# A PRELIMINARY STUDY OF THE BLOODSUCKING DIPTERA ON CAPE COD, MASSACHUSETTS

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The extensive salt marsh and fresh water habitats on Cape Cod are known to produce a variety of bloodsucking insects that attack man and animals. The majority of these pests belong to the families Tabanidae (horse flies, greenheads and deer flies), Heleidae (gnats, punkies or sand flies) and Culicidae (mosquitoes) of the order Diptera.

The purpose of our investigations conducted during the summer of 1958, was twofold: (1) to acquire general information relative to the breeding areas, distribution and comparative abundance of the various bloodsucking Diptera on Cape Cod; and (2) to utilize this information as a basis for the formulation of control measures. Since much active work was already in progress on mosquito control, the emphasis in our study was directed toward the nuisance species belonging to the Tabanidae and Heleidae.

## TABANIDAE

Four species of tabanids are known to breed commonly in salt marsh sod along the Atlantic seaboard (Pechuman 1957, Wall and Jamnback 1957). These are *Tabanus lineola* Fab., *T. nigrovittatus* Macquart, *Chrysops atlantica* Pech. and *C. fuliginosa* Wied. Of these, *T. nigrovittatus*, the greenhead fly, is considered to be the most serious pest of man.

### SAMPLING FOR ADULTS

MATERIALS AND METHODS. In order to determine the relative abundance, distribution and emergence peak of the salt-marsh tabanids, traps were placed in 31 principal marsh areas on Cape Cod. The traps consisted of a vertical square foot of masonite mounted on a stake and daubed with a slow drying adhesive, "Tanglefoot." Hansens (1952) successfully used this procedure in New Jersey, although "Deadline" was employed as the adhesive material. At each test site two traps were placed back to back facing east and west, and two others similarly placed facing north and south. The height of the traps above ground level was approximately 1 to 2 feet so that the masonite was just above the top of the marsh grass. This was found to be the most effective height to trap the migrating adults (Jamnback and Wall, 1959).

Counts were made weekly beginning on June 23 and ending on September 8. The flies entrapped in the sticky material were removed with forceps during each count and the trap was then resmeared. More frequent observations were made on a limited number of traps during the entire summer.

RESULTS AND DISCUSSION. Our catch included the four species previously mentioned as well as a number of *T. lasiophthalmus* Macquart and a few *C. carbonaria* Walker. In fact, the *Tabanus* counts recorded from June 23–July 7 were almost exclusively *T. lasiophthalmus*. From July 7 to September 8, *T. nigrovittatus* was found to be the principal species of *Tabanus* occurring on the traps, although a few *T. lineola* were also noted. From the initial counts on June 23 until July 7, *C. fuliginosa* was found in large numbers in certain of the marshes. By June 14, the last few *C. fuliginosa* and the first few *C. atlantica* were recorded on the traps. This latter species persisted throughout the summer, but in relatively small numbers. The data compiled from greenhead counts made on the adult traps located in marsh areas that remained unsprayed throughout the summer are shown in Figure 1.

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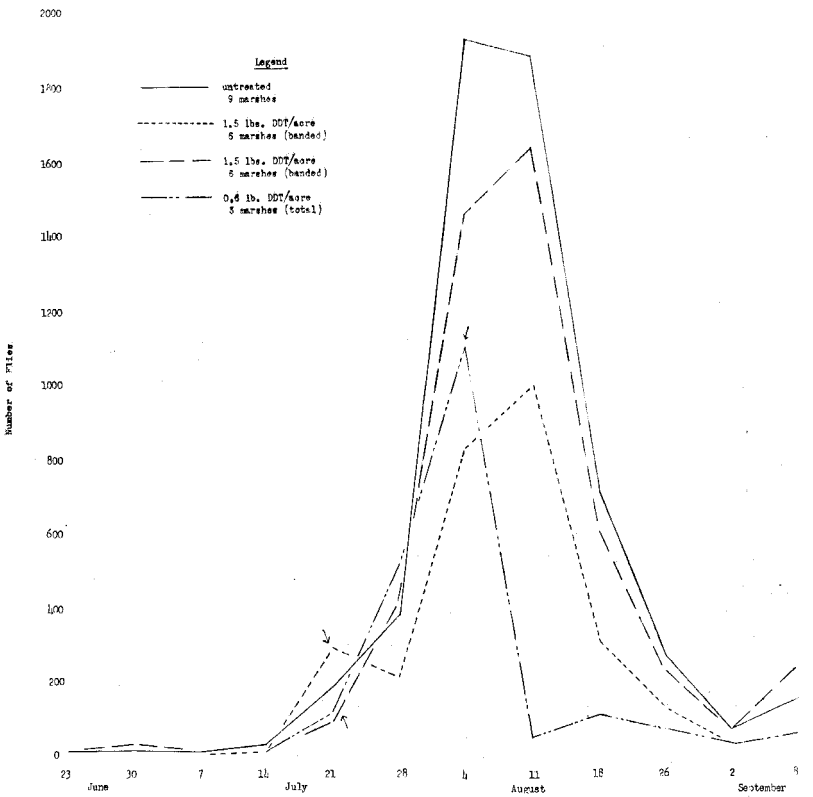


FIG. 1.—A comparison of greenhead fly counts from adult traps located in treated and untreated salt marsh on Cape Cod, 1958. Arrows indicate the dates of spray application.

The typical greenhead emergence pattern of: (1) the rapid increase of adult population; (2) the period of peak population; and (3) the sudden decrease in fly population is quite apparent. A similar pattern of fly emergence was obtained by Gerry (1950a) from studies made on the North Shore in Massachusetts, by Hansens (1952) in New Jersey and by Jamnback and Wall (1959) on Long Island. It may also be noted that the emergence peak did not occur until the first week in August which is approximately 2 to 3 weeks later than the emergence peaks found by these investigators. However, it is our opinion that this delay in adult emergence was primarily due to the cold rainy weather that prevailed on Cape Cod during the spring and early summer of 1958.

## CONTROL OF ADULTS

For the past two years a coordinated program of greenhead fly control has been carried out in all the towns on Cape Cod. Each town contributed its proportional share of money to finance the cost and application of the insecticide while the Cape Cod Mosquito Control Project coordinated and carried out the program. The program consisted of applying a DDT-oil spray to the inner (upland) margins of the salt marsh as recommended by Gerry (1950a, 1950b).

MATERIALS AND METHODS. To determine

if such a program caused a marked reduction in greenhead populations, it was decided to utilize the trap sites already available as a means of sampling the adult greenheads in treated and untreated areas. Nine marshes were left untreated throughout the summer to serve as control areas. Six marshes were "banded" on the upland margins on July 19, 20, and 21 and six others were treated in a similar manner on July 22 and 23. It was impossible to spray all the marshes on one given date because of inclement weather, the extent of the marsh area and the availability of only one helicopter. The spray application was put on by helicopter and consisted of 12 percent DDT in fuel oil applied in a swath about 100 feet wide at the rate of 1.5 pounds of actual DDT per acre. On August 4, three more marshes were treated with 5 percent DDT in fuel oil applied at the rate of 0.6 pound of actual DDT per acre, but these marshes were treated in total. The results obtained are given in Figure 1.

RESULTS AND DISCUSSION. From the graph it can be seen that the marshes "banded" on July 19, 20 and 21, showed a slight decrease in population counts during the week following the spray application. This decrease, however, was only temporary and the emergence curve increased thereafter until a natural decline occurred during the week of August 12–18. No noticeable decline occurred in the trap counts taken in the marshes "banded" on July 22 and 23 and the emergence pattern continued to approximate that of the untreated marshes very closely.

The three marshes in which the total marsh area was treated with the lower dosage of DDT, showed a decided decline in trap counts made the week following spray application. A slight increase in trap counts in these marshes occurred during the week of August 12–18 with a normal decrease thereafter. A slight increase in adult emergence was apparent in both treated and untreated marshes during September 3–8.

CONCLUSIONS. The results of our tests show that during the summer of 1958 banding the upland margins of salt marsh with DDT-oil applied at the rate of 1.5 pounds of actual DDT per acre did not effectively reduce greenhead populations in the marsh areas treated. However, total spraying of marshes with DDT-oil applied at the rate of 0.6 pound of DDT per acre reduced the greenhead population approximately 95 percent the week following spray applications; but the slight increase in trap counts taken the second week following spray application, indicates that the effectiveness of the insecticide was limited to approximately one week.

## LARVAL SAMPLING

MATERIALS AND METHODS. Two methods of larval sampling (New Jersey larvicide square-yard samples and Berlese funnel square-foot samples) were successfully employed during the summers of 1954–1956 on Long Island by Wall and Jamnback (1957). Using these two methods, a total of 99 square-yard samples and 56 Berlese funnel samples were taken during the summer from salt marshes in the vicinity of Yarmouth Port, Dennis, and Eastham. Normally, a series of three square yards was treated at one time and at least one square foot sample was taken adjacent to the square yard plots.

RESULTS AND DISCUSSION. The average number of *Tabanus* larvae emerging per square yard was 1.8 while the average collected from a Berlese funnel sample was 1.3. If it is assumed that all the *Tabanus* larvae present in a square foot of sod were collected, then, on a comparative basis, only about 15 percent of those present in a square yard of salt marsh came to the surface following application of the irritant. These results appear to be in general agreement with the results obtained on Long Island by Wall and Jamnback (1957) where a correlation figure of about 13 percent was obtained.

Samples were taken at random on the marshes and larvae were found to be fairly well distributed throughout the marsh areas. They were found close to the upland, a few feet from open water, and up to 300 yards out into the marsh from the upland.

From both methods of larval sampling mentioned above, the following species were collected and identified: *T. lineola, T. nigrovittatus, C. atlantica* and *C. fuliginosa.* A complete list of the identified species of adult and larval Tabanidae collected during our survey is given in the summary.

## HELEIDAE

Jamnback *et al.* (1958) recorded three species of this family as being particularly abundant and annoying on Long Island. These species were: *Culicoides canithorax* Hoffman, *C. furens* (Poey) and *C. melleus* (Coq.). This last named species is an intertidal sand breeding form while the other two species apparently breed in salt marsh mud (Goulding *et al.* 1953, Bidlingmayer 1957, Jamnback and Wall 1958). Since the environments and biotic communities of Long Island and Cape Cod are very similar, we expected to find these same species prevalent on Cape Cod. All three species have previously been recorded from Cape Cod by Coher *et al.* (1955).

### ADULT SAMPLING

MATERIALS AND METHODS. Four light traps were set up in widely dispersed areas on Cape Cod and in each instance were adjacent to both salt marsh and intertidal sand. Two traps remained in the same locality throughout the summer (June 23–August 2); one was moved to a mosquito breeding site on July 27 and one became inoperative due to mechanical failure on this same date.

RESULTS AND DISCUSSION. A total of 4082 *C. melleus,* 518 *C. furens,* 32 *C. canithorax* and 2 *C. spp.* were collected from the light traps during the summer. The presence of large numbers of *C. melleus* was also noted by personal observations made throughout the summer. There appeared to be a definite lack of correlation between the large numbers of *C. furens* and small numbers of *C. canithorax* taken in the light traps, and our other findings in regard to these two species. For example, a total of 47 biting adult *Culicoides* collected in the salt marshes on various dates throughout the summer all proved to be *C. canithorax.* Our larval samples from salt marsh mud proved to contain a very high percentage of *C. canithorax* and a very low percentage of what we believe to be *C. furens* larvae; the exact reverse of our light trap counts. It is possible that *C. canithorax* is not particularly attracted to lights or this species may not be active during periods of dusk and darkness. These hypotheses are somewhat substantiated by the findings of Jamnback *et al.* (1958) on Long Island where one light trap yielded approximately 1500 dark winged *Culicoides* of which about 2 percent were *C. canithorax* and 98 percent *C. furens.* We feel, however, that we did not have a sufficient number of light traps operating throughout the Cape Cod area to obtain a true picture of adult *Culicoides* populations.

### LARVAL SAMPLING

MATERIAL AND METHODS. Numerous areas of intertidal sand in the vicinity of Oyster Harbors, Cotuit and East Falmouth were sampled for *Culicoides* larvae using the method described by Jamback and Wall (1958). The method used to sample *Culicoides* larvae in marsh mud was modified slightly from that of Bidlingmayer (1957). Samples of marsh mud approximately equal to one-third pint were brought to the laboratory and each placed in a pint jar. Each mud sample was then covered with dry beach sand to a depth of about 1½ to 2 inches, flooded with tap water and allowed to stand overnight. During this time a high proportion of the larvae migrated into the sand. The next day the sand was removed from a sample and "washed" to remove the larvae as described by Jamnback and Wall (1958).

RESULTS AND DISCUSSION. Several hundred larvae were obtained from the intertidal sand samples and representative larvae were identified as *C. melleus.* The type of beach area in which the larvae were found varied from fine, clean sand to bands of stones and pebbles overlying sand and mud mixtures. Many were

found beneath stands of *Spartina alterniflora* growing in the intertidal sand. The location of the larvae between the high and low tide marks appeared to vary from locality to locality. In some instances, the larvae were found close to the low tide point, in others they were located midway between the high and low tide marks. The majority of the larvae were found in protected bays and inlets and were scarce or absent along areas exposed to heavy wave action. These findings are in general agreement with those of Jamnback and Wall (1958) on Long Island.

A total of 741 larvae were recovered from marsh mud samples and 388 specimens were identified. Of these, 97 percent were identified as *C. canithorax* and 3 percent tentatively identified as *C. furens*. Six larvae tentatively identified as *C. furens* were reared to adults and the identification in each case proved to be correct.

The majority of the larvae were found in the top inch of mud, but we have recovered them from samples taken to a depth of three inches in areas pocketed with fiddler crab holes. Although no attempt was made to locate them at greater depths, undoubtedly they will occur there since Bidlingmayer (1957) found *C. furens* larvae to a depth of 24 inches in Florida marshes.

We found the greatest numbers of larvae along the edges of bays and drainage ditches where long *Spartina alterniflora* is the predominant plant cover. However, the larvae were found widespread throughout all salt marshes sampled. They were recovered from moist or wet mud with *Spartina alterniflora, Spartina patens, Distichlis spicata* and *Salicornia* spp. as the dominant plant cover. None were recovered from soft, dry soil or from areas where the marsh surface was hard. These findings are in general agreement with those of Jamnback and Wall (1958) and Bidlingmayer (1957).

## CULICIDAE

Our preliminary investigations of the mosquito problems on Cape Cod were largely confined to rearing and identifying the various species encountered in the field. A list of the identified species with locality data will be included in a later paper.

## SUMMARY

Tanglefoot traps were used to sample adult Tabanidae in salt marshes on Cape Cod during the summer of 1958. *Tabanus lasiophthalmus* Macquart, *T. lineola* Fab., *T. nigrovittatus* Macquart, *Chrysops atlantica* Pech., *C. carbonaria* Walker, and *C. fuliginosa* Wied. were recorded on the traps. *T. nigrovittatus,* the greenhead fly, was the principal species found throughout the summer. The typical emergence peak of this species was two to three weeks later than normal in 1958.

A greenhead adult control program was carried out in the salt marshes during July and August. Results showed that banding the upland margins of marshes with DDT-oil spray applied at the rate of 1.5 pounds of actual DDT per acre did not effectively reduce greenhead populations. Total treating of the marshes with the same insecticide at the rate of 0.6 pound of actual DDT per acre reduced adult populations approximately 95 percent.

Marsh sod was sampled for tabanid larvae using the New Jersey larvicide square-yard method and Berlese funnel square-foot method. Small numbers of larvae were found distributed throughout the marsh and the following species determined: *T. lineola, T. nigrovittatus, C. atlantica* and *C. fuliginosa.*

The following adult Tabanidae were also collected at various localities on Cape Cod: *Chrysops aberrans* Philip, *C. carbonaria* Walker, *C. delicatula* Osten Sacken, *C. dimmocki* Hine, *C. frigida* Osten Sacken, *C. vittata* Wiedemann, *Tabanus atratus* Fabricius, *T. atratus nantuckensis* Hine, *T. cinctus* Fabricius, *T. nigripes* Wiedemann, *T. novae-scotiae* Macquart, *T. pumilus* Macquart, *T. trispilus* Wiedemann, and *T. typhus* Whitney.

Adult Heleidae were sampled throughout the summer using a limited number of light traps. The following nuisance species were recorded: *Culicoides cani-*

*thorax* Hoffman; *C. furens* (Poey); and *C. melleus* (Coq.). *C. melleus* was the most common species occurring throughout the summer. Larval samples were taken in the suspected habitats of these species. *C. melleus* was found in protected sections of intertidal sand and *C. furens* and *C. canithorax* in moist or wet marsh mud.

Numerous species of mosquitoes were reared and identified. A list of these species will be included in a later paper.

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