NOTES ON A *MANSONIA PERTURBANS* PROBLEM AT EDGEWOOD ARSENAL, MARYLAND

DAVID A. YOUNG, JR.*
Department of Biology, University of Louisville

Edgewood Arsenal is a Chemical Corps installation situated on the west shore of Chesapeake Bay. The populated portion of the reservation occupies the base of a peninsula, named Gunpowder Neck which is approximately eight miles long, and is bounded on the east by Bush River and small tributaries, on the west by Gunpowder River, and on the south by Chesapeake Bay. Approximately four miles wide at its base in the north, Gunpowder Neck tapers more or less gradually to its extreme tip. Only the basal portion is populated.

The entire peninsula is low, almost all of the surface standing at less than thirty feet above sea level. There are numerous tidal marshes along both rivers, some of which are inundated with each high tide, while others may be covered with water only a few times in the period of a month. Many fit into both of these categories, some portions of a given marsh being subject to daily tidal action, others being covered only at extremely high tides. The channels through the marshes are in many cases ill-defined and inadequate for drainage during low tide, resulting in large areas of stagnant water amidst typical aquatic vegetation, the commonest forms being *Typha, Pontederia, Sagittaria,* and numerous species of rushes, sedges, and grasses. More than 800 acres of such marsh are situated in the northern, populated, portion of the reservation.

Early in the season of 1946, it was decided that the Arsenal would be one of the twelve posts chosen for treatment with DDT from the air. The program of DDT dispersal from aircraft in the Zone of the Interior was still in the process of evaluation, and was a project of the War Department, with the Corps of Engineers, Army Air Forces, and Army Medical Department cooperating.[1] One of the chief reasons for the choice of Edgewood Arsenal was a rather high density of *Anopheles quadrimaculatus* (the malaria vector for Eastern United States) reported from light trap collections in 1945, and the high density of pest mosquitoes.

Careful study of data from previous years was necessary to determine the date for the plane-spraying from which the post might derive the greatest benefit, for there was a history of serious pest-species abundance to consider, secondary to the problem of reduction of disease vectors. Moreover, it was necessary to select this date far in advance of the actual application of spray. Past records revealed that *Culex* spp. had been present in large numbers, and that *Aedes vexans* and *Mansonia perturbans* had been common, although not by any means predominant, species. Salt marsh mosquitoes had not been encountered in any serious numbers. As a result of this study, it was decided to apply the spray on July 16, 1946, with a second application about one month later, if necessary.

The area chosen for the project consisted of approximately 3500 acres in two sectors: first, all of the peninsula south of the populated area for a distance of two miles; second, a much smaller similar peninsula to the northeast of Gunpowder Neck. It was planned that normal ground control measures would cover the populated northern area (the 800-odd acres of marsh could be covered by plane in connection with experimental work on DDT dispersal from aircraft, being carried

* The writer wishes to acknowledge the assistance of Mr. S. S. Easter, who helped greatly in various phases of the work.

[1] An evaluation of the over-all program has been published by the National Research Council under the title "Abstract of Report of Aerial Spray Operations in the Continental United States in 1946." April 1, 1947.

on at the post),[2] the two rivers to the east and west would form barriers averaging more than one mile in width, while the project already described would cover sources of infiltration from the south and the small neck in the northeast. It was not practical to include the private property beyond the northern boundary, but there was no breeding place of any consequence to the north for a considerable distance from the boundary.

The plan was not successful. *Mansonia perturbans* appeared in numbers during the third week in June. Of a total light trap collection of 4731 mosquitoes for the eight-day period from July 3–10, from six widely dispersed traps, 89% were *M. perturbans*. The river "barriers" were ineffective against a species with such strong flight habits; the distant marshes beyond the northern boundary became a source of constant influx; and the set date for the larger-scale airplane operation was unfortunately far in the future (although from a malaria control standpoint there was no reason to attempt any change). One biting collection, on July 2, near the center of the populated area of the post, produced specimens at a rate of 83 in five minutes (996 per hour), of which 81 were *M. perturbans*.

It was obvious either that the population of this species had been unusually small in the two preceding years (the only ones for which data were available), or that the 1946 season was producing a bumper crop.

Mansonia perturbans has a single generation each year. The eggs are laid in floating rafts during the summer. The larvae overwinter. Pupation occurs in summer and the adults emerge thereafter, the greatest emergence apparently taking place in early summer. The larvae possess a breathing tube but are said not to come to the surface for air as do other culicine larvae. Instead, the breathing tube is inserted into the stem of an aquatic plant beneath the surface of the water and air is obtained through the stem. Thus, conventional larviciding procedures are ineffective against this species, although much remains to be learned of the potentialities of DDT in this respect. The adults bite fiercely during a short period in the evening, making it necessary to obtain biting records within a very limited time interval to gain an accurate idea of the population. The biting collection already referred to was taken at the beginning of the flight period. So precise were the habits of these mosquitoes that, weather conditions remaining approximately the same, it was possible to predict within five minutes when heavy biting would begin, from observations of a previous evening. The length of the biting period was more variable, but generally speaking, an enormous difference in the data obtained at any given biting station resulted from a time lapse of twenty minutes after the onset of heavy biting.

Using the local equipment and 5% DDT in diesel oil #2, 3850 acres of the populated portion of the post were treated in eight flights, an average of slightly more than 480 acres per flight. Limitations of materials and the necessity of securing technical data on performance made larger scale operations impossible. Areas were selected in view of population densities as established by biting records and light trap collections. In general, an estimated 0.3 pound of DDT per acre was used in these tests. Results were gratifying, but of short duration. At the biting station mentioned above (rate before treatment 996 per hour), the biting rate was immediately reduced by 88%, and five days later the reduction was 78% of the original figure. But this was unusual. Another biting station in another test area showed a 100% reduction in twenty-four hours, but the rate nine days later was 163% of the original rate. In another area, immediate reduction by 45% was followed by an increase to 164%. It is realized, of course, that biting collections are liable to considerable error, and these figures are cited merely to demonstrate a trend. Unfortunately no data were obtained on the

[2] Details of this development are to be included in a report (TDMR) of the Chemical Corps at a future date.

emergence of adults. "Control" biting station records yielded invalid data because of the extreme periodicity of the biting habits of this species, and the lack of qualified personnel, at that time, to take records simultaneously in two separate areas. By the time a "control" area was reached, after having taken a biting collection in a sprayed area, the flight period was past, or nearly so.

Reasons for the rapid build-up in population after the immediate reduction are matters for speculation. Obviously the population might be restored by influx from neighboring untreated areas, as well as by new emergences of adults. Figures obtained in later operations in untreated control areas indicate a possibility that a constant and more rapid increase in population might have occurred, without treatment, and that the treatment was thus beneficial, even though the results were of short duration. Reduction in the number of natural enemies seems of little consequence in view of surveys which were made by the Fish and Wildlife Service at a later date.

In all of the airplane spraying described above, the area of the peninsula south of the populated area was practically untouched, to prevent introduction of imponderables to the conditions of the larger airplane-spraying operation to come, and none of these smaller operations took place in the two-week period preceding July 16.

On July 16, as scheduled, treatment of the 3500 acres already described took place. Using a 20% solution of DDT in a special solvent, the application was approximately 0.20 pound of DDT per acre. The plane was a C-47 equipped with a 675-gallon capacity belly tank with a 7/8 inch diameter discharge pipe which could be opened and closed by the pilot. The swath intervals were 100 yards and were marked on the ground by smoke grenades.

Data on this operation, from light trap records are set forth below. Traps 1 and 5 were located at such a distance from the sprayed areas that they fulfilled most requirements for "controls." The number of days, which is variable in these data, represents no selection by the writer—the dates include all those for which determinations were made by army laboratories.

The "after" records, in no instance, were taken more than six days after the spray was applied. Later catches were not determined to species, so that totals for all species are all that are available. These show that, until August 13, there was a gradual increase in population. The population by that date had not attained the pre-spray level, the total catch for all traps for the week ending on August 13 being only 23.3% of the total catch for the week ending July 15, the day before the spraying.

Numerous biting records made on the day before, and during the week after the large-scale spraying operation of July 16 present a picture similar to that presented by the light traps—with a similar unexpected effect on some "control" stations.

Conclusions concerning the effectiveness of DDT, applied as described above, as a measure against *M. perturbans* are to be drawn with caution. As previously noted, in the case of small areas treated from the air, reduction in population was swift and spectacular, but of short duration, the sort of result one might expect in the case of an "adulticide" used against a strong-flying species. No data were obtained on larvicidal action, if any, and none were obtained on emergence rates, a factor which should be of considerable

AVERAGE DAILY CATCH OF *M. PERTURBANS*

	Before spraying	*After spraying*
Trap #1 (nine days)	54.55	48.60 (five days)
Trap #2 (eight days)	223.63	9.50 (six days)
Trap #3 (nine days)	133.00	2.85 (six days)
Trap #4 (four days)	361.75	3.67 (three days)
Trap #5 (eight days)	49.63	15.17 (six days)
Trap #6 (nine days)	22.00	1.67 (three days)

importance in the reestablishment of a heavy population following an application of spray.

In the larger operation of July 16, the reduction was pronounced and longer-lived. Such a result, of course, would occur if neighboring sources of infiltration were treated, as was the case. However, it must not be concluded that such a result would prevail under different conditions. It is very probable that the peak of emergence of *M. perturbans* had occurred before July 16. If the date of the larger spraying operation had been prior to the peak of emergence, it is reasonable to entertain the possibility that the results would have been less gratifying from the standpoint of duration.

FIG. 1. Outlook from mouth of Watson's Creek showing typical *Mansonia* breeding ground.