

RHINOCEROS BEETLES POLLINATE WATER LILIES IN AFRICA (COLEOPTERA: SCARABAEIDAE: DYNASTINAE; MAGNOLIIDAE: NYMPHAEACEAE)

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In South America, night-blooming species of *Nymphaea* L. water lilies and other Nymphaeaceae are pollinated by scarab beetles of the subfamily Dynastinae (rhinoceros beetles) (Gottsberger 1986, Wiersema 1988). Nearly all of them belong to the endemic American genera *Cyclocephala* Latreille, *Erioscelis* Burmeister, and *Chalepides* Casey (Valla & Cirino 1972, Gottsberger 1986, Schatz 1990) of the tribe Cyclocephalini. In South America a species of a different dynastine tribe has been found in *Victoria* flowers on only two occasions, *Ligyris similis* Endrödi, 1968 (Prance & Arias 1975). Day-blooming water lilies are usually pollinated by Diptera and Hymenoptera (Wiersema 1988). Nothing is known about the pollinators of night-blooming *Nymphaea* species from outside America.

OBSERVATIONS

In and around the southern part of the Parc National de la Comoé in north-eastern Côte d'Ivoire and in Bénin we observed and collected beetles from flowers of *Nymphaea lotus* L., 1753. Almost all the beetles belong to the rhinoceros beetle species *Ruteloryctes morio* (Fabricius, 1798) (Scarabaeidae: Dynastinae: Cyclocephalini). We observed only one other

beetle species (*Anomala* sp., Scarabaeidae: Rutelinae) and bees (Apidae) in *Nymphaea* flowers. The records of *R. morio* are listed below:

– Côte d'Ivoire, southern part of the PN Comoé, "pond Hyperolius", 8°45'18"N, 3°46'37"W, 22. 09. 1996, 22:00–23:00 h (Fig. 1), 3 to 5 individuals of *Ruteloryctes morio* in each flower, altogether a few dozen specimens (R.S.); 27. 09. 1999 and 01. 08.–15. 09. 2000 (G.H.) (0/2 ♂/1 ♂, 1 ♀ in coll. Hirthe; 1



FIG. 1. *Ruteloryctes morio* in an open flower of *Nymphaea lotus* at night. (Phot. R.S., 22. 09. 1996, Hyperolius pond, PN Comoé).

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♂, 2 ♀ / 1 ♂ / 6 ♂ in coll. Krell [later in The Natural History Museum, London]).

– Côte d'Ivoire, pond between Parhadi and Nassian, 29. 09. 1999, 1 ♀ of *R. morio* (G.H./S.P.) (in coll. Krell, [later in The Natural History Museum, London]).

– Bénin, in a pond near Bassila, 9°00'04"N, 1°44'20"E, 30. 09. 2000, 2 ♂ and 2 ♀ (S.P.) (1 ♀ in coll. Hirthe).

Some of the beetles were covered by pollen (Fig. 3). During the day, the beetles stay in the closed flowers (Fig. 2). The flowers showed clear damage presumably caused by the beetles. In the study areas at least, *Ruteloryctes morio* may be specialized in *Nymphaea lotus* because in September/October no other cantharophilous plants were flowering.

Pollination of *Nymphaea lotus* by *Ruteloryctes morio* is probably more widely distributed since we also found a male of *Ruteloryctes morio* with the following data in the collection of The Natural History Mu-



FIG. 3. *Ruteloryctes morio* covered by pollen (yellow spots) in a flower of *Nymphaea lotus* in an aquarium. The beetle approached the flower on its own. (Phot. G.H., PN Comoé).



FIG. 2. *Ruteloryctes morio* in a closed flower of *Nymphaea lotus* during the day. The beetles look out of the flowers only after disturbance. (Phot. G.H., *Hyperolius* pond, PN Comoé).

seum, London: Nigeria, Calabar, Edge Atimbo Ferry Rd., 18. 11. 1984, "One of two, each in *Nymphaea flower*", leg. Reid.

DISCUSSION

All flower-visiting Dynastinae of South America belong to the Cyclocephalini. The only non-American species of this tribe is *Ruteloryctes morio* (Endrödi 1985). It has been recorded from Senegambia, Guinea Bissao, Sierra Leone, Liberia, Ghana, Niger, Nigeria, Chad, Cameroon, former Zaire, and Angola (Endrödi 1966, 1973; Ferreira 1966; Ministère du développement rural [...] 1983); our records are the first ones for Côte d'Ivoire and Bénin. Fabricius (1798) described it erroneously as from "India orientalis," but with the long forgotten but now confirmed detail "Habitat in *Nymphaeae floribus*." *Nymphaea lotus* is distributed in Egypt, tropical and southern Africa, Madagascar, and northwest Romania and is cultivated in the Americas (Verdcourt 1989). Since the range of

the plant is much larger than the range of the pollinator, *Ruteloryctes morio* may depend on *Nymphaea lotus*, but *Nymphaea lotus* is certainly not dependent on *Ruteloryctes morio*. Other species may act as pollinators for the water lily or autogamy occurs in areas where *Ruteloryctes morio* is not present.

The strong attraction of Cyclocephalini by nocturnally blooming Nymphaeaceae is a unique phenomenon within the Scarabaeoidea and is quite likely a parallelism within this tribe or even a synapomorphy. Gottsberger & Silberbauer-Gottsberger (1991) found that olfactory stimuli are important for *Erioscelis emarginata* (Mannerheim, 1829), another species of Cyclocephalini, in finding the flowers that they feed on. Since Scarabaeidae generally orientate by olfaction, we presume that *Ruteloryctes* also finds *Nymphaea* flowers by olfactory cues, although in *Nymphaea lotus* "Strong odors have not been observed" (Wiersema 1988) (by human noses).

Knowledge of the chemistry of attraction in Cyclocephalini is very poor. The only identified attractants for beetles of this group are phenol and a mixture of anethol and eugenol (Gruner & Marival 1974, Gruner 1975). The former acted like a sexual pheromone on *Cyclocephala insulicola* Arrow, 1937, since it attracted at least 90% males. The existence of (unidentified) sexual pheromones has been shown in two other *Cyclocephala* species (Potter 1980). However, the odor of *Nymphaea lotus* probably does not mimic sexual pheromones, since we found both sexes attracted to *Nymphaea* flowers. Anethol and eugenol attracted both sexes of *Cyclocephala insulicola*, but have only a small effect. In the only two fragrance analyses in Nymphaeaceae these substances have not been found, neither in *Victoria amazonica x cruziana* (Kite *et al.* 1991) nor in several varieties of an unidentified species of *Nymphaea* (Mookherjee *et al.* 1990), from which benzyl alcohol, benzyl acetate, anisic aldehyde, anisyl acetate, n-pentadecane, and heptadecadiene were identified. Flowers of *Victoria amazonica* (Poepig) Sowerby attract *Cyclocephala castanea* (Olivier, 1789), *C. hardyi* Endrödi, 1975, and *C. verticalis* Burmeister, 1847 (Prance & Arias 1975). Benzyl alcohol is present as a minor component in the odour of living *Victoria* flowers, but their main components are methyl-2-methylbutanoate, methyl tiglate, and methyl hexanoate (Kite *et al.* 1991). Hence there is so far no conclusive evidence for the attractive mechanism of *Ruteloryctes* to *Nymphaea*. Testing the described od-

orous components in the field and the analysis of the odor of living flowers of *Nymphaea lotus* will be the next step in explaining this mechanism.

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