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OBSERVATIONS OF TWO NOCTURNAL ORBWEAVERS THAT BUILD SPECIALIZED WEBS: *SCOLODERUS CORDATUS* AND *WIXIA ECTYPA* (ARANEAE:ARANEIDAE)

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ABSTRACT

The nocturnal araneid *Scoloderus cordatus* Taczanowski was observed in Florida and found to spin the same remarkable "inverted ladder web" described by Eberhard (1975) for a South American species. Other aspects of the spider's natural history and the unique "asterisk web" of another nocturnal araneid, *Wixia ectypa* Walckenaer, are described for the first time.

INTRODUCTION

Historically in the study of spiders, behavioral observation has lagged behind taxonomic description. This is particularly true for those genera in the orb weaving family Araneidae which spin their webs at night fall and take them down at dawn. However, the number of behavioral studies of nocturnal orbweavers is increasing and recent studies in the tropics have turned up a number of genera which show striking deviations from the standard orb web design and construction process (Robinson and Robinson 1972, 1975, Clyne 1973, Eberhard 1975). This paper deals with two species whose natural history shows that equally exciting discoveries are possible in the United States.

Scoloderus cordatus (Taczanowski) and *Wixia ectypa* (Walckenaer) are small brown spiders, with an average adult female length of approximately 5mm, which rest during the day on a brown twig with their legs pressed to the side of the body such that they closely resemble a bud or a broken side branch of the twig (Figs. 1, 2). Their similar appearance and diurnal cryptic behavior belie their radically different web forms. *S. cordatus* spins a narrow vertical "inverted ladder web" up to 1.2m (4 ft.) long (Fig. 4), a web form first described by Eberhard (1975). *W. ectypa*, on the other hand, spins an "orb web" consisting solely of a hub and radii (Fig. 3) which is described for the first time here and which I propose to call an "asterisk web".

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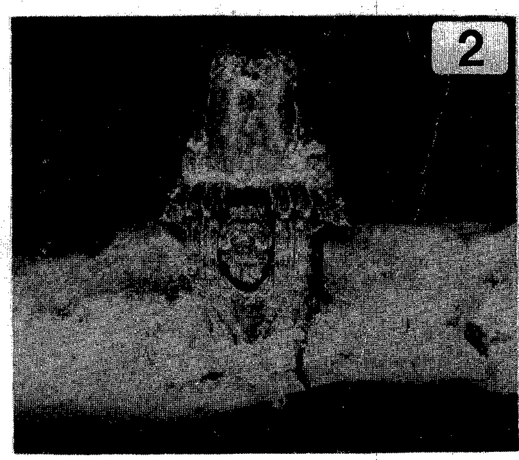

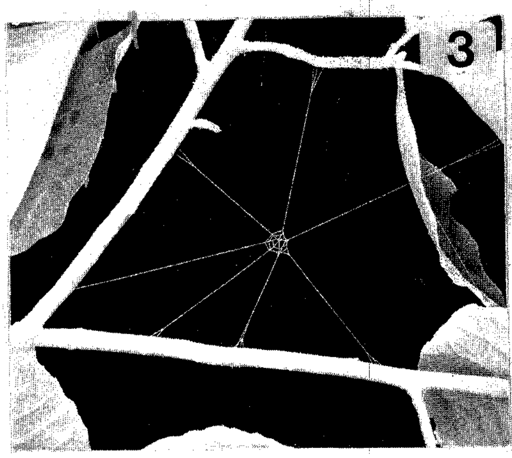

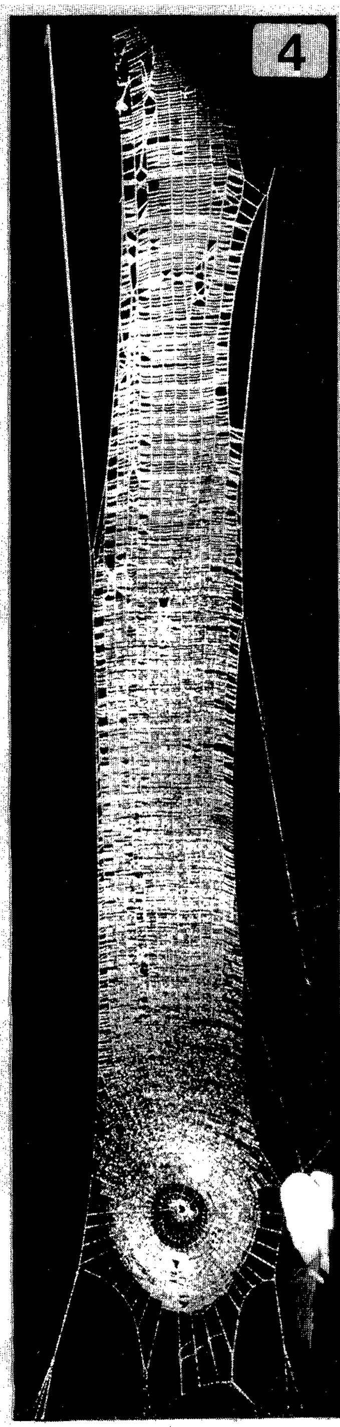

Fig. 1.–*Scoloderus cordatus* adult female (length 5 mm) in cryptic diurnal posture on dead twig.
Fig. 2.–*Wixia ectypa* adult female (length 5 mm) in cryptic diurnal posture on a branch.
Fig. 3.–The "asterisk web" made by *Wixia ectypa* (longest radius 6 cm).
Fig. 4.–The 70 cm web of an adult female *Scoloderus cordatus*.

METHODS

I studied *S. cordatus* during June, July and August of 1975 at the Archbold Biological Station, Lake Placid, Highlands County, Florida. The species is widely distributed in Florida (Levi 1976). *W. ectypa*, which is found along the East Coast of the U.S. (Levi 1976), was studied on the grounds of The Spider Museum, Powhatan, Powhatan Co., Virginia, during the summer of 1977.

Both species were found by chance after surveying at night with a headlamp. The spiders were quite common in the respective study areas, *S. cordatus* in vegetation bordering mowed grass, *W. ectypa* in the outer branches (low and high) of trees. Some observations were made with caged spiders.

I observed *S. cordatus* by placing markers near webs early in the evening and visiting the spiders hourly throughout the night. *Wixia ectypa* was observed over shorter (approx. two hour) periods at different times each night.

Cornstarch was dusted onto the webs to make them visible in the photographs (Eberhard 1976). For the *W. ectypa* web it was necessary to spray the web with a fine mist of water first so that the cornstarch would stick. Since dusting alarmed the spiders and caused them to damage or take down their webs, spiders were removed from the hub and hence do not appear in the photographs. In order to photograph the spiders in their natural diurnal resting sites, I followed the spiders after they took down their webs at dawn.

Scoloderus cordatus

The Web.—The spiders spin for the first time as early as shortly after sunset and as late as 0100 hrs. The spiders appeared to spin earliest on those days when the afternoon rains were late and when the sky was clear overhead.

The method of construction is essentially the same as that in the South American *S. tuberculifer* O. P. Cambridge (Eberhard 1975). Features not seen in the typical orb include the position of the hub near the bottom of the web, long parallel radii in the upper part of the web, web construction starting with an inverted "Y," and failure to remove the temporary spiral in the upper part of the web. Web length averaged 50 cm and width 7 cm (N=168) but webs up to 1.2 m long were seen. Larger webs took up to three hours to build. No webs deviated perceptibly from the vertical as gauged by a plumb bob.

The spiders take down and eat their webs usually one hour before dawn. Webs are destroyed by breaking the lower mooring threads and gathering up the web from the bottom.

Eberhard (1975) presents several hypotheses for the adaptive value of this unusual web form. I found evidence for one of these: increased moth capturing efficiency. A moth that flies into a normal orb is held only briefly because its scales come off and cover the viscous threads (Eisner *et al.* 1964). At first, a moth that flies into a *S. cordatus* web does not stick either. But unlike most orbs, the web is perfectly vertical, so the moth cannot fall out. Nor can it simply fly out since the web's fine mesh prevents the moth from fluttering effectively. The moth cannot control the direction of its struggles and frees itself from the original site of impact only to shift down into the viscous mesh below. If the moth originally flew into the upper part of the web it will descend through so many viscous threads that it will eventually lose enough scales that the viscous thread will adhere, at which point the moth descends no further. Over the summer I saw hundreds of webs with the characteristic vertical trail of scales left as a result of this process. Moths form the bulk of the spider's prey at the station (68% by number, N=212) and form a larger part of *S. cordatus* diet than of the diet of three other nocturnal orbweavers that spun nearby: *Eriophora ravilla*, *Wagneriana tauricornis*, and *Eustala anastera* (Stowe, unpublished). By making a long, narrow web the spider has effectively maximized its moth capturing potential while avoiding the unmanageably large web area of a normal orb of the same length.

Reproductive Behavior.—Courtship begins when a wandering male finds a female's web and spins a horizontal line to the upper portion of one of the vertical frame threads. The male strums the line with legs I and II, attracting the female from the hub. As soon as the female touches the line, the male turns around so that his spinnerets face the female.

What happens next is difficult to interpret. It seems that when the male turns around, he both attaches the line to his spinnerets and breaks it near his mouth and thus spans the broken line with his body. The female apparently attempts to crawl onto the strand but, like a mountain climber who tries to climb a rope that only gives slack, ends up reeling silk from the male's spinnerets. Although all I could be certain of was the flailing of the female's legs, the behavior reported above fits the pattern observed in *Isoxya* Simon (Robinson pers. comm.).

When the female stops pulling, the male turns around and strums the line until she starts again. As the cycle is repeated the male draws closer until eventually he strokes her whereupon they mate in the position classified type I by Gerhardt (1911) (mating observed once, courtship over 20 times).

Males appear to survive most matings; of 212 prey items I found females eating over the summer only one was a male spider. After mating, males may sustain themselves by stealing samll prey from the tops of females' webs (one observation).

One captive female made a flocculent white egg case containing approximately 50 eggs in the corner of its cage and a day later spun a normal ladder web. In nature females probably hide the egg case and produce more than one brood.

Wixia ectypa

The Web.—The spiders spin at dusk. The spinning process was extremely difficult to observe since it takes the spiders less than two minutes to make the web. I was able to observe parts of the procedure by labeling the diurnal resting postions of several spiders at dawn and walking from one positon to another at nightfall until one spider was found spinning.

Although I never saw the first steps, I presume that the spider starts as many araneids do, with a "Y" consisting of three radii (Witt *et al.*, 1968). Construction of subsequent radii starts in typical araneid fashion; as the spider proceeds from the hub down an extant radius toward the branch, a line (running back to the hub) is pulled from its spinnerets. The spider, holding this line away from its body with one leg IV, walks a short distance down the branch. The spider then attaches the line to the branch and returns to the hub along it. Unlike the radii of any described orb webs, most of the asterisk web radii end in two or three attachment points (e.g. the 12 o'clock radius in Fig. 3). Somehow the multiple attachments are created in one motion as the spider turns to climb onto the radius. It appears that the spider does not roll up and replace the original thread as it returns to the hub as most orbweavers do since no puffs of rolled up thread were evident.

Instead it lays new thread over the original line: I was able to separate most radii into two strands by pulling apart the attachment threads. With a few turns the spider produces a simple mesh hub. Although a few more radii may be added, hub construction usually marks the end of the web spinning process. Checking the webs at different times during the night confirmed that nothing is ever added to this remarkably simple structure which contains no sticky lines. The typical web has eight radii, is more nearly horizontal than vertical and fills in the fork of a branch (over 100 observed). Webs are usually absent during the day but I never observed the dismantling process.

The spider preys on pedestrian arthropods and the web serves as a trip line snare. The channeling effect of the narrow branches on arthropod traffic enables the spider to exploit a large number of prey (larger than the simplicity of the web would suggest) while investing a minimum of time and silk in web construciton.

I observed capture sequences by first creating vaseline barriers around the web. These confined introduced arthropods to branches with radius endpoints for enough time to allow the spider to recover from the disturbance created by introducing the arthropod (7 spiders used, 16 capture sequences observed). The sequence begins with the spider rushing down a radius that the prey has just brushed against (presumably the multiple attachments increase the chances of contact). If the prey item is not in the immediate vicinity of the radius endpoint the spider runs back and forth on the branch until contact is made. The spider is now in an unusual position for an orbweaver as it must tackle a prey item that grasps a solid substrate. Usually the spider first ties down the prey by rapidly circling the branch and the prey while laying down swathing silk. This prevents the prey from escaping and facilitates subsequent biting. When the venom takes effect, the prey is freed from the branch by biting the restraining threads and after more wrapping the prey is eaten at the capture site or at the hub.

This capture technique presumably requires closer contact and involves more risk to the spider than that employed by most orbweavers. Spiders did not attack all the kinds of arthropods introduced (e.g. predatory Hemiptera) and perhaps they can differentiate the vibrations produced by different taxa. The 11 identifiable prey items taken from spiders found eating consisted of eight weevils (*Cyrtepistomus castaneus* Roelofs), one mite, one opilionid and one alate ant.

DISCUSSION

Presumably the ancestors of these two spiders spun normal orb webs. Drastic modification of this type of web has enabled the two genera to exploit prey not effectively exploited by most orbweavers: moths in the case of *Scoloderus* Simon and pedestrian arthropods in the case of *Wixia* O. P. Cambridge. It is relatively easy to imagine how the ladder web might have evolved. However, it is difficult to imagine intermediates between the normal orb and the asterisk web and it would be of interest to determine what kind of webs are made by genera related to *Wixia*.

Working at night poses many difficulties but I hope my observations may encourage others to look at the large percentage of spiders that are strictly nocturnal. Even for the sole purpose of collection, searching at night with a headlamp is, in my experience, more effective than beating and sweeping vegetation during the day for many species.

ACKNOWLEDGEMENTS

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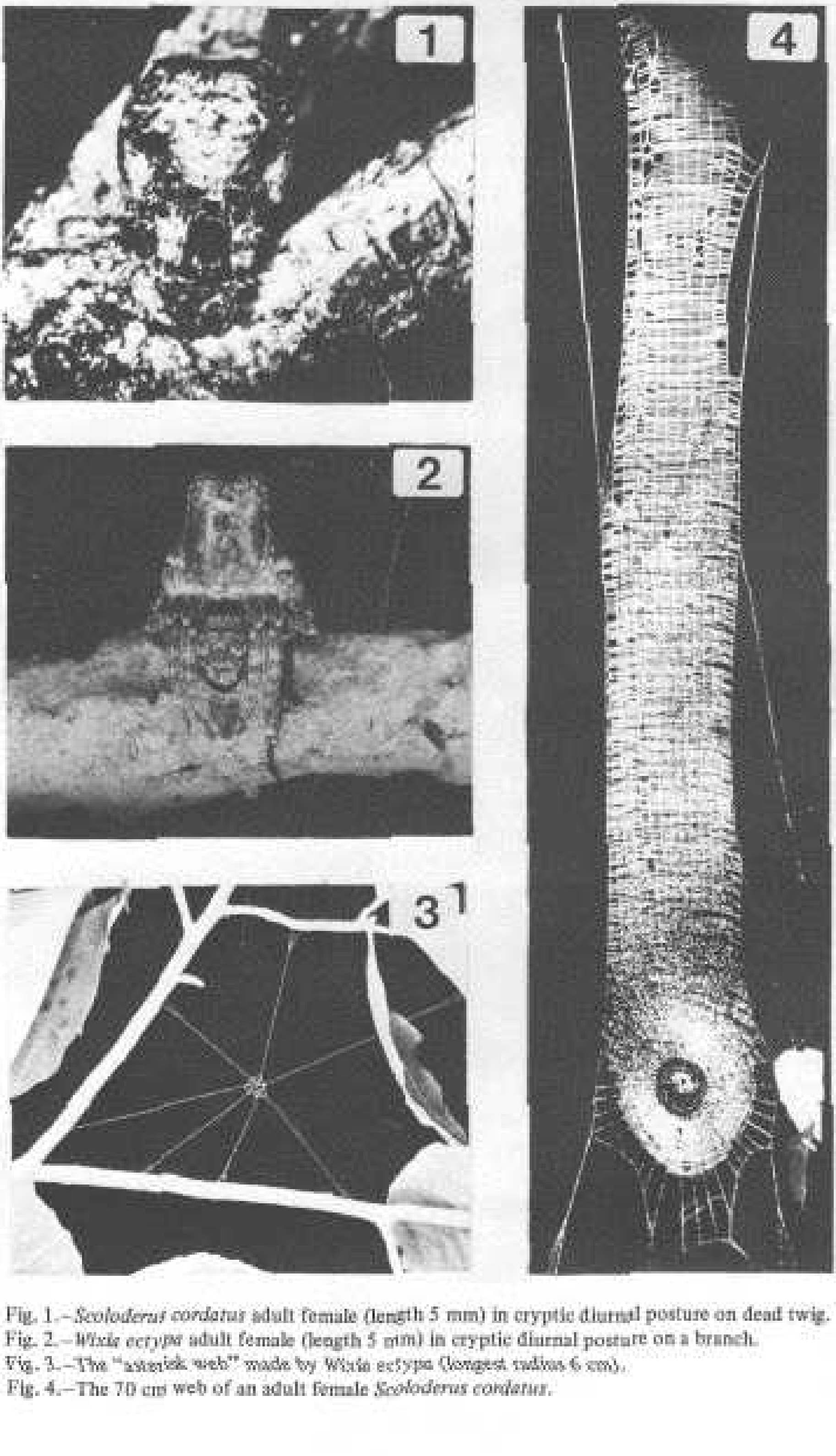

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