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Notes and Records

Gyna gloriosa, a scavenger cockroach dependent on driver ants in Gabon

Cockroaches are known to be heavily predated by swarming ants and have never been observed until now to be associated with these ants in any other way (Hölldobler & Wilson, 1990; Grandcolas & Deleporte, 1994). However, I observed several nymphs of *Gyna gloriosa* (Stål, 1855) (Blattaria, Gyninae) on the surface of the large nests of *Dorylus* ants, which suggested a possible commensalism between the cockroach and driver ants. The genus *Gyna* comprises 30 species in tropical Africa (Princis, 1964; Kumar, 1975; Grandcolas, 1993a, 1994) which inhabit cavities such as treeholes or holes in termite nests or even occasionally caves (Chopard, 1938; Girard & Lamotte, 1990; Grandcolas, 1993b; Roth & Willis, 1960; Vuattoux, 1968). According to these authors, the nymphs burrow in the dust at the bottom of the cavity. Adults have been rarely observed directly because they live in the canopy (Corbet, 1961).

The life habits of *G. gloriosa* were studied by direct observation and deduced from cockroach distribution in the ant nests. Other possible habitats, including the cavities where *Gyna* species are commonly found, were checked for the occurrence of *G. gloriosa*.

Observations were carried out during June 1994 in Gabon, mainly in Ogooué-Ivindo, (near the river Makandé, a tributary of Ofoué, 11°55′E–0°41′S, altitude 220 m), and in the south near Franceville (Kessalla). In the first location, one cave and 78 cavities in tree trunks or in arboreal termite nests on trees were examined for the presence of *G. gloriosa*. The nests of driver ants (*Dorylus* spp.) were searched for in the understorey, by observing ant swarms along 15 km of trails. Each nest was checked for *G. gloriosa* occurrence and was assessed as being fully active, inactive or abandoned, depending on evidence of raids or the presence of ants at nest entrances. The nests consisted of three types of mounds depending on the digging activities of ants: soil recently banked and forming fresh mounds, soil and prey remains recently banked with the same aspect, soil (possibly with remains) previously banked and compacted by rain. The numbers of spatially independent mounds, available and occupied by cockroaches, were counted and compared in each nest. All cockroach specimens were sexed and measured to provide an age estimate (pronotum width). Some nymphs were kept to check the identification when adult.

Cavities inside tree trunks and termite nests ($N=78$) and one cave did not harbour *G. gloriosa* but other species of *Gyna* were present (*G. capucina*, *G. foucarti*, *G. laticosta*), as well as species belonging to the subfamilies Oxyhaloinae or Polyphaginae. Five nests of *Dorylus nigricans* Ill. were found (Table 1) of which one was fully active while two appeared inactive and one was already abandoned. One of the inactive nests was abandoned by ants during the course of observations. The size of these nests on the surface was very variable, ranging from 1·5 to 8 m^2 (Table 1). Three of the five nests (all except the fully active and the abandoned) harboured *G. gloriosa*.

Table 1. *Dorylus* nests and their characteristics. Number of mounds referred to spatially independent mounds, respectively, made of soil freshly banked, soil and refuse freshly banked, compacted soil

No	Location	Surface (m^2)	Status	Number of mounds	Presence of *G. gloriosa*
1	Makandé	8	inactive/deserted	3	+
2	Makandé	5	inactive	3	+
3	Makandé	2·5	active	3	—
4	Makandé	4	deserted	1(compacted soil)	—
5	Kessalla	1·5	inactive	3	+

Table 2. Comparisons in each nest between the numbers of different mounds occupied by cockroaches and the available numbers of these mounds

Number	Type of mound	Number available	Number with *G. gloriosa*
1	soil	12	0
	soil and remains	10	4
	compacted mounds	11	0
2	soil	4	0
	soil and remains	1	1
	compacted mounds	4	0
3	soil	10	0
	soil and remains	3	1
	compacted mounds	0	0

Table 3. Population structures of cockroach *Gyna gloriosa* in three ant nests, according to numbers of nymphs with different pronotum widths (in millimetres) and sexes

	Sex	0–1·5	1·5–2·5	2·5–3·5	3·5–4·5	4·5–5·5	Total
nest *n*°1	male	3	—	1	2	—	6
	female	1	4	—	1	—	6
nest *n*°2	male	1	1	1	2	1	6
	female	1	1	1	—	1	4
nest *n*°5	male	—	—	—	—	1	1
	male	—	—	—	—	—	—

Observations of cockroach presence in each available mound showed that only recently banked areas with soil and refuse contain cockroaches (Table 2). Nymphs were found burrowing inside the dusty layer of refuse and banked soil, far away from the nest entrances with ants. When disturbed, the nymphs rapidly burrowed deeper into the substratum or froze for several tens of seconds. The three populations of *G. gloriosa* comprised ten, twelve and one nymph, respectively, of very different ages, with sex ratio (male/female) values ranging from 1·5 to 1 (Table 3). The youngest age corresponded to first instar nymphs and the oldest to last instar nymphs. Middle-aged nymphs kept in the laboratory developed after six months into adults which produced no broods. The brood

size of this species (28 eggs) is known from one female from Brazzaville (Congo, collections of Muséum national d'Histoire naturelle of Paris). Nymphs, when kept with a sample of the ant nest substratum, were often seen nibbling refuse.

Discussion

In all species of *Gyna*, only nymphs are found at ground level. Adults were not observed in the forest understory and this is consistent with previous observations that adults are arboreal (Corbet, 1961; Arbeille, 1986). The nymphs of *G. gloriosa* depend on the nests of *Dorylus nigricans* in contrast to other *Gyna* species, which inhabit cavities. This was assessed by their presence in several and geographically distant nests of driver ants and also by their absence from cavities where other *Gyna* species are always found. All *Gyna* species shared the same burrowing habits either in the dust at the bottom of cavities or in the dusty mounds of driver ants. Both types of dusty substrata contain significant amounts of organic refuse. In ant nests, this refuse is exclusively the remains of ant prey. Therefore, the nymphs of *G. gloriosa* may be considered scavengers, all the more because they occur only in those parts of the nests containing refuse. Their feeding behaviour in the laboratory also attested to their scavenger habits. Contrary to true myrmecophilous cockroaches (Chopard, 1938; Roth & Willis, 1960), *G. gloriosa* has never been seen close to ants and is therefore a commensal species.

As *G. gloriosa* burrows into dusty substratum and ants search for prey at the surface, encounters would be relatively uncommon. Moreover, *Gyna* nymphs readily display a freezing posture which is an efficient means for cockroaches to escape swarming ants which do not detect some motionless insects (Grandcolas & Deleporte, 1994, personal observation).

Driver ants are known to be moderately sedentary in contrast to wandering neotropical army ants (Hölldobler & Wilson, 1990). This probably allows *G. gloriosa* to colonize their nests. The observations suggest that a brood of *G. gloriosa* must develop before the nest entirely disappears after the ants' departure. When abandoned by ants, mounds become compacted and therefore unsuitable for cockroach burrowing. Some ant nests have been probably colonized by several broods because they harboured nymphs of very different ages. The survival rate was low (at the most 26%) according to the comparison between brood size and number of nymphs in each age cohort.

Scavenger habits have not been observed in other cockroaches though some species living as commensals may be hypothesized to behave in the same way. *Alloblatta nugax* and *A. magna*, belonging to the sister-genus of *Gyna*, were collected from the large nests of the ant *Paltothyreus tarsatus* (Arbeille, 1986; Kumar, 1975; Grandcolas, 1995) which also produces mounds and refuse piles (Braun *et al*., 1994). Scavenger habits, could have therefore arisen either once ancestrally or twice convergently, in the subfamily Gyninae.

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References

Arbeille, J. (1986) *Recherches Biologiques et Écologiques sur les Blattes de la Région de Lamto (Côte d'Ivoire)*. Thèse Doctorat, Université Paris VI.

Braun, U., Peeters, C. & Hölldobler, B. (1994) The giant nests of the African stink ant *Paltothyreus tarsatus* (Formicidae, Ponerinae). *Biotropica* **26,** 308–311.

Chopard, L. (1938) *La Biologie des Orthoptères. XX. Encyclopédie entomologique*. Lechevalier, Paris.

Corbet, P.S. (1961) Entomological studies from a high tower in Mpanga forest, Uganda. XII. Observations on Ephemeroptera, Odonata and some other orders. *Trans. R. ent. Soc. Lond.* **113,** 356–368.

Gautier, J.Y. (1980) Distribution spatiale et organisation sociale chez *Gyna maculipennis* (Insecte Dictyoptère) dans les cavernes et galeries de mines de la région de Belinga au Gabon. *Acta Oecol., Oecol. Gen.* **1,** 347–358.

Girard, C. & Lamotte, M. (1990) L'entomofaune des termitières mortes de *Macrotermes*: les traits généraux du peuplement. *Bull. Soc. Zool. Fr.* **115,** 355–366.

Grandcolas, P. (1993a) Monophylie et structure phylogénétique des [Blaberinae+Zetoborinae+Gyninae+Diplopterinae] (Dictyoptera: Blaberidae). *Ann. Soc. Entomol. Fr. (N.S.)* **29,** 195–222.

Grandcolas, P. (1993b) The origin of biological diversity in a tropical cockroach lineage: a phylogenetic analysis of habitat choice and biome occupancy. *Acta Oecol.* **14,** 259–270.

Grandcolas, P. (1994) Le genre *Gyna*: définition du groupe *oblonga* et de ses espèces constituantes (Dictyoptera, Blattaria). *Bull. Soc. Entomol. Fr.* **99,** 287–293.

Grandcolas, P. (1995) Nouvelles données sur le genre *Alloblatta* Grandcolas, 1993 (Dictyoptera, Blattaria). *Bull. Soc. Entomol. Fr.* **100,** 341–346.

Grandcolas, P. & Deleporte, P. (1994) Escape from predation by Army Ants in *Lanxoblatta* cockroach larvae (Insecta, Blattaria, Zetoborinae). *Biotropica* **26,** 469–472.

Hölldobler, B. & Wilson, E.O. (1990) *The Ants*. Springer Verlag, Berlin.

Kumar, R. (1975) A review of the cockroaches of West Africa and the Congo Basin (Dictyoptera: Blattaria). *Bull. IFAN ser.A* **37,** 27–121.

Princis, K. (1964) Pars 6: Blattariae: Subordo Blaberoidea: Fam.: Panchloridae, Gynopeltididae, Derocalymmidae, Perisphaeriidae, Pycnoscelididae. In: *Orthopterorum Catalogus* (Ed. M. Beier). W. Junk, The Hague.

Roth, L.M. & Willis, E.R. (1960) The biotic associations of cockroaches. *Smithson. Misc. Coll.* **141,** 1–470.

Vuattoux, R. (1968) Le peuplement du palmier rônier (*Borassus aethiopicum*) d'une savane de Côte d'Ivoire. *Ann. Univ. Abidjan, E* **1,** 1–138.

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