SHORT COMMUNICATION

Notes on the Reproductive Morphology of the Parasitic Bee *Megalopta byroni* (Hymenoptera: Halictidae), and a Tentative New Host Record

NATALIA B. BIANI[1] AND WILLIAM T. WCISLO[2]

Brood parasitism has evolved repeatedly in sweat bees (Halictidae) (Michener, 2000), and in other nest-making Hymenoptera (bees, wasps, and ants) (see e.g., Wcislo, 1987; Choudhary *et al.*, 1994; Savolainen and Vepsalainen, 2003). However, many parasitic species are relatively rare and therefore little is known of their biology. *Megalopta* (Augochlorini) is a Neotropical genus of sweat bees, most of which forage under extremely dim light conditions and nest in dead wood (reviewed in Wcislo *et al.*, 2004). It also contains several parasitic species (see Michener, 2000). *Megalopta noctifurax* Engel, Brooks & Yanega and *M. fununculosa* Hinojosa-Díaz & Engel are putative obligate parasites based on morphological features that are associated with parasitic behavior, but there are no rearing records (Engel *et al.*, 1997; Hinojosa-Díaz and Engel, 2003). A third parasitic species, *M. byroni* Engel, Brooks and Yanega, was reared from nests of *M. genalis* Meade-Waldo (Wcislo *et al.*, 2004), and is very rare: only three individuals have been found from >300 nests between 1998 and 2001 (Wcislo *et al.*, 2004). Here we provide notes on reproductive structures that are relevant for understanding the evolution of parasitism, and provide a tentative new host record for *M. byroni* in Panamá, which was collected from a nest of *M. ecuadoria* Friese. Engel (2006) selected the synonymous name *M. centralis* Friese as the name for this species, but a petition to conserve the commonly used name *M. ecuadoria* will soon be before the International Commission on Zoological Nomenclature for a decision; until a decision is rendered we use the name *M. ecuadoria*.

We collected 75 nests of *M. genalis* and *M. ecuadoria* Friese from June–August 2005, and 114 nests from March–July 2006, along Pipeline Road in Soberanía National Park (Colón Province, Panamá, N 09.14778 W 079.72997), in nearby secondary forests near Gamboa, and in the Barro Colorado Nature Monument. Nests were collected in the field, and opened in the laboratory to collect resident adults and brood.

The metasoma of each parasite was preserved in formalin and later dissected under light microscopy. The number of ovarioles per ovary was counted, as well as the number of yellow bodies. The width of the largest ovariole and the width of the Dufour's gland were measured using an ocular micrometer. Means are given with their standard deviations.

In 2005 only 2.7% of 75 nests contained an adult parasite, and in 2006 none of the 114 nests were parasitized (overall parasitism rate, ~1%). The first parasite was found in late June (beginning of the wet season) in a nest with two *M. ecuadoria* females and three open and empty brood cells. Thus, the new host record is tentative until it is confirmed with rearing records. The second parasite was found in a nest of *M. genalis* in early August. The nest was inhabited by a single *M. genalis* female and there were no cells in the nest, so apparently it was in an early stage of construction. Almost nothing is known on the biology of *M. byroni*, and we do not know if it is a cleptoparasite or a social parasite. Given the social flexibility of the host bees (i.e., some bees are solitary and some social) (Wcislo *et al.*, 2004), this classification might not fit at all, and host-parasite relationships might depend also on the social status of particular nests. These two potential host species, *M. genalis* and *M. ecuadoria*, are sympatric in Panama, which is the only locality record for *M. byroni*.

Both parasites had three ovarioles per ovary, which is the plesiomorphic number for Halictidae, including parasitic forms (Rozen, 2003), and the width of the largest ovariole was 0.45 mm for both parasites. By comparison, the resident *M. ecuadoria* had a mean ovariole width of 0.75 mm, slightly larger than the *M. ecuadoria* population mean of 0.37 mm $\pm$ 0.16 ($N = 54$) and the *M. genalis* population mean of 0.41 mm $\pm$ 0.18 ($N = 59$). Furthermore, the first parasite, collected in June, had 12 yellow bodies, while the second one, collected in August, had only one. In contrast, the nestmates had no yellow bodies, and the *M. ecuadoria* population mean was 0.32 $\pm$ 0.96 ($N = 54$) yellow bodies, and 1.16 $\pm$ 2.65 ($N = 59$) for *M. genalis*.

---

[1] University of Texas at Austin, Section of Integrative Biology, 1 University Station C0930, Austin, Texas, 78712-0253. E-mail: nataliab@mail.utexas.edu or natalia.biani@gmail.com

[2] Smithsonian Tropical Research Institute, Apartado 0843-03092, Balboa, Republic of Panama; Mailing address from the USA: Unit 0948, APO AA 34002-0948 USA; E-mail: WcisloW@si.edu

The Dufour's gland, which produces secretions used in the internal lining of the cell walls (Cane, 1983), was 0.15 and 0.20 mm, respectively for each parasite, which is much smaller than that of the resident host bees of *M. ecuadoria* (width, 0.37 mm $\pm$ 0.11, N = 2), implying that parasites do not use it in nest architecture or in antisocial communication. The *M. ecuadoria* population mean (N = 54) for Dufour's gland width was 0.41 mm $\pm$ 0.19, and 0.44 mm $\pm$ 0.19 for *M. genalis* (N = 59).

In most bee taxa, ovariole number per ovary is constant among individuals and within taxa, except for highly social bees (e.g., *Apis*) and some parasitic lineages that exhibit an increased number of ovarioles with respect to the plesiomorphic number in their free-living relatives (e.g., Alexander and Rozen, 1987; Rozen, 2003; Serrão and Martins, 2004). A larger number of ovarioles in parasitic species, or an increased number of oocytes per ovariole, might increase the probability of laying eggs both during a single nest usurpation event, as well as over the entire life of the parasite (e.g., Rozen, 2003; Ohl and Linde, 2003). However, other factors such as the number of mature oocytes, the size and thickness of the chorion, may also influence the time taken to produce eggs. Yellow bodies are remnants of re-absorbed oocytes (Bell and Bohm, 1975). The notable difference in the number of yellow bodies between the first and the second parasite (12 vs. 1 yellow body, respectively) might reflect the number of failures when trying to deposit an otherwise ready egg, given that the first parasite was found earlier in the season and in a well established nest.

The apparent rarity of this parasite might be explained by three aspects of the biology of hosts and parasite. First, the relative low degree of seasonality in tropical rain forests might diminish the synchronization of life cycles between hosts and parasites (reviewed in Wcislo, 1987), though central Panama is characterized by strong seasonal rhythms (e.g., Leigh, 1999). Second, the lower probability of locating a suitable nest in a three dimensional space (nests are hung in the vegetation) than in a two dimensional space (ground nests) may make host searching more difficult (reviewed in Wcislo, 1996). Finally, the fact that hosts fly at remarkably dim light levels and face severe challenges with respect to visual ecology (e.g., Warrant *et al.*, 2004; Kelber *et al.*, 2006), implies that the parasites also search for nests in the dark, which should be relatively more difficult. Alternatively, if parasites try to enter nests during the day, then hosts would always be present as functional guards.

Acknowledgments

Literature Cited

Alexander, B., and J. G. Rozen. 1987. Ovaries, ovarioles and oocytes in parasitic bees (Hymenoptera: Apoidea). Pan-Pacific Entomologist 63:155–164.

Bell, W. J., and M. K. Bohm. 1975. Oosorption in insects. Biological Reviews of the Cambridge Philosophical Society 50:373–396.

Cane, J. 1983. Chemical evolution and chemosystematics of the Dufour's gland secretions of lactone-producing bees (Hymenoptera: Colletidae, Halictidae, and Oxaeidae). Evolution 37(4):657–674.

Choudhary, M., J. E. Strassmann, D. C. Queller, S. Turillazzi, and R. Cervo. 1994. Social parasites in polistine wasps are monophyletic implications for sympatric speciation. Proceedings of the Royal Society of London, Series B, Biological Sciences 257:31–35.

Engel, M. S., R. W. Brooks, and D. Yanega. 1997. New genera and subgenera of augochlorine bees (Hymenoptera: Halictidae). Bulletin of the Natural History Museum The University of Kansas 5:1–21.

Engel, M. S. 2006. A nocturnal bee of the genus *Megalopta*, with notes on other Central American species. Mitteilungen des Internationalen Entomologischen Vereins 31:37–49.

Hinojosa-Díaz, I. A., and M. S. Engel. 2003. *Megalopta (Noctoraptor) furunculosa* sp.n., a new nocturnal, cleptoparasitic bee from Guyana (Hymenoptera: Halictidae). Folia Heyrovskiana 11:137–141.

Kelber, A. E. J. Warrant, M. Pfaff, R. Wallén, J. C. Theobald, W. T. Wcislo, and R. A. Raguso. 2006. Light intensity limits foraging activity in nocturnal and crepuscular bees. Behavioral Ecology 17:63–72.

Leigh, E. G., Jr. 1999. Tropical Forest Ecology: A View from Barro Colorado Island. Oxford University Press, New York. xvi + 245 pp.

Michener, C. D. 2000. The Bees of the World. John Hopkins University Press, Baltimore, MD. xiv ++ 913 pp.

Moure, J. S., and Hurd, P. D., Jr. 1987. An Annotated Catalog of the Halictid Bees of the Western Hemisphere. Smithsonian Institution Press, Washington D.C.. vii + 405 pp.

Ohl, M., and D. Linde. 2003. Ovaries, ovarioles, and oocytes in apoid wasps, with special reference to cleptoparasitic species (Hymenoptera: Apoidea: "Sphecidae"). Journal of the Kansas Entomological Society 76:147–159.

Rozen, J. G. 2003. Eggs, ovariole numbers, and modes of parasitism of cleptoparasitic bees, with emphasis on neotropical species. American Museum Novitates 3413:1–36.

Savolainen, R., and K. Vepsalainen. 2003. Sympatric speciation through intraspecific social parasitism. Proceedings of the National Academy of Sciences of the United States of America 100:7169–7174.

Serrão, J. E., and G. Martins. 2004. A comparative study of the ovaries in some Brazilian bees (Hymenoptera; Apoidea). Papéis Avulsos de Zoologia Museu de Zoologia da Universidade de São Paulo 44:45–53.

Warrant, E. J., A. Kelber, A. Gislen, B. Greiner, W. Ribi, and W. T. Wcislo. 2004. Nocturnal vision and landmark orientation in a tropical halictid bee. Current Biology 14:1309–1318.

Wcislo, W. T. 1987. The roles of seasonality, host synchrony, and behaviour in the evolutions and distributions of nest parasites in Hymenoptera (Insecta), with special reference to bees (Apoidea). Biological Reviews of the Cambridge Philosophical Society 62:515–543.

Wcislo, W. T. 1996. Parasitism rates in relation to nest site in bees and wasps (Hymenoptera: Apoidea). Journal of Insect Behavior 9:643–656.

Wcislo, W. T., L. Arneson, K. Roesch, V. H. Gonzalez, A. Smith, and H. Fernandez. 2004. The evolution of nocturnal behaviour in sweat bees, *Megalopta genalis* and *M. ecuadoria* (Hymenoptera: Halictidae): an escape from competitors and enemies? Biological Journal of the Linnean Society 83:377–387.