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SHORT COMMUNICATION

Egg sac construction by folding dead leaves in *Pozonia nigroventris* and *Micrathena* sp. (Araneae: Araneidae)

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Abstract. Published descriptions of egg sac construction behavior in araneids are scarce. We describe egg sac construction and oviposition in one individual of the poorly known araneid *Pozonia nigroventris* (Bryant 1936) and two individuals of *Micrathena* sp. These spiders folded dead leaves to protect their eggs. All individuals pulled up and hung a dead leaf above the forest floor, oviposited on the leaf, and then folded the leaf around the egg sac. They then deposited the enclosed egg sac in the leaf litter below. The use of dead leaves in this way probably evolved convergently, since these genera are only distantly related.

Keywords: Canopy spider, convergent behavior, oviposition, predator defense

Spider egg sacs protect eggs from damage by both biotic and abiotic factors (Austin 1985). Protection is not absolute, and spider eggs frequently suffer high mortality from organisms such as ants, wasps, flies and birds (Austin 1985; Hieber 1992). Egg sac construction varies widely among different spider taxa (Kullmann 1961; Robinson & Robinson 1973, 1976; Eberhard 1980; Manuel 1984; Austin 1985; Levi 1985; Barnes et al. 1992; Bukowski & Christenson 1997; Guarisco 2001; Gheysens et al. 2005). However, detailed descriptions of egg sac construction are lacking for many groups.

Here we describe for the first time the egg sac construction behavior of the araneid *Pozonia nigroventris* (Bryant 1936) and include additional information on the egg sac construction of an unidentified species of *Micrathena* Sundevall 1833. *Pozonia* is thought to inhabit the canopy of tropical forests (Levi 1993). *Micrathena*, in contrast, builds diurnal webs in the understory and has been more extensively studied (e.g., Uetz & Hartsock 1987; Bukowski & Christenson 1997).

We observed spiders opportunistically, including one *P. nigroventris* that was observed continuously between 21:38 and 03:20 h on 30–31 May 2009 in mature rainforest at La Tirimbina Biological Reserve (Heredia Province, Costa Rica: 10°26′N,83°59′W, 150 m elevation), and two individuals of *Micrathena* sp. on 13 June 2009 at 01:00 and 23:30 h in mature rainforest at the Alberto Manuel Brenes Biological Reserve (Alajuela Province, Costa Rica: 10°13′N,84°32′W, 800 m elevation). We identified the spiders using publications by Levi (1985, 1993). Voucher specimens of both species were deposited in the Museo de Zoología of the Universidad de Costa Rica. The *Micrathena* species did not match the descriptions of any of the species in Levi (1985).

Pozonia nigroventris.—We first noted the female *P. nigroventris* as she pulled up a nearly flat leaf (20 cm long and 6 cm wide) from the forest floor (Fig. 1). The line was attached above to a thick horizontal vine approximately 1.75 m above the ground. An additional, nearly vertical silk line extended upward out of sight from the vine toward the canopy. The horizontal line had several masses of white fluff, perhaps representing lines that had been reeled up by the spider in previous ascents.

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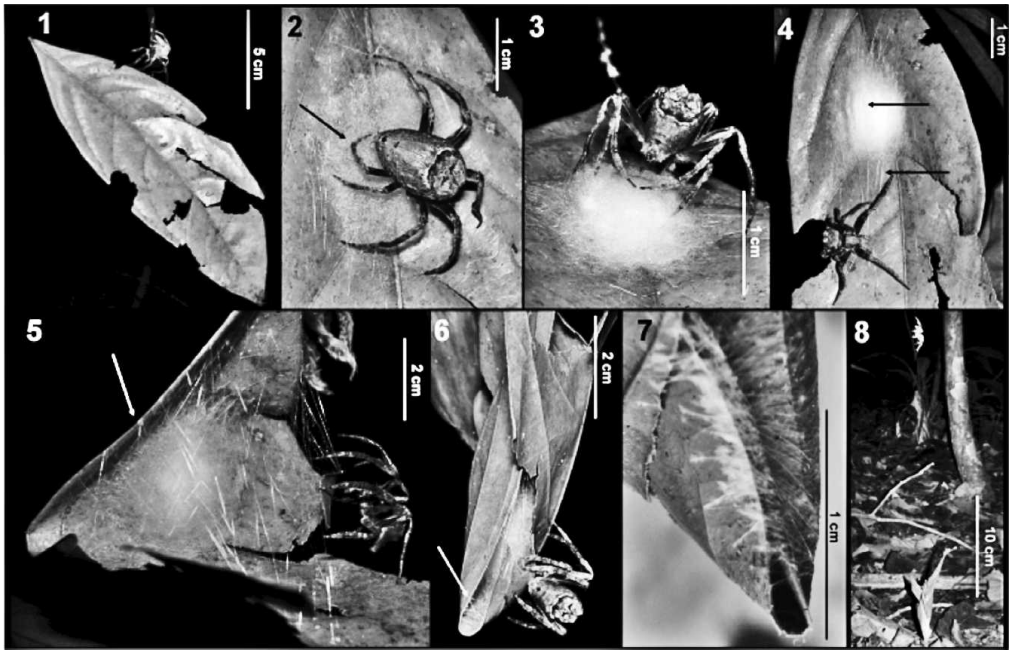
The spider reattached the vertical line to several points on and near the petiole of the leaf, and then began to lay fluffy white silk in a circular area 2–3 cm in diameter on the leaf. She laid lines by repeatedly touching the leaf and other silk lines with her widely-spread spinnerets as her abdomen bobbed dorsal-ventrally; occasionally she also pushed ventrally near her spinnerets with one tarsus IV (Fig. 2) or (less frequently) with both tarsi IV while continually touching the mass of silk with her palps. The circular silk mat eventually became a mound of fluffy silk several mm thick, with its peak slightly indented in the center (Fig. 3). Then, after a short pause, a mass of yellowish eggs gradually emerged on the female's ventral surface during approximately 3 min. The egg mass was pressed into the accumulation of fluffy silk while the spider's legs II and III held the sides of the silk mat. As soon as all the eggs had emerged, the spider began to add further fluffy white silk. She repeatedly dabbed her spread spinnerets to the sac wall and immediately raised her abdomen away from the sac as she pushed ventrally against the sac with both hind legs. Sometimes the spider made two or three dabs and pushes with her legs IV before she touched the sac again with her spinnerets. Up to three pairs of lines were seen being pulled simultaneously from her spinnerets (Fig. 3).

As soon as construction of the egg sac proper ended, the spider began to attach tight lines to the leaf using her spinnerets (her legs did not touch them). Most lines were oriented more or less vertically, running back and forth between the edge of the leaf above the sac and the leaf surface below it. Some early lines pressed against the sac, producing indentions in the fluffy silk mass (Fig. 4). The leaf gradually began to fold near the lower edge of the sac (Fig. 5), and the spider attached new threads farther down on the leaf. When the leaf was folded about 60°, she sealed the package with several short lines across the sharply folded portion of the leaf, which she attached to the leaf surface opposite the egg sac (Fig. 6). Then she walked over the leaf's surface, covering holes and cracks with silk (Fig. 7). Finally the spider lowered the leaf package to the forest floor. First she climbed up the line, cut it above the package, and began to descend by paying out silk (Fig. 8). When the folded leaf reached the leaf litter below, the spider gave three bursts of strong vertical shakes on the line. She then moved down, broke the line near where it was attached to the leaf package, and ascended her drag line.

Micrathena sp.—Egg sac construction behavior by *Micrathena* sp. was similar to that of *P. nigroventris* in several respects: an approximately circular accumulation of cotton-like silk was produced

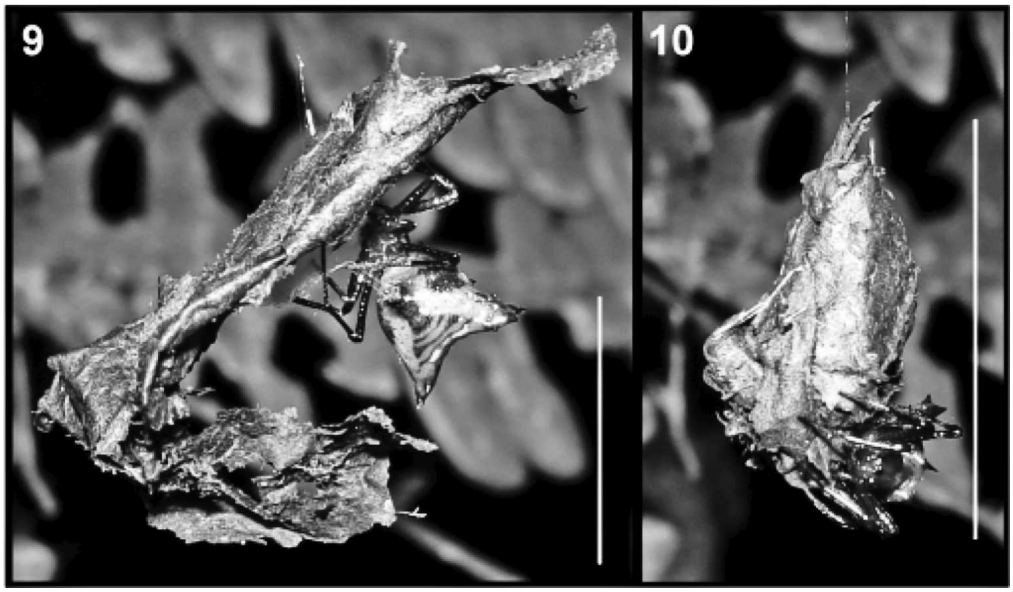


Figures 1–8.—Egg sac construction of *Pozonia nigroventris*. 1. Pulling up the leaf from the forest floor; 2. While constructing the basal pad of egg sac, spider pulls lines from her spinnerets by pressing one leg IV against the sac (arrow); 3. Spider uses both legs IV to pull multiple lines of silk from her spread spinnerets; 4–6. Spider gradually folds leaf. 4. Some early tense lines attached to leaf (arrows) caused indentations in the sac; 5, 6. Several lines attached to the edges of the leaf (arrows in 5 and 6); 7. Close-up shows how spider's lines sealed the sharp fold in the leaf; 8. Spider (top) lowers folded leaf with egg sac to forest floor. Photographs by J. Moya.

on a suspended dead leaf by dabbing the spinnerets repeatedly on the pile of fluffy silk; an egg mass was then laid, and further fluffy silk was added to the sac; finally the leaf was folded to seal the egg sac into a tight package, the package was lowered by paying out trail line, and the package was shaken with several bursts of vertical jerks.

In other aspects *Micrathena* sp. behavior differed from that of *P. nigriventris*. The leaves where *Micrathena* built the egg sac were only irregular pieces (Fig. 9). The spider pulled multiple silk threads from her spinnerets with alternate movements of her fourth legs and only seldom attached the lines by dabbing her spinnerets to the leaf or the pile of fluffy silk, and the leaf was rolled instead of folded (Fig. 10). When one sac was about 30 cm above the forest floor it encountered a fern leaf below, and the spider shook it with several vertical movements. She then lifted the package by reeling in the line, and cut the line near the leaf and let it fall to the leaf litter below.

Folding the leaf, sealing it tightly, and then placing it in the leaf litter may reduce damage to the eggs from aerial predators or parasites (Robinson & Robinson 1976; Hieber 1992; Bukowski &



Figures 9–10.—Egg sac construction of *Micrathena sp*. 9. Female makes mat of fluffy silk on partially curled leaf prior to oviposition; 10. Leaf folded around egg sac; scale = 1 cm. Photographs by J. Moya.

Christenson 1997). The egg mass wrapped in a dead leaf was extremely cryptic in the leaf litter, and this may protect it from large animals like birds foraging on plants, though it must expose them to another set of potential predators such as ants on the forest floor (Hieber 1992). The size and shape of a dead leaf would seem crucial, and we suspect spiders actively select appropriate leaves.

The similarity between egg sac construction behavior in *Pozonia nigriventris* and *Micrathena* sp. is impressive, especially the ratchet-like mechanism that sums up small increments in tension in order to fold relatively stiff dead leaves, and the agitation of the finished sac as it was lowered into the litter, which was apparently an attempt to insert it more securely. This behavior differs sharply from that of *Gasteracantha cancriformis*, a close relative of *Micrathena* (Scharff & Coddington 1997), which deposits its egg sac on the underside of a flat, unfolded leaf (Muma 1971), and also from that of other spiders (Blanke 1973; Jackson et al. 1997; Morse 1985; Li et al. 2002) The striking similarities between the distantly related genera *Pozonia* and *Micrathena* (Scharff & Coddington 1997) suggests that wrapping the eggs in a leaf evolved convergently in the two genera. However, further information, particularly on the use of leaves, in other araneid species is necessary to fill in the evolutionary history of egg sac construction behavior.

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LITERATURE CITED

Austin, A.D. 1985. The function of spider egg sacs in relation to parasitoids and predators, with special reference to the Australian fauna. Journal of Natural History 19:359–376.

Barnes, J.K., L.E. Higgins & C.W. Sabrosky. 1992. Life histories of *Pseudogaurax* species (Diptera: Chloropidae), descriptions of two new species, and ecology of *Nephila clavipes* (Linnaeus) (Araneae: Tetragnathidae) egg predation. Journal of Natural History 26:823–834.

Blanke, R. 1973. Neue Ergebnisse zum Sexualverhalten von *Araneus cucurbitinus* Cl. (Araneae, Araneidae). Forma et Function 6:279–290.

Bukowski, T.C. & T.E. Christenson. 1997. Natural history and copulatory behaviour of the spiny orbweaving spider *Micrathena gracilis* (Araneae: Araneidae). Journal of Arachnology 25:307–320.

Eberhard, W.G. 1980. The natural history and behavior of the bolas spider, *Mastophora dizzydeani* sp. n. (Araneae). Psyche 87:143–170.

Gheysens, T., L. Beladjal, K. Gellynck, E. Van Nimmen, L. Van Langenhove & J. Mertens. 2005. Egg sac structure of *Zygiella x-notata* (Arachnida, Araneidae). Journal of Arachnology 33:549–557.

Guarisco, H. 2001. Description of the egg sac of *Mimetus notius* (Araneae, Mimetidae) and a case of egg predation by *Phalacrotophora epeirae* (Diptera, Phoridae). Journal of Arachnology 29:267–269.

Hieber, C.S. 1992. Spider cocoons and their suspension systems as barriers to generalist and specialist predators. Oecologia 91:530–535.

Jackson, R.R., D. Li & M.B. Robertson. 1997. Cues by which suspended-leaf nests of *Euryattus* (Araneae: Salticidae) females are recognized by conspecific males and by an aggressive-mimic salticid, *Portia fimbriata*. Journal of Zoology 243:29–46.

Kullmann, E. 1961. Der Eierkokonbau von *Cyrtophora citricola*. Zoologische Jahrbuch Systematics 89:369–406.

Levi, H.W. 1985. The spiny orb-weaver genera *Micrathena* and *Chaetacis* (Araneae: Araneidae). Bulletin of the Museum of Comparative Zoology 150:429–618.

Levi, H.W. 1993. The neotropical orb-weaving spiders of the genera *Wixia, Pozonia,* and *Ocrepeira* (Araneae: Araneidae). Bulletin of the Museum of Comparative Zoology 153:47–141.

Li, D., S.W. Yik & W.K. Seah. 2002. Rivet-like nest-building and agonistic behaviour of *Thiania bhamoensis*, an iridescent jumping spider (Araneae: Salticidae) from Singapore. Raffles Bulletin of Zoology 50:143–151.

Manuel, R.L. 1984. The egg sac of *Pityohphantes costatus* (Hentz) (Araneae, Linyphiidae) and its phorid parasite. Journal of Arachnology 12:371–372.

Morse, D.H. 1985. Nests and nest-site selection of the crab spider *Misumena vatia* (Araneae, Thomisidae) on milkweed. Journal of Arachnology 13:383–390.

Muma, M.H. 1971. Biological and behavioral notes on *Gasteracantha cancriformis* (Arachnida: Araneidae). Florida Entomologist 54:345–351.

Robinson, M.H. & B. Robinson. 1973. Ecology and behavior of the giant wood spider *Nephila maculata* (Fabricius) in New Guinea. Smithsonian Contributions to Zoology 149:1–76.

Robinson, M.H. & B. Robinson. 1976. The ecology and behavior of *Nephila maculata*: a supplement. Smithsonian Contributions to Zoology 218:1–22.

Scharff, N. & J.A. Coddington. 1997. A phylogenetic analysis of the orb-weaving spider family Araneidae (Arachnida, Araneae). Zoological Journal of the Linnean Society 120:355–434.

Uetz, G.W. & S.P. Hartsock. 1987. Prey selection in an orb-weaving spider: *Micrathena gracilis* (Araneae: Araneidae). Psyche 94:103–116.

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