OCCURRENCE OF *CULICOIDES MISSISSIPPIENSIS* ON DIFFERENT TYPES OF VEGETATION

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ABSTRACT

An AFS Sweeper was used from 11 February to 8 April 1985 to examine the occurrence of *Culicoides mississippiensis* Hoffman adults on *Spartina alterniflora* Loiseleur, *Ilex vomitoria* Aiton, *Juniperus silicicola* (Small), *Juncus roemerianus* Scheele, and an undetermined species of short grass. *Spartina alterniflora* and *I. vomitoria* harbored significantly more specimens than the other plants. The sex ratio was 1:1 on *S. alterniflora*, the dominant plant type in the breeding area. *Ilex vomitoria* contained a male-biased sex ratio and significantly more *C. mississippiensis* adults when in flower than when not in flower. The association with flowers suggests a response to a visual or chemical cue.

RESUMEN

Se usó un esparavel tipo AFS del 11 de Febrero al 8 de Abril de 1985 para determinar la frecuencia de adultos de *Culicoides mississippiensis* Hoffman en *Spartina alterniflora* Loiseleur, *Ilex vomitoria* Aiton, *Juniperus silicicola (Small), Juncus roemerianus* Scheele, y una indeterminada especie de hierba corta. *Spartina alterniflora* y *I. vomitoria* albergaron significativamente más especies que las otras plantas. La proporción del sexo fue de 1:1 en *S. alterniflora*, que es el tipo de planta que predomina en el area de cruzamiento. *Ilex vomitoria* contenía una proporción de sexo, parcial hacia los machos y significativamente tenía más adultos de *C. mississippiensis* cuando estaba florido que cuando no lo estaba. La asociación con las flores sugiere una reacción a un estímulo visual o químico.

Some species of bloodsucking insects show a preference for settling at specific sites between periods of flight. Females may land on a vertebrate host to obtain a bloodmeal, or rest on man-made structures, plants, or the soil, while they digest a bloodmeal. Also, both sexes may visit sap flows or flowers to obtain nectar. Knowledge of the association with a particular host, resting site, or nectar source may be useful when planning a control program. A repellent can be applied on the host, resting sites can be treated with a residual insecticide, or extracts from a nectar source can be used as attractants.

Several workers have examined the host range for various species of *Culicoides*, but little research has been done regarding resting sites or nectar sources. The latter are of particular importance because nectar provides energy for sustained flight in mating swarms (Downes 1969), increases adult longevity (Linley 1966a), and may play a role in egg maturation (Linley 1966b). The females of some species are not able to survive to the time of the first oviposition without nectar (Downes 1958).

Neither resting sites nor nectar sources are known for the biting midge, *Culicoides mississippiensis* Hoffman (Diptera: Ceratopogonidae), a common pest of man along the

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Gulf Coast from Texas to southern Florida (Blanton and Wirth 1979). We designed a study to examine the association between this species and 5 plant species.

Materials and Methods

Possible resting sites and nectar sources were determined following preliminary tests in March and April 1984 near Yankeetown, Levy County, Florida. Adult *C. mississippiensis* were found in great numbers, at that time, near flowering shrubs and breeding sites in the marsh. With this in mind, *Juncus roemerianus* Scheele, *Ilex vomitoria* Aiton, *Spartina alterniflora* Loiseleur, *Juniperus silicicola* (Small), and an undetermined species of short grass were selected. The specific plants ranged in heights as follows: *J. roemerianus*, 1-1.5 m; *I. vomitoria*, 1-2.5 m; *S. alterniflora*, 0.25-0.75 m; *J. silicicola*, 2-3 m; and short grass, 0.1-0.2 m.

We used a portable suction device, an Arbovirus Field Station (AFS) Sweeper (Meyer et al. 1983), to collect *C. mississippiensis* adults. Similar devices have been used in prior studies of biting midges (Bidlingmayer 1961, Tanner and Turner 1975) and mosquitoes (Nasci 1981). We always began sampling 4-5 hrs after sunrise to avoid the possible bias of any diel periodicity. The suction device was moved over each type of plant for 2 min at 3 different sites on 11, 22, and 26 February, 11 and 26 March, and 1 and 8 April 1985.

Since shape and size varied between species of plant selected, the specific pattern of movement of the sweeper varied also. For the shrubs, *J. silicicola* and *I. vomitoria*, the intake port was moved over the outer canopy and along the branches. For the grasses, *J. roemerianus*, *S. alterniflora*, and the short grass, the device was moved through the vegetation. For all 5 plant species the sampling device contacted the plant so as to disturb any resting insects, causing them to take flight and be sucked into the sweeper. The time of each sample remained constant, but variation in the area sampled was unavoidable from day to day because the operator determined the pace of the sweeper around and through the plants. We calculated this variation by measuring the area the operator was able to cover in 2 min while sampling for *C. mississippiensis* in short grass. The average area for 7 samples was 6.7 ± 0.7 m^2 (mean ± standard deviation). Since the sweeper was easy to move through the short grass, the area covered on other plants was probably less.

One hundred and five samples were obtained in the above manner. We also collected 21 control samples by holding the suction device 45-60 cm away from plants included in the study. All samples were placed in a styrofoam container with solid CO_2 (dry ice) for transport to the laboratory in Gainesville, where the number of *C. mississippiensis* males and females (gravid and non-gravid) was recorded. Data were subjected to a chi-square/G-statistic with multiple column analysis to assess the significance of differences we observed.

Results and Discussion

We collected *C. mississippiensis* adults on all plants and in the controls. More individuals were found on *S. alterniflora* and *I. vomitoria* than on the other plants (Table 1). The former harbored the most individuals initially, and the sex ratio was approximately 1:1 for each day we collected specimens (Fig. 1). In contrast, *I. vomitoria* contained few specimens when we began the study, but the number greatly increased on the last 2 sampling dates (Fig. 2). *Ilex vomitoria* had significantly more males (65%) ($p<0.005$, $X^2= 19.15$, d.f. = 1) than *S. alterniflora* (49%) on these 2 dates.

The sex ratio varied significantly ($p>0.005$, $X^2=29.08$, d.f. = 4) when we combined

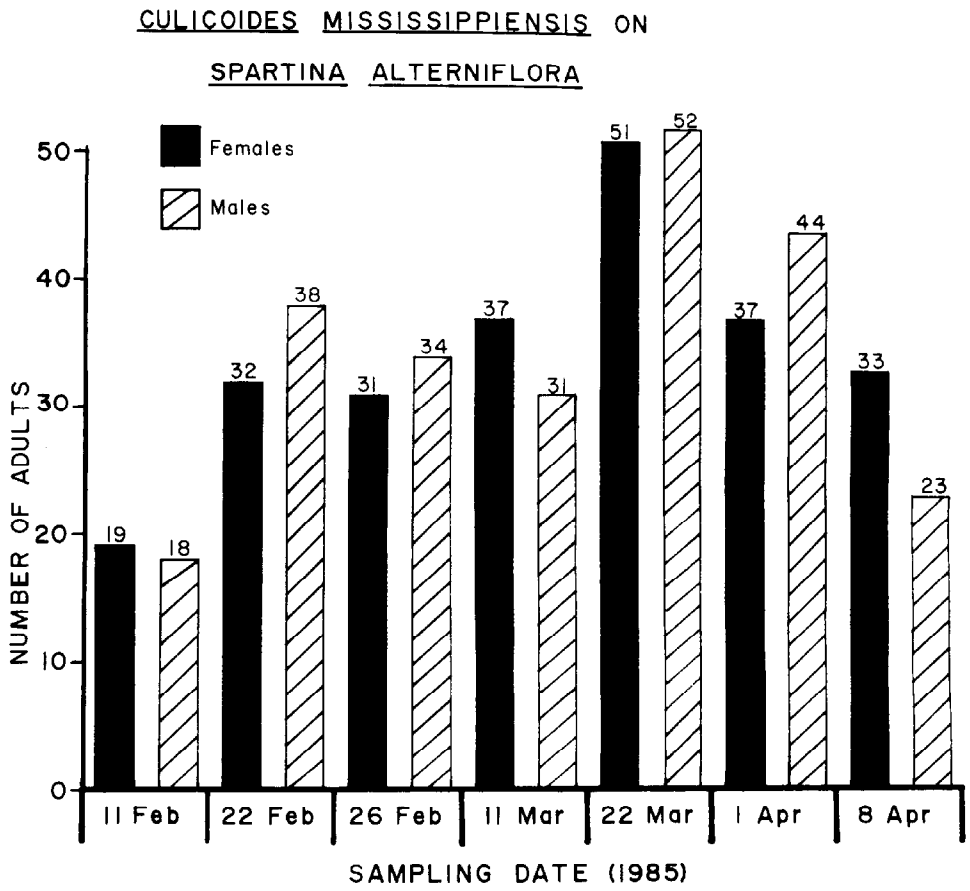

Fig. 1. Number of *Culicoides mississippiensis* adults collected on *Spartina alterniflora* by using a portable suction device.

data for each plant species and compared it statistically. Most ceratopogonid species have a sex ratio of 1:1 at adult emergence (Kettle 1955). Such a ratio for specimens collected on *S. alterniflora* should not be unusual (Table 1) because *C. mississippiensis* immatures are often found in salt marsh soil where this plant grows (Kline 1986). The immatures are also associated with soil where *J. roemerianus* grows; 57% of the specimens found on this plant were female. Samples from *J. silicicola*, which grows near the salt marsh in areas not regularly flooded by tides, were composed 57% of females.

The sex ratio was not 1:1 on *I. vomitoria* (37% female, 63% male). Such a deviation may occur if there is differential mortality between the sexes (Linley and Mook 1978), or if the site where specimens are being collected contains an attractant that lures one sex in greater abundance over the other. Differential mortality may be ruled out in this case because the ratio remained 1:1 on plants such as *S. alterniflora*. We suspect an attractant is involved in the relationship between *C. mississippiensis* and *I. vomitoria*. A sudden increase in the number of specimens (Fig. 2) coincided with the flowering period for this plant, late March to early May. On 1 April we noticed more midges in collections obtained on plants in flower than on plants not in flower. Consequently, on 8 April we sampled 5 flowering plants and 3 non-flowering plants to compare the number of *C. mississippiensis* associated with each. The data (Table 2) strongly suggest that the number of specimens is related to the flowering condition. We did not sample

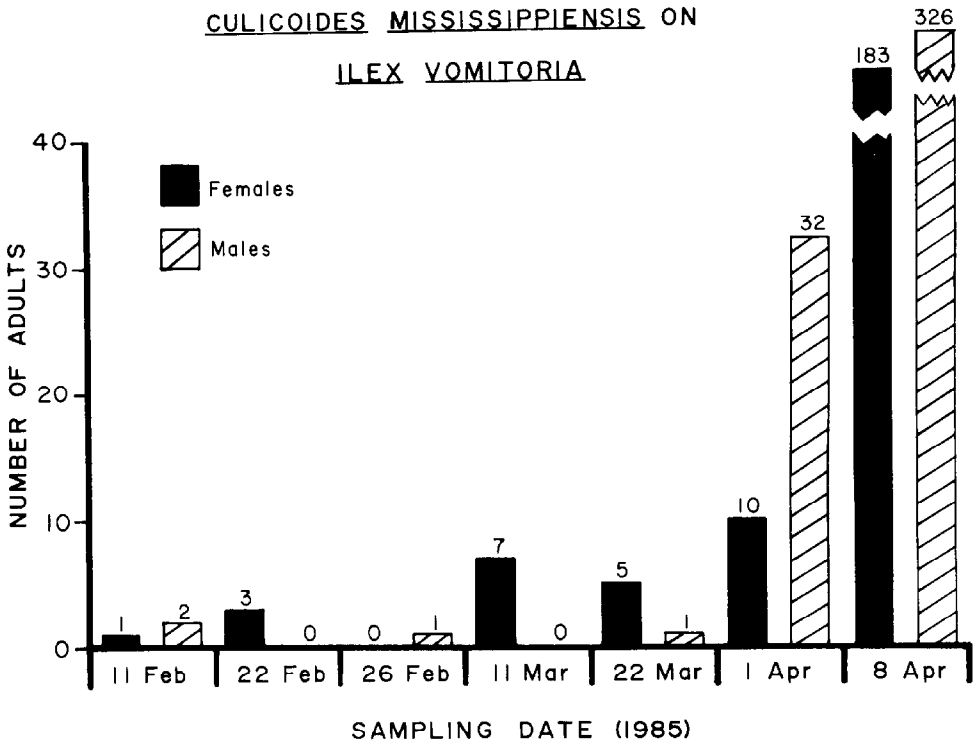

Fig. 2. Number of *Culicoides mississippiensis* adults collected on *Ilex vomitoria* by using a portable suction device.

beyond 8 April because *I. vomitoria* was no longer in flower at the Yankeetown site soon after that date.

Ilex vomitoria is the most common flowering shrub in the area in late March and early April. Midges were observed crawling into and out of the flowers and over branches. Gravid females were found in significantly greater frequency ($p<0.005$, $X^2=44.30$, d.f. = 4) on *I. vomitoria* than on other plants. Since females often do not survive in the laboratory to the age of their first oviposition without ingesting some

TABLE 1. RESTING SITES OF *CULICOIDES MISSISSIPPIENSIS* ADULTS AS DETERMINED BY PORTABLE SUCTION DEVICE COLLECTIONS.

Material sampled	Number of individuals			
	Non-gravid females	Gravid females	Males	TOTAL
Spartina alterniflora	206	34	240	480
Ilex vomitoria	147	62	362	571
Juniperus silicicola	47	0	35	82
Juncus roemerianus	29	1	23	53
Short grass	12	2	16	30
Control[1]	32	0	0	32
TOTAL	473	99	676	1248

[1]Specimens in flight near plants rather than resting on plants.

TABLE 2. PREFERENCE OF *CULICOIDES MISSISSIPPIENSIS* ADULTS FOR FLOWERING AND NON-FLOWERING *ILEX VOMITORIA* AS DETERMINED BY PORTABLE SUCTION DEVICE COLLECTIONS.

	Number of individuals			
Ilex vomitoria	Non-gravid females	Gravid females	Males	TOTAL
Flowering				
A	117	62	326	505
B	82	43	225	350
C	57	20	83	160
D	10	12	28	50
E	6	4	27	37
CONTROL	14	0	0	14
Non-flowering				
F	2	0	2	4
G	3	0	0	3
H	0	0	0	0
CONTROL	0	0	0	0

type of sugar, they were probably on the plants to obtain nectar. Males also ingest sugar in the laboratory and require similar materials in their natural environment. Nectar provides energy for metabolic activities, and may play a role in egg maturation.

Other plants evaluated in this study did not produce nectar in flowers like *I. vomitoria*, or they did not grow in areas of high larval density like *S. alterniflora*. *Juniperus silicicola* is a gymnosperm and the others (*J. roemerianus* and shortgrass) are monocots. Collections for these 3 species and the controls accounted for only 16% of the specimens recorded. Of these, only 3 were gravid females. The control samples did not contain any males or gravid females.

The purpose of the controls was to determine the number of specimens in flight near a plant as opposed to those resting on the plant. We did not contact the plant while collecting these samples. It is possible that some midges were disturbed when the AFS sweeper was 45-60 cm away but this is unlikely because only non-gravid females were obtained, even when sampling near *I. vomitoria* that harbored many males and gravid females (Table 2). The preponderance of non-gravids could have been due to the operator of the suction device attracting host-seeking females. Such attraction is an extraneous factor that might lead to false conclusions. For example, the short grass may be a resting site for females if you consider only data from sweeps through the grass. However, it is actually a poor resting site if it is assumed that many of the females were attracted to the operator from other sources.

Further studies are planned to examine the relationship between *C. mississippiensis* and flowering plants in the Yankeetown area. Some type of visual or chemical cue is probably involved. Extracts from *I. vomitoria* will be evaluated as a midge attractant. Other efforts will be directed toward the search for alternative sources of nectar. Since the midges are active in spring, fall, and winter (Kline 1986; Lillie 1985), and *I. vomitoria* flowers for only a short time, other sources of nectar are probably important. *Vaccinium arboreum* Marsh is a good candidate plant; it occurs in the area and it is a source of nectar for bees.

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