the 4th day, 5 on the 5th day, and 5 on the 6th day after the blood meal. None of the eggs from these rafts hatched, nor from 5 other rafts obtained from a different lot of mosquitoes after chicken feedings.

The egg rafts, examples of which are shown in figure 1-a were about 2.0–2.5 mm. in diameter and bowl-shaped. Some of the rafts were almost perfectly round; others were oval, with one side incomplete. The bottom contours of the rafts were strongly rounded so that only the centrally located eggs were in contact with the water surface, those on the margin and submargin being entirely out of the water (fig. 1-b). Each raft contained about 100 eggs (2 average-sized rafts consisted of 85 and 102 eggs respectively). Individual eggs (fig. 1-c) were about 0.84 mm. long and 0.22 mm. wide at the greatest point. Some had begun to collapse when the photographs were taken, probably because these eggs were infertile.

Successful colonization of this mosquito would be an important contribution to encephalitis workers, for then more critical and complete biological and disease transmission studies could be conducted than are possible when only occasional wild-caught specimens are available. It is hoped that this article will stimulate further investigation of *C. melanura* which may lead to its successful colonization. The authors would appreciate notification by field collectors when large numbers are encountered so that specimens may be obtained for additional laboratory work.

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THE NON-BLOOD FEEDING HABITS OF *AEDES TAENIORHYNDUS* (DIPTERA, CULICIDAE) ON SANIBEL ISLAND, FLORIDA

JAMES S. HAEGER [1]

The feeding of mosquitoes on nectar-producing plants was reviewed by Howard, Dyar and Knab (1912), and more recently by Hocking (1953) whose extensive observations in the Arctic are an exception to the more or less casual observations reported elsewhere in the literature. Such feeding of salt-marsh mosquitoes has not so far been reported beyond the observation of Smith (1904) on *Aedes sollicitans* in New Jersey: "I have seen both sexes of this species feeding in the blossoms of wild cherry and it is quite probable that vegetable juices form a considerable element in the food of this species" (p. 203).

FIELD OBSERVATIONS. Although *Aedes taeniorhynchus* has been closely studied in Florida since 1948, it was not until the spring of 1953 that feeding on nectar was

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observed. On the evening of April 24 while observing a brood recently emerged on Sanibel Island, it was noticed that many of these mosquitoes were among the tender branch tips of buttonwood (*Conocarpus erectus*), a small tree of salt-marsh and mangrove swamp edges in south Florida. The mosquitoes were crawling and probing on twigs with new leaves, especially about the leaf petioles. They seemed to be feeding on nectar secreted by extrafloral glands on the petioles. The presence of such glands was verified the following day by microscopic examination. On the same night mosquitoes were found feeding on the flowers of black mangrove (*Avicennia nitida*). Both sexes were present and there were as many as 8 or 10 per flower head and several times two were feeding simultaneously on a single flower only 5 mm in diameter. Feeding was further observed on Spanish needle (*Bidens* sp.), not on the flowers present but on green aphid honeydew on the leaves. These observations of April 24 initiated a three-month series of observations, at all times of the day and night on various dates.

Wesenberg-Lund (1921) was the first to mention that mosquitoes in nature often were found with the abdomen swollen by a clear fluid. Nielsen and Greve (1950) used this observation in determining at what time the mosquitoes were feeding. The species these Danish observers studied were rather large and it was easy to observe the clear fluid in the abdomen. In *Aedes taeniorhynchus* this is considerably more difficult, but in both sexes it was possible to see if they had fed on nectar by placing a flashlight at arm's length with the light directed at an angle towards the observer through the abdomens of mosquitoes resting on foliage of shrubs. Those containing nectar or honeydew will, under these circumstances, appear to be clear with the abdomen swollen. Females with ovaries filled with large eggs will also have the abdomen swollen but they will appear opaque or yellowish-green.

FEEDING AND WEATHER. Larsen (1948) found nectar-feeding of mosquitoes to be influenced especially by humidity and wind, but most of her observations were made during adverse cold-weather conditions. In Florida, weather factors usually were of little importance to the flower visits of the salt-marsh mosquitoes, but one observation on the behavior of both sexes feeding on buttonwood flowers during a heavy summer shower should be noted. For a while the feeding adults continued to take nectar heedless of the rain, but when the rain drops became larger and more numerous the mosquitoes proceeded to walk to the cover afforded by leaves and stems. They stayed there motionless until the rain was over and then crawled back to the flowers again to resume feeding and, needless to say, the nectar was quite diluted by this time and they did much probing around before they fed.

MAIN NON-BLOOD FOOD SOURCES. Flower nectar was by far the most important source of sweet food. From April to July on Sanibel Island many flowering plants produce large amounts of nectar. Beekeepers in southern Florida often obtain 150 to 200 pounds of honey per hive per season from flowers growing in or adjacent to salt marshes. The most important plants for mosquito nectar-feeding and their flowering times are as follows:

Plant Species	Months of Flowering J. F. M. A. M. J. J. A. S. O. N. D.
Bidens sp.	———
Serenoa repens (saw palmetto)	———
Conocarpus erectus	———
Coccolobus uvifera (sea grape)	———
Avicennia nitida	———
Sabal Palmetto (cabbage palm)	———

This phenology is for Sanibel Island. Variations in temperature and rainfall for each locality on the Florida coastline result in different phenologies. Thus on Sanibel Island the saw palmetto is still in bloom when the cabbage palm first flowers, whereas at Vero Beach palmetto blooming is over one to three weeks before the palm begins.

Honeydew secreted by aphids is next in importance to flower nectaries as a mosquito food source, although it is much inferior in number of visits.

Leaf petiole nectaries were, as mentioned, found on buttonwood, a salt-marsh transition zone tree. Male swarms of *Aedes taeniorhynchus* are often found over the tops of these shrubby trees. Nectar from the petioles is produced only during the night and early morning. This tree also produces abundant flowers during most of the year except in the wintertime, and thousands of males and females have been observed feeding both night and day on the flowers on numerous occasions. There are two types of perfect flowers borne on separate trees, some with long stamens and others with short stamens. The trees bearing the long-stamened flowers are most often frequented by mosquitoes and have a most distinct honey odor, whereas the flowers of short-stamen type trees are not as strong scented. Only the trees with short-stamened flowers produce seed.

FEEDING TIME IN RELATION TO DAILY ACTIVITY. Previous workers have reported that nectar-feeding in mosquitoes is not equally distributed over the twenty-four hours. Larsen (1948), observing species of *Aedes* and *Culex* feeding on the flower heads of *Tanacetum vulgare* in Denmark, found a maximum activity in morning and evening during daylight hours; Nielsen

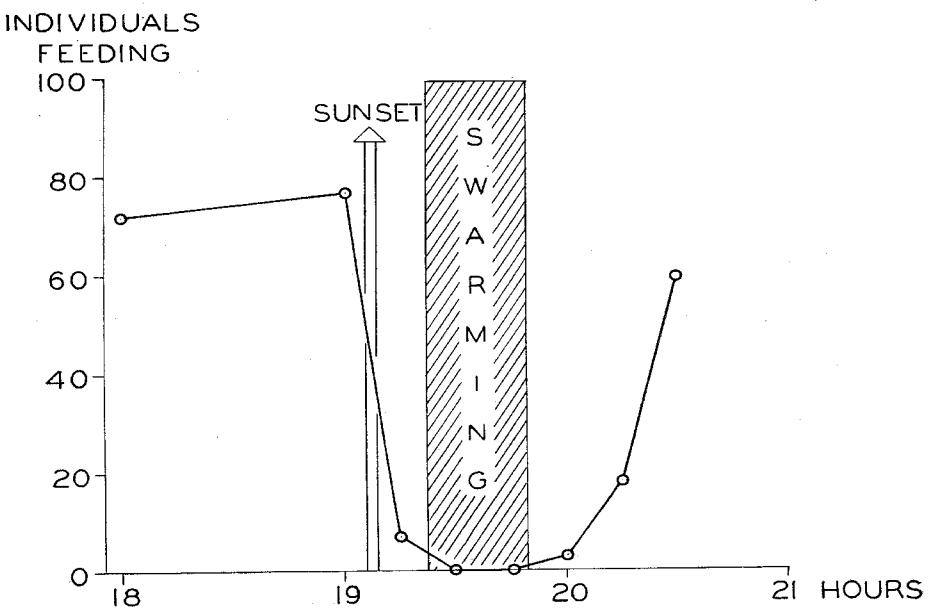

FIG. 1.—Number of *Aedes taeniorhynchus*, both sexes, observed feeding on sweets around sunset. The figures are means for the four days, May 24–27, 1953. Brood 2.

and Greve (1950) found that feeding took place before the evening swarms at dusk and after the morning swarms at dawn. In *Aedes taeniorhynchus* it was also found that there were main feeding periods, both during the daylight and dark hours. In the general population not newly-emerged the daily sequence was as follows. In the middle of the day, between 1100 and 1500, mosquitoes were never found feeding, but between 1600 and 1700 there were many on the food sources. Around sunset there was a very sudden decrease, and during the period of male swarming (from about 15 to 40 minutes after sunset) not a single mosquito of any sex was feeding. Four of the several observations at this time of day are represented in Figure 1. When the swarming period was over, feeding started again and went on for several hours. During the middle of the night, from about 2300 to 0300, few were feeding and these were mostly males, but there was never a complete cessation as at midday. In the morning (Figure 2) there was usually a small increase in the number of feedings before all feeding stopped, again, during the morning swarming of the males. After that there was a very sharp rise in feeding during sunrise, and feeding persisted until 0900 or 1100 (Figure 3).

Most of the observations on feeding were made on two distinct broods, one of them emerging in the last part of April and the other in the last part of May. In both cases it was found that the flower visits were observed in abundance for the first ten days of the brood, after which there was a sharp decline in feeding and many flowering plants had to be searched to find any nectar-feeding mosquitoes. There seemed still to be a very large population of mosquitoes at that time and the decrease in nectar feeding appeared not to reflect a decrease in population.

The large emergence of May 21–22 took place in a black mangrove swamp con-

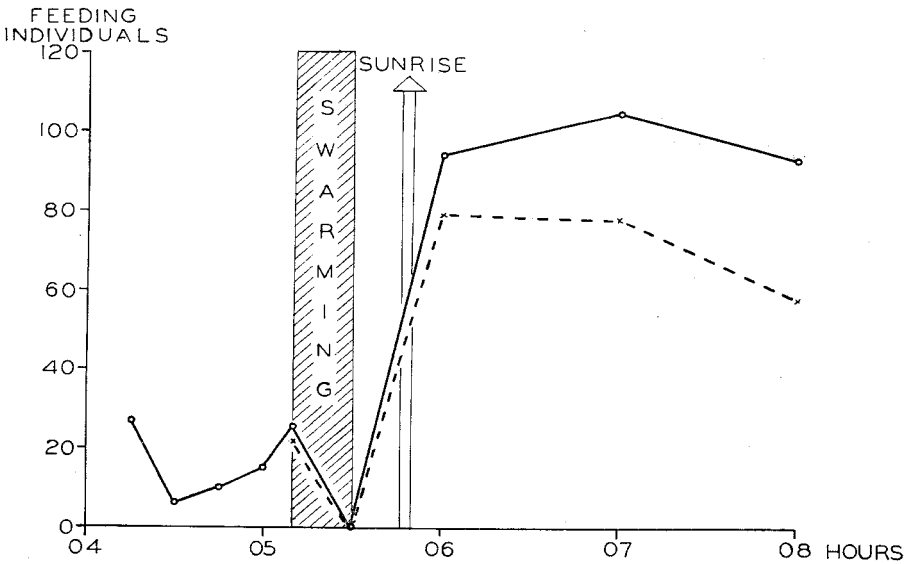

FIG. 2.—Number of *Aedes taeniorhynchus*, both sexes, observed feeding on sweets around sunrise. The solid line is for April 30, 1953 and the broken line for the mornings of May 3 and May 5, 1953. Brood 1.

taining a large area of dead trees beneath which were patches of the saltwort (*Batis maritima*). Adults had been emerging since early morning and when observations were being made at 1500 thousands of adults, both male and female, were ravenously feeding on the flowers of small black mangrove trees. This feeding continued toward evening and sunset. By 1900 they were not only feeding at low levels but also on trees 18 to 24 feet above the marsh. All flower heads at this height were covered and hundreds of mosquitoes hovered over the clusters. They continued to feed right up to the time of exodus, between 1920 and 2045, and many matings took place as they left the flower heads. There was in this case, of course, no question of male swarming period since this swarming occurs only after the migration (Nielsen and Nielsen 1953).

OBSERVATIONS ON OTHER SPECIES. During the course of this study four other species of mosquito were seen feeding at night between 2000 and 2400 and one species at about 1600 in the afternoon. One male of *Aedes sollicitans* was found feeding on honeydew of green aphids covering the leaves of *Bidens* at 2030 on April 25. Again on April 30, 2 male *sollicitans* were seen on honeydew of aphids and 3 females on *Bidens* flowers. On July 2, 2 male *Psorophora howardii* were found feeding on the flowers of buttonwood at 2040. This is the first nectar-feeding record for this species. On the night of April 30, 3 males and 2 females of *Anopheles atropos,* 5 males and 1 female of

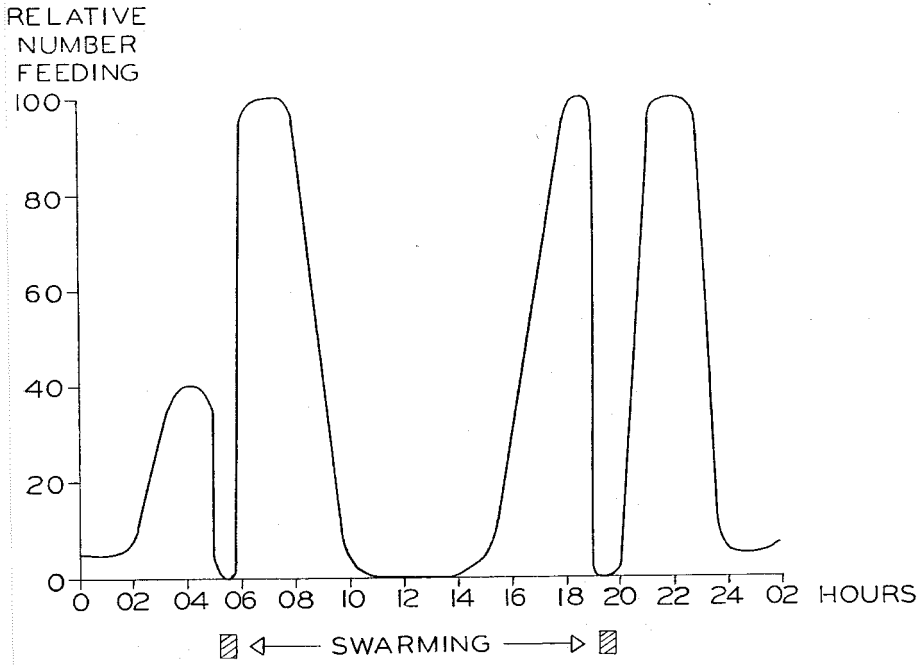

FIG. 3.—The daily cycle of sweet feeding activity in *Aedes taeniorhynchus.* The relative number is an approximation based on all observations and has no numerical value.

Culex nigripalpus were observed feeding on honeydew on the same plants with *Aedes sollicitans*. On May 27, 4 males and 1 female *Culex nigripalpus* and 2 male *Anopheles atropos* were again found feeding, same location as above, on aphid honeydew on leaves of *Bidens*. Finally, a fifth species, 1 female of *Psorophora ferox*, was observed feeding on the flowers of buttonwood at about 1600 on August 4.

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AN EASILY CONSTRUCTED RACK FOR MASS STAINING ONE HUNDRED MALARIA SLIDES

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A rack for mass staining at least 100 malaria slides or any other kind of slides can be easily made from an ordinary cardboard-covered, wooden-framed slide box made to hold 100 slides in two columns of 50 slides each. There are several sizes of such slide boxes. The smallest one, measuring about 7½ inches wide and 8¾ inches long, was selected for this rack, although the larger sizes may also be used.

First, the two hinges at the back are removed, and the upper and lower halves are separated. Then the cardboard is cut away from the wooden frame of the cover half. Any paper remaining attached to the wooden frame may be removed by soaking the frame in water until the paper can be peeled off. One of the long sides of the rectangular frame is then removed, preferably by sawing, since the dove-tailed joints are rather secure. Two small nails or brads are then nailed at each of the remaining two corners for reinforcement. This will become the handle of the rack.

In preparing the other part of the rack, the three grooved units of the lower half of the original box are removed individually after first tearing away the thin cardboard backing behind each unit. Then the cardboard is cut away from the frame, and all vestiges of paper are removed by soaking the frame in water. Small nails are used to reinforce the four corners, two at each corner.

All that remains of the original slide box now are one complete wooden frame, a 3-sided frame, and the 3 grooved units for holding slides. The latter are then nailed directly to the 4-sided frame in the exact positions they originally occupied in the slide box.

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