

Unveiling the Dark Side of Nature: Exploring Cannibalistic Behavior in Insects

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ABSTRACT

Cannibalism in insects is a diverse behavioral phenomenon, encompassing intra and interspecific interactions, in which insects consume members of their own or other species. This behavior is driven by different factors like nutritional stress, territorial disputes, reproductive strategies and survival tactics. Cannibalism is reported in insects of various orders like Coleoptera, Lepidoptera, Hemiptera, Hymenoptera, Isoptera, Blattodea etc., This behaviour has significant implications on the dynamics of insect populations influencing competition, predation pressures and overall ecosystem functioning. Understanding the ecological and evolutionary drivers of insect cannibalism can provide deeper insights into insect behaviour, resource allocation and species interaction within ecosystem.

INTRODUCTION

In insects, some behaviors are understudied and overlooked even though they contribute to the insect world. One such behaviour is cannibalism. It is also called as intraspecific predation. Cannibalism means killing and consumption of all or part of a

conspecific. The word Cannibal is derived from 'Carib' which is a tribe on the North West coast of Cuba, because caribs are man-eaters. This behavior was first reported by human beings for survival during the periods of food scarcity or catastrophes. It is reported

in many groups like protozoa, planaria, rotifers, snails, copepods, centipedes, mites, insects, fish, anurans, birds and mammals (Fouilloux *et al.*, 2019). There are 4 types of cannibalism:

1. **Sibling cannibalism:** siblings consume on each other
2. **Filial cannibalism:** parents eat their own offspring
3. **Hetero cannibalism:** devouring of unrelated conspecific progeny
4. **Sexual cannibalism:** In this type, male is devoured by his mate after copulation. As of now, it is documented among Insecta and Arachnida. This kind of cannibalism increases the number and viability of the eggs in female. Females have their own reason for eating their mate following copulation, it is to obtain energy for the production of gametes and to rear offspring.

The reason for less knowledge and research on this behavior is due to its rarity. This behavior is uncommon in many species due to the costs of acquiring pathogens or parasites by cannibals. Pathogens and parasites will be transferred even through interspecific predation, but due to their genetic comparability conspecifics obtain more pathogens and parasites when compared to hetero specific. The exact reason or mechanism that is responsible for this behavior is not yet known.

Cannibalism in Insects

Among insects, cannibalism is very well known to occur in predators, but the fact is that, it is also seen in detritivores and herbivores. In class Insecta, cannibalism is disclosed in various orders like Odonata, Orthoptera, Thysanoptera, Hemiptera, Trichoptera, Lepidoptera, Diptera, Neuroptera,

Coleoptera and Hymenoptera. Cannibalism is practiced by ambulant adults and larvae or nymphs on one another or static eggs and pupa. Cannibalism occurs mostly due to crowding and starvation. Females being gigantic, helps them to get the upper hand over the males. So, females are more cannibalistic than males (Santana *et al.*, 2012).

Aspects that persuade insects to perform cannibalism

Density-dependent factors like food, overcrowding, lack of alternative forms of nutrition and density-independent factors such as high temperature, low humidity, asynchrony with host plant, poor nutritional quality of host plant, availability of vulnerable conspecifics lead insects to cannibalism. Cannibalism is imputed chiefly because of density-dependent factors when compared to density-independent factors (Santana *et al.*, 2012).

Sexual cannibalism

The type of cannibalism which we are aware of is sexual cannibalism. In this, females eat their mate before or during or after copulation. It is mostly documented by preying mantids. Several hypotheses like adaptive foraging, aggressive spillover, mate choice and mistaken identity were presented to elucidate sexual cannibalism (Aisenberg *et al.*, 2011).

Sometimes, males eat females. This is referred to as reversed sexual cannibalism. It is reported by spiders *Micaria sociabilis* and *Allocosa brasiliensis*. As the males and females of these species are similar in size, this reversed sexual cannibalism is thought to be regulated by size dimorphism. These males mostly eat the older females whose reproductive value is vague.

Cannibalistic necrophagy

Cannibalistic necrophagy means eating the corpses that are taxonomically and genetically

related. This kind of behavior is mostly seen in social insects like ants and termites (Sun and Zhou, 2013).

Cannibalism in non-carnivorous insects

Noncarnivorous insects mostly lay eggs in groups than singly. Because of this, there is a high chance of encounter among conspecifics. Most of the cannibals are juveniles and they prey on eggs and also juveniles of small size. Ex: larva of *Scolytus multistriatus* feed on smaller conspecifics when they are boring into phloem. In *Schistocerca gregaria*, *Carmentia bematica* and *Labidomera clavicollis*, cannibalism occurs among instars of smaller size.

Taxonomic distribution of cannibalistic insects

75% of cannibalistic insects were reported from orders Coleoptera and Lepidoptera (Richardson *et al.*, 2010). Few insects of orders Orthoptera, Blattodea, Hemiptera, Hymenoptera and Diptera show cannibalistic behaviour.

Coleoptera

50 species of Coleopterans are reported to be cannibalistic. *Tribolium confusum* and *Tribolium castaneum* larvae and adults eat their conspecific eggs and pupae. 24 hours after hatching, neonates of the willow leaf beetle, *Plagioderma versicolor* cannibalize each other.

Lepidoptera

In Lepidoptera, adults due to their siphoning type of mouth parts cannot cannibalize. Only larvae can cannibalize. Among Lepidopterans, cannibalism is a common phenomenon in *Helicoverpa armigera*. The major reason for this behavior to occur in *Helicoverpa armigera* is the lack of food availability. Later instars

are more cannibalistic than early instars. Larva of a pierid, *Ascia monuste* feeds on the chorion of egg from which it is hatched prior to feeding on plants. Sometimes, cannibalism is reported from insects to compensate the toxins or nutritional deficiencies (Richardson *et al.*, 2010). Some insects develop counteracting measures to this behavior like females of pierid moth, *Anthocharis cardamines*, *Ostrinia nubilalis*, *Pieris brassicae* deposit an epidictic pheromone while ovipositing on flowers, so that no other female lays eggs on that flower.

Orthoptera

In orthoptera, 7 species of Acrididae, 1 species of Gryllotalpidae and 1 species of Tettigonidae exhibit cannibalistic behaviour. Neonates of desert locust, *Schistocerca gregaria* enhance their potential to get through drought conditions by cannibalizing.

Blattodea

In Blattodea, 6 species belonging to 3 families exhibit cannibalism. Density-independent factors like high temperature leads to cannibalism in cockroaches, *Blatta orientalis*, *Blatella germanica* and *Periplaneta americana*. Nymphs of *Blatella germanica* avoids cannibalism by feeding during day, when activity of adults is less and they also release a pheromone which causes dispersal in adults.

Hemiptera

In Hemiptera, 7 species show cannibalistic behavior. In this order, mostly nymphs cannibalize eggs. Cydnid - *Parastrachia japonensis*, milkweed bug - *Lygaeus kalmii*, *Oncopeltus cingulifer*, *Oncopeltus unifasciatellus*, stink bug – *Nezara viridula* cannibalize eggs or weakened conspecifics.

Hymenoptera

In Hymenoptera, few reports of cannibalism were outlined. Larvae of European stem fly, *Cephus pygmaeus* consume eggs and other larvae along with their endoparasitoids. Because of this, rate of parasitism in next generations is reduced. Ants belonging to genera *Pheidole* and *Solenopsis* also showed cannibalism. Egg cannibalism was noticed in genus *Formica*.

Isoptera

In termites, cannibalism was considered as a mechanism that recycles nitrogenous nutrients. This is because, their diet is nutritionally poor. *Coptotermes formosanus* exhibit cannibalism when starved. Lower termite species *Reticulitermes speratus* and higher termite species *Microcerotermes crassus* consume freshly dead or injured termites.

CONCLUSION

As a whole, this behaviour “cannibalism” has its benefits as well as costs. It provides nutrition, prolonged survival, high rate of development and high fecundity. It also helps in reducing the attack by natural enemies. Disadvantages include role reversal in insects,

transmission of pathogens and it also sometimes leads to elimination of mates. But as a whole, population density of insect pests will be abated.

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