

Observations on the life cycle and nymphal development of *Odontomantis planiceps* (Mantodea: Mantidae)

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Abstract

Mantids (Class: Insecta; Order: Mantodea; Family: Mantidae) play an imperative role as prey and predator to maintain the balance of trophic levels of the food chain. They control the potential in the fight against various insect pests in the environment. Both nymphs and adults are generalist predators that are mainly insectivorous and rarely consume small vertebrates. The life cycle study of *Odontomantis planiceps* (De Haan, 1842) was studied during April 2023 to September 2023 under laboratory conditions at 28 °C to 36 °C and 60% to 70% RH. Mantids undergo incomplete metamorphosis and have three life stages: egg, a nymph stage which resembles smaller wingless sub-adult and adult.

Keywords: Mantids, life cycle, mating, development, moulting

Introduction

Insects play an important role in running an ecosystem and help to perform various activities which are necessary for an ecological balance (Khadijah *et al.*, 2013) [15]. Mantids (Class: Insecta; Order: Mantodea; Family: Mantidae) play an imperative role as prey and predator to maintain the balance of trophic levels of the food chain (Sathe, 2014) [21]. Both nymphs and adults are generalist predators that are mainly insectivorous and rarely consume small vertebrates from nature and from captivity (Jehle *et al.*, 1996; Prete *et al.*, 1999; Tomasinelli, 2000; Dale, 2005; Costa-Pereira *et al.* 2010; Mebs *et al.*, 2016; Battiston *et al.* 2018) [14, 20, 25, 7, 5, 17, 3]. They play an important role in ecology and predatory behaviour (Frederick *et al.*, 1999) [10]. They act as indicators for biodiversity and environmental conservation (Ghate and Ranade, 2002; Battiston *et al.*, 2020; Dwari and Mondal, 2018) [11, 2, 8] and are used as biological control agents to control pest populations (Shar and Panhwar, 2020) [22] and ecosystem management (Hedric and Geden, 2001) [13].

There are around 2300 species of mantids under 434 genera all over the world (Ehrmanm, 2002; Otte and Spearman, 2005) [9, 19]. 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) [18]. A Preliminary Study on the Mantid Fauna of Orissa, India was reported by Sureshan (2009) [24]. *Odontomantis planiceps* (De Haan, 1842) commonly known as the Asian Ant Mantis resembles a little black ant perfectly. *O. planiceps* was 1st recorded by Chanda (2017) [4] from district Paschim Medinipur, West Bengal and identified by a nymph stage of the mantis. *Odontomantis Saussure* was recorded in Kerala (Vyjayandi, 2007) [26].

To our knowledge, no details work on the life cycle of the *O. planiceps* has been recorded and thus, this study aimed to understand the various observations such as oviposition, mating, hatching, nymphal development, food and colour

morphs. This study will generate some valuable information about the developmental stages and reproduction.

Materials and methods

As top-level predators in their ecological systems, they are not highly abundant in number, but 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) [1]. A few mantids species were observed in the garden and were collected by a 30 cm diameter sweep net on 25th 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 these authentic literature (Ehrmanm, 2002; Mukherjee *et al.*, 1995) [9, 18]. The adult male and female species of *O. planiceps* were put into the same size plastic jar on 29th April 2023 at 8 am. The life cycle study of *O. planiceps* was studied during April 2023 to September 2023 under laboratory conditions at 28 °C to 36 °C and 60% to 70% RH.

Results and discussion

In the present study, the life cycle of *O. planiceps* is studied along with the various observations such as oviposition, mating, hatching, nymphal development, food and colour morphs. Mantids undergo incomplete metamorphosis and have three life stages: egg, a nymph stage which resembles smaller wingless sub-adult and adult. Table 1 shows the list of body lengths (cm) with their characters and duration of different life stages of *O. planiceps*. Nymphs were appropriately supplied with their prey which was collected from an insect net. After each moult, as the size of the nymph increases the consumption of the prey also increases. The mating behaviour of praying mantis was very well studied in different 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. A list of different stages of the life cycle of *O. planiceps* is shown in Figure A (Plate 1 to Plate 14). During mating the male approaches the female from behind. The male leapt with the female from its back and grabbed its pronotum to hold the female. Immediately after that the male started to find the ovipositor of the female by curling its abdomen under the female's body. As soon as the male found the female's ovipositor, it inserted its clasper on 30th April 2023 (Figure A: Plate 1). The copulation continued for almost an hour. Then after 15 minutes the male and female were separated from each other and put into different containers for observation.

Egg clusters are protected inside papery cases known as ootheca. The female *O. planiceps* produces two ootheca after mating. On 5th May 2023, the female mantis laid 1st ootheca on the covering cloth which was used to cover the opening of the jar (Figure A: Plate 2). The dorsal wall of the ootheca was white and foamy but gradually developed a mustard-yellow colour. The external surface was coarse and scaly. On 10th May 2023, the female mantis produced 2nd ootheca on the middle surface of the leaf inside the jar (Figure A: Plate 4). The ootheca were foamy in nature after laying but after a few hours, it became hard. The 1st ootheca hatched on 24th May 2023 (Figure A: Plate 3) and the 2nd ootheca hatched on 28th May 2023 (Figure A: Plate 5). Twenty-five black colour ant-like nymphs have emerged from the 1st ootheca whereas eleven nymphs have emerged from the 2nd ootheca within a day. According to Crosby (1984) [6], all nymphs were hatched out from ootheca within a day whereas Heath (1980) [12] observed that hatching requires a period of several weeks in some mantid species.

Both nymphs and adults are generalist predators. Being a predator in nature they have carnivorous type of mouthparts (Khokhar and Soomro, 2009; Soomro *et al.*, 2012) [16, 23]. At first newly emerged nymphs seem to be black ants and they are active immediately after hatching for prey. 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. Only three nymphs have become adults (one male and two females) from the 1st ootheca whereas all the nymphs hatching from the 2nd ootheca have died within ten days. As the nymphs grow, they eventually lose their ant-like appearance and begin to look more like our conventional praying mantis.

Moulting is the process by which the Praying Mantis grows. It involves shedding its skin to grow. Figure B shows the different developmental shaded skin of *O. planiceps*. Molting is routinely shedding the outer layer which has a protective role in Mantises. They moult faster as nymphs and slower as adults. Without this outer layer, a Praying Mantis is more vulnerable in front of predators. Praying Mantis is known to hang upside down either in captivity or out in nature just before moulting starts. The moulting process was observed and the exuviae of different stages of nymphs were also collected from the jar. After each moult nymphs become sluggish and for some time stop feeding. It has been observed that they will not eat 2-3 days before it starts to moult and will begin eating again after one day. It has also been observed that if food was provided in front of its mouth, it refused to eat during moulting time.

Table 1: List of body length (cm) with their characters and duration of different life stages of *O. planiceps*

| Instars | Length (cm) | Appearance | Duration | |
|-------------------------------|-------------|---|--|---------|
| 1 st | 0.5-0.6 | The body is black, resembling black ants. Green bands are present at the edges of every thorax segment. | 12 days | |
| 2 nd | 0.8-1.0 | The body is black. The coxa, tibia of the foreleg and the femurs of the middle and hind legs are turned brown or red colour. | 13 days | |
| 3 rd | 1.2-1.3 | The body is brown or black but the legs turned into yellow or green. | 14 days | |
| 4 th | 1.5-1.6 | The body is brown or green. Abdominal segments are 8 in the case of males and 6 in the case of females. Wing buds are absent. | 13 days | |
| Sub-adults | | | | |
| 5 th | Male | 1.7 | The body is green. Wing buds are formed and become prominent just 1-2 days before the final moult. Presence of black spots on the dorsal side of 1 st two abdominal segments. | 13 days |
| | Female | 1.8 | The body is green. Wing buds are more prominent. Presence of black spots on the dorsal side of 1 st two abdominal segments. | 14 days |
| 6 th instar female | 2 | The body is greenish in colour. The wing buds are more prominent. The ovipositor is clearly visible. | 14 days | |
| Adults | | | | |
| Male | 1.8 | The body is green in colour. The forewings were dark brown in colour with a green line in the margin. The anterior portion of the hind wings is golden in colour and the rest of the part is blackish in colour. A pair of anal cerci is present. | 1 month | |
| Female | 2.4 | The colour pattern is the same as the male. The forewings are yellowish in colour just after the final moult. The hind wings are golden in colour at the anterior and brown at the posterior portion. | 1 month | |



Figure A: List of different stages of the life cycle of *O planiceps* (Plate 1: Mating Male & Female); (Plate 2: 1st Ootheca); (Plate 3: Hatchling nymph from the 1st Ootheca); (Plate 4: 2nd Ootheca); (Plate 5: Hatchling nymph from the from 2nd Ootheca); (Plate 6: Newly hatch nymph after few hours); (Plate 7: 1st instar nymph); (Plate 8: 2nd instar nymph); (Plate 9: 3rd instar nymph); (Plate 10: 4th instar nymph); (Plate 11: 5th instar sub-adult nymph); (Plate 12: 6th instar female); (Plate 13: Adult male); (Plate 14: Adult female).



Figure B: Exuviae of *O. planiceps* (1st, 2nd, 3rd instar nymph, 5th instar male, 5th and 6th instar female).

Acknowledgement

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

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