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Notes on the natural history of *Wendilgarda galapagensis* (Araneae: Theridiosomatidae)

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Summary

Wendilgarda galapagensis, a species endemic to Cocos Island in the eastern Pacific, attacks prey by biting and post-immobilization wrapping. Sticky lines in webs on land apparently have low-shear joints similar to those of sticky lines in the webs of some distantly related araneoids. Egg sacs are geometrically regular, and tend to be placed away from sites where spiders build prey-capture webs. Egg sac form may serve to trap drops of water on the sac.

Introduction

Spiders of the genus *Wendilgarda* spin remarkable webs which are attached to the surfaces of tropical forest streams and capture insects trapped in the surface film of the water and flying in the air nearby (Coddington & Valerio, 1980; Coddington, 1986a; Eberhard, 1989). This note describes attack behaviour, escape behaviour, and egg sac design and placement of *W. galapagensis* Archer, a species endemic to Cocos Island. This species has apparently undergone niche expansion on the island, as it spins a diversity of web-forms in an unusually wide variety of habitats over both water and land (Eberhard, 1989). Webs attached to water surfaces (water webs) are similar to those of other *Wendilgarda* species, while those on land (land webs) have fewer, longer sticky lines running down to the substrate (low land webs), or even fewer and longer sticky lines running in variable directions from a central area (Eberhard, 1989).

Materials and methods

Observations were made from 2-7 December 1987 on Cocos Island, approximately 500 km W of mainland Costa Rica in the eastern Pacific. Spiders were observed during the day, and at night with a headlamp covered with red cellophane.

Spiders were identified by comparing them with the type specimen of *W. galapagensis*. Voucher specimens are deposited in the U.S. National Museum, Washington, DC 20560, and the Museum of Comparative Zoology, Cambridge, MA 02138.

Results

Egg sac form

Egg sacs were similar to those of *W. mexicana* Keyserling and *W. clara* Keyserling (Coddington, 1986a) in hanging from a single, long line, in having ribs which were largest toward their lower extremes, and in having a sharp upper point where the suspension line was attached (Fig.1). There were always five longitudinal ridges, arranged symmetrically, so that seen from above the sac had a regular pentagonal outline (Fig. 1). As in *W. mexicana* (Coddington, 1986a), the sacs lacked a cap which opened easily, and instead spiderlings apparently made an exit hole in one of the sides or near the top (Fig. 1) when they emerged. The edges of these holes were smooth, indicating that the spiderlings cut and/or digested the silk rather than forcing their way out. The sacs differed from those of *W. mexicana* and *W. clara* (Coddington, 1986a) in having relatively pointed bottom ends (Fig. 1). The sacs were light brown and shiny; the colour was not uniform, being darker nearer the knobs on the ridges. The eggs were in a loose ball embedded in white fluffy silk which filled the interior of the sac. The number of eggs in seven sacs ranged from 10 to 17, and averaged 14.3 ± 3.0 (standard deviation).

During and after rains several sacs in the field were covered by a drop of water, each sac forming a "nucleus" for the water drop. Similar drops formed when collected egg sacs were exposed to a fine mist from a spray bottle (Fig. 2).

Egg sac distribution

W. galapagensis is very common on Cocos Island, and large numbers of sacs (probably thousands) were seen. The greatest concentrations of sacs were in relatively sheltered sites such as under overhanging stream-banks or near the bases of large trees, but scattered sacs also occurred in forest undergrowth and even in open sites in 10-15 cm high grass. Densities of sacs reached up to $100+/m^3$. In such sites many sacs were in chains, with newer sacs attached to the lower tips of older ones. It was clear that spiders were *not* common where sacs were common. In one perhaps extreme case, an approximately $0.5m^3$ cavity under an overhanging bank of a stream had >50 sacs but only 5 spiders, all very early instars (perhaps the first instar found outside the egg sac).

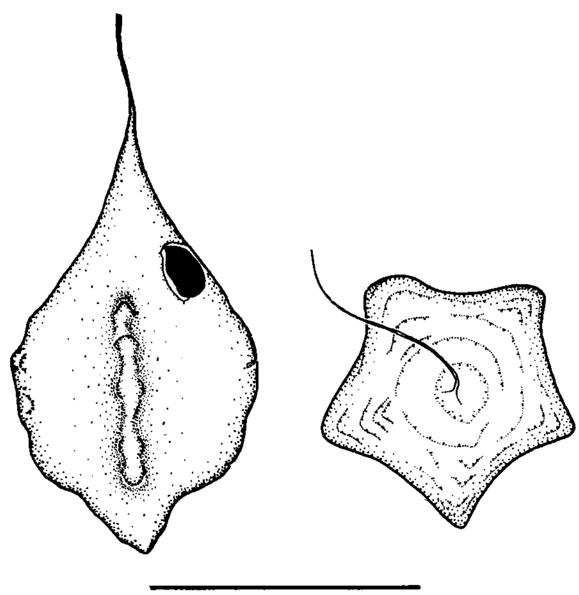

Fig. 1: Lateral (left) and dorsal (right) views of a *Wendilgarda galapagensis* egg sac, showing the emergence hole of spiderlings (left) and the pentagonal outline (right). Scale line = 4mm.

Prey capture

I witnessed the capture of 15 prey, each by a different spider. Three prey became entangled in a sticky line as they floated on the water surface, and the rest when they flew into a sticky line. Spiders on water webs responded as described for other *Wendilgarda* species (Coddington & Valerio, 1980), pulling on the sticky line until the connection with the water surface broke, and then reeling up the prey on the sticky line. Captures on land webs varied. In 7 cases the spider jerked energetically on the inner end of the sticky line, and in all but one of these cases the line broke and the prey dangled free on the end of it. The site where the line broke appeared to be near the outer end of the sticky section of the line. In two other captures the spider reeled in the sticky line while resting on a horizontal, non-sticky line, but the sticky line did not break. In eight captures in land webs the spider eventually moved out along the sticky line, reeling up the line and replacing it with a dragline as it moved. In all cases the spider's first attack on the prey was to bite it, as is apparently typical for theridiosomatids (Eberhard, 1982; Coddington, 1986b). Prey were wrapped only after being bitten, and were not wrapped in "rotisserie" fashion (Eberhard, 1982).

In no case did I see a spider "spring" its web by quickly reducing web tensions, as occurs in many other theridiosomatids (McCook, 1889; Shinkai & Shinkai, 1985; Coddington, 1986a).

Some sticky lines in land webs broke as a result of strong wind gusts, movement of the substrate, or when the spider blundered into them while laying other lines. In these cases a clear "blob" formed at the end of the sticky line. The length of the line hanging free was similar to the length of the sticky section of the line before it broke, suggesting that the break occurred near the end of the sticky section.

Defensive use of water surface

When spiders on water webs were disturbed, some dropped to the surface of the stream, with all legs folded tightly against their bodies. The spiders apparently did not break the surface film, and were swung erratically by the current as they held their draglines. When I attempted to seize one of these spiders with my fingers, it repeatedly slipped away as my fingers closed, apparently as a result of being carried on the surface film of the water. When these spiders climbed out of the water on to a twig, they were apparently completely dry, without any obvious droplets of water clinging to them.

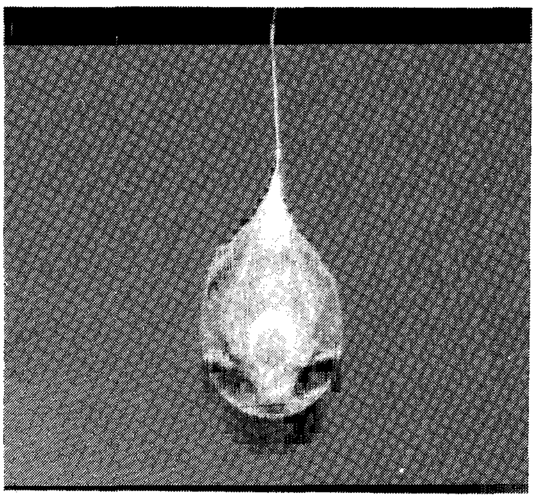

Fig. 2: Drop of water enclosing an egg sac of *Wendilgarda galapagensis* which was sprayed with a fine mist of water.

Possible retreat from high water levels

Coddington & Valerio (1980) commented that the water levels of many tropical streams rise abruptly after heavy rains, and speculated on how *Wendilgarda* spiders survive such emergencies. I observed that after a heavy early-morning downpour, many *W. galapagensis* had climbed 20->100 cm above the water in vegetation overhanging the stream, and were resting immobile without prey-capture webs. Climbing up this way during or immediately after heavy rains could enable spiders to avoid being washed away by rising waters.

Discussion

The difference between egg-sac and spider distributions implies that mature female *W. galapagensis* probably leave their normal web-sites and search out other habitats when they are about to oviposit. Coddington's note (1986a) that egg sacs of some other *Wendilgarda* species (species identities not clear from descriptions) occur away from water suggests that females of other species also move away from web-sites to oviposit.

The reasons for the geometric regularity of egg sacs in theridiosomatids (Coddington, 1986a) (also in Anapidae – pers. obs.), whose forms include near-spheres, cubes, and other shapes incorporating flat faces with regular triangular, pentagonal, and circular shapes is as yet unexplained. The observations of *W. galapagensis* sacs enclosed by water droplets suggest that egg sac forms may represent different ways of trapping water from the environment (rain, mist, dew) (see Rovner, 1987 for demonstration that spiders can survive long periods when in bubbles in water).

Breakage of sticky lines occurred frequently, and the spiders' attack behaviour often included pulls and jerks which caused breakage, suggesting that the sticky lines are designed to break free in this way. This appears to be a convergence in web design with distantly related species in the families Araneidae (*Pasilobus, Poecilopachys, Cyrtarachne* – Robinson & Robinson, 1975; Stowe, 1986; Robinson, 1991) and Theridiidae (e.g. *Achaearanea, Theridion, Steatoda* – Wiehle, 1931; Nielsen, 1932; Bristowe, 1958). Such low-shear joints probably aid in prey capture, since once the line has broken free the prey generally loses contact with the substrate and thus cannot brace itself as it struggles to pull free (Stowe, 1986).

Production of low-shear joints may be related to one of the more puzzling details of web construction behaviour by *W. galapagensis* – the series of three quick 180° turns that immediately precedes sticky-line construction (Eberhard, 1989). This behaviour occurs at the sites where the lines apparently break.

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References

BRISTOWE, W. S. 1958: *The world of spiders*. London, Collins.

CODDINGTON, J. A. 1986a: The genera of the spider family Theridiosomatidae. *Smithson. Contrib. Zool.* **422**: 1-96.

CODDINGTON, J. A. 1986b: The monophyletic origin of the orb web. *In* W. A. Shear (ed.), *Spiders, webs, behavior, and evolution:* 319-363. Palo Alto, Stanford Univ. Press.

CODDINGTON, J. A. & VALERIO, C. E. 1980: Observations on the web and behavior of *Wendilgarda* spiders (Araneae: Theridiosomatidae). *Psyche, Camb.* **87**: 93-105.

EBERHARD, W. G. 1982: Behavioral characters for the higher classification of orb-weaving spiders. *Evolution* **36**: 1067-1095.

EBERHARD, W. G. 1989: Niche expansion in the spider *Wendilgarda galapagensis* (Araneae: Theridiosomatidae) on Cocos Island. *Revta Biol. trop.* **37**: 163-168.

McCOOK, H. C. 1889: *American spiders and their spinning work,* **1**: 1-372. Philadelphia, published by the author.

NIELSEN, E. 1932: *The biology of spiders* **1**: 1-248. Copenhagen, Levin and Munksgaard.

ROBINSON, M. 1991: One man and the beasts. *In* M. Robinson (ed.), *Man and beast revisited:* 291-315. Washington, Smithsonian Inst. Press.

ROBINSON, M. & ROBINSON, B. 1975: Evolution beyond the orb web: the web of the araneid spider *Pasilobus* sp., its structure, operation, and construction. *Zool. J. Linn. Soc.* **56**: 301-314.

ROVNER, J. S. 1987: Nests of terrestrial spiders maintain a physical gill: flooding and the evolution of silk constructions. *J. Arachnol.* **14**: 327-337.

SHINKAI, A. & SHINKAI, E. 1985: The web-building behavior and predatory behavior of *Theridiosoma epeiroides* Bösenberg & Strand (Araneae, Theridiosomatidae) and the origin of the ray-formed web. *Acta arachn. Tokyo* **33**: 9-17.

STOWE, M. 1986: Prey specialization in the Araneidae. *In* W. A. Shear (ed.), *Spiders, webs, behavior and evolution:* 101-131. Palo Alto, Stanford Univ. Press.

WIEHLE, H. 1931: Neue Beiträge zur Kenntnis des Fanggewebes der Spinnen aus den Familien Argiopidae, Uloboridae und Theridiidae. *Z. Morph. Ökol. Tiere* **22**: 348-400.