

# Nuptial Gifting- A Unique Reproductive Behavior in Insects

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**FIGURE:** Nuptial Gifting in crane fly

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## SUMMARY

Reproduction is one of the important phenomenon in insects for their successful establishment and predominance in the Universe. It is not only involved by joining of male and female insects together and oviposition rather involves many pre copulatory behaviors which significantly influence the rate of success in reproduction. In most cases, male insects are attracted towards females by sensing through a specific cues includes pheromones, visual activities, acoustics etc. In order to ensure the copulation and reproductive success, a specialized behavior, Nuptial Gifting is noticed in many insects. It encompasses transfer of any form of nutrients from the male to the female during or directly after copulation. This transfer of gifts can be performed in three ways viz., oral gifting, seminal transfer and transdermal injection. This behavior secure the paternal investment through increase the life fitness, offspring population of the gift offering male insects and entice females for copulation and ensures maximum sperm transfer. Thereby, nuptial gifts evolved as ban to balance reproductive costs between the sexes.

## INTRODUCTION

High rate of reproduction is one of the important phenomenon in insects for their successful establishment and predominance in the Universe. Interestingly, reproduction will not only the mating of male and female sexes, rather involves many kinds of peculiar behaviors during pre-copulation. Offering nuptial gifts is an important and most significant behavior in insects and this help them for prolonged and successful courtship. This may also ensures sufficient transfer of sperms to female reproductive system. The activity of nuptial gifting is well studied in insect evolution and this helps to avoid inter specific competition for courtship activity. Nuptial gifts are common in insects and some invertebrates, but are less common in spiders. Male insects offer nuptial gift to females for prolonged and successful mating.

This transfer of material can be performed in three ways. One way is directly offering to female insects for feeding. Second type involves seminal gift that are ejaculated into female reproductive tract and absorbed from there. Thirdly, chemical gift is injected into the body wall and termed as transdermal gifts. Anyway, the gifts may include nutrients (or) defensive chemical substances. Nuptial gifts are also classified based on source of the gift as endogenous and exogenous gifts. Endogenous gifts are produced by mating

donor whereas exogenous gifts are captured, collected or found by the donor. Endogenous gifts often carry great cost to the donors and mostly contain body haemolymph or body parts commonly secreted through their salivary and reproductive glands. The secretions often carry nutrients which are severally lacking in the body of recipient insects. Some Unique examples are given as follows,

### Courting with seminal gift

Females of snowy tree cricket, *Occerthly fultoni* T. Walker (Orthoptera: Gryllidae) will remain in a specific mating position for long time by chewing on thick glutinous fluid from male's meta notal gland as well the spermatophores (Fig. 1). During copulation males of katydid, *Isophya krausii* Brunner von Wattenwyl (Orthoptera: Tettigonidae) inject nutritionally rich spermatophores (Fig. 2) in to its female genitalia to meet out the calorific needs.

During some instances, immature of certain insects feed and accumulate various toxins especially alkaloids in their tissues and subsequently carry on to adulthood males. The rattie box moth, *Utetheisa ornatrix* Linnaeus (Lepidoptera: Erebidae), seems highly prone to host-derived chemical defenses. The larvae acquire pyrrolizidine alkaloids while feeding on toxic legume, *Crotalaria spectabilis* Roth (Fabaceae) and it will be carried until the adulthood in turn female moth pass to their

eggs. During copulation male moths also transfer these alkaloids to females as seminal gift (Fig. 3). This helps to protect their eggs from predation by natural enemies.

### Courting with oral gift

Males of dance fly, *Rhamphomyia longicauda* L. (Diptera: Empididae) offer an insect prey of various sizes to females while mating with females in the vicinity of dense vegetation (Fig. 4 & 5). Hence, the sexual selection is relied up on size of the gift that is offered by male insects. But, males are highly maneuverable and efficient flier in the lek with a small sized prey and this helps to minimize the carrying costs to male insects.

Panorpid female scorpionfly is known to feed on white salivary mass secreted by its male offered as nuptial gift which serves as extra oral nutrition to females (Fig. 6). Similarly female camel cricket also ingest gelatinous spermatophylax secreted by male after mating (Fig. 7). Female of Hawaiian sword tail cricket, *Laupala cerasina* D. Otte (Orthoptera: Trigonidae) consumes on protein packed nuptial gifts from its male (Fig. 8) prior to copulation.

Similarly, male beetles of *Neopyrochroa flabellata* B. (Coleoptera: Pyrochroidae) ingest toxic cantharadin (Fig. 9) while feeding on host plant and this will be

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transferred during mating so that female can enable to use this chemical in order to protect eggs from natural enemies.

Prophalangopsidae), consumes on parts of the male's wings during mating. In *H. agitator*, female eats the male's tegmina

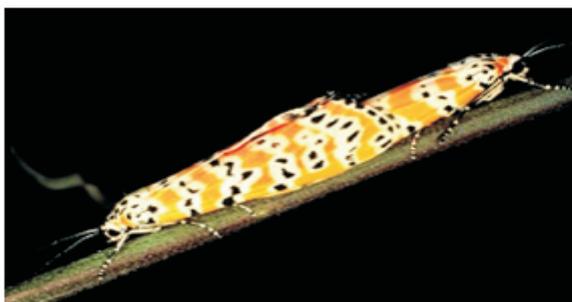
insemination and to prevent the consumption of spermatophore before it is emptied. While mating, female



**FIGURE: 1** Copulation Snowy tree cricket



**FIGURE: 2** Copulation Katydid



**FIGURE: 3** Copulation in *U. ornatix*



**FIGURE: 4** Nuptial Gifting in crane fly



**FIGURE: 5** Nuptial gifting in Dance fly



**FIGURE: 6** Oral gifting in Panorpidid scorpion fly



**FIGURE: 7** Ingestion of oral gift by camel cricket

Similarly, females of *Hapithus agitator* Uhler (Orthoptera: Gryllidae) and *Cyphoderris* spp. (Orthoptera:

when both pairs remain in copulatory position. This behavior helps to retain the female insects in a place during

cockroaches (Dictyoptera: Blattidae) are observed to feed on spermatophores containing stored uric acid secreted.

Males of non predatory bug, *Stilbocoris natalensis* Distant (Hemiptera:

Males of *Cosmosa myrodoxa* moths, usually attractive boy pheromones

by females and help to protect her eggs herself and from natural enemies.



FIGURE: 8 Nuptial gifting in Hawaiian swordtail cricket



FIGURE: 10 Nuptial gifting in *Cosmosa myrodoxa* moths

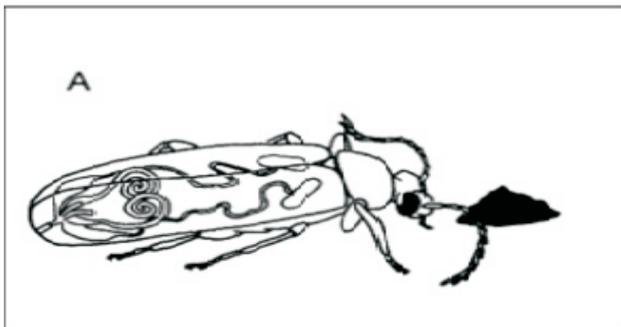


FIGURE: 11 Nuptial gifting in Praying mantis – Sneak attack

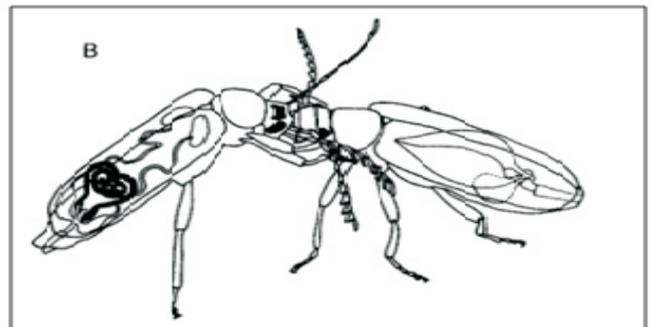
Rhyparochromidae) offers saliva injected, apparently partially predigested seeds to its females and this convince their female to

emanated by their females and flutter their wings, then suddenly discharge bursts of fine filaments that swirl in the air around

In praying mantis at the time of copulation, the mating females normally consume head, prothorax and legs of its



Ingestion and Storage of cantharidin by male beetle in its cephalic and accessory glands



Transfer of cantharidin to female from male's cephalic gland

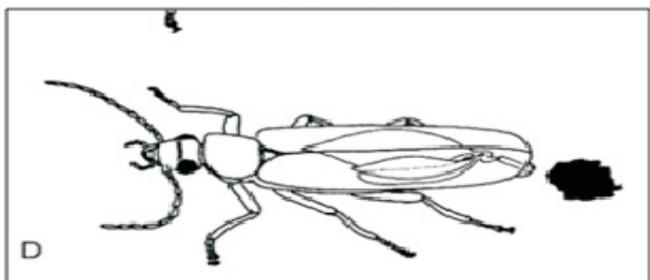
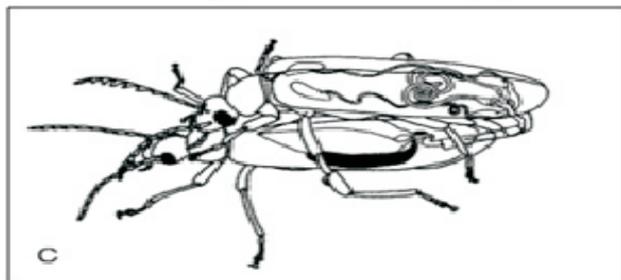


FIGURE: 9. Use of Cantharidin in *Neopyrochroa flabellata*

copulate each other. Nevertheless, male without this may court, but cannot sufficiently persuade its female insect to copulate.

female like an explosively delivered net. These filaments cling over female body and lead to lengthy copulation over long time (Fig. 10). This is also in turn injected

partner and leaving genitalia and this refers to "Sneak attack" or "Sexual cannibalism" (Fig. 11). The injected male body parts secretes as food source for

newly emerging nymphs. Usually females make coating (Spuma line) over its egg mass.

After completion of copulation, female katydid, *Requena verticalis* Walker F. (Orthoptera: Tettigonidae) grasp large sized spermatophore secreted by its male at the base of ovipositor (Fig. 12). Then, female grasps the nutritious spermatophylax on a

elytral tips (anthicidae) of male insect during pre-copulatory courtship as food. Apart from all these, this behavior curtails the multiple mating with other males and the consequent receipt of sperms from diverse sources. In fruit flies, katydids and scorpion flies nuptial gifts contain substances that reduce receptivity of females to additional mating.

reproductive success of both sexes in insects. Also in many insects stop feeding altogether once become adult hood. Hence, nuptial gifts evolved as ban to balance reproductive costs between the sexes.



**FIGURE: 12** Female katydid, *Requena verticalis* ingesting the oral gift



**FIGURE: 13** Nuptial gifting by males of hanging flies, *Hylobittacus apicalis*

specialized hind leg spur and eats by leaving the sperm ampulla and it will also be eaten at the end of insemination. This contributes enormous nutrient to females and end up with high reproductive success.

Similarly it is reported that the female of hanging flies, *Hylobittacus apicalis* Hagen (Mecoptera: Bittacidae) is feeding on a blow fly captured and gifted its males (Fig. 13) increased the duration of mating and rate of sperm transfer. Often, scorpion fly males can switch gifts depending on the situations. In good conditions, they produce a large salivary mass which is referred as Spitballs and offer to females. On the other hand, when courtship is in bad shape, instead offers a nuptial gift, male insects try to steal back from the female after copulation. Hanging flies are highly vulnerable to be predated upon by web-building spiders whilst foraging. Nuptial gifts offered by males give minimum chance to hunt for prey themselves and are therefore female insects are less likely to kill by predators than males. It is also recorded female insects nibble either the frontal glands (pyrochroidae and certain malachiidae) or

## CONCLUSION

When food resources are scarce or unrewarding, females may rely on males that can provide valuable gifts. In general, male spermatophores provide amino acids or sodium which is likely to be limiting resources for female insects and obviously, these enhance a female's lifetime egg production, longevity and lifetime fitness. In light of above examples, it is clear that nuptial gifting of male insects enhances the fecundity of females, reduces the risks that must be taken by the female to obtain nutritious food after copulation and therefore promotes the male's reproductive success by assuring the production of its own offspring. Presumably, even though larger gifts increased duration of copulation and result in adequate sperm transfer and increasing its paternity share when females are promiscuous. Therefore successful mated male insects strongly imprint their paternity in the offspring. Hence, it is very clear that both offering and receiving nuptial gifts can deliberately influence the

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