Journal of the Arkansas Academy of Science

Volume 40 Article 10

1986

Special Adaptations of Orb Weavers and Prey

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ABSTRACT

Orb weaving spiders have devised both webs and special devices for capturing prey. The prey have also evolved mechanisms for eluding spiders and for living with them. Some of the mechanisms involved are discussed in this paper.

INTRODUCTION

Orb weavers have devised webs and other devices for capturing prey. Prey have also evolved mechanisms for eluding spiders. Eberhard (1976, 1977) discussed physical properties of sticky spirals and their connections and aggressive chemical mimicry by a bolas spider. Eisner (1964) also commented on the adhesiveness of spider silk. Craig, Akira, and Viggo (1985) indicated that oscillation of orb webs had an effect on prey interception. Ploy and counterploy in predator-prey interactions was discussed by Eisner and Dean (1976). Some spiders are so small that they are unnoticed in other webs as pointed out by Exline and Levi (1962). Web structure and function is cited by Lubin (1973). Some spiders show adaptive advantage by living in colonies (Lubin, 1974). Rypstra (1984) discussed the importance of food and space in limiting web-spider densities. McMillan (1975) observed flies of the family Milichiidae cleaning the anus of *Araneus* and *Nephila*. Predatory behavior is discussed by Robinson (1969, 1973). Thornhill (1975) referred to scorpionflies as kleptoparasites because of the way in which they steal food from spiders webs. Mechanisms involved in predator-prey relationships have been noticed by various investigators.

MATERIALS AND METHODS

A 35 mm camera with various lenses was used to photograph webs of spiders. Some webs were sprayed with white spray paint with a black velvet cloth used as a background, some webs were photographed in the wild without a background, others were photographed from books or journals where appropriate.

Spiders and insects were collected from webs, put in 70% ethyl alcohol and brought to the laboratory for identification with a stereoscopic microscope.

RESULTS

Of the approximately 35,000 species of spiders, one half make webs for trapping prey. Rypstra (1984) pointed out that prey availability and habitat structures were possible limiting factors of web spider density. It appears that large numbers of prey and suitable habitat structures almost always determine spider densities. However; some New Guinea spiders live in large colonies that span huge areas with contiguous webs. These webs are not removed often and they catch few insects. Orb webs, sheet webs, and irregular webs comprise the basic types of webs. There are trip lines leading from tubes, bits of bark or webbing situated in webs to mimic spiders and many other modifications of these three basic types of webs used for trapping prey. Spiders may also build a retreat in a crack of wood or a rolled leaf, (Figure 1). Orb weavers use viscid sticky silk or hackled wooly threads in the permanent spiral threads which adhere to prey. It was also shown by Craig, Akiro, and Viggo (1985) that orb webs are not static nets and capture reflects a dynamic interaction between spider and insect. One component of this interaction is web oscillation. The natural oscillations of orb webs greatly enhances web interception of small and slow flying prey. Size of mesh also has a distinct bearing upon prey trapped, (Figures 2 and 3). Generally speaking, spiders run from a nearby retreat and thrust their poison fangs into prey caught in the web; (Figure 4) however, if the prey is a stinging insect the spider will usually immediately attack-wrap by throwing swaths of silk over it and then rolling the insect into the silk to prevent counter attack (Figure 5).

Figure 1. Bits of webbing used to mimic spiders sitting in web. (See spider at top of plant.)

In some species of orb weavers the spider bites the center out entirely and leaves a hole, (Figure 6) which permits the spider to move from one face of the web to the other. Some spiders control web tension by holding to the rim of the hole. In a zigzag fashion a stabilimentum which is a heavy decorative band of silk may be added above and below the hub. Many orb-weavers place irregular threads — a barrier web — in front of or behind the main web, perhaps as an alarm system to warn of the approach of larger predators. Some species sit on a branch holding a single line with a visual glob at its end: they attract male moths with a pheromone that mimics the pheromone of the female moth according to Eberhard (1977).

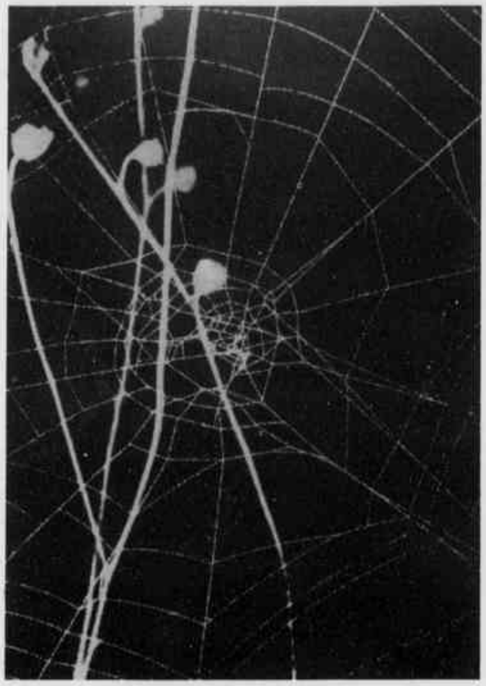
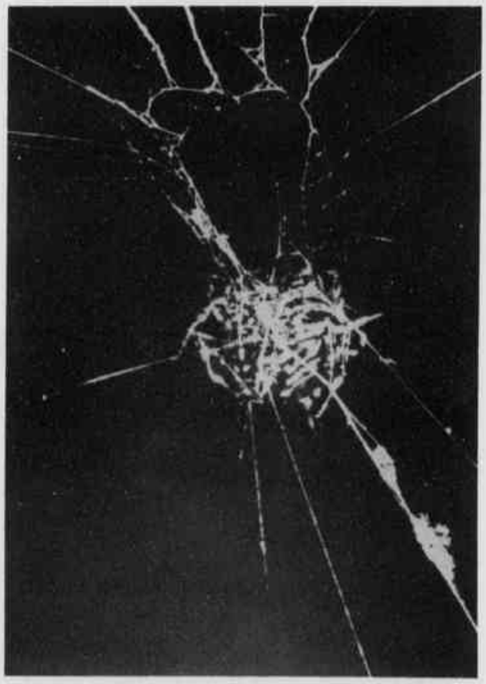


Figure 4. Spiders run from a retreat and thrust fangs into prey.



Figures 2 & 3. Size of mesh has a distinct bearing upon prey trapped.

Figure 5. Insect wrapped.

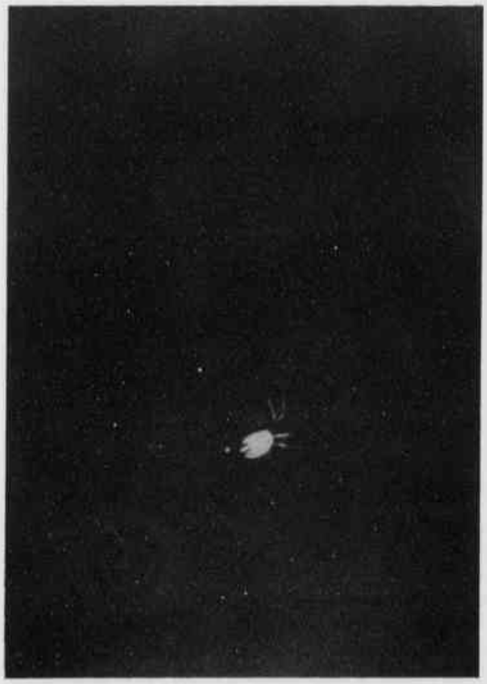


Figure 6. Spider bites out center of web and leaves hole to move from one face of the web to the other.

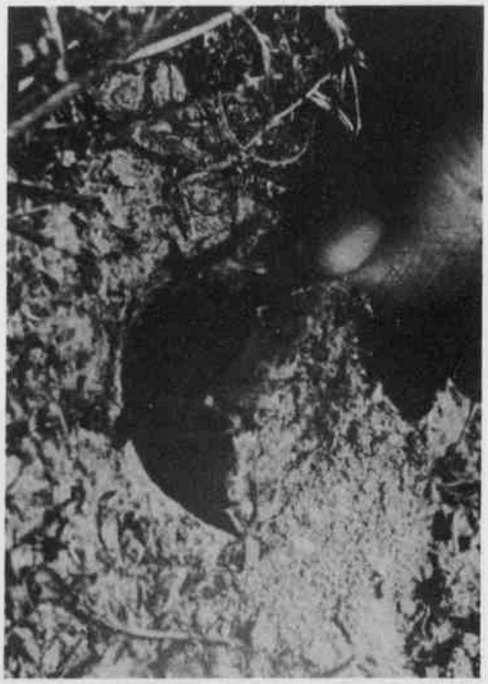


Figure 8. The trapdoor spider's door is flush with the ground and at night it opens the door slightly and preys on passersby.

Figure 7. Spider tearing down its web to prevent kleptoparasitism by spiders and to prevent other prey from locating them so easily.

Some orb-weavers make webs during different times of the day or night to attract different insects and many species tear down their webs each day to prevent an abundance of kleptoparasites, web robbers, diurnal predators, human spider collectors, and other prey from locating them so easily (Figure 7).

The trapdoor spider's trap is an example of a different approach to catching prey. It lives in a silk-lined burrow that has a trapdoor flush with the ground (Figure 8). At night the spider opens the trapdoor slightly and preys on passersby. Wolf spiders, jumping spiders, fishing spiders, and some ground spiders hunt, fish or prey without the use of webs.

Once the prey is safely ensheathed it cannot use bites, stings, kicking legs, or noxious defense fluids. Various authorities have reported adaptations of prey to thwart spiders. Robinson (1976) reported on a pyralid moth that rests on silk strands of a *Nephila* web. The fact that it looks like debris protects it from birds flying above and prevents attack from the spider also. Eisner (1964) showed that moths and butterflies are protected from sticky threads. Scales covering their wings get stuck to the web, but the moths can easily pull away from the scales and elude the owners of their temporary retreat. According to Robinson (1969) some orb weavers can differentiate moths and butterflies from other insects and employ different attack strategy. Moths are immediately bitten and held down until their movements cease.

Panorpa species of scorpionflies which scavenge on dead and dying insects, have been observed removing silk from wrapped insects in webs by regurgitating a brown fluid which dissolves the webbing; thereby permitting the scavenger to fly away with the insect. According to Thornhill (1975) 59% of scorpionfly mortality is due to getting caught by orb weavers.

Levi (1978) watched small phorid flies sitting around the head of the orb-weaver *Araneus bogotensis*. As soon as the spider retrieved an insect the flies started feeding at one end while the spider fed more slowly at the other end. Robinson and Robinson (1978) observed drosophiloid flies sitting on the head of a golden silk spider waiting for it to catch food.

Spiders must adapt not only to the defense mechanisms of potential prey but to web-robbers as mentioned above. The most common kleptoparasites are not insects but spiders. Tiny spiders of the genus *Argyrodes* (family Theridiidae) have been observed at one time with some feeding and removing prey in the daytime and some at night. This behavior has also been noted in webs of spiny bellied spiders such as **Microthena** and *Gasteracantha.* Most spiders tear down their webs daily to prevent kleptoparasitism.

Symbiotic relationships have been observed by McMillan (1975). A mechilid fly in Australia cleans orb-weavers. It licks around the anal area and is allowed to clean up food remains.

Spiders obviously have evolved many strategies and counter-strategies against protective devices, kleptoparasites, web robbers and other would-be enemies or prey. Likewise, prey have evolved mechanisms to cope with these adaptations and strategies.

DISCUSSION

The present research has indicated that spiders and their webs show certain adaptations for trapping prey; whereas, some prey also seem to be anatomically, physiologically, behaviorally, or ecologically adapted for obtaining food from spiders webs or for eluding spiders while trying to steal food. Webs are ideal for studying spider's adaptations to the food supply and to prey's evasive behavior. Different web configurations and the expense of making webs compared to the energy obtained from catching prey are all interesting aspects associated with adaptations of spiders and prey.

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