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Tonic Immobility: A Defence Strategy in Insects

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Abstract

Anti-predatory defences are crucial to many aspects of behavioural ecology. Thanatosis (often called death-feigning) in this regard has long been an under-appreciated defence, despite being taxonomically and ecologically widespread. The behavioural defence in insects has been well established among insects, out of which tonic immobility or feigning death or thanatosis is a distinguishing phenomenon.

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Introduction

Insects experience a wide range of biotic and abiotic stresses in the natural environment, which is impressively tackled by some of the defence mechanisms which may be physical, behavioural or morphological (Pullin, 1996). Among the behavioural factors, adaptation is essentially a product of natural selection acting on the populations. Natural selection means differential reproduction *i.e.* some members of population have traits which enable them to grow up and reproduce at a high rate and leave the more off springs in the next generations than others. Generally those individuals which are best adapted to the environment have a greater number of surviving young ones. The well adapted individuals on the whole are healthier, can find food and mate readily. Adaptation is essentially a product of natural selection acting on the populations. Natural selection means differential reproduction *i.e.* some members of population have traits which enable them to grow up and reproduce at a high rate and leave the more off springs in the next generations than others. Generally those individuals which are best adapted to the environment have a greater number of surviving young ones. The well adapted individuals on the whole are healthier, can find food and mate readily.

Adaptations may refer to an organism's ability to change in order to cope with changing environmental circumstances. Also it may be a special feature or behaviour that makes an organism particularly suited to its habitat. The following categories of adaaptations are recognised:

1. Behavioural
2. Morphological
3. Physiological

Behavioural adaptations deal with an organism's actions, either solitarily or as a group. Behaviour is what animals do. It can be defined more precisely as an internally directed system of adaptive activities that facilitate survival and reproduction. Innate behaviour is genetically programmed. Individuals inherit a suite of behaviours (often called an ethogram) just as they inherit physical traits such as body colour and wing

venation. In general, innate behaviours are:

• ***Heritable***: encoded in DNA and passed from generation to generation.

• ***Intrinsic***: present in animals raised in isolation from others.

Thanatosis (Feigning Death)

One interesting and well-known defence that prey can exhibit late in the sequence of a predation event is Tonic Immobility (Arduino and Gould, 1984). TI typically occurs when animals are physically restrained, and it involves prey adopting a relatively immobile state that can last from seconds to hours even after the physical constraint has been released. In some vertebrates, the behaviour can involve reduced breathing rates, bradycardia, tongue protrusion, and setting the eyes wide open features very reminiscent of dead individuals of that species. TI is, therefore, also known as death feigning, playing dead, playing possum, animal hypnosis, and thanatosis. Death feigning as a defensive response is very widespread in insects. A remarkable example of intraspecific death feigning comes from the fire ants. In the highly territorial species *Solenopsis invicta*, when neighbouring colonies are at war, youngest feign death, after danger has apparently passed, they look around before fully reviving as they are the most vulnerable and ineffective in fight due to their relatively soft cuticle, this seems a sensible strategy, and it was shown that death feigning increases their chances of survival fourfold compared to older workers. This is important; because these young workers have the longest life expectancy and are hence most valuable to the colony (Holldobler and Wilson, 1995). Red flour beetles (*Tribolium castaneum*) feign death upon encountering a predator such as a jumping spider. Artificial selection experiments have shown that the duration of death feigning is variable and heritable. Beetles selected for long duration thanatosis had a lower frequency of predation when exposed to the jumping spider (*Hasarius adansoni*). A particularly intriguing case of death feigning is found in a

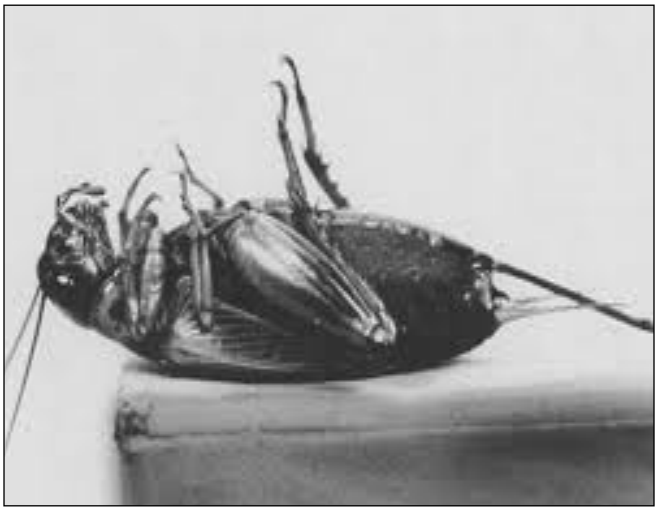

Figure 1: feigning death in cricket

Figure 2: Thanatosis by weevil

Figure 3: Tonic immobility by Broad nosed weevil

Figure 4: Female dragon fly, Aeshna juncea dragonfly has a creative technique to ward off unwanted male advances

Figure 5: Feigning death by Pentodon bidens punctatus

Figure 6: Thanatosis in pill beetle, Birrhus pilula

Figure 7: Thanatosis behaviour of Lytta zubovi

pselaphid beetle (*Claviger testaceus*). Entering an ant nest is not an easy proposition, but by feigning death it is treated as a cadaver and the ants (*Lasius flavus*) attempt to dismember it as they drag this beetle to the nest. Once safely ensconced, the beetle unexpectedly revives and not only manages to

Figure 8: The moorland hawker dragon fly fakes death to avoid mating

Figure 9: Fire ant, Solenopsis invicta play possum or feigning death for protection

trick the ants into feeding and caring for it, but also preys on its eggs, larvae and pupae. Death feigning has been reported from several other groups of insects and in different contexts. It serves as an anti-predator adaptation in the nymphs of the blue-tailed damselfly (*Ischnura elegans*) and in the pygmy grasshopper (*Criotettix japonicus*). Emerging queens of the stingless bee (*Melipona beecheii*) feign death to avoid being attacked by their workers and female robber flies (*Efferia varipes*) to evade harassment by males. Males of the praying mantis (*Mantis religiosa*) freeze immediately after mating, apparently so they don't end up as a meal for the female.

Conclusion

Insects are adapted for life in every environment and have evolved a number of physiological, behavioural and morphological changes or variations. These variations are governed by genetic characteristics and the well suited ones

to environment are selected. Thus, among these adaptations, thanatosis is an important feature in deciding the defensive strategy of the insect preys against the range of predators.

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