Baited McPhail Fruitfly Traps to Collect Euglossine Bees

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Abstract: Modified McPhail traps baited with essences were utilized to capture male euglossine bees in British Honduras. The performance of these traps was superior to that of Steiner traps during trials in British Honduras and demonstrated that many of the euglossine species occurring in the area could be collected with little expenditure of time and effort. The presence of female euglossines in McPhail traps baited with SIB7, a partially hydrolyzed protein used in Mexican fruitfly trapping programs, is also reported.

Males of euglossine bees are the sole pollinators of certain neotropical orchids, e.g., *Gongora, Catasetum, Coryanthes.* They are attracted to the essences or perfumes produced by the flowers of these orchids as well as to certain other plants which they collect, by means of special pads on the tarsi of the forelegs, and store in the pockets in the hind tibia (see Evoy and Jones, 1971). As the reasons for the collection of these esssences is not well understood and as the biology and the identity of many of the species is not known, any methods which facilitate the collection of representative series of adults are of interest.

While testing new compounds to obtain a satisfactory lure for the Mexican fruitfly *Anastrepha ludens* (Loew), Lopez (1963) reported the collection of large numbers of males of *Eulaema polychroma* (Mues.) (= *Eulaema tropica* Auct. non L.) in McPhail traps baited with a mixture of a-ionone and b-ionone. The use of essences to attract males of euglossine bees has since attracted widespread attention (Dodson et al., 1969), and enormous collections containing previously unknown species have been assembled from various parts of the neotropics. The usual methods of utilizing these compounds have been quite simple. A 5 × 5 cm. square of blotting paper saturated with a few drops of the appropriate compound is tacked to a convenient tree and the bees as they approach are collected with a net or, later, after they have alighted and become less wary, are collected by hand (Dodson et al., 1969). While very straightforward and rewarding, this method requires almost constant attendance during the hours when the bees are active. However, when I visited British Honduras in June 1969 to release parasites of the Mexican

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fruitfly *A. ludens*, my investigations did not permit adequate time to follow these procedures and if bees were to be collected a method of trapping them had to be devised. Earlier attempts to construct a suitable trap for euglossine males had not been entirely satisfactory (H. Hills, pers. comm., 1968). However, in view of the work by Lopez (*loc. cit.*) and as McPhail traps utilized in the Mexican fruitfly control program were readily available, these were tried.

It was noted during the visit to British Honduras that euglossine females were occasionally present in fruitfly traps baited with a partially hydrolyzed protein, so data on the frequency of their appearance in the traps was recorded.

METHODS

A. *For trapping males.* Basically the McPhail trap (Fig. 1) consists of a glass dome 20 to 25 cm. in diameter and 12 to 15 cm. in height with a cork in the top and with an invaginated bottom which provides a ventral circular opening 12 to 16 cm. in diameter surrounded by a canal. In normal operation the canal is filled with a liquid bait in which the victims drown, e.g., to attract Mexican fruitfly the traps contain Staley's Insect Bait 7 (SIB7) which contains a partially hydrolyzed protein.

For the present purpose the traps were modified slightly; a 2-dram glass vial filled with the appropriate attractant and plugged with an extruding cotton wick was suspended wick downward within the dome of the trap (Fig. 1). After filling the canal with water containing a small amount of household detergent, the trap was suspended from the branch of a tree ca. 1.5 m. from the ground. Traps containing one of the following compounds, methyl salicylate, 1,8-cineole, b-ionone, eugenol, benzyl acetate, or methyl cinnamate were suspended in mango trees at the UWI Citrus Research Unit, Melinda, in the Stann Creek Valley, about 60 meters from a forested area. Although the traps were inspected daily and the bees removed, the attractants needed to be replenished only once or twice per week. Traps with these attractants were operated from June 30 to July 12, 1969, at Stann Creek.

During a second visit, a series of traps was operated for a further two-week period (October 28 to November 15, 1969). In addition to the attractants utilized earlier methyl benzoate, piperonal, 2-phenyl ethyl acetate, 2-phenyl ethyl alcohol, skatole, b-pinene, coumarin "stock," and "stock" plus ocimene were also tried. "Stock" consisted of 2.0 parts of a-pinene, .08 parts b-pinene, 1.6 parts myrcene, and 16.0 parts cineole. The formula "stock" plus ocimene was the same except for the addition of 15 parts of ocimene.

To compare the efficiency of the McPhail traps with the traditional method of placing a few drops of the compound on a 5 cm. square of blotting paper and netting the approaching adults, traps baited with a number of compounds

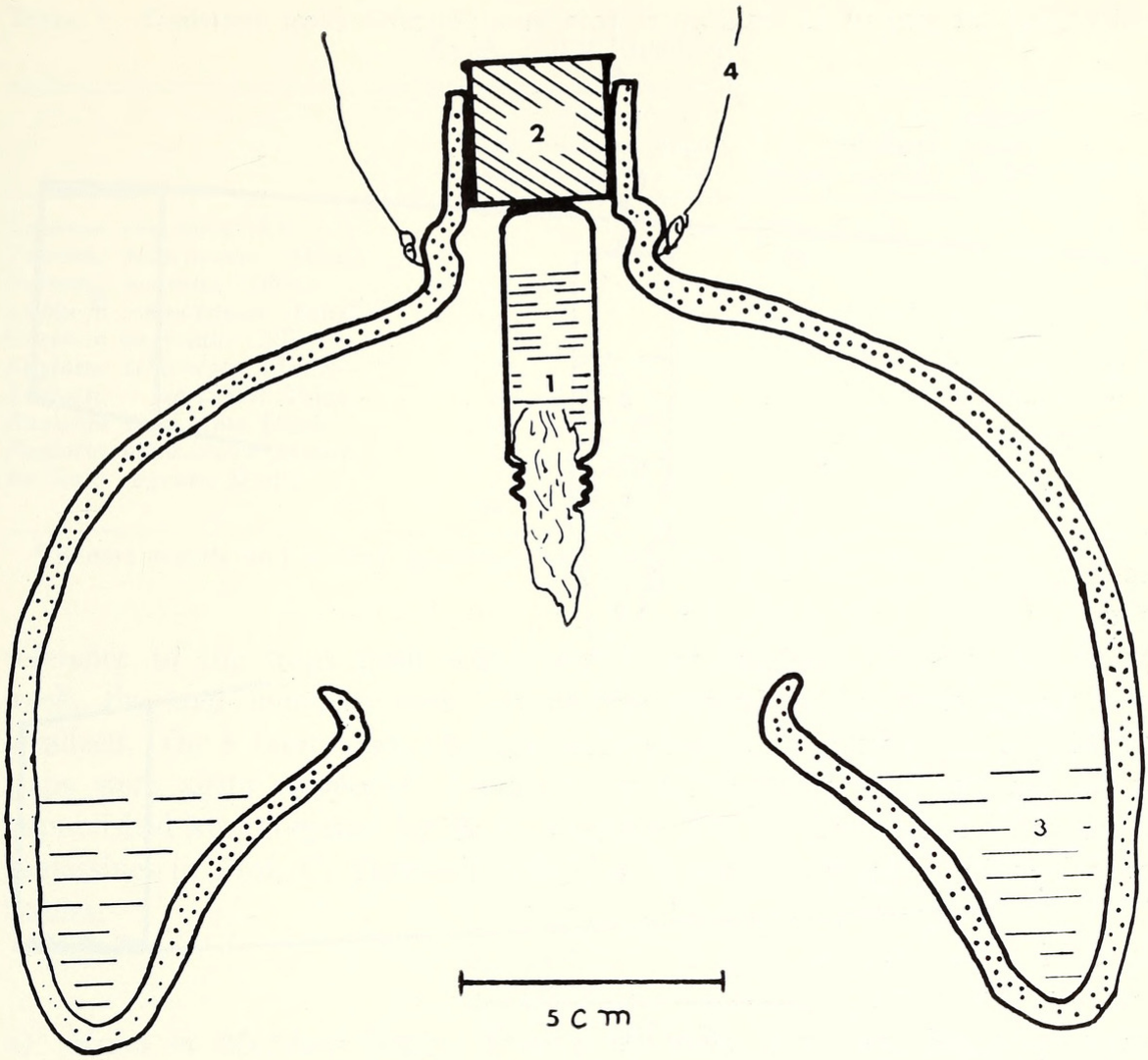

FIG. 1. McPhail Trap—Cross Section. Vial of attractant (1) with cotton wick glued or wired to rubber cork (2). Canal of trap (3) filled with water and detergent. Trap suspended by wire (4) from convenient tree.

were placed in one location and at another ca. 3 km. distance, squares of blotting paper kept moist with the same attractants were pinned to the sides of trees, and observed at frequent intervals from 8:00 A.M. to midday. Bees were netted as they were about to settle on the pads for comparison with those caught in the McPhail traps during the same period.

On a third visit to British Honduras (July 7 to 12, 1970), an experiment was set up to compare the effectiveness of the McPhail trap to the Steiner trap which is commonly used in programs of trapping Mediterranean fruitfly *Ceratitis capitata*. As the Steiner trap modified to hold a vial of essence (Fig. 2) is not designed to retain liquids, aldrin powder was dusted in the bottom of the trap to kill any bees that entered. Paired traps, i.e., one Steiner and one McPhail each baited with the same essence, were hung on

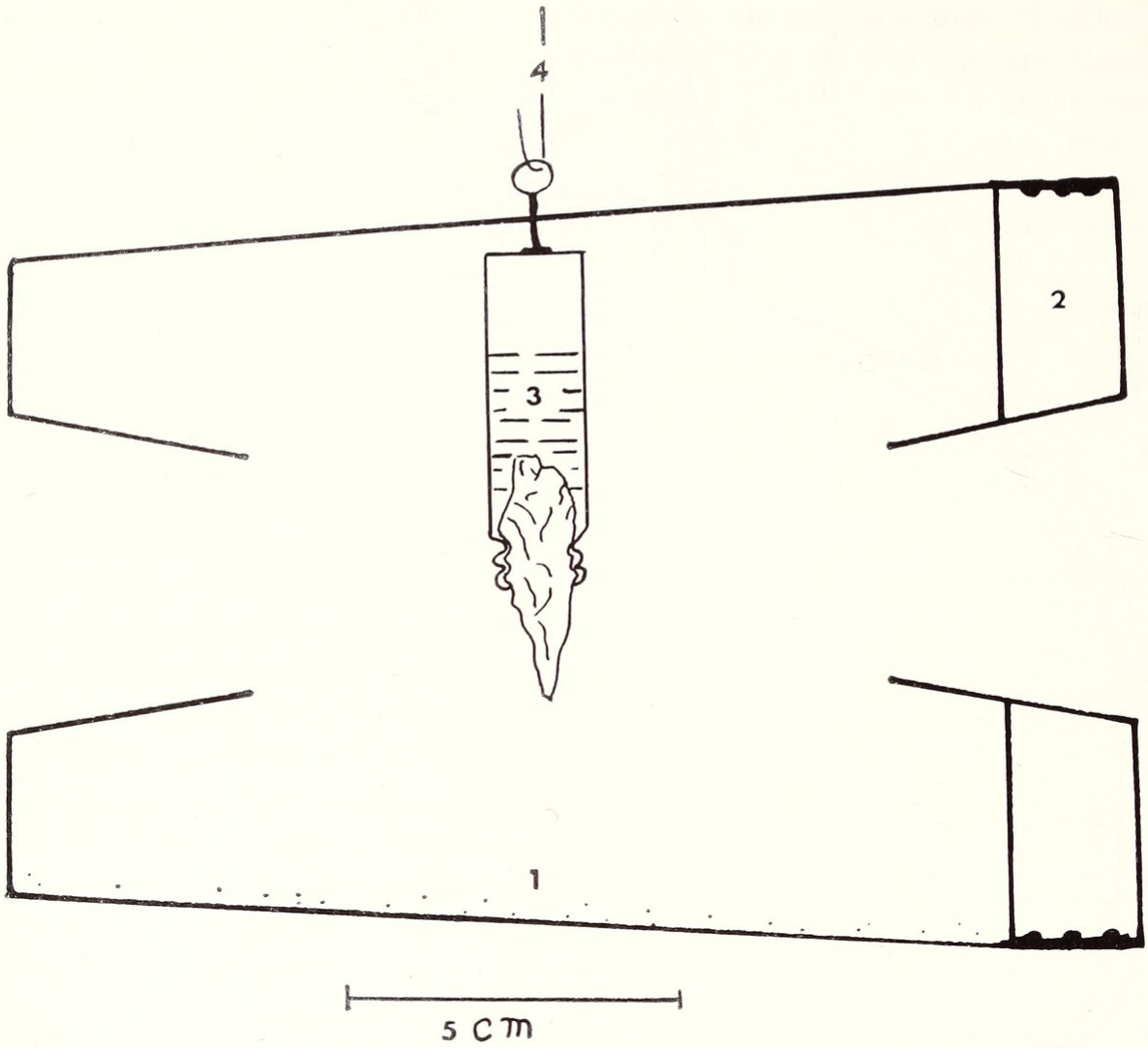

FIG. 2. Modified Steiner Trap—Cross Section. Poison sprinkled in bottom of trap (1). Removable end (2). Vial of attractant with cotton wick (3). Wire to suspend trap (4).

opposite sides of a large mango tree or on two adjacent citrus trees. The traps were interchanged every two days to offset the possibility that one site might have been more favorable than another. Dr. K. Houston kindly continued to record the trap contents until July 19, by which time most of the vials of essence were dry.

B. *For trapping females.* During the time of the visit the UWI Citrus Research Unit was operating a grid of 350 McPhail traps distributed through 7,000 acres of citrus groves. The traps baited with SIB7 are examined for fruitflies at weekly intervals. As four females of *Eulaema* spp. were collected during the first afternoon of my visit, Mr. A. Lewis, the technician who inspects the traps kindly consented to collect and save all bees found in the traps during the next fortnight. During the first week, specimens were saved without

TABLE 1. Euglossine males collected in McPhail traps, June 30 to July 12, 1969. Stann Creek, British Honduras

	1,8 cineole	methyl salicylate	eugenol	b-ionone	benzyl acetate	methyl cinnamate*	Total
Eulaema cingulata (Fab.)			2	76	3		81
Eulaema polychroma (Mocs)				20			20
Eulaema meriana (Oliv.)					1		1
Euplusia schmidtiana (Friese)	3						3
Euglossa imperialis Ckll.	3	1					4
Euglossa tridentata Moure	7					1	8
Euglossa ? variabilis Friese	3		3			13	19
Euglossa viridissima Friese	1						1
Euglossa heterosticta Moure	1						1
Euglossa cognata Moure	1	3					4
	19	4	5	96	4	14	142

* Benzyl acetate and methyl cinnamate used only from July 7 to 12.

reference to the traps from which they were obtained. During the second week, the trap numbers were recorded to determine whether catches were localized. On a later visit, October to November 1969, the contents of the traps were again examined. Specimens were identified with the aid of an unpublished key prepared by R. L. Dressler, and by comparison with named euglossines in Prof. C. Dodson's collection at the University of Miami, Coral Gables.

RESULTS

a) *Males in McPhail Traps*: During the first visit, 142 euglossine males representing 3 genera and 10 species were captured in the McPhail traps. The numbers of each species caught at the various compounds are listed in Table 1.

Of the fragrances exposed during the second visit, no euglossines were attracted to methyl salicylate, benzyl acetate, or eugenol, all compounds which had attracted species in the first experiment. Nor were bees caught in the traps baited with methyl benzoate, piperonal, b-pinene or coumarin. Two other compounds, 2-phenyl ethyl acetate and 2-phenyl ethyl alcohol, each attracted one male of *Eulaema cingulata*. The remaining traps caught 147 euglossine males (Table 2). In addition four females of *E. cingulata* were also taken, three in the trap baited with "stock" and one in the trap baited with "stock" plus ocimene.

b) *Comparison of McPhail Trap to Netting*: The results of the experiment to compare the numbers caught in McPhail traps with the number caught by netting at pads were not very conclusive. Only 11 male euglossines were captured in the McPhail traps and 14 with the net.

TABLE 2. Euglossine bees collected in McPhail traps, October 28 to November 10, 1969. Stann Creek, British Honduras

	cineole	dilute b-ionone	methyl cinnamate	skatole	"stock"	"stock" plus ocimene	Total
Eulaema cingulata (Fab.)		11		17			28
Eulaema polychroma (Mocs)		27					27
Euglossa imperialis (Ckll.)	1						1
Euglossa allosticta Moure				8			8
Euglossa mixta Friese				2	1		3
Euglossa purpurea Friese				19			19
Euglossa tridentata Moure	9				11	2	22
Euglossa ? hemichlora Ckll.						1	1
Euglossa deceptrix Moure			1				1
Euglossa ? variabilis Friese	1				7		8
Euglossa heterosticta Moure	6		4		9	3	22
Euglossa sp. indet.	1		2	1	2		6
Euglossa ? gorgonensis Cheeseman				1			1
	18	38	7	48	30	6	147

c) *Comparison of McPhail and Steiner Traps*: The results of the experiment comparing the two types of traps indicate that the McPhail trap is considerably more efficient than the Steiner trap. The specimens from the traps were determined only to genus; of the euglossines, 100 (92.6%) were caught in the McPhail traps and eight (7.4%) were taken in the Steiner traps.

d) *Other bees Captured in McPhail Traps*: In addition to male euglossines, three females of *E. cingulata* were taken in a trap baited with "stock" and one in a trap baited with "stock" plus ocimene. Non-euglossine bees were also occasionally attracted. On July 10, 1969, about 20 specimens of *Trigona* sp. entered the trap baited with b-ionone and two specimens of a second species of *Trigona* were drowned in the trap baited with methyl salicylate. Again, on November 1 *Trigona* entered the trap baited with b-ionone, over 30 individuals drowning in the water. On July 12, a female of *Ptiloglossa* sp. was captured in the trap baited with benzyl acetate. The same species was noted hovering near filter paper saturated with this compound on a different day. In July one worker of the honey bee, *Apis mellifera* (L.) drowned in the trap baited with eugenol.

e) *Capture of Females in Traps Baited with SIB7*: Females of three species of *Eulaema* and one species of *Euglossa* were present in the traps baited with SIB7.

In 1969 during a two-week period in June to July, 41 females of *Eulaema cingulata*, 10 of *E. polychroma*, one of *E. meriana*, and two of *Euglossa* sp. were captured. During a comparable period in October to November of the same year, 33 *E. cingulata* and two *E. polychroma* were taken.

DISCUSSION

There is no doubt that the McPhail trap baited with attractants is a useful apparatus for collecting euglossine males. While in a single experiment more specimens were obtained by collecting with a net at moistened pads than in the traps, the time involved was much greater and it is likely that over an extended period all of the species attracted to the pads would be taken in the traps. Compared with catches in many parts of Central America and northern South America, the daily catches either from the traps or by netting are low both in the number of species taken and the total number of adults, suggesting that the area is not ideal for collecting euglossines. They do, however, compare favorably with those obtained by Dodson et al. (1969) for nearby Guatemala where 68 specimens representing six species were collected in six days, i.e., a daily average of 11. During the three visits to British Honduras, 15 or more species of euglossines and including all of the species taken with a net at baited pads were collected in the McPhail trap.

The catches at the Steiner trap were disappointingly small and there are a number of reasons which may account for this. The entrance holes to the traps are considerably smaller, less than 4 cm. in diameter, and while the horizontal opening permits bees to alight and crawl in, the larger species can enter less freely than into the McPhail trap. Furthermore the killing agent differed, i.e., aldrin powder in the Steiner trap versus detergent and water in the McPhail trap. While there was apparently no repellent effect from the aldrin, adults did not die very rapidly and on two occasions *Euglossa* adults were observed to leave the trap after visiting the bait.

An important advantage of the McPhail traps is that they are in place throughout the entire period that euglossine males are active. Whereas it is generally accepted that the peak period of activity around baits, orchids, etc., of most species is in the morning, a smaller peak often occurs during the late afternoon. Sporadic visits may also take place during the balance of the afternoon and during this period the bees are frequently very wary and retreat if disturbed. Hence while the patroling of pads to detect the sporadic visits of bees is time consuming and may tend to frighten the bees away, the traps remain attractive and capture bees regardless of the hour they visit the essences. If data on the time that the various species are attracted are required, the traps can be inspected at hourly intervals.

The use of McPhail traps may also be preferable when comparing the relative attractiveness of various fragrances and combinations of fragrances. As stated by Dodson et al. (1969) the strong attraction of euglossine bees to specific fragrances produced by the flowers provides the necessary reproductive isolation to maintain the integrity of interfertile species of orchids. Whereas many bees are attracted to the general locality by one essence, e.g., over

70% of the euglossine species collected at fragrances were collected at 1,8-cineole yet the addition of one or two other compounds greatly reduced the number of species visiting the mixture (Dodson et al., 1969). Bees attracted from great distances by one component might approach to within a few centimeters pads containing a combination of fragrances but once in the vicinity may be repelled from actually collecting by the presence of a second less volatile component. Whereas these species might be collected by means of a net as they approached but did not settle on the impregnated pads, they might be less likely to enter the traps.

Only one male of *Eulaema cingulata* was collected at each of the two compounds phenyl ethyl acetate and phenyl ethyl alcohol. The two males were obtained on the same day, whereas on previous and on succeeding days all other males of this species were collected at skatole and/or b-ionone. The trap containing phenyl ethyl alcohol was under observation as the bee approached and entered. This trap was about 4 meters downwind from the one containing skatole and as the odor of skatole was very evident at the point of observation another three meters downwind and as the bee hovered beneath the first trap for more than one minute it could hardly have failed to detect the aroma from the skatole trap. The two males entering traps containing phenyl ethyl compounds on the same day, whereas males of this species visited the other traps on all other occasions, suggests that the requirements must vary from time to time. Dodson et al. (1969) reported that males of *E. cingulata* are attracted to at least nine compounds. Furthermore in Trinidad males of *E. cingulata* have been observed to visit in sequence three pads, each moistened with a different essence (author's unpubl. data).

McPhail traps baited with essences, if run throughout the year at the same location, should provide reliable quantitative and qualitative data on the seasonal fluctuations of populations of male euglossines, and might also indicate any seasonal shift in preference for one compound over another.

Turning to the attraction of females of *Eulaema* spp. to McPhail traps baited with SIB7, the factor triggering this response has not been ascertained. The following are possible stimuli: (a) searching for materials to construct or provision cells; (b) searching for food for their own use; (c) searching for a suitable nesting site; (d) responding to a sex attractant. The first suggestion seems the most probable. As in addition to *Anastrepha ludens* and *Eulaema* spp., the traps frequently contain several thousand adults of other insects, mainly Diptera belonging to the families Calliphoridae and Muscidae, and as the traps are emptied only once a week it is possible that odors emitted by the decomposing carcasses of these insects suggest the presence of suitable materials for cell construction. Females of *E. cingulata* are known to collect a variety of substances including human feces to construct their cells (Dodson and Frymire, 1961).

Dodson et al. (1969) when collecting male euglossines mentioned that myrcene was the only compound to which females were also attracted. During the current investigations females of *E. cingulata* were taken in traps baited with "stock" and with "stock" plus ocimene, both containing myrcene. Females collect resinous materials for lining their cells and it is surmised that the odor produced by myrcene or another component of "stock" suggested the presence of resinous materials and attracted the females. Two of the trapped females already had particles of a white resinous material on the scopae of the hind legs. Hence the same principle, i.e., the emission of odors suggesting the presence of materials suitable for cell construction, may be involved when *Eulaema* females visit traps baited with SIB7.

The wing margins of several (9 of 23 examined in November) of the *E. cingulata* females were somewhat frayed and the mandibles worn, suggesting that these individuals had been active for an extended period, whereas the wings and mandibles of the remainder being intact indicated that bees of varying ages visited the traps. Hence it seems unlikely that a sex attractant or a search for a suitable nesting site is the motive for entering the traps.

Whether the occasional *Euglossa* female enters a trap baited with SIB7 for the same reason cannot be readily ascertained. As they use predominantly resinous materials for cell construction, they may have been attracted for an entirely different reason.

Finally it would be interesting to know but difficult to determine in the absence of population data before the fruitfly trapping program commenced, whether the weekly removal of 15 or more females drastically affects the population of *E. cingulata* in the Stann Creek Valley.

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