then after 15 minutes the male and female were separated from each other and put into different containers for observation. After five days the female mantis laid the ootheca on the covering cloth which was used to cover the opening of the jar. The ootheca was foamy after laying but after a few hours, it became hard and after nineteen days about twenty-five black-coloured ant-like nymphs emerged from the ootheca within a day (Figure B: Plate 9 and 10). According to Crosby (1984) [8], all nymphs were hatched out from ootheca within a day whereas Heath (1980) [17] observed that hatching requires several weeks in some mantid species. Only three nymphs have become adults (one male and two females) from the ootheca and observed different behaviour patterns such as head rotation, feeding, drinking, swaying movement, stretching forelegs, grooming foreleg and grooming antennae. The head rotation usually indicates an attentive response by the animal to potential prey items (Figure B: Plate 12 and Plate 13).

Nymphs were appropriately supplied with their prey collected from an insect net. After each moult, as the size of the nymph increases the consumption of the prey also increases. Both nymphs and adults are generalist predators. They play an imperative role as prey and predator to

maintain the balance of tropic levels of the food chain. Being a natural predator, they have carnivorous mouthparts (Khokhar and Soomro, 2009; Soomro *et al.*, 2012) [21, 29]. The instars were fed on a diet of *Drosophila* sp., flower thrips, aphids, mosquitoes, whiteflies and mealybugs on alternate days. The sub-adults and adults were fed on the houseflies, mosquitoes, leaf hoppers and nymphs of grasshoppers (Figure B: Plate 14). They drank water from the droplets as water was sprinkled in the container (Figure B: Plate 15). As the nymphs grow, they eventually lose their ant-like appearance by shedding their old skin and begin to look more like our conventional praying mantis. The foreleg and antenna grooming behaviours are often involved during food acquisition (Figure B: Plate 19 and Plate 20). Evidence from certain species suggests that some behaviours are consistent within individuals across ecological contexts and correlate with different behaviours among individuals (Sih *et al.*, 2004) [28]. This has the potential to restrict behavioural variation within individuals (Pruitt *et al.*, 2008) [25], which may have implications for species' ecology (Pruitt and Riechert, 2012) [24]. They are beneficial insects that help control populations of other insects that can be pests to crops and gardens.



**Fig A:** List of reproductive behaviour of *O planiceps* (Plate 1: Adult female scanned the male before mating); (Plate 2 & 3: Male approaches the female from its behind); (Plate 4 & 5: Male started to find the ovipositor of the female); (Plate 6: Refused to take food during copulation); (Plate 7: Copulation continued for one to two hour); (Plate 8: Female accepted to take food after copulation).



**Fig B:** List of different life stages behaviour of *O. planiceps* (Plate 9: Hatching nymph from ootheca); (Plate 10: Newly hatched nymphs moving); (Plate 11: 2<sup>nd</sup> instar nymph standing inactive); (Plate 12 & 13: Sub-adult head rotation); (Plate 14: Feeding a grasshopper leg); (Plate 15: Sub-adult was drinking water); (Plate 16: Swaying movement); (Plate 17: Stretching forelegs of 5<sup>th</sup> instar female); (Plate 18: Male stand still inactive); (Plate 19: Antenna grooming); (Plate 20: Forelegs grooming).

### Acknowledgement

The authors thank the Principal and HOD of Zoology, Bethune College, Kolkata for providing the necessary laboratory facilities.

### References

- Barry KL, Holwell GI, Herberstein ME. Female praying mantids use sexual cannibalism as a foraging strategy to increase fecundity. *Behavioural Ecology*,2008;19:710-715.
- Barry KL, Holwell GI, Herberstein ME. Male mating behaviour reduces the risk of sexual cannibalism in an Australian praying mantid. *Journal of Ethology*,2009;27:377-383.
- Battiston R, Picciau L, Fontana P, Marshall J. *The Mantids of the Euro-Mediterranean Area*. Verona,2010: WBA Handbooks.
- Battiston R, Pietro W, Amerini R, Sciberras A. The praying mantids (Insecta: Mantodea) as indicators for biodiversity and environmental conservation: a case study from the Maltese and Balearic archipelagos. *Biodiversity*,2020;1-8.
- Battiston R, Puttaswamaiah R, Manjunath N. The Fishing Mantid: Predation on Fish as a New Adaptive Strategy for Praying Mantids (Insecta: Mantodea). *Journal of Orthoptera Research*,2018;27(2):155-158.
- Chanda, A. First record of *Odontomantis planiceps* from Paschim Medinipur, West Bengal. *World Wide Journal of Multidisciplinary Research and Development*,2017;3(9):1-2.
- Chapman PM. Adaptive monitoring based on ecosystem services. *Science of the Total Environment*,2012;415:46-60.
- Crosby, TK. Observations on the winter survival of the praying mantis, *Orthodera ministralis* (Mantodea: Mantidae), in Auckland (New Zealand). *New Zealand Entomologist*,1984;8:90-96.
- Dale S. Praying mantis preying on vertebrates. *Western Australian Naturalist*,2005;24:247-249.
- Dwari S, Mondal AK. Diversity of mantids (Insecta: Mantodea) of Howrah District, West Bengal, India. *Journal of Entomology and Zoology Studies*,2018;6(2):1038-1042.
- Ehrmann R. *Mantodea: Gottesanbeterinnen der Welt*. Naturund Tier-Verlag GombH (NTV), Munster, Germany,2002:519.
- Elgar MA. Sexual cannibalism in spiders and other invertebrates. In: Elgar Mark Adrian, Crespi BJ, editors. *Cannibalism: Ecology and Evolution Among Diverse Taxa*. Oxford: Oxford University Press,1992:128-155.
- Elgar MA, Nash DR. Sexual cannibalism in the garden spider *Araneus diadematus*. *Animal Behavior*,1988;36:1511-1517.
- Fea MP, Stanley MC, Holwell GI. Fatal attraction: sexually cannibalistic invaders attract naive native mantids. *Biology Letters*,2013;9:20130746.
- Frederick RP, Wells H, Wells PH. The predatory behaviour of mantids: Historical attitudes and contemporary questions in Prete, F, Wells, H., P. Wells, and Hurd. L. (Eds.). *The Praying mantids*. The Johns Hopkins Univ. Press,1999:1-18.
- Ghate HV, Ranade SP. Biodiversity of mantids (Insecta: Mantodea) in Pune (Western Ghats) with notes on other regions of Maharashtra, *Journal of the Bombay Natural History Society*,2002;99(2):348-352.
- Heath GL. Rearing and studying the praying mantids. *Amateur Entomologist's Society leaflet*,1980;36:1-15.
- Hedrick DH, Goeden RD. Biological control as a tool for ecosystem management. *Biological Control*,2001;21:249-257.
- Jehle R, Franz A, Kapfer M, Schramm H, Tunner HG. Lizards as prey of arthropods: praying mantis *Mantis religiosa* (Linnaeus, 1758) feeds on juvenile sand lizard *Lacerta agilis* Linnaeus, 1758. *Herpetozoa*,1996;9:157-159.
- Khadijah AR, Azidah AA, Meor SR. Diversity and abundance of insect species at Kota Damansara Community Forest Reserve, Selangor. *Scientific Research and Essays*,2013;8:359-374.
- Khokhar JA, Soomro NM. Structural adaptations of mouthparts in Mantodea from Sindh. *Pakistan Journal of Zoology*,2009;41(1):21-27.
- Mukherjee TK, Hazra AK, Ghosh AK. The mantid fauna of India (Insecta: Mantodea). *Oriental Insects*,1995;29:185-358.
- Otte D, Spearman LA. *Mantida species file, catalog of the mantids of the world*. Association of Insect Diversity, Philadelphia,2005:489.

24. Pruitt JN, Riechert SE. The ecological consequences of temperament in spiders. *Current Zoology*,2012;58(4):589-596.
25. Pruitt JN, Riechert SE, Jones TC. Behavioural syndromes and their fitness consequences in a socially polymorphic spider, *Anelosimus studiosus*. *Animal Behavior*,2008,76:871-879.
26. Sathe TV, Vaishali PJ. Report on nine new species of mantids (Insecta: Mantodea) and their insect pest predatory potential from agroecosystems of Kolhapur region. *Journal of Entomology and Zoology Studies*,2014;2(5):304-307.
27. Shar KA, Panhwar WA. *Rhomboderella scutate*, Boliver, 1889 (Mantidae: Mantinae): A new record from Sindh Pakistan. *Journal of Entomology and Zoology Studies*,2020;8(2): 470-473.
28. Sih A, Bell A, Johnson JC. Behavioral syndromes: an ecological and evolutionary overview. *Trends Ecology and Evolution*,2004;19:372-378.
29. Soomro NM, Khokhar JA, Jabeen TA. Comparative study of mouthparts in praying mantids from Sindh. *Sindh University Research Journal (Sci. Sr.)*,2012;44(4):741-744.
30. Sureshan PM. A Preliminary Study on the Mantid Fauna (Insecta: Mantodea) of Orissa, India. *Records of Zoological Survey of India*,2009:305:1-56.
31. Tomasinelli F. Predation of vertebrates by praying mantids. *Mantis Study Group Newsletter*,2000:17:1-3.
32. Vyjayandi MC. Mantid fauna of Kerala, India. *Records of Zoological Survey of India*,2007:267:1-169.
33. Walker LA, Holwell GI. Sexual cannibalism in a facultative parthenogen: The springbok mantis (*Miomantis caffra*). *Behavioural Ecology*,2016;27(3):851-856.
34. Wilder SM, Rypstra AL. Sexual size dimorphism predicts the frequency of sexual cannibalism within and among species of spiders. *The American Naturalist*,2008:172:431-440.
35. Wilder SM, Rypstra AL, Elgar MA. The importance of ecological and phylogenetic conditions for the occurrence and frequency of sexual cannibalism. *Annual Review of Ecology, Evolution, and Systematics*,2009;40:21-39.