



Scientific Note

INCUBATION OF ZIGZAG-SHAPED OOTHECAE IN SOME OVOVIVIPAROUS COCKROACHES *Gyna capucina* AND *G. henrardi* (BLATTARIA: BLABERIDAE)

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INTRODUCTION

Reproductive modes are diverse in cockroaches, especially with respect to the different kinds of ootheca incubation (Roth, 1970). All species belonging to the family Blaberidae—mostly considered as ovoviviparous or false ovoviviparous—protrude their oothecae and then retract them into an abdominal brood sac (Roth, 1989). Prior to this retraction, the ootheca is protruded and rotated so that the keel is reoriented laterally. In the family Blaberidae, several different modalities have derived from this basic mode of retraction and internal incubation. Either the oothecal membrane disappeared in the subfamily Geoscaphinae and separate eggs are retracted into the brood sac (true ovoviviparity, Rugg and Rose, 1984), or nutrients are supplied by the maternal brood sac to the embryos in *Diploptera punctata*, (viviparity, Stay and Roth, 1958).

While dissecting the genital parts of the cockroach *Gyna capucina* Gerstaecker and *Gyna henrardi* Hanitsch (subfamily Gyninae), a third and undescribed modality—the “zigzag retraction” of the ootheca into the brood sac—was discovered. This paper describes this new modality of ootheca retraction and explores its relationships with brood size.

Gyna capucina and *G. henrardi* are large and widespread species in central Africa (Princis, 1964); they belong to the subfamily Gyninae in the ovoviviparous family Blaberidae (Grandcolas, 1993a, 1996). The genus *Gyna* comprises many species distributed mainly in forested regions of tropical Africa. They burrow in dust at the bottom of cavities either in treeholes or in termite nest holes, or in the mounds of Driver ant nests (Grandcolas, 1993b, 1994, 1997). Their reproductive biology has never been studied.

Oothecae of *G. capucina* and *G. henrardi* were observed

and compared with those of 3 other species of *Gyna*, namely, *G. gloriosa*, *G. oblonga* and *G. laticosta*, and with one species belonging to the same subfamily (*Pseudocalolampra* sp.). Ootheca retraction was observed in specimens captured in the field and checked in the laboratory. Cultures of *G. capucina*, *G. laticosta*, *G. henrardi* and *Pseudocalolampra* sp. were maintained in laboratory under a photoperiod of 12:12 (L:D) h, at 25°C, and provided with dehydrated dog food and water *ad libitum*. The cultures of the first 2 species were initiated with specimens from the Gabonese rainforest (Ogooué-Ivindo region, near the River Makandé, a tributary of Offoué, 11°55'E–0°41'S, altitude 220 m), the culture of the third with specimens of Cameroon (Ottotomo, provided by Alain Dejean), and the culture of the fourth with specimens from Tanzania (Dodoma). Ootheca shape and size were observed after dissection of the brood sac.

Very few females of *G. capucina* and *G. henrardi* among both field and culture specimens had oothecae in their brood sac: for instance, among a sample larger than 200 female field specimens, less than 3 were pregnant. The pregnant females of these 2 species had zigzag-shaped oothecae (i.e., oothecae folded 2 times) in their brood sacs (Fig. 1). The 2 folds always occurred at the same place in the abdominal cavity: one at the anterior end of the sac adjacent to one end of the ootheca (the first oviposited), the second in the middle of the sac. Before retraction, the ootheca is rotated laterad and lies horizontally, but it is vertical in its folded part in the brood sac, and horizontal only in the region close to the brood sac opening. Thus, a second, inverse and internal rotation must occur during retraction to explain this position. The fully extended brood sacs of *G. capucina* and *G. henrardi* are smaller than the abdomen as in other ovoviviparous species belonging to the family Blaberidae. When they contain the folded ootheca, the brood sac represents about half of the abdominal volume. The digestive

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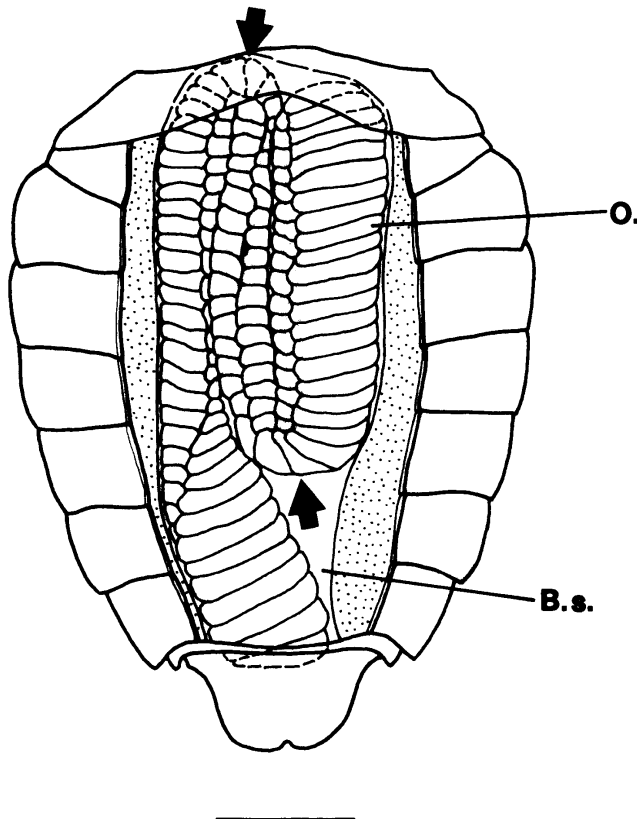


Fig. 1. Dorsal view of the abdomen of *Gyna capucina*. The tergites have been cut to show the ootheca in the brood sac. The arrows indicate the folds of the ootheca. O: ootheca; B.s. = Brood sac. Morpho-anatomical details (ootheca keel, cerci, legs, digestive track) have not been represented. Bar = 4 mm.

tract—in its section posterior to the hindgut—has been observed to be either displaced on the right side of the abdomen, or compressed dorsally between the brood sac and the tergites. One behavioral sequence of ootheca retraction was observed in the laboratory in both *G. capucina* and in *G. henrardi*: the female first protruded its ootheca and then rotated it laterad, the dorsal keel being turned to the left side, as do most blaberid cockroaches. The ootheca in this position was very long and straight, extending backwards to a distance as long as the body length itself. The retraction took a long time (40 min) and the zigzag folding, taking place in the brood sac, was not externally visible. The retraction appeared progressive, and it was assumed that the ootheca, when pulled into the bottom of the brood sac, retracted continuously, folded a first time, and then folded a second time as a simple consequence of being forced into the small sac.

All other Gyninae species have normally unfolded oothecae (Table 1). Brood size, though poorly known in this subfamily, were found clearly larger in *G. capucina* and *G. henrardi* than in other Gyninae species (Table 1), and also clearly much larger than the size of many blaberid broods figured by Roth (1968, 1971).

The peculiar ootheca retraction in *G. capucina* and *G.*

Table 1. Brood characteristics in several Gyninae cockroaches. Shape: zigzag or straight; number of eggs: mean, range in brackets; number of individuals *N*

Species	Shape	Egg number
<i>Gyna capucina</i>	zigzag	128.3 [96–144] (<i>N</i> = 3)
<i>Gyna henrardi</i>	zigzag	191 [142–243] (<i>N</i> = 5)
<i>Gyna gloriosa</i>	straight	28 (Grandcolas, 1997)
<i>Gyna laticosta</i>	straight	45 [38–52] (<i>N</i> = 2)
<i>Gyna oblonga</i>	straight	62 (Grandcolas, 1994)
<i>Pseudocalolampra</i> sp.	straight	18.8 [9–24] (<i>N</i> = 5)

henrardi is not correlated with any obvious anatomical modification (modifications in cuticular sculpturing of the sac could however be searched for with scanning electron microscopy). It can be hypothesised that it results from a very high increase in brood size relative to the female size. Multiple folding has permitted the ootheca to be retracted in the comparatively small female body. This kind of constraint on clutch size is well-known in vertebrate ovoviviparous taxa (e.g. Roff, 1992). Ecological studies will be necessary to assess the population correlates of respectively small and large brood sizes in *Gyna* spp. (Grandcolas, in prep.).

Because all observed Gyninae species—except *G. capucina* and *G. henrardi*—show the same basic ootheca retraction as other blaberid cockroaches, zigzag-shaped ootheca retraction may be considered to have appeared in the ancestor of both *Gyna capucina* and *G. henrardi* rather than to be ancestral to the genus *Gyna* and to have reversed in *Gyna* species other than *capucina* and *henrardi*. This hypothesis could be substantiated by further biological and phylogenetic studies within the genus *Gyna*.

Finally, moderately curved oothecae occur in *Panchlora nivea* in the subfamily Panchlorinae (Roth, 1968; Roth and Willis, 1958). It is however not known whether this is a kind of deformation analogous to the situation that we presently describe in some *Gyna* species, i.e. a folding caused by a too large size, which prevents the ootheca from remaining straight when retracted into the brood sac.

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