VOLUME 8 ISSUE 1 2022

ISSN 2454-3055

INTERNATIONAL JOURNAL OF ZOOLOGICAL INVESTIGATIONS

Forum for Biological and Environmental Sciences

Published by Saran Publications, India

International Journal of Zoological Investigations Vol. 8, No. 1, 531-536 (2022)

International Journal of Zoological Investigations
Contents available at Journals Home Page: www.ijzi.net
Editor-in-Chief: Prof. Ajai Kumar Srivastav
Published by: Saran Publications, Gorakhpur, India

ISSN: 2454-3055

A Review on Social and Economical Status of Asian Weaver Ants (*Oecophylla smaragdina*)

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Received: 10th April, 2022; **Accepted:** 16th May, 2022; **Published online:** 21st May, 2022

https://doi.org/10.33745/ijzi.2022.v08i01.059

Abstract: The Asian weaver ants **(***Oecophylla smaragdina***)** are one of the most social insects that actually work effectively for their existence from generation to generation. These ants are totally social as they always recruit their activities like nesting, foraging, migrating, and protecting their nest mates in huge number. Weaver ants also plays role as pest managing in several farms by dominating in numbers and eliminating other pests by their presence. In countries like Thailand and other Asian countries they have propogated naturally and artificially in order to combat against other pest impeding the trees to destroy them. Additionally these ants also have different castes to manage all the activities to continue their livelihood that work depending upon their actual needs. These ants also build arboreal nests on trees of mango, ashoka and other citrus plants by bringing the close proximity leaves. The workers squeeze up the unfertilized larva which helps to ooze out the silk like fluid that acts as a packing material to seal the edges of leaves and build a nest. *Oecophylla smaragdina* shows courtship behavior during nuptial flight during monsoon seasons to expand their colony. The female and male alate exchange their gametes in air and later on locate their own nest from the colony thereby laying eggs once the female ant loses its wings. These ants are of economical importance as their larvae are consumed by people of many countries as highly protein diet in a fried form as fritter. They are also highly possessive for their nest mates. Weaver ants forage socially by making different groups to locate, reach and lodge the food inside the nest by using landmarks.

Keywords: *Oecophylla smaragdina,* Biocontrol, Nesting, Courtship, Foraging

Citation: Patel Divyangi and Bhatt Nikunj: A review on social and economical status of Asian weaver ants (*Oecophylla smaragdina*). Intern. J. Zool. Invest. 8(1): 531-536, 2022.
https://doi.org/10.33745/ijzi.2022.v08i01.059

Introduction

Ants are one of the most plentiful and omnipresent arthropod groups present on earth and cooperate in regulating the environment at a huge level than any other creatures existing on a planet (Hölldobler and Wilson, 1994). Weaver ants constitute the genus *Oecophylla* (Order: Hymenoptera, Family: Formicidae) which consists of only two extant species, *O. longinoda* and *O. smaragdina* (Bolton *et al*., 2006). *O. longinoda* (Latreille, 1802) is widespread in the forested regions of tropical Africa, and *O. smaragdina* (Fabricius, 1775) ranges from India across almost all of tropical Asia to the Solomon Islands and northern Australia. Moreover, these ants have different castes within the nest. There are workers, queen and drones just as in case of honey

bees. The workers are meant to build the nests, the queen produces offspring while the drones help the queen to produce offspring via fertilization. Additionally weaver ants also show nest construction as far as social behavior is concerned. They together with their nest mates with a fascinating division of labour, develop their nests for their survival and retention of next generation. These ants are highly specific in selection of trees for weaving nests. Normally they prefer citrus trees for building nests. Sometimes they also like to construct their nest on Mango and Ashoka trees too. Feeding behavior is also required to sustain the lives of organisms. *Oecophylla smaragdina* shows feeding behavior by forming group called 'Foragers'. The foragers basically locate the position of food in the environment and then bring it to the nest for other members of the nest throughout the season. Food preference is also important. The type of food and its size does matter in weaver ants. Furthermore as these organisms also undergo the phenomenon of reproduction for continuing their race, courtship behavior is more important too. In these species there is less chance of non-specificity with other ants as there are only two varied species existing in world and both of them are distributed in specific places only. Thus there is no chance for its contamination. Here the ant produces two types of offspring. One type is fertile, where queen mate with fertile male to produce diploid offspring while another type of offspring is produced by the process of parthenogenesis formed without male parent. The phenomenon of reproduction is carried out as nuptial flight. The queen that is to be fertilized is having wings, the male ants will transfer the semen into female's body for producing offspring. This is highly cost consuming process as it is totally driven in air. Although, around the world there are very few scientists who have taken keen interest to study its aspect as pest management in agricultural farms. Pest management is a serious issue as far as agricultural system is concerned. Increase in number of pests and its attacks had led to decrease in the yield of crops. In recent times, scientists in Australia (Peng *et al.*, 1995), Southeast Asia (Van Mele and Cuc, 2001), Latin America (Perfecto and Castineiras, 1998) and Africa (Seguni, 1997) have studied large number of endemic voracious ants in a variety of tree crops that have been proven profitable and advantageous to the farmers. One of the key species that actually played important role in pest management is weaver ant. They help to reduce the role of other insects on crops and trees.

Weaver ants as biocontrol agent:

Oecophylla smaragdina and the other species *Oecophylla longinoda* have been documented as most effective biocontrol agents of a range of insect pests. More than 100 pest species belonging to 8 orders and 26 families on 8 tropical tree crops and 6 forest trees are highly controlled and protected by *Oecophylla* ants. These findings have been useful for many agricultural based people. The tree-inhabiting weaver ant *Oecophylla smaragdina* effectively protects tropical tree crops as it actively patrols canopies and preys upon or deters a wide range of impending pests. These species always keep watch on all the pests that are invading on trees and also in agricultural farms. Their presence on trees makes other species to stay away from the trees to develop their habitat. During 1980s in Asian rice fields, the importance of native natural enemies became obvious only after broad spectrum pesticides had swept aside many of the natural enemies and triggered secondary pest outbreaks, such as the brown plant hopper. Many farmers reduced the use of pesticides only because the existence of weaver ants in the fields proven to be very helpful as natural avoidance for other insects. But after a long time presence of *O. smaragdina* had negligence effect on invasive arthropods and again the use of pesticide was increased. As pesticide misuse was identified, entomologists were increasingly asked to provide input in farmer training programmes, such as farmer field schools based on agroecology. Biological control agents can be broadly divided into specialists and generalists. Specialists have long been used as

successful biological control agents, with part of their effectiveness lying in an ability to quickly reproduce and outnumber the relatively few prey/host species on which they feed while, generalist predators can combat a suite of pests and this polyphagy allows them to remain in a field as various prey species become more or less common. It has been reported that many crop species have been shown to benefit from weaver ant attendance, as the ants are able to control more than 50 different pest species thus weaver ant larvae are sold for up to 16 USD (2010 prices) per kg. Consequently, these ants have been used as biological control agents to reduce the damage caused by insect pests in coconut, cashew, tea, mango, cocoa, and citrus trees. The weaver ants hunt on the insects that extract the tissues as well as the sap of the trees by combating. Weaver ants are increasingly being implemented in the management of tropical plantations and ant nurseries are being developed to provide farmers easy access to live queen-right colonies (M.G. Nielsen, personal communication). Communication in companionable and social insects is totally based on pheromones. Cuticular hydrocarbons of insects help to recognize signals allowing tolerance between individuals of the same group (Lenoir *et al.*, 1999) and also act as aggregation pheromones (Vander Meer *et al.*, 1998).

Castes:

There are two sub-castes of *Oecophylla* workers, the minor workers and the major workers. A caste can be characterized as a set of individuals in a colony, morphologically distinct from other individuals and specialized in behavior which performs specialized task in the colony (Oster and Wilson 1978). Several studies showed that different caste of *O. smaragdina* ants performed diverse but unambiguous task to uphold their colony in a proper manner. Minor workers normally remain within the brood chambers where they tend larvae, whereas the major workers tend to defend the colony against the enemies (Hölldobler, 1983; Dejean, 1990), assist with the care of the queen, and forage food for colony mates (Hölldobler and Wilson, 1990; Lokkers, 1990). A unique feature to this genus is the major workers are more in number than minor workers within the colony and nest (Hölldobler and Wilson, 1990). *Oecophylla* species attack the other arthropods they come across, and consequently reduce the number of those insects on the trees they dwell in (Lokkers, 1990). The *O. smaragdina* colonies could produce a large number of “queen brood” every year. The “queen brood” refers to larvae and pupae, which are destined to become new queens as well as their final stage as imago virgin queens (Cesard 2004; Offenberg and Wiwatwitaya, 2010). *O. smaragdina* ants build new nests in a span of 14 days after their nests were taken. The new nests were located near to the nests which were taken for a known reason. Paimin and Paimin (2001) reported that when the conditions are normal, weaver ants make a rapid recovery in its population with a regeneration time between 17 and 24 days. Cesard (2004) reported that it takes five days before new nests appear and almost 20 days for the ants to produce new larvae in the nests. Female alates are found inside the nests, the yellow color was also observed in the study of intercolony transplantation of *O. smaragdina* by Krag *et al.* (2010). They described that the *O. smaragdina* can be categorized into the following distinct groups: larvae, pupae, light yellow callow workers and red mature workers. Lee *et al.* (2003) explained about callow as a newly hatched adult which has not yet acquired its deep coloration. It will endure coloration as it grows older and older. Normally the eggs of *O. smaragdina* are very small and ellipse-shaped with a size approximately 0.5 mm x 1.0 mm. The eyes and mouth of the larvae within the eggs can be observed under a magnifying glass or a dissecting microscope. The pupae are white in color and thus could be differentiated from the mature ones very easily (Van Mele and Cuc, 2007). The colonies of *O. smaragdina* could produce a large number of “queen brood” every year. The “queen brood” refers to larvae and pupae, which are intended to

become new queens as well as their last stage as imago virgin queens (Cesard, 2004; Offenberg and Wiwatwitaya, 2010). Hölldobler and Wilson (1990) stated that a colony which is large enough to produce new virgin queens known as "mature colony" and the efficiency of the mature colony is determined by the number of workers in each temporal caste at any given moment.

Nesting behavior:

The tailor or weaver ants of genus *Oecophylla* (Hymenoptera: Formicidae) are eusocial insects. They are obligately arboreal and are known for their unique nest building behaviour where workers construct nests by weaving together leaves using larval silk. Weaver ant nests are made with the use of living leaves that have been pulled collectively by the worker ants and afterward have been shut mutually with silk from their larvae to form the walls of the nest. However, the nests are vulnerable to storms and heavy rain, as the accompanying physical forces may tear them apart (Peng *et al.*, 2004). This is especially the case for nests built with leaves growing on different branches of a tree, as wind and rain may force branches apart, resulting in a broken nest. African weaver ants (*O. longinoda*) have been described to move their nests to the leeward side of their host trees as the monsoon changes direction on Zanzibar that actually depicts how they react to the external environmental condition (Way, 1954). Ants adapt themselves according to the seasonal changes that might make them to build their nests consequently. In *Oecophylla longinoda* different nesting have been recorded other than regular nest during the rainy season in Northeast Thailand and in Darwin, Northern Territory, Australia. Due to storms the nests which were destroyed have been observed, the workers have been seen struggling to pick up brood fallen to the ground. Such challenges can be helpful for social behavior during nesting, foraging as well as mating as an adaptation challenge. It has been summarized that the day before nest construction, large number of worker crawls to the nesting site for estimating the cost and time for building the nest. Additionally they also look upon the leaves and its distribution for constructing the nest. An alternative explanation for the observed seasonality in nesting behavior could be that weaver ants avoid leaf nests on mango during the onset of the rainy and stormy season, as at this time the mangoes shed part of their leaves without producing new leaf flush, which is their preferred building sites for new nests (Offenberg *et al*., 2006). Thus, during this season, new nests can only be placed on old foliage that is at risk of being shed. This hypothesis, however, does not explain why the ants used artificial nests in the pomelo plantation. Colonies of weaver ants can be tremendously large with a mature colony containing between 100,000 and 500,000 workers (Hölldobler and Wilson, 1978), and may cover as many as 12 trees and contain up to 150 nests (Way, 1954). Thus these ants produce large number of nests in an area contributing a huge colony.

Foraging behavior:

Feeding behavior is totally dependent on the castes work allocation. In ants feeding is preferably recruited into the nests with the help of workers and then fed to the queen. Several studies revealed that they have food preferences as far as foraging behavior is concerned. Group activity can easily be helpful to locate, drag and carry the food towards the nests. These ants are carnivorous, so they totally feed upon the small insects, annelids and also provided flesh food for experimental purpose. Almost worldwide, the ant prefers carbohydrate and protein rich food as their diet. In one of the study it has been found that food preferences and foraging behavior by the *Oecophylla longinoda* can be influenced by food type, form, as well as particle size. *Oecophylla smaragdina* also have same type of feeding behavior. When the size of the food particle is large few ants come together to bring the food to the nest collectively. Anchovy, a type of fish meat was the highest preferred food across orchards in some areas and seasons but the order of preference for other food types may varied

between seasons. In some studies it is concluded that chicken intestine is least preferred food during the rainy season by ants. The reason behind is, it is more firm as the tissues are very tightly bound with each other. Apart from these two species, the insects belonging to the order hymenoptera shows highly social behavior in context of feeding or foraging behavior. These ants also carry annelids, caterpillars, other ants and spiders to their nest as food in a large group (Divyangi and Nikunj, 2020). They also feed on some insect larva as the larvae are proteinaceous.

Courtship behavior:

Organisms mate to produce new generations. In *Oecophylla smaragdina* colonies can be polygynous or monogynous and polyandrous or monoandrous. Depending upon the number of times the organism mate, the genetic makeup of an organism or colony is formed accordingly. Additionally, this also enhances or reduces the population within the colony and nests. *Oecophylla* species queens disperse from the natal colonies at the onset of rainy season. Unrelated sexual forms help in mixing of genetic makeup when they copulate in nuptial flight. Basically, there are two types of mating strategies in ants, viz. male aggregation and female calling. Male aggregation is a phenomenon where a winged male will copulate with female during nuptial flight. The female further will mate with other male mates and becomes a fertile female to lay eggs. On the contrary, in female calling system, the female releases pheromones near the natal nest with proper positioning near male. The mating occurs outside the nest but sometimes it may occur inside the nest. It has been hypothesized by Vanderplank (1960) that mating by *O. longinoda* takes place within the nest, before dispersal of the queens. Also males liberated from their natal nests, disperse and enter into the nests of other colonies, where mating with alate queens takes place. While in studies it has been reported about sexuals of the closely related Asian green tree ant, *Oecophylla smaragdina,* unveiled that mating occurs during nuptial flights (Peng *et al*., 2013).

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