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Nesting and Territorial Behavior of *Philanthus barbatus* Smith (Hymenoptera: Sphecidae)

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ABSTRACT: Behavior of females and males in a small aggregation of *Philanthus barbatus* in Colorado is described. Nest entrances have conspicuous tumuli as well as 1 or 2 blind accessory burrows. Nests have up to 10 cells each and are provisioned primarily with Halictidae. Males establish territories adjacent to the nesting site and interact with intruding conspecifics as well as with other insects. Grass stems in the territory are scent-marked periodically.

Philanthus barbatus Smith is a moderately large species of its genus with a wide distribution in the western United States and the more temperate parts of Mexico. It is commonly encountered in canyons along the eastern slopes of the Rocky Mountains, where members of both sexes are often seen on the flowers of *Solidago, Melilotus,* and other plants, from late July into early September. Nothing as been published concerning either male or female behavior. The recent Catalog of Hymenoptera in America North of Mexico (Krombein et al., 1979) lists two prey records based on Evans and Lin (1959). This is erroneous. Evans and Lin studied *P. albopilosus* Cresson, a dune-inhabiting species which differs from *barbatus* in several important aspects of behavior.

Materials and Methods

This report concerns a small population found in Hewlett Gulch, just north of Poudre Park, Larimer Co., Colorado, at an elevation of 1980 m. From 19 August to 7 September 1978, eight nests were found and studied in an area 2 × 3 m in slightly sloping soil beside a trail through open woodland. From 2 August to 11 September 1981, only two nests could be located at this same site. The soil here was a sandy loam, containing many pebbles and partially overgrown with grasses. Males occupied territories adjacent to the nesting site. Nests and territories were marked and observed periodically for several days. Selected nests were excavated and their contents recorded.

Results

NESTING BEHAVIOR: Active nests were easily visible, since each had a conspicuous tumulus of soil at the entrance as well as one or two open accessory burrows. Tumuli measured 1.0 and 1.5 cm deep and often had one or more

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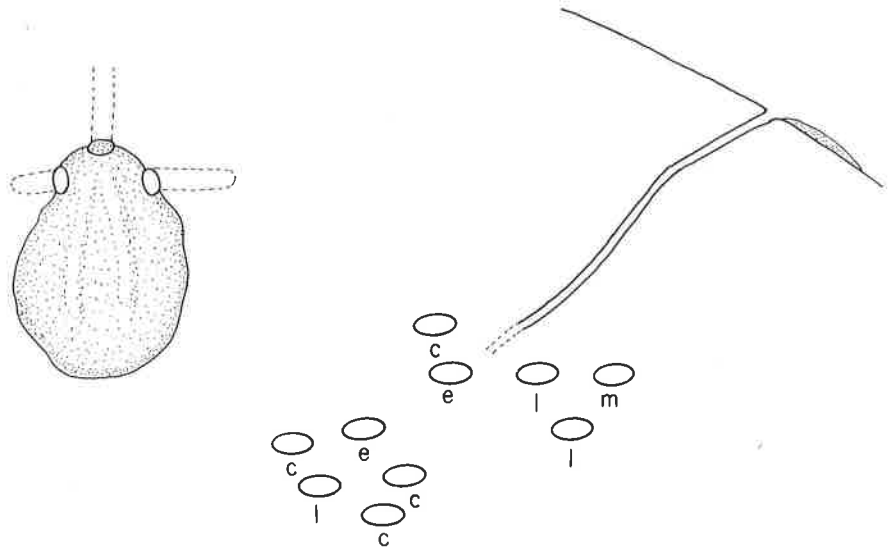

Fig. 1. Nest structures of *Philanthus barbatus*. Left: tumulus at nest entrance, showing two open, blind accessory burrows, with closed true burrow at top. Right: nest profile, cell contents identified as follows: e, egg; l, larva; c, cocoon; m, molded contents.

shallow grooves passing across them (Fig. 1, left); most were longer than wide, but sometimes the reverse was true. Length of the tumulus varied from 10 to 14 cm ($\bar{x}$ = 12.0, N = 7), width 9–15 cm ($\bar{x}$ = 11.1, N = 7). Six of eight active nests had two accessory burrows, one on each side of the true burrow and at approximately a right angle with it; the remaining two had one such burrow. Accessory burrows varied in depth from 0.2 to 4.0 cm ($\bar{x}$ = 1.9, N = 13). True burrow entrances were closed by the wasp whenever she left or remained in the nest for more than a few minutes.

Burrows entered the slope at a 50–80 degree angle with the surface. A series of cells was constructed from 30 to 42 cm from the entrance, in a somewhat irregular pattern but generally with the first cells deepest in the soil, later cells somewhat closer to the entrance, a pattern the reverse of that reported in some other *Philanthus,* for example for *crabroniformis* (Evans, 1970) and for *bicinctus* (Gwynne, 1981). (Only two of the nests were excavated with complete success.) Cell depth, measured vertically from the surface, varied from 15 to 30 cm ($\bar{x}$ = 21.0, N = 26). The maximum number of cells found in a nest was ten (Fig. 1, right). Females preyed on bees of the family Halictidae and less frequently on small wasps (Table 1). Prey were carried with the middle legs in the common manner of members of this genus. Eight to 13 prey were provided per cell. The egg was laid on the topmost prey and the cell then closed off.

Table 1. Prey records for *Philanthus barbatus*, Hewlett Gulch, Larimer, Co., Colorado.

Species	Number taken
HALICTIDAE	
Agapostemon texanus Gresson	7 ♂ ♂
Augochlorella striata (Provancher)	2 ♀ ♀, 1 ♂
Dialictus cressonii (Robertson)	1 ♀
Dialictus sp.	1 ♂
Evylaeus cooleyi (Crawford)	2 ♀ ♀
Evylaeus near *pulveris* (Cockerell)	2 ♀ ♀, 1 ♂
Evylaeus sp.	2 ♂ ♂
Halictus sp.	1 ♀
Lasioglossum manitouellum (Cockerell)	1 ♀, 1 ♂
Lasioglossum sisymbrii (Cockerell)	11 ♂ ♂
Lasioglossum sp.	2 ♀ ♀, 17 ♂ ♂
Sphecodes sp.	1 ♂
SPHECIDAE	
Alysson oppositus Say	1 ♀
EUMENIDAE	
Eumenes crucifera nearcticus Bequaert	2 ♂ ♂

MALE TERRITORIAL BEHAVIOR: Males were found to defend territories adjacent to the nesting site as early as 28 July and as late as 29 August, but at no time were more than three males active at one time. Male territorial activity began at 1100–1200 hours, when the sun began to strike the site fully, and continued into mid-afternoon, when the site became more or less shaded. Territories were 1–1.5 m in diameter. In two instances (on separate dates) territories were established in the trail immediately adjacent to the nesting site, within 2 m of the nearest nest. Here the major perch was on the ground, while grasses 40–70 cm high beside the trail were scent-marked in a manner similar to that of other species of the genus (e.g., Alcock, 1975; Gwynne, 1978; O'Neill, 1979). Males assumed a broadly V-shaped position while marking, head and abdomen closely pressed to the grass stems. Each time they walked up the stem a short distance, (5–10 cm), then downward a greater distance (10–25 cm); in some cases they walked downward only. It appeared that they walked much more slowly than in other species of the genus. As in other *Philanthus* species, scent-marking as well as interactions with other males occurred more frequently soon after the territory was established than later. Interactions with intruding males consisted of pursuit from the territory and occasionally butting in the air. Other insects were merely pursued a short distance. Males changed perches frequently, generally one to three times a minute.

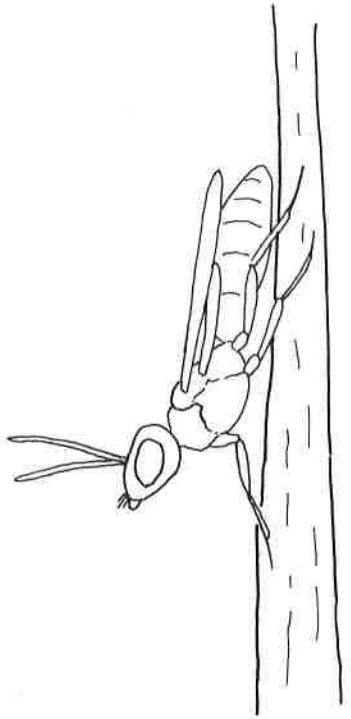

Fig. 2. Male *Philanthus barbatus* perched in "alert" posture on grass blade in territory.

Two other males were territorial in dense, tall grass beside the trail, where there was no bare ground. In these cases all perches were on grass blades, up to 70 cm high, and were generally made in an "alert" posture, facing downward but with the head directed outward and the antennae extended (Fig. 2). These males made long, circling flights over the grass-tops in and around their territories. A ten-minute record on one such male is shown in Fig. 3, top. This male had only just established his territory and scent-marking was frequent (18 times in 10 minutes); there were three interactions with other males. A second male, recorded some time after territory establishment, marked 13 times in 10 minutes and showed no interactions with other males (which were in any case not common in the area) (Fig. 3, bottom). In both cases scent-marking occurred in bouts of up to four; that is, up to four grass blades were marked without pause between them. Note also that the male of Fig. 3, top, made many long, circling flights, while the other made only one such flight in 10 minutes but often made short, hovering flights within the territory. This may at least in part reflect the fact that the

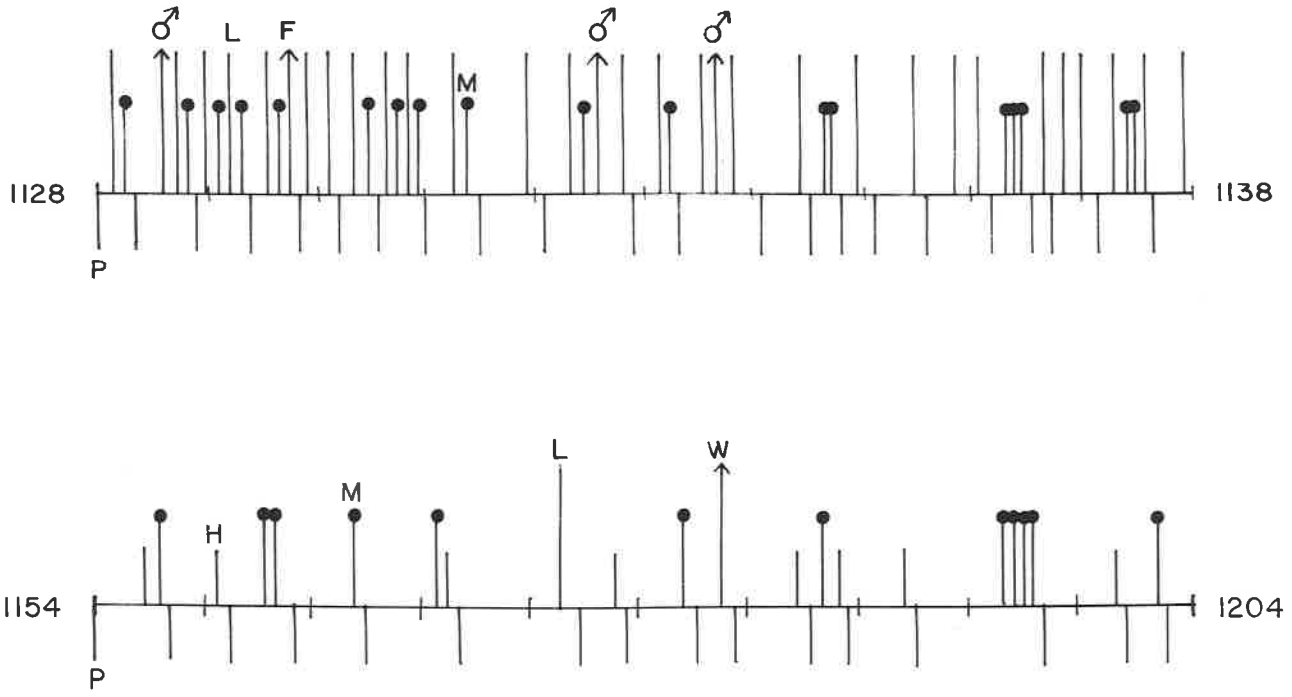

Fig. 3. Ten minute behavioral samples of two different male *Philanthus barbatus*. P, perching; H, hovering within territory; L, long flight around or out of territory; M, scent-marking; W, interaction with ichneumon wasp; F, interaction with bee fly; ♂, interaction with conspecific male.

latter perched on bare soil in the trail, while the first male had a territory amid tall grass.

No odor could be detected on grass blades freshly marked by males. It is assumed that the pheromone attracts females to the territories, where mating occurs, as in other species of the genus (e.g., Gwynne, 1978; O'Neill, 1979). No matings were observed at this site, however.

Discussion

In general, neither male nor female behavior of *P. barbatus* departs greatly from that of most other well-studied members of this genus. Interesting features include the consistency of accessory burrows, the tendency for cells to be made progressively toward the entrance (confirmed in only two nests), the tendency for males to move rather slowly when scent-marking but to cover a considerable extent of the plant, and tendency of males to make long, circling flights through and over the tops of grasses in and around their territories. Unfortunately the sample size is small and all records from one site, so it would be desirable to study other and if possible more populous aggregations before attempting a detailed comparison with other species of the genus.

Acknowledgments

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