stigma was not available upon the first pollinator visit, it is less likely that the pollinator would transfer pollen from the anther to the stigma of the same flower. Preventing this waste of pollen could potentially increase the flowers' male fitness. Furthermore, because the stigma were not available until after traplining pollinators had potentially visited many distant flowers, it is likely that a more diverse collection of pollen would be deposited on the stigma when it finally became available. This could potentially increase female fitness of the flower.

Although we discount their significance, two potential sources of error may have biased our results. First, the mosquito nets did not entirely prevent hymenopteran access to test flowers. We observed a bee under a net on 2 occasions; on one of these occasions, the bee contacted the anthers of a test flower in the stimulated treatment. Thus, the potential exists that other bees may have agitated anthers on control flowers, although we believe we probably would have seen them. Second, we did not control for nectar robbery in test flowers and 7 of 19 test flowers did show signs of nectar robbery. It is possible that nectar robbery had some effect on stigmatic deflection.

Table 1: Times of stigmatic deflection for untouched controls and (stimulated) Passiflora pollinator-simulated flowers at Corcovado National Park.

Trial	Control(min)	Stimulated(min)
1	41	45
2	59	84
3	42	42
4	60	37
5	60	49
6	55	49
7	62	80
8	72	60
9	64	58
10	67	?

BURROW LOCATIONS IN A SPECIES OF ANDRENIDAE GROUND BEE

Edward Gilmartin, Todd Gorman, and Ann Schrot

Abstract (E.G.)

An unidentified species of solitary ground burrowing bees in the family Andrenidae were found in grass covered and open areas of the Camino a Penas Blancas, Monteverde, Costa Rica. We hypothesized that bees would burrow in the grassy areas in greater densities than open areas, because grass might provide more protection from erosion and predators. Bee burrow densities were indeed found to be significantly greater in the grass covered areas. This information provides the bases for further studies on bee's burrow location selection mechanisms.

Introduction (T.G.)

We studied burrow location in a population of bees in the family Andrenidae. Bee burrows were aggregated in an area of homogeneous soil type, though each bee is solitary. Burrows were found in both grass and bare areas. As the site was located in a cloud forest environment exposed to heavy rainfall, one might predict that the grass area would offer a greater degree of burrow protection from erosion, and that these areas would be preferred for burrow construction. Our first hypothesis was that burrow density would be greater in areas covered by grass than in bare areas. Also, if the grass area was limited, one could expect that competition for these areas might occur and certain bees would be forced to burrow in sub-optimal bare areas. As the mass of an organism is often a factor in its ability to win a confrontation, our second hypothesis was that bees with burrows in the grass areas would have greater mass than those with burrows in the bare areas.

This study provides preliminary information for investigations into burrow location mechanisms for these bees, and the consequences of spatial limitations on intraspecific interactions.

Methods (E.G.)

Our study plot was a 3 x 6m quadrat on the crest of the Camino a Penas Blancas, within the Basque Nubceso Monteverde. It was in the center of the road, which was used only as a horse path and foot traffic. We selected it because it had a good representation of grass-covered and open ground, with many bee burrows aggregated inside the plot. We divided the plot into eighteen

$1m^2$ quadrats. We mapped the location of the bee burrows and the regions covered by grass in $1m^2$ quadrats. Areas of cover were tabulated by counting the number of $1mm^2$ squares on the map covered by grass and barren ground.

We attempted to capture bees by netting them as they emerged from or entered grass and open ground burrows. Unfortunately, due to weather and inactivity, no bees were caught and thus weights could not be obtained to test the second hypothesis.

Results (E.G.)

Burrow density was significantly greater in grass covered areas, 16.38 holes/m^2, than open areas, 3.54 holes/m^2 (Galy: = 3.992, df = 1, $p < .05$) (Table 1).

No bee weight data could be collected due to be inactivity, presumably due to rain.

Discussion (A.S.)

We believe there are many possible reasons why bees burrow in the grass in greater densities. Since the plot is along a road used by people and horses, the lack of grass in some areas can be attributed to soil compaction and disturbance. The bees may choose grassy areas for their burrows because the soil is less compacted and thus easier to burrow in. The bees may also choose the grassy area because it has less disturbance.

The grass itself may provide benefits to the bees. The roots might loosen the soil making digging easier. Roots may also provide stability to the burrows and help prevent erosion. The burrows are more difficult to see in the grass, giving the added advantage of protection from wasps and dipterans which parasitize the bee larvae by laying their eggs on them (Jack, pers. comm.).

We did however, find some burrows in the bare areas. The bees may dig burrows in both areas with equal frequency, but burrows in the bare, more well traveled areas may be destroyed at a much faster rate. If a bee builds a new burrow when the old one is destroyed, the bees in the road will have to keep building new burrows. Even if there is no preference for the grass, by chance alone, most nests will eventually be located in the grass.

If the grass covered areas are preferred, we would not expect to find any burrows in the bare areas. It is possible that the grass areas were at maximum density and the bees in bare areas had been forced to nest in less optimal areas. However, we were unable to collect any data on bees weights because of bee inactivity due to rain. Further study on bee interactions and territoriality is needed to determine if grass areas are preferred.

Table 1: Number and density of ground bee burrows found in grass covered areas, open areas, and totals for the $18m^2$ plot (Camino a Penas Blancas, Monteverde, Costa Rica).

	Grass	Open Ground	Totals
Number of burrows	96	43	139
Area (m^2)	5.86	12.14	18
*Burrow Density (burrows/m^2)	16.38	3.54	7.72

*Significantly different by G-test (G_{adj}=3.992, df=1, $p < .05$).

Appendix Map of study site. Burrows are the black dots; shaded areas illustrate grass.