

ECOLOGY AND TAXONOMY OF LOWER  
RÍO GRANDE VALLEY *ZETHUS*<sup>1,2</sup>CHARLES C. PORTER<sup>3</sup>Department of Biological Sciences  
Fordham University, Bronx, N.Y. 10458

## ABSTRACT

Lower Río Grande Valley populations of *Zethus miscogaster* Saussure, *Z. montezuma* Saussure, *Z. otomitus* Saussure, and *Z. aztecus* Saussure vary dramatically in abundance from year to year and within each year show some differences in monthly phenology. They are active well into winter and fly on any day when the shade temperature reaches 22°C. All visit the same rather wide range of flowers. They are Neotropical taxa which approach their northern limit in Texas. *Z. otomitus* is recorded for the 1st time from the United States.

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In a review of the Lower Río Grande Valley *Zethus* (Porter 1975b), I reported *Z. aztecus* and *Z. montezuma* as new for the United States, cited *Z. miscogaster* for the 1st time from Texas, and offered a key to all United States members of this primarily Neotropical genus. After more collecting in Hidalgo County, Texas, at the Bentsen Río Grande Valley State Park and the Valley Botanical Garden, I have obtained more specimens and ecological data on *miscogaster*, *montezuma*, and *aztecus*. I have established also the presence in south Texas of *Z. otomitus*, a species hitherto unknown north of central México.

*Zethus* are strong-flying vespoids that provision their nests, made in twigs or trunks or attached to twigs, with lepidopterous larvae. Of the 187 American species, 98 either enter or are restricted to the evergreen and deciduous forests of tropical South America (Bohart and Stange 1965:22). Middle America has 36 species, and all throughout its range *Zethus* tends to evolve forms adapted to thorn scrub or even deserts. It is thus not surprising that 4 species have reached the semiarid Lower Río Grande Valley, although remarkable that 3 of these, *miscogaster*, *montezuma*, and *aztecus*, often become abundant here at the northern limit of their range.

In this paper, I have summarized monthly and yearly phenologic records accumulated since 1973, indicated those plants most often visited by *Zethus*, and provided a 1st report on observations of daily phenology and activity temperatures commenced in 1977. Periods available for collection of Valley *Zethus* have included, in each year since 1973, 30 days in December and January, 1 week in March, 2 weeks in May, 2 weeks in June, 1 week in August, and 1 week in September, as well as 1 week each in April and November. Between 19-27 November 1977, I sampled *Zethus* every hour from 0900-1700 and separately labeled each hour's catch. From 18-31 December 1977 this technique was supplemented with maximum-minimum thermometers to record daily temperature ranges and small, portable thermometers

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<sup>1</sup> Contribution No. 411, Bureau of Entomology, Division of Plant Industry, Florida Department of Agriculture and Consumer Services, Gainesville, Fla. 32602.

<sup>2</sup> Hymenoptera: Eumenidae.

<sup>3</sup> Research Associate, Florida State Collection of Arthropods, Florida Department of Agriculture and Consumer Services, Gainesville.

to obtain hourly readings of both sun and shade temperatures at each collecting site.

#### KEY TO UNITED STATES *Zethus*

1. Third gastric sternite with a conspicuous translucent apical lamella or flange that is truncate abruptly on each side before attaining lateral margin of sternite ..... 2
- 1'. Third gastric sternite with apical flange weakly to conspicuously differentiated but not abbreviated toward lateral margin of sternite ..... 3
2. Hind margin of 2nd gastric tergite evenly convex, hardly membranous; 1 well developed mid-tibial spur; interocellar area without tubercles (Texas to El Salvador) ..... 4. *Z. aztecus* Saussure
- 2'. Hind margin of 2nd gastric tergite divided into 3 sections by translucent lateral lobes; 2 mid-tibial spurs; interocellar area with broad, more or less polished tubercles separated by a narrow line of punctures (Arizona to El Salvador) ..... *Z. guerreroi* Zavattari
3. Female clypeus mat with very minute regular longitudinal striae, as well as numerous large punctures; male flagellum rolled toward apex; mid-tibia with 1 well developed apical spur; gaster mostly red (Florida) ..... *Z. slossonae* Fox
- 3'. Female clypeus shining with strong punctures and/or coarse striations but without minute wrinkling; male flagellum hooked toward apex; mid-tibia with 1 or 2 apical spurs; gaster mostly black or in occasional specimens of *miscogaster* largely red ..... 4
4. Stem of 2nd gastric tergite definitely longer than that of 1st; notaulus weakly impressed or absent (Arizona and Texas to Argentina) ..... 1. *Z. miscogaster* Saussure
- 4'. Stem of 2nd gastric tergite definitely shorter than that of 1st; notaulus distinct over at least apical 0.5 of mesoscutum ..... 5
5. Apical propodeal lamella produced into a rounded lobe above valvula; 2 well developed mid-tibial spurs; petiole slender (Texas to Colombia) ..... 2. *Z. montezuma* Saussure
- 5'. Apical propodeal lamella scarcely distinguishable from rest of submarginal carina; only 1 well developed mid-tibial spur; petiole moderately to very stout ..... 6
6. Height of petiole markedly less than 1/2 the distance from insertion of flexor muscle to apex; 1st hind tarsomere of male narrow (Texas to Panamá) ..... 3. *Z. otomitus* Saussure
- 6'. Height of petiole equal to 1/2-3/5 the distance from insertion of flexor muscle to apex; 1st hind tarsomere of male flattened beneath and conspicuously broadened (eastern United States) ..... *Z. spinipes* Say

#### 1. *Zethus* (*Z.*) *miscogaster* Saussure (Fig. 1)

MATERIAL EXAMINED. 81 females, 104 males: Bentsen Park, Botanical Garden, Santa Ana National Wildlife Refuge.

MONTHLY PHAENOLOGY. 7 females and 3 males in January, 1 male in

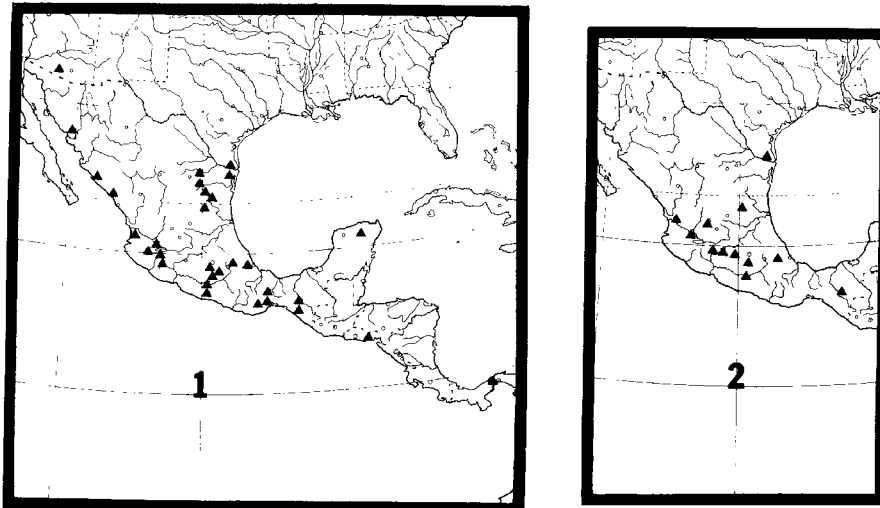


Fig. 1. *Zethus miscogaster*. Triangles indicate geographic distribution in Middle and North America. Fig. 2. *Zethus montezuma*. Triangles indicate geographic distribution in Middle and North America.

March, 1 male in May, 2 females and 1 male in June, 10 females and 24 males in August, 25 females and 21 males in September, 24 females and 35 males in November, and 10 females and 11 males in December.

**ANNUAL PHAENOLOGY.** 2 females and 3 males in 1973, 2 males in 1974, 4 females and 4 males in 1975, 20 females and 16 males in 1976, and 57 females and 77 males in 1977.

**TEMPERATURE AND DAILY ACTIVITY PERIOD.** From 20-22 November 1977, when maxima and minima in the shade were about 18-28°C and skies ranged from clear to partly cloudy, 1 *miscogaster* was taken between 0900-1000, 3 from 1000-1100, 2 from 1100-1200, 3 from 1200-1300, 6 from 1300-1400, 6 from 1400-1500, 5 from 1500-1600, and 1 from 1600-1700.

Sampling from 22-27 December, when better temperature records were kept, yielded the following data.

**22 December.** Minimum -0.6°C, maximum in shade 23°C; sky clear; 2 males from 1400-1500 (23°C shade, 37°C sun).

**24 December.** Minimum 12.9°C, maximum in shade 27.5°C; partly cloudy; 1 male from 1100-1200 (22°C shade, 29°C sun), 2 males from 1300-1400 (26.5°C shade, 39°C sun), 2 males from 1400-1500 (27.5°C shade, 32°C sun), 1 female and 2 males from 1500-1600 (22°C shade, 29°C sun).

**25 December.** Minimum 12.9°C, maximum in shade 25.5°C; partly cloudy; 1 female from 1400-1500 (25.5°C shade, 28.5°C sun).

**27 December.** Minimum 10°C, maximum in shade 22°C; partly cloudy; 1 female from 1200-1300 (22°C shade, 33°C sun).

The above data from late fall and early winter 1977 show that *miscogaster* may be active from 0900-1700 and at a shade temperature range of 22-27.5°C and at a sun range of 28.5-39°C. It flies most abundantly during early afternoon, when temperatures are highest, and normally seeks herbs, shrubs, or trees in direct sun.

## 2. *Zethus (Z.) montezuma* Saussure (Fig. 2)

MATERIAL EXAMINED. 71 females, 25 males: Bentsen Park, Botanical Garden, Santa Ana National Wildlife Refuge.

MONTHLY PHAENOLOGY. 34 females and 7 males in January, 3 females and 3 males in March, 1 male in April, 2 males in August, 3 females in September, 11 females and 2 males in November, and 20 females and 10 males in December.

YEARLY PHAENOLOGY. 3 females and 1 male in 1973, 15 females and 6 males in 1974, 28 females and 7 males in 1975, 6 females and 5 males in 1976, and 19 females and 6 males in 1977.

TEMPERATURE AND DAILY ACTIVITY PERIOD. From 21-24 November 1977, when shade minima and maxima were about 10-28°C and skies ranged from clear to partly cloudy, 1 *montezuma* was netted between 1000 and 1100, 2 from 1100-1200, 2 from 1200-1300, 4 from 1300-1400, and 2 from 1500-1600.

During the December 1977 period of hourly collection and temperature recording, this species appeared only on the 24th, a warm, partly cloudy day (minimum 12.9°C, maximum in shade 27.5°C), when 1 specimen was registered from 1100-1200 (22°C shade, 29°C sun), 1 from 1300-1400 (26.5°C shade, 39°C sun), and 1 from 1400-1500 (27.5°C shade, 32°C sun).

During November and December, *montezuma* may fly from 1000-1600 and at shade temperatures of 22-27.5°C and in a sun range of 29-39°C. Most specimens are captured in bright sun and in early afternoon when temperatures are hottest.

### 3. *Zethus (Z.) otomitus* Saussure (Fig. 3)

MATERIAL EXAMINED. 2 females: Bentsen Park, 1 female, 30-VIII-77; Botanical Garden, 1 female, 27-VIII-8-IX-73.

FIELD NOTES. My Valley *otomitus* were netted from flowers of *Baccharis* in bright sun at the edge of dense woods. I have also collected many in northeast México, mostly in deep, humid forest as they flew around the dead trunks and logs in which they were nesting. Calmbacher (1977:135-7) has described the nest of this species.

DISTRIBUTION. Bohart and Stange (1965:118) cite *otomitus* from no farther north in México than Nayarit and Veracruz, so the Valley records provide a noteworthy range extension. I have also found it common in late May and early June every year from 1974-77 in the densely forested Cola de Caballo ravine near Monterrey, México, and only 240 km west and a little south of the Valley.

### 4. *Zethus (Zethoides) aztecus* Saussure (Fig. 4)

MATERIAL EXAMINED. 25 females and 32 males: Bentsen Park, Botanical Garden.

MONTHLY PHAENOLOGY. 1 female and 1 male in January, 1 female in May, 3 males in June, 2 females and 9 males in August, 13 females and 14 males in September, 4 females and 3 males in November, and 4 females and 2 males in December.

YEARLY PHAENOLOGY. 7 females and 3 males in 1973, 1 male in 1974, 3 females and 4 males in 1975, 8 females and 21 males in 1976, and 7 females and 3 males in 1977.

TEMPERATURE AND DAILY ACTIVITY PERIOD. On 21 November 1977, I collected 3 *aztecus*, of which 1 was taken between 1000 and 1100 and the

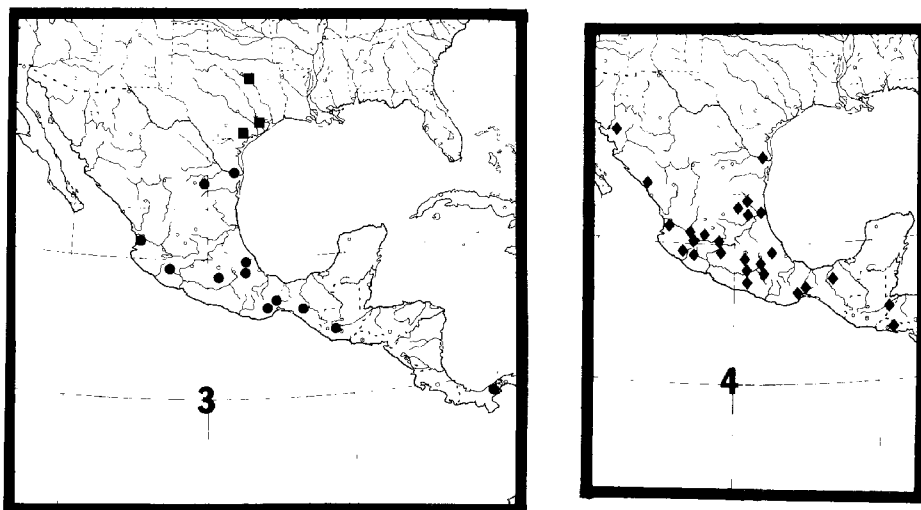


Fig. 3. *Zethus otomitus*. Circles indicate geographic distribution in Middle and North America. *Zethus spinipes*. Squares indicate geographic distribution in Texas. Fig. 4. *Zethus aztecus*. Rhombs indicate geographic distribution in Middle and North America.

other 2 from 1300-1400. The day was clear with a shade temperature range of 18-28°C.

Only 1 *aztecus* was netted during the December sampling period and this on the 31st (minimum 16.7°C, maximum in shade 25.5°C) and between 1500 and 1600, when the shade temperature was 25°C and the sun reading 27°C.

In fall and winter, *aztecus* thus may be active from 1000-1600, apparently when shade temperatures have reached at least 25°C. It almost always flies in bright sun and becomes most abundant during the warmest part of the day.

#### CONCLUSIONS

**ZOOGEOGRAPHY.** *Zethus* is a huge genus centered in tropical South American forests and thorn scrub. It also has a substantial endemic Middle American radiation plus some species in warmer parts of the Old World. Only 7 *Zethus* reach the United States, and 1 ranges north of the Mexican border area or south Florida. These wasps are well sclerotized, tolerant of bright sun and high temperatures, and seem able to fly long distances. Available information suggests that most species also can use a wide variety of caterpillars as prey. Low winter temperatures consequently may be the major factor which keeps them from invading more successfully the deserts of the southwestern United States or the Pine-Oak woods of the northeast Gulf strip.

Valley *Zethus* belong to several of the major zoogeographic patterns displayed by Neotropic biota. *Z. miscogaster* ranges from Arizona and south Texas to Argentina and pertains to a group of 6 species, in which 4 are strictly South American and 2 extend over much of South and Middle

America. Such ichneumonids as *Coccygomimus caeruleus* Brullé, *C. sumichrasti* Cresson, and *Eiphosoma dentator* Fabricius, the sphecids *Sphex servillei* Lepeletier and *Isodontia fuscipennis* Fabricius, the vespids *Brachygastra lecheguana* Latreille, and the papilionid butterflies *Papilio anchiades* Esper and *P. astyalus* Godart provide other examples of the same wide-ranging, endemically South American biogeographic category. *Z. montezuma* has been found from Texas to Colombia but pertains to a species group that ranges south to Paraguay, although centered in Middle America. The ichneumonids *Coccygomimus punicipes* Cresson (Texas to north Chile), *Conopyge* spp. (Texas to Brasil) and *Eurydacus* spp. (México to coastal Perú) furnish other examples of this northern South American and Middle American tropical pattern. In contrast, *Z. aztecus* reaches only El Salvador and forms a monotypic, predominately Middle American group but one with close relatives in South America. Ichneumonids such as *Cryptanura compacta* Cresson, *C. lamentaria* Cameron, *Lyneon leucosoma* Cameron, and *Polycyrtidea limitis* Cushman, and the sphecids *Trachypus mexicanus* Saussure follow a similar pattern. Finally, *Z. otomitus*, which ranges from Texas to Panamá, has a close relative in Colombia, while the other member of its group, *Z. spinipes*, occurs in the eastern United States from Massachusetts to Kansas and into Texas as far south as Victoria. Although *otomitus* and *spinipes* come within 350 km of each other in east Texas, they do not intergrade, so their geographic isolation may have been lengthy. This now mainly Middle and South American species group must have ranged far north into the eastern United States during warmer Tertiary times, so that the ancestor of *spinipes* survived in some Austroriparian refugium during Pleistocene glacial maxima while those populations that were to become *otomitus* retreated into México. Both remained forest adapted, and thus during interglacial expansion have not reestablished contact across the south Texas thorn scrub. Remnants of the eastern North American Neotropic biota are detectable among many groups of organisms. Forty Neotropic genera of Ichneumonidae, many with species restricted to the eastern United States, attain at least Maryland (Porter 1977:77-78). Among the Heteroptera of Connecticut, 33% of the genera show Neotropic affinities (Slater, 1974:153). The southeastern United States even has a few Neotropic reptiles, such as *Rhadinaea flavilata* Cope, *Tantilla coronata* Baird and Girard, and *Anolis carolinensis* Voigt.

PHAENOLOGY: as detailed under each species, Valley *Zethus* follow a uniform daily phaenologic regimen. They begin to fly when the shade temperature is 22C and the sun temperature 27C and during the cooler months peak in early to mid afternoon and rarely appear before 1000 or after 1600. All 4 species are thermophilic, but *miscogaster*, *montezuma*, and *aztecus* easily survive light frosts, as shown by their continued presence in December and January. I do not have quantitative data on their daily flight periods in summer, but they seem most abundant from 0900-1200 with less activity after 1300, when shade temperatures attain 34-35C.

Valley *Zethus* show substantial differences in monthly phaenology, as summarized in Table 1.

*Z. miscogaster* peaks between August and December with maximum abundance in November. The November figure is significant because I collected in the Valley during that month only in 1977; whereas the data for May, June, August, September and December derive from 1973-77 and

TABLE 1. MONTHLY PHAENOLOGY OF *Zethus* SPECIES FROM THE LOWER RIO GRANDE VALLEY.

Species	Jan.	Mar.	Apr.	May	June	Aug.	Sept.	Nov.	Dec.
<i>Z. miscogaster</i>	10	1	-	1	3	34	56	59	21
<i>Z. montezuma</i>	41	6	1	-	-	2	3	13	30
<i>Z. otomitus</i>	-	-	-	-	-	2	-	-	-
<i>Z. aztecus</i>	2	-	-	1	3	11	27	7	6
Total specimens/ month	53	7	1	2	6	49	86	79	57
Total specimens collected:	340								

those for January and March from 1974-77. *Z. aztecus*, always less common than the preceding, has a comparable cycle but reaches greatest abundance in September, and is relatively rare by November. *Z. otomitus* has been collected in the Valley only in August but is common near Monterrey, México in late May and early June. *Z. montezuma* is strongly invernial, with 74% of the specimens taken in December and January. Thus, although all 4 Valley *Zethus* may coincide at certain times of the year, each species has a different peak. When we know more about prey preferences and nesting habits, we may find that this temporal displacement helps reduce competition for resources such as prey or nesting sites, particularly since all species frequent the same habitats. However, *Z. montezuma*, whose optimum flight period is most out of phase with its congeners, also differs from them in being smaller (average length to apex of tergite 2 about 11-13 mm in *miscogaster* and *aztecus* and 9-11 mm in *montezuma*), and this size difference alone should eliminate spatial and trophic conflicts.

Valley *Zethus* also fluctuate in numbers from year to year, as documented in Table 2.

Yearly population density fluctuations of the type noted above are normal for most Valley insects. Probably they result from the region's unstable climate characterized in winter by occasional killing frosts and at any season by droughts which often last 2-3 months. Under these conditions, few species can be equally abundant from year to year, and some of those

TABLE 2. ANNUAL PHAENOLOGY OF *Zethus* SPECIES FROM THE LOWER RIO GRANDE VALLEY.

Species	1973	1974	1975	1976	1977
<i>Z. miscogaster</i>	5	2	8	36	134
<i>Z. montezuma</i>	4	21	35	11	25
<i>Z. otomitus</i>	1	-	-	-	1
<i>Z. aztecus</i>	10	1	7	29	10
Total specimens/yr.	20	24	50	76	170

with strong dispersal powers may disappear from the Valley, only to be renewed in favorable periods from the more diverse and stable communities that occupy the lush eastern slopes of the Sierra Madre Oriental in nearby México.

**HABITAT PREFERENCES AND PLANT ASSOCIATIONS:** Valley *Zethus* occur in all environments from open fields with scattered shrubs to dense gallery woods but almost always are found in direct sun. The species visit a variety of plants, where they feed on nectar of flowers, honeydew, or seek twigs suitable for nesting. All species seem to have about the same range of habitat and plant preferences, some of which are discussed in the following list of plants with which I have found Valley *Zethus* most consistently associated.

*Acacia farnesiana* L. (Leguminosae). Occasional *Zethus*, particularly *miscogaster*, fly around this shrub at almost any season. The flowers, which appear mostly in spring, attract a few *montezuma* but are not regularly visited by other *Zethus* species.

*Acacia greggii* A. Gray (Leguminosae). The flowers of this shrub, which appear sporadically in winter and last through spring into early summer, consistently attract *miscogaster*, *montezuma*, and *aztecus*.

*Prosopis juliflora* DC. (Leguminosae). In spring and early summer the flowers of this shrub are visited by an occasional *Z. montezuma* but are not commonly frequented by any *Zethus*.

*Serjania* sp. (Sapindaceae). I have swept a few *Z. montezuma* from this ubiquitous vine.

*Condalia obovata* Hook (Rhamnaceae). During November-January some specimens of this shrub become very attractive to *Z. miscogaster*, *montezuma*, and *aztecus*. At this season, *C. obovata* often is the best source of *Zethus* but during the rest of the year is not especially productive.

*Bumelia* sp. (Sapotaceae). Like *C. obovata*, this shrub may be visited by many *Zethus* during late fall and winter.

*Labiatae* (unidentified species). This small, white-flowered, scarcely aromatic mint carpets the forest floor in many areas of the Bentsen Park and Valley Botanical Garden. During fall and winter specimens in bright sun may attract numerous *Z. miscogaster* and *montezuma*.

*Aster spinosus* L. (Compositae). Numerous *Z. miscogaster* were netted from the flowers of this tall, green-stemmed herb during November 1977.

*Aster* sp. (Compositae). This brownish-stemmed species also attracted many *miscogaster* in November 1977.

*Baccharis* spp. (Compositae). At least 2 species of these shrubs grow in the Valley. When they are in bloom, from late August to November, they attract multitudinous *Zethus* and other aculeates. This is the only plant visited by all 4 Valley *Zethus* and the one which consistently has been most productive.

All Valley *Zethus* show about the same floral associations, which vary seasonally according to which species are blooming or covered with honeydew. Shrubs and small trees are the favored plants, and I have collected *Zethus* most often in the 2-4 m stratum of Valley woodlands, although during late fall and winter I have often taken *miscogaster* and *montezuma* from small labiates only 150-300 mm above the ground.



## COLLECTIONS

Material covered in this study has been deposited in the Florida State Collection of Arthropods (Division of Plant Industry, P.O. Box 1269, Gainesville, Fla. 32602) and in the author's private collection at 301 N. 39th Street, McAllen, Texas 78501.

## ACKNOWLEDGMENTS

My Valley fieldwork has been supported in 1976-1977 by United States National Science Foundation Grant DEB-75-22426 and during 1973-1975 by grants from the Committee for Research and Exploration of the National Geographic Society. Collecting permits for Bentsen Park were issued by the Texas Parks and Wildlife Department (current permit number 1-78), and Mrs. Vivian Thacker and Mr. A. R. Baker of McAllen, Texas, have facilitated fieldwork in the Valley Botanical Garden. Mr. Anthony F. Cerbone of Fordham University ably assisted me during some of the fieldwork involved in this project.

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FIREFLY FLICKER FUSION FREQUENCY.—(Note). Flicker fusion for an adult female of *Photuris versicolor* (complex) (Coleoptera: Lampyridae) was found to occur at 41.6 and 45.4 flickers per second in 2 successive trials on the same insect. The stimulus had an absolute energy level of 0.602 microwatts per square centimeter and a peak intensity at 550 nanometers. The insect had been allowed to dark-adapt for 45 minutes before testing. Equipment and technique were those used by H. R. Agee (1971, Ann. Ent. Soc. Amer. 64:942). The test animal, captured as a larva, eclosed 11 days prior to the study. It has been deposited with Dr. J. E. Lloyd, Department of Entomology and Nematology, University of Florida. I thank Drs. H. R. Agee (U.S.D.A.), J. E. Lloyd (Univ. Fl.), and J. C. Davis (U.S.D.A.) for their assistance and use of facilities.—R. M. Merkhofer, Department of Botany, University of Florida, Gainesville 32611.