

A POPULATION STUDY OF THE *CULICOIDES* OF FLORIDA (DIPTERA: HELEIDAE)

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INTRODUCTION. During the years 1955 and 1956 a study was made by the Bureau of Entomology, Florida State Board of Health, to learn something of the seasonal abundance of the various species of *Culicoides* occurring in this state.

Florida is a peninsula of low elevation with broad lowlands around the entire coast. These lowlands are characterized by pine forests and palmetto, interspersed with cypress or mangrove swamps. This vast area of mangrove swamps, marshes, and tidal flats breeds tremendous numbers of the salt-marsh species of *Culicoides*: *furens*, *canithorax*, and *melleus*. Inland, the numerous lakes, ponds, rivers, streams, swamps and tree holes afford breeding places for the fresh water species. Consequently, sand fly annoyance is a major problem in Florida.

Six regularly operated mosquito light traps were the sources of material for this study. During 1955 and early 1956, the *Culicoides* from each of these traps were counted and identified from one collection each week during the year. Beginning in May, 1956, through December of that year, counts were made twice each week. If a collection ran high enough to make counting and identifying the total collection impractical, aliquots were identified.

During the two-year study approximately 108,000 specimens, representing twenty-five species, were identified from these six traps.

The majority of the faunal studies done on *Culicoides* in the past have been based on light trap collections. The studies of James (1943), Fox and Kohler (1950), Beck (1952), Khalaf (1952), Fox (1953), Fox and Capriles (1953), Williams (1955), and Wirth and Bottimer (1956), all indicate that light traps do attract large numbers of *Culicoides* species.

Light traps have these obvious advantages: they are comparatively inexpensive to operate; they require little of the collector's time; and the efficiency of the light trap (within the limits of its location) is the same in different areas, giving a "standard" collection at different times and in different localities.

F. W. Preston (1948) says that a sample will be a sufficiently accurate replica of the universe (parent populations) provided: it is a perfectly "random" sample, and no species is represented by fewer than 20 or 30 individuals. He continues: "A light trap is satisfactory in this respect [with respect to commonness or rarity] and samples its own universe appropriately. It is definitely *selective* in respect of phototropism, but it is random in respect of commonness, i.e., it does not care which of two moths, equally phototropic, it catches, though one may be a great rarity and the other of a very common species."

While Preston bases his ideas on collections of moths, the same principles seem applicable to *Culicoides*. Certain facts should be kept in mind however:

1. Light trap collections, over a long period, are probably directly related to the actual numbers of phototropic species in the parent population, since long term collecting would tend to level out the effects of meteorological factors which influence size and kind of the collection.

2. Large collections in weekly or semi-weekly light trap catches are largely accidental, depending on whether or not they happen to coincide with emergences, and upon meteorological factors.

3. Light trap collections favor not only those species which are phototropic, but also those which are active at comparatively lower temperatures. This is true because nights are cooler than days, and

some species may be annoying during a day, but not active during the following cooler night.

4. While there is no way of estimating accurately the total parent populations from the collections, the ratio of one positively phototropic species to another in these collections should be a fair estimate of the ratio in the parent populations. Also collections from different areas can be compared, giving an idea of relative size of the populations in two areas where the same species occur.

5. It should be borne in mind that a light trap samples a comparatively small area, probably not more than a mile radius of the trap. It therefore indicates the population of the trap area, and does not necessarily represent the geographical area as a whole.

Within these limitations light trap collections should show us what species are present in the area, which species are present in the greatest numbers, and in which months the various species are most abundant.

The six traps used for this study were located so as to give as wide a variation in climate and ecological habitat as possible, as follows:

LIGHT TRAP RECORDS. TRAP #1. Highlands Hammock State Park near Sebring in Highlands County in south central Florida. There is a creek one-half mile east of the trap and a canal about one mile south. Both of these streams are bordered by marshy areas.

Twelve species, six in sizeable numbers. Most abundant were *inamollae*, *niger*, and *floridensis* in that order. Peak periods for the more common species were: *niger*, Feb.-Mar.; *knowltoni*, *haematopotus*, *stelifer*, Mar.-Apr.; *floridensis*, July-Sept.; *inamollae*, Aug.-Oct. Other species present at the trap were: *arboricola*, *crepuscularis*, *nanus*, *obsoletus*, *piliferus*, and *villosipennis*.

TRAP #2. Vero Beach, Indian River County on the southeastern (Atlantic) coast; on U. S. 1, about 3 miles south of Vero Beach, at the edge of a hammock

just outside the salt marsh bordering Indian River, on the mainland.

Ten species, but only one, *furens*, is taken in large numbers. It reaches a population peak Dec.-Aug. Also taken sporadically are *inamollae*, *haematopotus*, *arboricola*, *canithorax*, *crepuscularis*, *floridensis*, *knowltoni*, *melleus*, and *pusillus*.

TRAP #3. Three miles north of Sneads, Jackson County, this trap is well inland in northwest Florida. The trap was set up to keep check on the mosquitoes attributable to the impoundment created by Jim Woodruff Dam. The trap is only about one-quarter mile from the impoundment.

Fourteen species, 5 fairly numerous. Most abundant were *crepuscularis* and *haematopotus*, followed by *arboricola*. Peak periods were: *niger*, Mar.-Apr., *crepuscularis* and *haematopotus*, Mar.-June; *stelifer*, May; *arboricola*, May-Sept. Also occurring at this trap were *biguttatus*, *khalafti*, *ousairani*, *piliferus*, *variipennis*, *venustus*, *villosipennis*, and *travisi*.

TRAP #4. On the northern or bay shore of Sanibel Island in Lee County, on the southwestern (Gulf) coast of Florida. Red and black mangrove and gumbo-limbo trees are common in the area. The Gulf of Mexico lies about two and one-half miles away.

Ten species, 5 are fairly common. Most abundant were *furens* and *barbosai*, followed by *canithorax*, *melleus*, and *loughnani* in that order. Population peaks for the species were: *furens* and *barbosai* (on the basis of nine months collections) Mar.-July, and possibly Oct.; *crepuscularis*, March; *canithorax* and *melleus*, Mar.-May; *loughnani*, May-July. Some specimens of *arboricola*, *haematopotus*, *inamollae*, and *knowltoni* have also been taken in this trap.

TRAP #5. St. Johns County, on the northeastern (Atlantic) coast, near St. Augustine. It is about three miles from the beach on Mantanzas Bay. Within a few hundred yards are ditches dug to make dike's to hold a fill. In dry weather the water is about one foot deep in these ditches; when it rains the whole area becomes swampy.

TABLE 1--Average number of *Culicoides* per light trap night taken at Florida locations 1955-1956 (Female Counts only)

<i>Culicoides</i>	Highlands		Indian River		Jackson		Lee		St. Johns		Walton	
	1955	1956	1955	1956	1955	1956	1955	1956	1955	1956	1955	1956
<i>arbitrícola</i>	.83	.44	.02	.01	5.33	3.88	.17	.63			.01	
<i>bermudensis</i>											.17	.04
<i>biguttatus</i>					.45	.10					2.98	.30
<i>canithorax</i>			.02				6.44	19.01			.23	
<i>crepuscularis</i>	1.08	.39	.08		46.39	1.48	4.14	1.19	1.11	.13	300.59	180.75
<i>floridensis</i>	6.46	2.84	.04	.09							1.15	.37
<i>barbosai</i>												
<i>jurens</i> & <i>barbosai</i>							146.99	{ 59.43				
<i>jurens</i>			76.92	42.63				{ 12.73				
<i>haematopodus</i>	5.50	.28	1.96	.12	45.31	4.46	.27	.11	4.62	2.31	245.48	313.94
<i>inamollae</i>	30.04	52.76	.85	3.78			.06	.02	.21		.67	.11
<i>khalafi</i>											.04	
<i>knoultomi</i>	4.56	1.28	.11	.09		.04						
<i>longhuanii</i>			.02									
<i>melleus</i>												
<i>nanus</i>	.02											
<i>niger</i>	15.23	1.89			.51	.50	5.94	10.49			.85	.14
<i>obsoletus</i>	.25	.04					8.35	13.21	5.49	13.40	4.44	2.24
<i>ousarumi</i>												
<i>piliferus</i> & <i>spinostus</i>												
<i>piliferus</i>	1.31	.37										.03
<i>pusillus</i>			.04									
<i>stellifer</i>	3.35	.13			1.18	2.08					.19	.67
<i>travisi</i>						.01						
<i>uartipennis</i>					.06						.02	.09
<i>venustus</i>					.67	.10					.29	.05
<i>villosipennis</i>	.68	.01			.59	.74					.02	.01
unidentified	.02		.01		.04	.11			.02	.01	.71	
Total No. <i>Culicoides</i>	3583	4541	4161	3552	5168	1175	8962	15,777	590	1317	29,008	39,399
No. nights traps operated	52	75	52	76	51	83	52	81	52	83	52	79
Average per light trap night (all species)	68.90	60.43	80.01	46.74	101.33	14.16	172.34	194.77	11.35	15.87	557.85	498.72

Seven species, 2 fairly abundant. *C. melleus*, with peak population Mar.-May, was the most common species, then *fuscus* with peak period Apr.-May. Also occurring in very small numbers were *arboricola*, *haematopotus*, *niger*, *stellifer*, and *canithorax*.

TRAP #6. At Santa Rosa, Walton County, about one and one-half miles from Choctawhatchee Bay in northwest Florida. It is on a bayou with swampy areas at the edges and is about three miles from the Gulf beach. There are two ditches within a few hundred yards of the trap.

Thirteen species, 2 very abundant. The largest collections during this study were taken in the Walton County trap. Both *canithorax* and *fuscus* were taken in large numbers, several thousand specimens each per collection in some instances. *C. melleus* was the third most common species. Peak periods for these species were: *canithorax*, Apr.-May, smaller peak Nov.-Dec.; *fuscus* and *melleus*, May; *bermudensis* and *crepuscularis* August. Other species taken at this trap were: *arboricola*, *biguttatus*, *haematopotus*, *inamollae*, *niger*, *piliferus*, *stellifer*, *variipennis*, *venustus*, and *villosipennis*.

Table 1 shows the average number of females of each *Culicoides* species taken at each of the six light traps operated during 1955 and 1956.

ANNOTATED SPECIES LIST. (Dates at end of each section represent the earliest and latest dates on which the species was collected.)

Culicoides inamollae Fox and Hoffman. This species occurs in large numbers in two traps, Highlands and Indian River Counties; larger numbers were taken at the Highlands trap. Catches from both traps indicate that this species reaches its greatest abundance during the late summer and early fall, the peak month being October. At Highlands the population is significantly high from August through December. (Jan. 4-Dec. 31.)

Culicoides niger Root and Hoffman. This species was taken in appreciable numbers at Highlands and Jackson County traps. More specimens were taken at High-

lands, where it apparently emerges in large numbers earlier than it does in Jackson County. The peak months in Highlands are January through March, while in Jackson they are March and April, which may indicate earlier emergences in South Florida than in North Florida. (Jan. 4-June 28.)

Culicoides knowltoni Beck occurred in large numbers only at the Highlands trap. The peak population occurs in March and April. (Jan. 17-Dec. 31.)

Culicoides crepuscularis Malloch reaches its peak of abundance in traps from both Lee and Jackson Counties in March. In 1955 the species remained significant through July in Jackson County, but in 1956 only a few of this species were collected at that location. (Jan. 4-Dec. 13.)

Several gynandromorphs of this species were taken at the Jackson County light trap. In all cases the head appendages and body size were female, the genitalia male, and the abdominal cavity was always occupied by a mermithid worm. One gynandromorph of *haematopotus* was also taken at this trap.

Culicoides haematopotus Malloch occurred in large numbers at Jackson, Highlands, and Indian River County traps. At the Jackson County trap this species reached a peak in March, but was also at a high level through July. At Highlands the peak month was also March. At Indian River trap the number of specimens taken was too small to indicate a definite peak, though the larger catches occurred January through April. (Jan. 11-Dec. 31.)

Culicoides stellifer (Coquillett) was taken in appreciable numbers at Highlands and Jackson County traps. The peak in Highlands occurred in March, that in Jackson occurred in May. This again suggests that certain species may emerge earlier in the year in the southern part of the State. (Jan. 11-Nov. 15.)

Culicoides floridensis Beck was taken in significant numbers only at the Highlands trap. The population peak occurred July through September. (May 15-Sept. 8.)

Culicoides fuscus (Poey). Until April

1956, *C. furens* and *C. barbosa* were not separated. Subsequent identification has indicated that *barbosa* occurs at Lee County trap, but not at any other of the traps included in this study. Therefore, at Lee County, only collections taken since March 1956, are used for these species. This species is extremely abundant at the four coastal traps. However, the population peaks at the trap locations differ and in some areas more than one brood is indicated.

At Walton County, on the northwest gulf coast, *C. furens* occurs in large numbers from April through September. There was no evidence of a winter brood in either 1955 or 1956, the species being represented in each month from November through March by an average of fewer than one specimen per light trap collection. Of course, this could be because the species is inactive during the cold nights here.

In St. Johns County *C. furens* was taken in much smaller numbers. This was probably due to the exact trap location rather than the geographical location. Peak months were April and May.

At Indian River trap large numbers of *C. furens* were taken each month December through June, the peak occurring in April.

In Lee County, as previously noted, the records for *C. furens* were taken from collections made April 1956 through December 1956. These records indicate a significant population occurring May through July, and in October, suggesting two broods a year. (Jan. 3–Dec. 18.)

Culicoides barbosa Wirth and Blanton, is represented only in collections from Lee County, April through December, 1956. There is a sizable population April through July, and in October, with the peak in May. The close relation between the number of *furens* and *barbosa* present in the trap might suggest that these numbers reflect favorable collecting conditions rather than existing populations. That this is not the case is evident from the fact that other species present at this trap do not fall in the same abundance pattern.

Consequently, it seems probable that *furens* and *barbosa* population abundance cycles may well run parallel courses, at least in the vicinity of this trap. (Apr. 10–Dec. 21.)

Culicoides arboricola Root and Hoffman, a tree hole species, was taken in large numbers only at the Jackson County trap. It was never very abundant, the largest single collection being sixty-six specimens. The population peak occurred in July. (Feb. 7–Dec. 14.)

Culicoides melleus (Coquillett), a salt water species, reached a peak in March through May at both Lee and St. Johns County traps. In Walton County, where the species was less frequently taken, the peak occurred in May. (Jan. 2–Dec. 21.)

Culicoides canithorax Hoffman, also a coastal form, was taken in large numbers at Lee, St. Johns, and Walton Counties. At St. Johns trap it did not occur in large numbers; the peak was in March. In Lee County, where it was more common, the peak occurred March through May. In Walton County, where it occurred in extremely large numbers, the peak occurred March through May, but the species was present in great numbers every month of the year. *C. canithorax* was taken in larger numbers at the Walton trap than any other species at any trap studied. (Jan. 4–Dec. 27.)

Culicoides loughnani Edwards occurred only at the Lee County trap. It had a high population March through July, with the peak in May. (Jan. 11–Dec. 28.)

Culicoides bermudensis Williams was recorded only at the Walton County trap. It was not abundant in light trap collections there. The peak was in August, and it was only rarely present in collections for the rest of the year. (Mar. 13–Aug. 21.)

Eleven species of *Culicoides* occurred in such small numbers that no definite statements should be made regarding their seasonal trends. These low numbers may be due to: (1) actually very small populations, (2) very short period of abundance, (3) poor location of light traps with regard to their breeding areas, (4) negative phototropism.

Culicoides nanus Root and Hoffman is represented by a single specimen taken at the Highlands trap on May 24. *C. trauisi* Vargas is also recorded from a single specimen, this from Jackson trap on May 8. *C. biguttatus* (Coquillett) was taken in small numbers in early spring at Jackson and Walton traps. (Apr. 6–May 15.) *C. obsoletus* (Meigen) was rarely taken at the Highlands trap. (Jan. 17–June 28.) *C. villosipennis* Root and Hoffman was taken at Jackson trap and a few specimens at Highlands trap. (Apr. 6–Oct. 25.) *C. ousairani* Khalaf (Apr. 6–Aug. 3) and *C. khalafi* Beck (May 15–Oct. 9) were taken only at the Jackson trap. At the Indian River trap two specimens of *C. pusillus* Lutz were captured. (Jan. 17, April 1.) *C. variipennis* (Coquillett) was taken in Jackson and Walton Counties. (May 3, Nov. 6.) *C. piliferus* Root and Hoffman occurred at Highlands, Jackson, and Walton Counties. (Mar. 11–May 15.)

It is evident that Florida has a large number of species of *Culicoides* and that these occur in great abundance. Many of these species are present for a greater part of the year. At least seven species have been taken every month in the year. Apparently, most species occur over a longer season in Florida than elsewhere, but in the case of *biguttatus*, *obsoletus*, *piliferus*, *variipennis*, and *venustus*, the period of occurrence was shorter than that given by Foote and Pratt (1954). These species are rarely taken in Florida, so that the small number taken may account for the shorter period recorded.

SUMMARY. To summarize briefly, six light traps were operated at regular intervals in different areas of Florida in order to learn something of the relative and seasonal abundance of the various *Culicoides* species. Of the 25 species taken during this study, 14 were taken in

large enough numbers to indicate that they contribute to the sand fly annoyance problem. On the coastal regions *furens*, *canithorax*, *melleus*, and possibly *loughnani* in some regions, are the problem. Inland, *inamollae* in South Florida, and *crepuscularis* and *haematopotus* in northern Florida appear to be the most abundant species.

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