



E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2016; 4(2): 07-10
© 2016 JEZS
Received: 16-01-2016
Accepted: 20-02-2016

Ganesh B Gathalkar
Department of Zoology,
MJF Educational Campus,
RTM Nagpur University,
Nagpur- 440033, MS, India.

Deepak D Barsagade
Department of Zoology,
MJF Educational Campus,
RTM Nagpur University,
Nagpur- 440033, MS, India.

Correspondence
Ganesh B Gathalkar
Department of Zoology,
MJF Educational Campus,
RTM Nagpur University,
Nagpur- 440033, MS, India.

Predation biology of weaver ant *Oecophylla smaragdina* (Hymenoptera: Formicidae) in the field of tasar sericulture

Ganesh B Gathalkar, Deepak D Barsagade

Abstract

The weaver ant, *Oecophylla smaragdina* (Fabricius) (Hymenoptera: Formicidae) is known for an aggressive painful bite and a predator of various insect species. Workers of *O. smaragdina*, attack and kill numbers of early larval instars of tropical tasar silkworm, *Antheraea mylitta* (Drury) (Lepidoptera: Saturniidae). The lethal predation of *A. mylitta* by the workers of *O. smaragdina* reduces wild tasar silk production which in directly contributes to the loss in total silk production. The arboreal nature of *O. smaragdina* and highly aggressive predatory habit coupled with extensive foraging on tasar host plants (eg. *Terminalia* sp.), often poses a serious risk in tasar sericulture. Therefore, a survey was undertaken in the tasar rearing fields in Vidarbha, Maharashtra, India to study the predatory potential of *O. smaragdina* on *A. mylitta*. Furthermore, based on the attack and symptoms of predation on *A. mylitta*, the loss (mortality) is also discussed.

Keywords: Aggressive predation, invasion, tasar silk, *Oecophylla smaragdina*, weaver ant.

1. Introduction

The Asian weaver ant, *Oecophylla smaragdina* (Fabricius) is a social and arboreal ant recognized by its nest building behaviour. The workers of *O. smaragdina* are very active, fierce and they are a serious predator feeding on the early larval instars of tasar silkworm, *Antheraea mylitta* (Drury) ^[1-3] which affects tasar silk production.

The worker ants construct their nest, with leaves of the host plant that are glued together with the help of larval silk. The colony consists of workers (reserve force, defenders and nurses) and sexual (male and female) with a clear cut division of labor ^[4]. The major workers are engaged in the foraging and nest construction activity, while the minor workers remain in and around the nest, caring for the brood and queen. The minor workers also hold the larvae during the weaving operation in the nest building ^[5-6].

The arboreal habit of *O. smaragdina* extensive foraging for carbohydrate- rich plant secretions as well as insect exudates ^[7, 8]. Although *O. smaragdina* is aggressive, it defends its colony against intruders. The workers of *O. smaragdina* bite on human skin, while a painful bite by *O. longinoda* due to poison sprayed on the wound from the tip of the gaster ^[5, 9].

Due to its highly aggressive predatory and far-reaching foraging habit *O. smaragdina* is usually used as a biological control agent against all major pests of economically important crops ^[10-13], like against the Mango leafhoppers, thrips, fruit flies, tip borers, scale bugs and mealy bug ^[14, 15]. Due to the predatory behaviour of *O. smaragdina*, total tasar silk production is affected due to larval mortality of *A. mylitta*. Therefore, the present work was undertaken to study the predation biology and feeding behaviour of *O. smaragdina* on the silkworm *A. mylitta*.

2. Material and Methods

2.1 Study area and climatic conditions

A survey was conducted in tasar rearing sites of Chandrapur (Lat, Long: 20.399291, 79.539701; GPS Coordinates 20° 23' 57.4476" N 79° 32' 22.9236" E and Gadchiroli (Lat, Long: 20.508963, 79.984988; GPS Coordinates 20° 30' 32.2668" N 79° 59' 5.9568" E) and adjoining districts of Vidarbha in Maharashtra, India. Observations on host-predator interactions were taken during each crop from 2010 to 2013 and photographed.

The environmental parameters, viz., temperature, relative humidity and rainfall were recorded

at the study sites during the period of study. The average temperature ranged between 35.5 ± 0.3 °C to 38.4 ± 0.2 °C during the first crop (June-August); 31.8 ± 0.2 °C to 33.4 ± 0.3 °C during the second crop (August-November) and 17.4 ± 0.4 °C to 21.2 ± 0.3 °C during the third crop (November-February) while the relative humidity varied between $87.2\pm 0.2\%$, $90.8\pm 0.6\%$ and $77.2\pm 0.6\%$ during first to third crops. Similarly, the mean rainfall recorded 361.6 ± 0.9 mm, 195.8 ± 0.6 mm and 39 ± 0.5 mm during the first to third crop respectively (unpublished data).

2.2 Tasar silkworm, *Antheraea mylitta*

The tasar silkworm *A. mylitta* is the principal non-mulberry silk producing insect in the tropical forest belt of Bhandara, Chandrapur, Gadchiroli and Gondia districts of Vidarbha in the Maharashtra state, India. The larval stages of *A. mylitta* primarily feed on *Terminalia tomentosa* (Yen) and *T. arjuna* (Arjun) (Figs. 1 a-f) and numbers of secondary and tertiary food plants. There are three crops viz., Crop I, Crop II and Crop III in the months of June-August, August-October and October-January respectively.

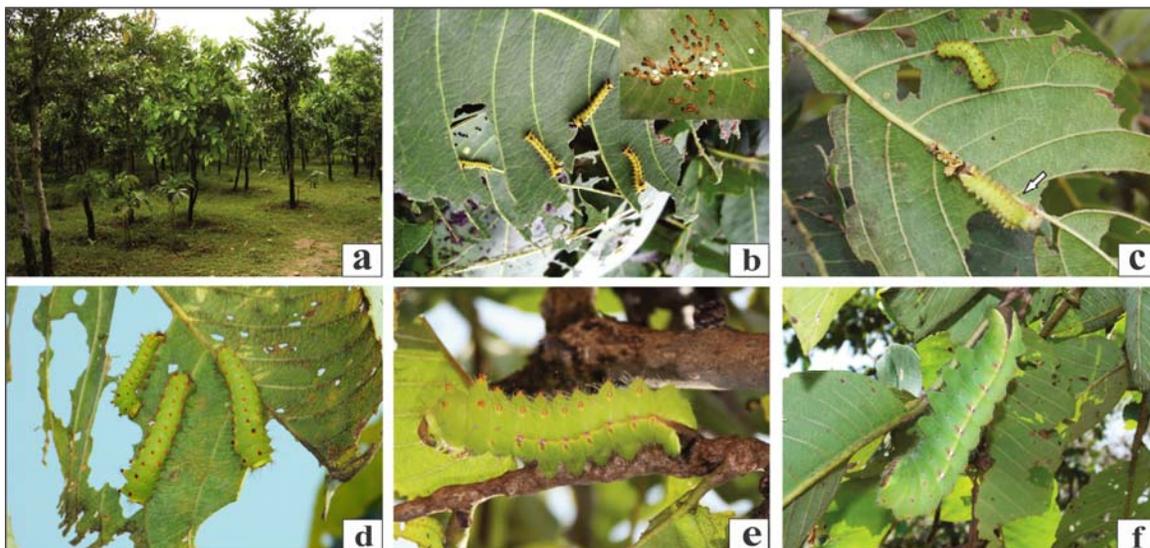


Fig 1: Rearing of tropical tasar silkworm *A. mylitta* (D) showing **a:** Host plant (*T. tomentosa* and *T. arjuna*) of *A. mylitta*; **b:** First instar larvae, in inset, just hatched first instar larvae; **c:** Second instar larvae, newly molted larva (arrow); **d:** Third instar; **e:** Fourth instar larva **f:** Fifth instar larva.

2.3 Identification of predator

Identification of the predator, *O. smaragdina* was done on the basis of morphological characteristics of collected specimens with the help taxonomic literature [16] in the Department of Zoology, RTM Nagpur University, Nagpur, and also confirmed with the help of Network Project on Insect Biosystematics (NPIB), Indian Agricultural Research Institute (IARI), New Delhi.

2.4 Field observations and behaviour Study

Tasar rearing sites were surveyed based on the area under tasar cultivation. Colonies of the ant predator, *O. smaragdina* were observed. The predatory incidences of the ant on the stages of silkworm were observed visually. Host- predator interactions, in the field as well *in situ* were observed in the present study. To study the predatory behaviour *i.e.* host searching and feeding behaviour the different events were observed visually and photographs taken with a digital camera.

3. Results

The numbers of colonies of predatory ant (Fig. 2 a) were observed in the rearing fields of tropical tasar silkworm *A. mylitta* (D) in Bhandara, Gadchiroli, Chandrapur and Gondia districts of Vidarbha and identified as weaver ant, *O. smaragdina* (Fabricius).

The predatory attack by *O. smaragdina* on first to third instar larvae of *A. mylitta* was very aggressive and leads to the death of host larva (Fig. 2 b- d). The rate of predation by this predator was higher on early larval instar of *A. mylitta* and also during moulting than the late instars. It produces an irritation to the larval skin due to its mandibular secretion and cut the tasar larvae by its sharp mandibles. The workers attack in a group and within a minute, the early larval stages of the silkworm are consumed.

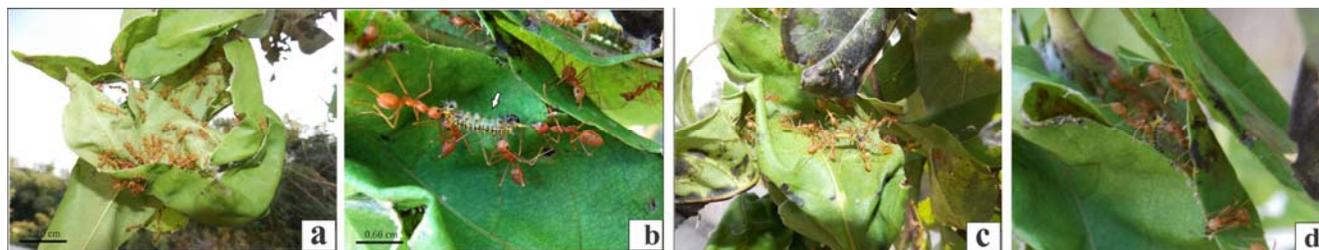


Fig 2: Predation of *A. mylitta* by the weaver ant, *O. smaragdina* showing, **A:** Colony of *O. smaragdina* on tasar host plant (*T. tomentosa*); **b:** Predatory attack by *O. smaragdina* on early larval instars of *A. mylitta*; **c:** Group attack on single tasar larva **e:** Tasar larva with predators inside the nest of *O. smaragdina*.

3.1 Predatory behaviour of the ant *O. smaragdina* (worker)

3.1.1 Sequence of Attack

In the present study, the aggressive feeding habit of workers of the weaver ant, *O. smaragdina* was observed. During host searching, the workers of *O. smaragdina* follow the moving larvae catch with the help of their strong mandibles initially by one or few workers. Subsequently, the integument of the larva of *A. mylitta* was pricked resulting in oozing of the haemolymph. The nearby ants are also attracted towards the punctured larva and added in a group for feeding on the same larva. Often, the workers also carry the young larvae of *A. mylitta* to their nest. The workers of *O. smaragdina* feed on the larval appendages including hairs and setae. This caused a swelling, paralysis and eventual death of the larvae were observed (Fig. 2 b- c).

3.1.2 Preference for prey type

The early instar larvae of *A. mylitta* were preferred by *O. smaragdina* as they cannot resist the attack of predatory ant and within a few minute, these were ingested. The late instar larvae tried to escape from the predatory attack by *O. smaragdina* but once caught, it leads to death. The fourth and fifth instar larvae oppose the predator ant as they have some defense power to fight against the predator but sometimes they were also captured by groups of a predator. The predatory activity of *O. smaragdina* affected the larval instar of *A. mylitta* which resulted in the loss of tasar silk production.

3.2 Damage caused by *O. smaragdina* on tasar silkworm *A. mylitta*

The tasar silk is commercially an important silk crop which provides the bread and butter to the rural tribal families. As we observed, the tasar silkworm crop was affected by *O. smaragdina* by which the early larvae of *A. mylitta* were devoured quickly. The attack of weaver ant was very aggressive, initially, one or very few predators attack the larva of *A. mylitta* and then other ants nearby joined the group feeding. As the feeding started, the ants tear the larva by using strong mandibles due to which excess amount of haemolymph oozes out and causes larval mortality. Usually, *O. smaragdina* attacks first to third instars tasar silkworm larvae whereas its attack was also lethal to the late instars. The attack of ants, *O. smaragdina* on *A. mylitta* resulted in 4%-5% loss (unpublished observations) in tasar sericulture.

4. Discussion

Weaver ants or Green ants *Oecophylla* are eusocial insects of the family Formicidae (Order- Hymenoptera). Castes in the colony may be defined broadly as any set of individuals of a particular morphological type or age group or both that perform specialized labour in the colony [7]. In the ants, the chief criteria for separating castes are reproductive capability which distinguishes workers from alates (or reproductive) and sex and separates males from gynes (or females) within the reproductive caste [17]. Within a mature colony, the range of individuals of one sex varies widely in size and allometrically in proportion a phenomenon and known as polymorphism [7]. Distinctions based on such physical traits are common and lead to the designation of minor, medium and major worker sub castes [18].

Workers of *O. smaragdina* predator of *A. mylitta* larvae and these attack on early larvae of *A. mylitta* very assertively and kill the host larvae very quickly. The workers cut the host larvae and carry them to the nest resulting in heavy larval mortality of *A. mylitta* as also reported earlier [1-3, 19]. Workers

are dimorphic viz. major and minor forms, a division of labour as the major workers forage as a predator while the minor workers remain in the nest is observed during present study similar to the earlier work [5, 20]. The major workers are mostly engaged in foraging and nest construction and the minors, care for the brood and queen and help during nest building [5, 6]. The predatory success of *O. smaragdina* may be due to morphological adaptations, like strongly dentate mandibles for prey capture and transport. It lacks a sting apparatus and they use their mandibles during foraging to handle the prey.

The brood of *O. smaragdina* includes the eggs, larvae, pupae and particularly the seasonally available large larvae and pupae are the queen brood that develops into winged reproductive females. The queen produces hundreds of eggs a day and the increased worker population in the colony up to 500,000 offspring's of the single queen [21]. These weaver ants are one of the most dominant, successful and highly social species of ants in the world and the dominance of these ants is certainly due to their highly social nature [7]. The powerful mandibles give a painful bite, followed by irritating acidic mandibular secretions [7]. The cooperation within the colony, aggressiveness of the workers and high reproductive rate of the queen allow this ant to cover large territories [22] with hundreds of thousands of individuals [7].

One of the reasons for the loss in wild tasar silk production is due to the invasion of *A. mylitta* larvae by its predator *O. smaragdina*. The occurrence of the predator depends on the variability in biotic factors like temperature, relative humidity and rainfall. The rearing performance of tasar silkworms is affected by the population of *O. smaragdina* causing loss up to 4-5% of total tasar silk production (unpublished observation). To increase wild silk production, attack by this predatory ants need to be extruded from tasar rearing fields.

5. Acknowledgements

Authors are grateful to the Directorate of Sericulture, Government of Maharashtra and Training Center, and Central Silk Board Government of India, for their help to access the tasar rearing field in Vidarbha, Maharashtra, India.

6. References

- Jolly MS, Chaturvedi SM, Prasad SA. Survey of Tasar crops in India. Indian J. Seric. 1968; 1:50-58.
- Jolly MS, Sen SK, Sonwalkar TN, Prasad GS. Non-mulberry silks. Food and Agric. Org. United Nations, Serv. Bull. 1979; 29:1-178.
- Singh RN, Thangavelu K. Parasites and Predators of Tasar silkworm- *Antheraea mylitta* has many enemies. Indian Silk, 1991; pp. 33-36.
- Hingston RWC. The habits of *Oecophylla smaragdina*, Proc. Ent. Soc. London, 1927 pp. 90-94.
- Weber NA. The functional significance of dimorphism in the African ant, *Oecophylla*. Ecology 1949; 30:397-400.
- Ledoux A. Recherche sur la biologie de la fourmi fileuse (*Oecophylla longinoda*). Ann. Sci. Nat. 1950; 12:313-461.
- Hölldobler B, Wilson EO. The Ants. MA: Belknap Press of Harvard University, Cambridge, MA, 1990; pp. 732.
- Davidson DW. The role of resource imbalances in the evolutionary ecology of tropical arboreal ants. Biol J Linn Soc. 1997; 61:153-181.
- Vanderplank FL. The bionomics and ecology of the red tree ant *Oecophylla* sp. and its relationship to the coconut bug *Pseudothraupis wayi* Brown (Coreidae). J. Ani. Ecol. 1960; 29:15-33.

10. Peng RK, Christian K, Gibb K. Distribution of the Green ant, *Oecophylla smaragdina* (F.) (Hymenoptera: Formicidae), in relation to native vegetation and the insect pests in cashew plantations in Australia, *Int. J. Pest Management*. 1997; 43(3):203-211.
11. Peng RK, Christian K, Gibb K. The effect of colony isolation of the predacious ant, *Oecophylla smaragdina* (F.) (Hymenoptera: Formicidae), on protection of cashew plantations from insect pests. *Int. J. of Pest Management*. 1999; 45:189-194.
12. Van Mele P, Cuc NTT. Evolution and status of *Oecophylla smaragdina* as a pest control agent in citrus in the Mekong Delta, Vietnam. *Int. J. of Pest Management*. 2000; 46(4):295-301.
13. Van Mele P, Cuc NTT, Van Huis A. Direct and indirect influences of the weaver ant *Oecophylla smaragdina* on citrus farmers' pest perceptions and management practices in the Mekong Delta, Vietnam. *Int. J. of Pest Management*. 2002; 48:225-232.
14. Peng RK, Christian K. The weaver ant, *Oecophylla smaragdina* (Hymenoptera: Formicidae), an effective biological control agent of the red-banded thrips, *Selenothrips rubrocinctus* (Thysanoptera: Thripidae) in mango crops in the Northern Territory of Australia. *Int. J. of Pest Management*. 2004; 50:107-114.
15. Peng RK, Christian K. The control efficacy of the weaver ant, *Oecophylla smaragdina* (Hymenoptera: Formicidae), on the mango leafhopper, *Idioscopus nitidulus* (Hemiptera: Cicadellidea) in mango orchards in the Northern Territory. *Int. J. of Pest Management*. 2005; 51:297-304.
16. Cole AC, Jones JW. A study of the weaver ant, *Oecophylla smaragdina* (Fab.). *American Midland Naturalist* 1948; 39:641-651.
17. Wilson EO. The soldier of the ant, *Camponotus (Colobopsis) fraxinicola*, as a trophic caste. *Psyche* 1974; 81(1):182-188.
18. Wilson EO. The fire ant. *Sci. Amer.* 1958; 198:36-41.
19. Singh KC. Controlling the Insect enemies of Oak Tasar Silkworms. *Indian silk*, 1991; pp. 19-2.
20. Gotwald WHJ. *Oecophylla longinoda*, an ant predator of *Anomma* driver ants (Hymenoptera: Formicidae). *Psyche* 1972; 79:348-356.
21. Hölldobler B, Wilson EO. Weaver ants – social establishment and maintenance of territory. *Science* 1977; 195:900-902.
22. Hölldobler B, Wilson EO. The evolution of communal nest-weaving in ants. *American Scientist* 1983; 71:490-499.