FIRST NEOTROPICAL MUTUALISTIC ASSOCIATIONS IN BUMBLEBEE NESTS (HYMENOPTERA: APIDAE)

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ABSTRACT

Ectosymbionts of bumblebee nests of *Bombus ephippiatus* are recorded for first time from the American Tropics. An overview of this interaction is provided.

“The insect colony and its immediate environment can be thought of as an island which symbiotic organisms are continuously attempting to colonize”

E.O. Wilson, 1971

INTRODUCTION

Much is known about the enemies and inquilines which, directly or indirectly, affect the existence of the bumblebees (Alford, 1975). Many occur in nests as either accidental visitors or harmless scavengers, some may be beneficial, but several are either parasites of adult bees or they damage the brood or the comb. A large number act either as social parasites as in the case of *Psithyrus* Lepeletier (Hymenoptera: Apidae) (Sladen, 1915; Frison, 1916, 1921; Plath, 1922a), or as parasites of the adults, larvae and pupae as in the case of the conopid flies *Physocephala sagittaria* (Say) (Packard, 1865; Meijere, 1904; Frison, 1918), *Spherularia bombi* Dufour (Réaumur, 1742; Leuckart, 1887), *Brachycoma sarcophagina* (Townsend)(Davidson, 1894; Sladen, 1912; Plath, 1922b), *Melilotobia* sp. (Frison, 1926), *Parasitus* sp. (Oudemans, 1902; Banks, 1919; Richards, 1976; Richards and Richards, 1976), or as insect enemies of the bumblebee comb, like the pyralid moths *Vitula edmandsii* (Packard) (Franklin, 1912–13; Frison, 1918) and *Plodia*

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interpunctella Hübner (Davidson, 1894), or as scatophagus associates and occasional lodgers. A number of insects act as scavengers within the bumblebee nest. Among the most interesting of these is the beetle *Antherophagus* Latreille (Coleoptera: Cryptophagidae). Many European and American investigators record the capture of *Antherophagus* (*pallens* F., *silaceus* Herbst and *nigricornis* F.) in the nests of bumblebees. As Carus and Gerstaecker (1863) stated of *Antherophagus*: "The species live on flowers, attach themselves to bumble-bees and permit the latter to transport them to their nests, probably for the purpose of oviposition." In fact several authors (Gorham, 1869; Perris, 1869–70; Bugnion, 1869–70; Seidlitz, 1869–70) described seeing the larvae of these beetles in the nests of bumblebees.

Several observations have been made comparing the European and American beetle species and have found that both species are similar in habits. The adults of *Antherophagus* gain admittance to the nests of bumblebees often if not always by attaching themselves to the proboscis of bumblebees while the bees are feeding at the flowers. They are then carried back to the nests and upon releasing their hold fall onto the comb and eventually reproduce in the debris of the nest, particularly at the bottom of the comb. Packard (1864) said that these beetles have a certain attraction for sweet flowers and that they visit the nests of the bees for the purpose of consuming the honey stored there, but Packard (1873) inferred that the beetles probably feed upon the wax and pollen. However, it seems that the views of various other authors are unanimous concerning the feeding habits of the larva. Perris (1875) says that the larvae of *Antherophagus* probably play the same role in the bumblebee nests as do *Cryptophagus* in the nests of wasps, "they live on the feces of the inhabitants and that they are, properly speaking, merely scavengers" and that seems to be the most realistic explanation.

MATERIAL AND METHODS

During a field trip to Cerro de la Muerte, Costa Rica in July, 1993 and January, 1994, while collecting bumblebee nests for studies on nesting behavior, the author collected four nests of *Bombus ephippiatus* Say. The bumblebee nests were collected at Cerro de la Muerte in the Talamanca Cordillera in Costa Rica. Some other

nests of other bumblebee species were collected in other areas and contained no ectosymbionts. Several bees were collected while flying and while foraging; observations were made also on several flower patches, in order to find a possible phoretic organism.

Bumblebee nests were dissected and all inquilines were placed in 80% ethanol and samples of the different inquilines were sent to Q.D. Wheeler and P. Fraissinet (Cornell University) for identification. Field collected adult bumblebees were pinned.

RESULTS AND DISCUSSION

Adults, larvae, and pupae of a number of species of different families of primarily Coleoptera and Diptera were found in all four nests (Table 1), and a new species of *Antherophagus* (Wheeler and Fraissinet, pers. comm.) is reported for the first time. The study of bumblebee nests is at an early stage, therefore, not so many nests of Neotropical bumblebees have been studied in detail. Flies (Phoridae) were also found; this is not unusual because phorid flies have been reported as guests of many social insects, including bumblebees (Wilson, 1971).

Of the bumblebees that were collected while flying or foraging (157 specimens), none had any inquilines except for mites.

All bumblebee colonies were very active and were producing a lot of brood, and in two cases the colonies were producing queens. This activity in the nests, in conjunction with the presence of several inquilines, demonstrates that the inquilines are probably obligate ectosymbionts (Wilson, 1971) in some kind of relationship other than internal parasitism.

In 1982 Roubik and Wheeler mentioned Roubik's personal observation of a nest of *B. atratus* Franklin, kept in captivity at the Universidad Nacional de Colombia in Bogotá, where beetles of the genus *Antherophagus* lived in the nest and left phoretically on foraging bees; however aside from this report, such behavior has not been mentioned for the Neotropical bumblebees.

More studies are needed, especially field work, in order to understand truly the behavior and other patterns of these beetles, including whether there is any specificity in relation to different bumblebee species. This type of study will contribute to a better understanding of the host relationships. Finally, the concept of an insect colony as a partially isolated ecosystem can be extended and

Table 1. Insect ectosymbionts of <i>Bombus ephippiatus</i> nests.			
NEST # 1	NEST # 2	NEST # 3	NEST # 4
COLEOPTERA	COLEOPTERA	COLEOPTERA	COLEOPTERA
– adult <i>Antherophagus</i> n.sp. (Cryptophagidae)	– adult <i>Antherophagus</i> n.sp.	– larval <i>Antherophagus</i> n.sp.	– adult <i>Antherophagus</i> n.sp.
– larval <i>Antherophagus</i> n.sp.	– larval <i>Antherophagus</i> n.sp.	– adult Tenebrionidae undet.	– larval <i>Antherophagus</i> n.sp.
– adult <i>Loberopsyllus</i> * n.sp. Cryptophagidae	– adult <i>Gonicoelus</i> sp. (Biphyllidae)	DIPTERA	– larval ?Carabidae undet.
DIPTERA	– adult <i>Ptomaphagus</i> sp. (Leiodidae:Cholevinae)	– larval & pupal Phoridae	DIPTERA
– larval & pupal Phoridae	– adult Ptiliidae n.sp. ? (blind, flightless)	– adult Brachycera undet.	– adult Phoridae
	– adult Ptiliidae normal sp.	HEMIPTERA	– larval and pupal Phoridae
	– adult <i>Amblyopinus</i> (Staphylinidae)	– adult Cydnidae	– adult Brachycera undet.
	– pupal Staphylinidae		
	– larval Staphylinidae		
	DIPTERA		
	– larval or pupal Phoridae		
	– larval Scatopsidae		

* Determined by R. Leschen, University of Kansas, Lawrence

this way we can gain a better understanding of biological aspects of the symbionts.

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