AN OUTBREAK OF *CULICOIDES GUYANENSIS* IN THE CANAL ZONE

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Culicoides spp. sand flies have been a continuous pest problem in the Panama Canal Zone. The areas most severely affected have been those near the mangrove swamps on both the Atlantic and Pacific sides of the Isthmus. Among the several indigenous species that bite man, *Culicoides furens* (Poey) has been the predominant pest. Until 1950, one of the largest sources of *C. furens* was an intertidal mangrove swamp near the Pacific entrance to the Canal. In that year the United States Army and the Panama Canal Company installed tide gates which prevented salt water from flooding this 1200 acre swamp. Ditches were dug throughout the swamp to facilitate drainage of rain water. The saline mud was leached by heavy tropical rains and the area gradually became a well drained grassland. This effectively reduced the breeding of *C. furens,* as reported by Blanton *et al.* (1955).

The Dredging Division of the Panama Canal Company began cleaning the channel of the Canal with a suction dredge on November 16, 1967 and pumped the spoil into the region just north of Farfan swamp. By the time these dredging operations ended on February 23, 1968, enormous quantities of silt, mud, and sea water had poured into the area covering the drainage ditches, killing most of the vegetation on approximately 900 acres of swamp.

In late February complaints of biting sand flies were received from the residents in the housing areas of Ft. Kobbe and Howard Air Force Base adjacent to the swamp. Truck trap samples made on March 4 revealed high populations of *Culicoides guyanensis* Flock and Abonnenc. No *Culicoides furens* were collected. This was a radical change from previous years when Blanton *et al.* (1955) found an almost pure colony of *C. furens* in the same area.

METHODS. In an effort to determine the breeding sources of *Culicoides guyanensis,* mud samples were taken at random at 100 collecting stations. The stations were established by placing marker poles at 50 foot grid intersects at four regions in the swamp. One-pint samples of mud were placed in clean quart oil cans, labeled and taken back to the laboratory. As described by Bidlingmayer (1957), a layer of white sand was placed over the mud with enough fresh water added to flood the sample. These samples were allowed to stand overnight before larval separation. No attempt was made to identify or to determine the stage of development of the larvae. The identity of the species breeding in each of the regions of the swamp was made using adult emergence cages made from 55 gallon steel drums. Early in the study determinations were made of pH, salinity, and water content of the mud from several collection stations. Tests were later conducted to assess the organic content of the mud from the dredge spoil deposit.

Adult populations were monitored with a variety of sampling methods. Three horse-baited traps were established on the southeast side of the swamp at the same locations used for this purpose by Blanton *et al.* (1955). Castor oil treated paper panels, as described by Carpenter (1951), were used to capture the *Culicoides* flies as they entered the trap. Results are shown in Graph 1. Two New Jersey

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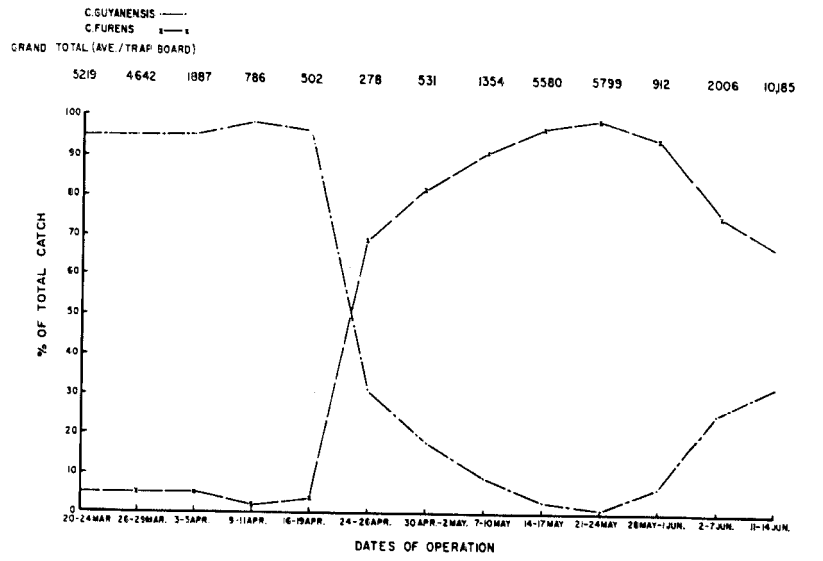

GRAPH. 1.—*Culicoides* sandflies collected in horse baited insect traps at Fort Kobbe, Canal Zone during 1968–1969. (Combined data from three horse baited traps expressed as percent of total catch for each species).

light traps were operated 4 nights per week at sites on the southeast side of the swamp. The results from these collections are shown in Table 1. Several times during the study a truck trap similar in design to that described by Bidlingmayer (1966), with a funnel opening of 8 sq. ft., was used to make sequential collections from about sunset until about 90 minutes after sunset in the residential area of Howard Air Force Base. This device was used primarily to determine comparative peaks of flight activity. The trap was mounted on a pickup truck driven at approximately 20 m.p.h. over a predetermined route for a set period of time. At the end of each period, a new collection bag was attached to the trap and another trip was made over the same route. Results are shown in Tables 2 and 3.

TABLE 1.—Average number of *Culicoides* spp. collected per trap night in New Jersey light traps at Howard Air Force Base and Ft. Kobbe, Canal Zone.

	Trap Location			
	Qtrs. 373 and 379		Motor Pool #33	
Date	*Culicoides guyanensis*	*Culicoides furens*	*Culicoides guyanensis*	*Culicoides furens*
2/6 Apr.	224	41		
7/12 Apr.	42	15		
14/20 Apr.	74	10	105	12
21/27 Apr.	219	13	84	19
28 Apr.–4 May	212	20	205	44
5–9 May	189	17	133	16
12/17 May	50	8	55	8
18/21 May			242	26

TABLE 2.—Time of peak flight activity of *Culicoides guyanensis* at Howard Air Force Base and Fort Kobbe, Canal Zone during 1968. Based on truck trap collections.

Date of Collection	Number of Collections	Time of Peak Flight Activity (Minutes after Sunset)	Specimens Collected Per Minute in Peak Collection	Percent of Specimens Collected During Peak Activity Period
Mar. 4	8	41–51	103	54
Mar. 11	7	23–26	520	47
Mar. 16	7	6–16	66	54
Apr. 8	4	17–22	28	64
Apr. 16	4	14–24	2	66
Apr. 29	4	14–24	2	66
May 6	4	46–56	1	52
June 18	6	52–62	31	38
June 24	6	20–30	57	40

TABLE 3.—Time of peak flight activity of *Culicoides furens* at Howard Air Force Base and Fort Kobbe, Canal Zone during 1968. Based on truck trap collections.

Date of Collection	Number of Collections	Time of Peak Flight Activity (Minutes after Sunset)	Specimens Collected Per Minute in Peak Collection	Percent of Specimens Collected During Peak Activity Period
April 16	4	7–17	.3	43
April 29	4	−3 to +17	.3	60
May 6	4	1–11	.1	100
June 18	6	−8 to +2	22	71
June 24	6	5–15	9	38

RESULTS AND DISCUSSION. The analysis of the mud from the dredge spoil where *Culicoides guyanensis* occurred showed it to be generally acidic and of variable moisture content and salinity. Organic content was high, 8 to 12 percent of dry weight. Forattini (1957) reported that *C. guyanensis* is able to endure great variations in the salinity of the mud in which it breeds. Forattini (1958) stated that this species was found to breed in ditches both with and without saline concentration. In both papers *C. guayensis* was recorded as breeding in ditches. It is likely that small numbers of this species bred in the many drainage ditches in Farfan swamp prior to the inundation by the dredge spoil. The highly organic mud would have provided ample food resources for larval development and the soil conditions would have been well within tolerance of salinity for this species. Forattini (1957) mentioned that *C. guyanensis* was found mainly in places with poor vegetation fully exposed to the sun. The killing of the vegetation by the salt water left the mud in Farfan swamp without shade thus providing another factor optimal for larval development. The greater exposure to the sun during the beginning of the dry season plus all of the above mentioned factors may well have led to this population explosion.

Graph 1 shows a changeover from an abundance of *Culicoides guyanensis* to *Culicoides furens* in horse-baited trap collections after April 18. This occurred 9 days after granular insecticide application to the swamp. This change was not evidenced in either light trap or truck trap collections. The first *C. furens* was taken by truck trap on April 16. If there was

an actual change it was probably due to the decreased emergence of *C. guyanensis* from the swamp after the insecticide application, coinciding with a general increase of *C. furens* emerging from outside the treated area after the beginning of the rainy season. The attempts at control of these *Culicoides* spp. and discussion of the mud sampling data are treated in a second paper.

Tables 2 and 3 show that all peaks of flight activity occurred within a period from 6 to 62 minutes after sunset. The differences in the time when these peaks occurred possibly were caused by several factors; light level differences caused by clouds on horizon; weather conditions, and wind speed changes. More than 75 percent of the *Culicoides guyanensis* were collected from 4 minutes prior to and 62 minutes after sunset. Peak collections of *Culicoides furens* occurred within a period from 8 minutes before to 17 minutes after sunset. Over 80 percent *C. furens* were collected between 10 minutes prior to and 35 minutes after sunset. Biting activity, noted by the collector, was correlated with peaks of flight activity. Woke (1954) reported collecting *C. furens* biting man at Balboa, Canal Zone in sunlight, in the shade of mangrove trees, under electric lights, and in darkness from 9 a.m. to 9 p.m. He collected *C. guyanensis* biting man between 7 and 8 p.m. in the same area. We found that *C. guyanensis* bite more aggressively than *C. furens* and have the especially annoying habit of crawling into the hair and biting the scalp. Skin reactions to the bites are very similar to those from *C. furens*. The bites of both result in intense itching, thus leading to secondary infections from scratching.

There was heavy *Culicoides furens* breeding in the highly organic saline mud of the dredge spoil in Farfan swamp during the rainy season. *Culicoides guyanensis* is still breeding in the swamp but not to the extent of the previous year. *C. furens* is again the most predominant pest species being produced in Farfan swamp.

SUMMARY. Beginning in November of 1967 a large quantity of sea water and mud was pumped from a Panama Canal dredging operation into a fresh water swamp located on the west bank of the entrance to the Panama Canal. About three months thereafter *Culicoides guyanensis* Flock and Abonnenc appeared in extremely large numbers and severely annoyed the residents of the area. Both larval and adult populations were monitored utilizing mud sample collections, emergence cages, horse-baited traps, light traps and a truck trap. *C. guyanensis* were found breeding in the mud from the dredging operation after it had inundated their normal breeding areas in Farfan swamp. The mud was acidic in character, varied in salinity and water content and showed an organic content of 8–12 percent dry weight. The breeding areas were nearly clear of vegetation and exposed to direct sunlight. The optimal food conditions, tolerance of this species to variations of salinity, and exposure of the mud to the sun all possibly contributed to the explosive outbreak of *C. guyanensis* observed. Recently the affected area has been exploited by *Culicoides furens* which prefers to breed in saline mud. The peaks of flight activity were from 6 to 62 minutes after sunset for *C. guyanensis* whereas the peaks for *C. furens* occurred from 8 minutes prior to 17 minutes after sunset. Attempts to control these *Culicoides* spp. are reported in a second paper.

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CONTROL OF *CULICOIDES* SAND FLIES, FORT KOBBE, CANAL ZONE IN 1968[1]

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Prior to 1951 *Culicoides furens* (Poey) were a severe problem at Fort Kobbe, Canal Zone and other adjacent military installations. The principal breeding area was an intertidal mangrove swamp (Farfan swamp) located on the west bank of the Pacific entrance to the Panama Canal. In 1950 the United States Army and the Panama Canal Company installed tide gates at the mouth of the swamp to exclude the salt water. Ditches were dug in the swamp to facilitate drainage of rain water. The area gradually became a well drained grassland and as reported by Blanton *et al.* (1955), this effectively reduced the breeding of *C. furens*.

From November 16, 1967 to February 23, 1968 the Dredging Division of the Panama Canal Company cleaned the channel of the Pacific entrance to the Canal and dumped enormous quantities of mud and sea water into Farfan swamp. The salt water killed most of the vegetation in approximately 900 acres of the swamp and when the water evaporated a large quantity of salt was left in the soil. The mud from the dredging operation blocked the drainage system and permitted the formation of many shallow pools.

Large numbers of *Culicoides* spp. rapidly developed in the swamp and became a severe problem in the adjacent residential areas. Based on horse trap collections, *Culicoides guyanensis* Floch and Abonnenc was the predominant species until the week of April 21 when there was an abrupt change and *C. furens* become more numerous. The rainy season started May 6 and there was an increase in the population of both species. The occurrence of *C. guyanensis* in large numbers was a radical change from the observations of Woke (1954) and Wirth and Blanton (1959). A detailed discussion of this event is presented in another publication.

Plans were made to restore the drainage system, but the mud was so fluid that ditching was impossible. It is anticipated that once the drainage system is re-established, the ground will not become stabilized for several years. Temporary con-

[1] Mention of a proprietary product does not necessarily imply endorsement of any products mentioned by the U.S. Army or by the U.S. Department of Agriculture.

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