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Crepuscular Mating Aggregations in Certain *Ormia*¹ and *Sitophaga*¹

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ABSTRACT

The tachinid species *Ormia dominicana*, *Ormia lineifrons*, and *Sitophaga aurigera* were observed to aggregate atop 2 towers in central Florida shortly after sunset. The activity period for each species was brief, and that of *O. dominicana* was temporally separated from that of *S. aurigera*. Aggregations occasionally exceeded 100 individuals of a species and were predominantly com-

posed of males. Although no matings were seen, it is presumed that this behavior facilitates mating. The behavior of these flies was typical of insects at a waiting station. *Eucelatoria rubentis* and the anthomyiids *Pegomyia affinis* and *Pegomyia gopheri* were occasionally collected from the towers.

Series of ♂ tachinid flies have frequently been reported in collections from hill and mountain tops (Chapman 1954, Dodge and Seago 1954). Male aggregative behavior has been described for parasitic Oestridae (Catts 1964) and Cuterebridae (Catts 1967, Hunter and Webster 1973). Males are localized around physical prominences like the waiting stations of Downes (1969). Haddow and Corbet (1961) report swarming behavior of mosquitoes and tabanids above a high tower in East Africa.

We have observed aggregative behavior on towers in central Florida for 3 species of Tachinidae: *Ormia dominicana* Townsend, *Ormia lineifrons* Sabrosky and *Sitophaga aurigera* Coquillett, and one species of Anthomyiidae: *Pegomyia gopheri* Johnson. Both *Ormia* species have been rarely collected, usually at blacklights. Sabrosky (1953) notes that some adult *Ormia* are nocturnal and parasitize adult Orthoptera.

Procedure.—Observations of fly activity and weather were made on 21 different days in early 1972 and 1973. Observation was started at or slightly before visual sunset. Sunset times were calculated using almanac charts. The 2 study sites were on the Archbold Biological Station, 8 mi S of Lake Placid, FL at long. 81°20'32"W, lat. 27°11'24"N. The primary site was a water tower 34.4 m high. It is 24.4 m to the base of the bulb of the tower and surrounding vegetation has an average maximum height of 16 m. The 2nd site was a fire tower on the same station 32 m high; the vegetation around it averaged 19 m. The vegetation is characterized by slash pine—turkey oak, sand pine, and scrubby flatwoods communities.

RESULTS

Four species of tachinid flies and one anthomyiid species were collected from the water tower site. *O. dominicana* was observed and collected on 20 of 21 days during March 1972 and January to June 1973. It was the most abundant species with estimated aggregations of over 100 individuals on several dates

in late March 1972, and on June 27, 1973. Sixty-two specimens were collected at the fire tower site on March 23, 1972. *O. lineifrons* was present on 8 (38%) of the observation periods, and its abundance rarely exceeded 25 individuals. *S. aurigera* was not observed during 1972, but this was probably due to its earlier activity period (Table 1). It was seen on 7 of 10 dates in 1973. Peak abundances of about 30 occurred on the June 1973 dates. One specimen of *Eucelatoria rubentis* Coquillett was collected on Jan. 7, 1973. A single *Pegomyia affinis* Stein was caught on March 29, 1972. Approximately 20 *P. gopheri* were observed on June 11, 1973. Again, earlier activity periods and their smaller size may account for the infrequent observations of the anthomyiid species. The remainder of this paper focuses on the 2 *Ormia* species and *S. aurigera*.

Individual flies behaved like members of a waiting station group. A fly perches on the tower surface and flies out to investigate other flying individuals. The flight may include apparent attempts to clasp other flies. After a short flight period the fly lands again on the tower. These flights are repeated often and appear to be directly proportional to the number in the aggregation. The aggregation invariably forms on the leeward side of the tower if there is any breeze. A wind of more than 10 mph inhibits activity. No gross differences in behavior have been observed for any of the species. The activity period is relatively short, rarely lasting more than 20 min, and is closely correlated with sunset. The aggregative period of *O. dominicana* follows sunset and shifts seasonally with changing day length (Fig. 1). The mean duration between sunset and the initiation of activity is 14.7 ± 3.7 min with an active period of 12.8 ± 4.1 minutes. None of the species was observed at dawn on the few occasions when the tower was searched.

The activity periods of *S. aurigera* and *O. dominicana* are separated temporally (Table 1). *S. aurigera* arrives at higher light intensities, sometimes preceding sunset, and leaves the site usually before *O. dominicana* arrives. *P. gopheri* was observed earlier than *S. aurigera* with a considerable time overlap. *Ormia lineifrons* seemed to have roughly the same activity period as *O. dominicana*. However, there may be a partial spatial separation. On 3 different

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Table 1.—Temporal separation of aggregation behavior of 2 tachinid species.

Date	Time of sunset	Activity period (EST)		Interval between species (min)
		<i>Sitophaga aurigera</i>	<i>Ormia dominicana</i>	
Jan. 1	1741	1755-1756	1800-1808	4
Jan. 7	1746	1750-1758	1758-1806	0
Feb. 5	1809	1805-1815	1818-1835	3
April 18	1850	1900-1910	1907-1923	-3
April 19	1851	1900-1909	1911-1922	2
June 11	1920	1910-1936	1938-1948	2
June 27	1924	1921-1938	1939-1950	1

dates *O. lineifrons* was observed at the top of the tower only, while *O. dominicana* was restricted to the base of the bulb. This may be due to different flight abilities under different wind conditions.

Of 209 specimens identified as *O. dominicana*, only 7 (3.3%) were female. None of 58 *O. lineifrons* and 12 *S. aurigera* was female. No copulations were observed in the aggregations by any of the species.³

³R. D. Fell observed 3 copulating pairs of *S. aurigera* in early April, 1976.

DISCUSSION

We believe that the behavior described constitutes mating aggregations in these species. Individual behavior is similar to that described for oestrid (Catts 1964) and cuterebrid (Catts 1967, Hunter and Webster 1973) males on hilltops. It fits the basic category of a waiting station. Downes (1969) views this as a reduction of swarming behavior where the substrate serves as a swarm marker. The aggregating individuals perch for various percentages of the active time on the substrate. It is not unusual to find few females in such aggregations. Females are detected and mated quickly and leave the aggregation afterwards. The same males may return repeatedly, yielding an apparently skewed sex ratio; we did not mark individuals to check this. The attempted clasplings may have been unsuccessful mating tries, perhaps incorrectly directed at other males (McAlpine and Munroe 1968). Wood (pers. com.) feels that tachinid species, where the male has a narrower frons than the female, are aggregating species. Males of both *Ormia* species have a much narrower frons than the females; ♂ *S. aurigera* have a slightly narrower frons than females. Parasitic species that have relatively low population densities and unpredictable emergence sites might have a more efficient mating system if it

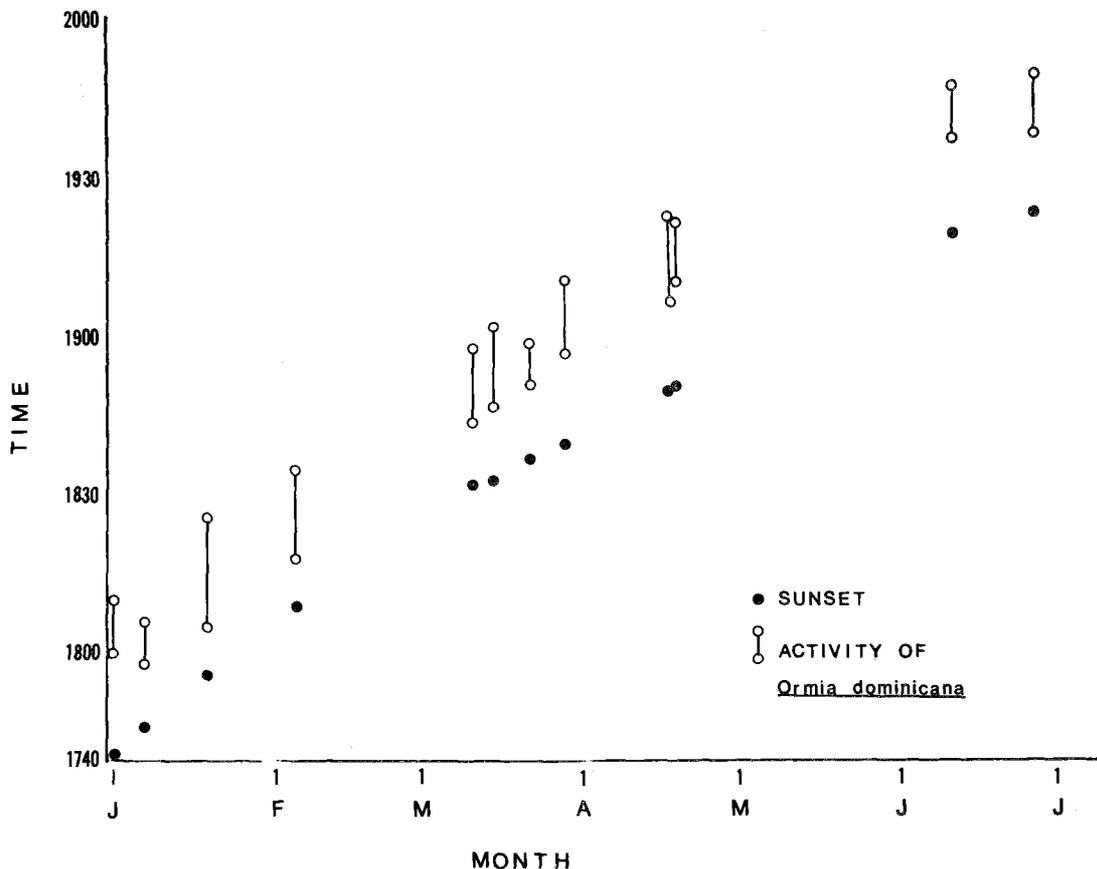


FIG. 1.—Aggregative behavior of *Ormia dominicana* relative to sunset.

were tied to prominent topographic features (Shields 1967). Man-made structures may serve as such sites as well as hilltops and treetops.

Swarming activities often are restricted to a limited range of light intensities (Wright et al. 1966). Haddow and Corbet (1961) show that the onset of swarming may be triggered by the rate of change of light intensity as well as by light intensity at the sky's zenith. Cessation of activity after sunset may be due to a threshold below which visual acuity is insufficient to maintain the activity. Haddow and Corbet (1961) also document much greater swarming activity of mosquitoes after sunset than before sunrise. Lower ambient temperatures at dawn may restrict swarming at this time. The fact that we did not observe either *Ormia* or *Sitophaga* at dawn may be due to the infrequency of activity except on particularly favorable mornings, or a restriction of activity to the sunset period.

It is interesting that *O. dominicana* and *O. lineifrons* are not among insects collected at light traps at the Archbold Biological Station (Frost 1964, 1966), although this is the way most previous collections were made. Frost collected *Ormia ochracea* Bigot from November to April. We collected 2 specimens at a blacklight at the station in March 1972 while the observations were being made, yet none were collected on the towers. Cade (1975) has demonstrated that ♀ *O. ochracea* orient to cricket songs and larviposit on crickets. This nocturnal behavior might increase the chance of collecting individuals at blacklights. The host relationships of *O. dominicana* and *O. lineifrons* are unknown. Frost (1964) lists one collection date in March for *S. aurigera* and 2 in January for *E. rubentis*.

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were made. This research was supported in part by NSF grant GB 3369, Reproduction in Honey Bees, which clearly has nothing to do with the subject of this paper; while in Florida undertaking research with honey bees we happened upon the phenomenon reported here and thought it worthy of further study.

REFERENCES CITED

- Cade, W. 1975. Acoustically orienting parasitoids: fly-phonotaxis to cricket song. *Science* 190: 1312-3.
- Catts, E. P. 1964. Field behavior of adult *Cephenemyia* (Diptera: Oestridae). *Can. Ent.* 96: 579-85.
1967. Biology of a California rodent botfly *Cuterebra latifrons* Coquillett (Diptera: Cuterebridae). *J. Med. Entomol.* 4: 87-101.
- Chapman, J. A. 1954. Studies on summit-frequenting insects in western Montana. *Ecology* 35: 41-9.
- Dodge, H. R., and J. M. Seago. 1954. Sarcophagidae and other Diptera taken by trap and net on Georgia mountain summits in 1952. *Ibid.* 50-9.
- Downes, J. A. 1969. The swarming and mating flight of Diptera. *Annu. Rev. Entomol.* 14: 271-98.
- Frost, S. W. 1964. Insects taken in light traps at the Archbold Biological Station, Highlands County, Florida. *Fla. Entomol.* 47: 129-61.
1966. Additions to Florida insects taken in light traps. *Ibid.* 49: 243-51.
- Haddow, A. J., and P. S. Corbet. 1961. Entomological studies from a high tower in Mpanga Forest, Uganda. V. Swarming activity above the forest. *Trans. Roy. Entomol. Soc. London* 113: 284-300.
- Hunter, D. M., and J. M. Webster. 1973. Aggregation behavior of adult *Cuterebra grisea* and *C. tenebrosa* (Diptera: Cuterebridae). *Can. Entomol.* 105: 1301-7.
- McAlpine, J. F., and D. D. Munroe. 1968. Swarming of lonchaeid flies and other insects, with descriptions of four new species of Lonchaeidae (Diptera). *Ibid.* 100: 1154-78.
- Sabrosky, C. W. 1953. Taxonomy and host relations of the tribe Ormiini in the western hemisphere (Diptera, Larvaevoridae). *Proc. Entomol. Soc. Wash.* 55: 167-83.
- Shields, O. 1967. Hilltopping. *J. Res. Lepid.* 6: 69-178.
- Wright, J. E., K. D. Kappus, and C. E. Venard. 1966. Swarming and mating behavior in laboratory colonies of *Aedes triseriatus* (Diptera: Culicidae). *Ann. Entomol. Soc. Am.* 59: 1110-2.