

INVESTIGATIONS OF THE BIOLOGY OF A GROUND-NESTING BEE (APIDAE: EUGLOSSINAE) IN MADRE DE DIOS, PERU

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INTRODUCTION

Insects are known to be extremely diverse, especially in the rainforest. Depending on the individual, insects can be perceived as dangerous or harmless. This study was prompted by observation of people's behavior around a colony of ground-nesting bees. At Los Amigos Research Station, a colony of ground-nesting bees was observed in a clearing in the entrance yard. Due to their fear of the insects, people avoid crossing through this area. When asked, employees of Los Amigos revealed the lack of any knowledge about the biology of these insects. Consequently, investigations were undertaken to answer questions about the insects in the clearing. The objectives were to identify the insect, determine its diet and if sexual dimorphism exists, ascertain if they have a parasite, and observe the daily activity patterns. Other purposes of the present article were to examine the characteristics of burrows, area of the colony and number of burrows within.

STUDY AREA

This study was conducted at Los Amigos Research Station in Madre de Dios, Peru. It occurred January 11-17, 2003. The colony was located in an open expanse of land containing low grasses and surrounded by higher vegetation. The area received direct sunlight. The soil consisted of red clay laterite. The soil profile had two layers. The A horizon (approximately 20 cm) was rich in organic matter and a darker grey. The B horizon (2+ m) was more compact and brighter red.

METHODS

Specimen Collection

Males were collected while mating with females since it is difficult to intercept in flight. Females were captured upon entering and exiting burrows, and also during mating. Other insects, which were possible parasites, were captured on vegetation in the study area. All insects were detained by a small net and transferred into a glass vial with ethyl acetate to kill/preserve. Specimens were identified using Borror, Triplehorn, and Johnson (1989).

Sexual Dimorphism

Specimens were examined with stereo dissecting microscope. The features of males and females were compared. The putative parasite was also examined.

Observations of Daily Activity, Mating and Interactions

Approximately twenty-seven hours of observation were made over seven days at various times of day and during differing weather conditions. Time of initiation and cessation of activity was monitored and recorded.

Diet

Sticky traps were placed at opening of burrow one day as activity was beginning and females were exiting. This technique was used because it is assumed females are exiting the burrow to hunt and provision their nest with food. If ensnared in glue upon return, the food obtained could be discovered. The sticky traps consisted of glue and paper with a hole cut out the diameter of entrance to burrow. A small net was used to immobilize the female to transfer into a glass vial with ethyl acetate.

Determination of Burrow Sharing

Study began with the working hypothesis that burrows were occupied by a single female.

Burrow Examination and Excavation

A female was captured exiting a burrow and plaster was poured into it to make a cast. The diameter of the burrow opening was measured and depth of burrow. In order to excavate a burrow, a sturdy reed of grass had to be inserted to follow while shaving away dirt. Excavating was done in very small increments in order to maintain and preserve the shape and direction of the tunnel.

Colony Area and Quantity of Burrows

The perimeter of the colony was staked out and measured by locating the burrows on the edge of the colony. The colony area was calculated. Three transects were made through the area, one in the middle and two near the edges. The length of the transects was recorded. The number of burrows were counted within one meter of each transect line. Number of burrows in the colony was calculated three times based on the estimate derived from each transect. The three estimates were averaged to area at an estimate of colony density.

Response to Color

In order to gain some insight into this insect's attraction to color, a simple procedure was undertaken. Using markers, three differently colored circles, four inches in diameter, were placed on white paper (red, blue and green). A single white sheet and yellow bowl were also used. The five objects were placed in the grass in the center of the colony for one half hour and the insect's behavior was recorded.

RESULTS

Specimen Collection

Nine females, two males, and four of one type of parasite were collected. The ground-nesting bees were identified as members of the family Apidae, specifically

part of subfamily Euglossininae (orchid bees). The parasite was identified as a member of the family Vespidae.

Sexual Dimorphism

Males and females are shown in Figure 1 and 2. Females are larger than males. Males have larger eyes and have a reddish-brown face. The females have a black face with white patches, more robust mandibles, and a longer tongue. The female antennae are arcuate, whereas the males are horizontal and straight. The female thorax is black. The male possess an extremely hairy thorax which is reddish brown. Both have a metallic green abdomen. Female hind legs are larger with more pollen brushes on the metatibia.



Figure 1. Male ground-nesting bees



Figure 2. Female ground-nesting bees

Observations of Daily Activity, Mating and Interactions

Daily activity began around five am each day and ceased five pm or slightly later. On overcast days, less activity occurred. During moderate to heavy rain, no activity was observed.

Several males pursue a single female during mating. A congregation of five males was seen on one female trying mate (Figure 3). Males never enter or approach burrows. They never land rotate in circles when hovering. Males tend to hover and occupy approximately from the ground up to



Figure 3. Several males on a female

meter above. Females were observed entering and exiting nests at the highest frequency during the early to midmorning. At times, females rest in the top of the burrow and pause for about ten to fifteen seconds before exiting. Females have been observed pushing dirt out of burrow openings. Females, when pursued by males, fly directly up and males do not follow the great distance.

A parasite was determined and captured during observations (Figure 4). Red wasps were seen hovering around burrows, normally when females are most active. These wasps land on blades of grass in the proximity of the burrow entrance. They pulled their wings in and thrust their abdomen. This behavior was observed on numerous occasions. The female and male ground-nesting bees chase away these wasps at times. On one occasion during the final days of the study, a red wasp was seen entering a burrow after a female exited.



Figure 4. Parasite of ground-nesting bees

Diet

Diet was difficult to ascertain. The bees were not seen catching, obtaining or carrying any food into the burrow. Three females were obtained using the sticky traps. One of the three females was covered in pollen. This strongly indicates pollen as the food source.

Determination of Burrow Sharing

Only one female was observed entering and exiting a burrow at one time. It was believed only one female existed within a single burrow. However, after capturing a female exiting a burrow, plaster was poured in to make a cast. Another female bee exited the nest, covered in plaster. The plaster cast could not be excavated due to time constraints.

Burrow Examination and Excavation

Burrows were found at various stages, which have not been determined.

Some of the burrows had no opening, but the majority had one.

Some burrows had fresh surrounding the entrance. The diameter of open burrows was consistent and measured 1.5 cm, as shown in Figure 5.

Excavation of a burrow was performed, however not of the plaster one since it was not dry. A sturdy reed of grass was inserted

as the dirt was shaved away, while following the contours of the tunnel.



Figure 5. Ground-nesting bee burrow

Excavation was extremely tedious and the burrow depth was much deeper than expected. Weather conditions were unfavorable the majority of days and deterred progress. Fifteen hours of excavation were performed. The burrow measured 2+ meters when excavation ceased. The tunnel maintained the 1.5 cm diameter up to this point.

Colony Area and Quantity of Burrows

The area of the colony was estimated to be 236 m². The three transects made measured 12 m, 25m, and 11m. The number of burrows within one meter of each line was 34, 102, and 45 respectively. The center of the colony is more densely populated, whereas the edges contain fewer burrows. The estimated total of burrows was calculated to be 436. Numerous burrows were found more sparsely in the far perimeter and also a satellite colony was found but not included.

Response to Color

The results of the color study are inconclusive. Time constraints and weather were affecting variables. Out of the five colors, three males were seen near the blue circle. However, the bees did not land or inspect the color physically. The males hovered about a half-meter above the paper with the blue circle.

DISCUSSION

The specimens of the ground-nesting bees were identified as part of the Apidae family. Borror, Triplehorn, and Johnson (1989) list the characteristics of this family. Their bodies are usually hairy with at least some body hairs branched or plumose; first segment of hind tarsus usually wider than remaining segments and generally as long or longer than remaining segments combined; metasoma not petiolate, posterior margin of pronotum usually more or less arcuate. It was further classified

as a member of the subfamily Euglossinae (orchid bee). This bee is found only in New World tropics. It is relatively large in size with a brilliant metallic coloration and has an exceptionally long tongue (Cameron & Ramirez, 2001). The bees have apical spurs on hind tibiae, lack a jugal lobe in hind wings and the scutellum is produced backward over the metasoma. The members of Apidae are bumble, honey and orchid bees. They are known to be eusocial (Borrow et al., 1989).

Originally, early on in the study, these insects were identified as wasps, Sphecidae. Like bees, Sphecidae are known to dig holes in the ground. Adult activity occurs in sunlight, and much less of it on overcast days. Adult sphecids resemble bees. Harris (1994) states that bees arose from a sphecid-like ancestor. Bees are sphecoid wasps whose larvae feed on pollen and nectar rather than insect or spider prey. One out of nine female specimens was covered in pollen. Thus, it would be important to determine what species of flower this bee favors. Families of flowers in bloom at the time of this study were Lecythidaceae, Bignoniaceae, Fabaceae, and Arecaceae. Pollen was preserved from the bee and will be sent to a paleontologist. All of the specimens collected will be sent to Jack Neff of Texas Mellitological Institute at St. Edwards University in Austin, Texas for identification.

These ground-nesting bees appear to be affected by sunlight. The lack of sunlight decreases their activity. Rain also hampers activity. It would be interesting to research the activity pattern during all times of the year (i.e. dry season). Female and male interactions need further studying. In a species of Sphecidae, males gather around burrows to wait for virgin female to hatch and exit. Competition for females is evident in this colony (i.e. five males on one female). Whether the males remain for the sole purpose of mating or guard the females was not determined.

Burrow studies should be continued to find out nest structure and characteristics. Is there more than one female per burrow? What do they provision their nests with? What are the characteristics of their larvae? What are the parasitic relationships within the burrows? Do abandoned burrows serve as possible decoys for parasites? How deep are the burrows?

The color study requires a longer amount of time and better materials. The color study would be useful to possibly determine the food source of these bees. Color perception of insects is an interesting topic and is studied extensively in honeybees. Any information about color perception would be helpful in learning more about the biology of this bee. It is possible that these bees pollinate the Brazil nut tree which is of great economic importance to this area.

CONCLUSION

Time constraints heavily interfered with this study. Several methods were left unfinished and numerous questions remain. I recommend this species of ground-nesting bee be further studied, especially excavation of burrow(s). Determining the food source is a key factor. Lyon (2003) states it is best not eliminate ground-nesting bees and wasps because of their importance to agricultural production. These insects pollinate different plants or serve as useful predators in controlling pests. These bees have not been identified and it would be beneficial to pursue investigations more in depth and with more time.

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