NEW JERSEY STATE MOSQUITO CONTROL COMMISSION

Vector Surveillance Report

MOSQUITO RESEARCH AND CONTROL

Vol. 2 **No.** 4 **Period** August 22-23, 1977

Introduction

The brood of Aedes sollicitans which emerged from New Jersey's coastal salt marshes during the second week of August is still very much in evidence at most of the sites. Extended emergences as a result of intermittent rains have added fresh mosquitoes to the populations which are now seeking their second bloodmeal.

This brood was unique in many respects. The mosquitoes were spread out over a wide area which made larval control difficult and the repeated rains compounded the problem by reinfesting areas of marsh that had already been treated. The emergence occurred during the peak of the tourist season and the combination of rainy weather and mosquito annoyance provoked numerous complaints from the public.

The brood was unique in another aspect because 90% of the surviving population was able to acquire blood, lay eggs and seek a second host within 7-8 days' time. An Ae. sollicitans population usually requires at least two weeks to reach this status but this brood accomplished the numerous events in half the time. Had EE virus been active, the brood would have been in an excellent position to acquire virus and serve as a vector to humans. Luckily, virus was not active, thus the mosquitoes caused nuisance only.

One of the aims of the Vector Surveillance Program is to keep health related agencies up to date on the current knowledge pertaining to EE. Had virus been active, mosquito control would have been besieged with questions. The following discussion sums up the current knowledge on the disease and points out some of the aspects which require further investigation.

Current Knowledge of the Epidemiology of Eastern Encephalitis

Eastern encephalitis virus is one of many mosquito-borne arboviruses that occur in the United States. Virus activity appears to be restricted to the eastern seaboard which includes a belt from New England south to the Gulf coast states. The distribution of cases follows the Atlantic flyway, thus, virus activity also occurs in much of the Carribean region.

The Causal Agent

Like most of the arboviruses, the causal agent has an affinity for the central nervous system in the vertebrate host and replication of virus particles takes place in the brain and spinal fluid. This produces fever, nervous dis-functions and coma which lead to the common name of sleeping sickness. Many different viruses produce similar symptoms thus diagnosis is dependent upon serological data.

Eastern encephalitis virus is particularly severe in the human host and approximately 50% of the cases which develop overt symptoms end in death. A large percentage of those that recover suffer permanent brain damage which ranges from a mild lack of coordination to complete incapacitation of the mental faculties depending upon the severity of the infection. Fortunately, very few individuals who contract EE virus ever develop overt symptoms. An overwhelming percentage result in an inapparent infection which usually goes unnoticed or is thought to be a common summer cold.

The Reservoir Hosts

The virus responsible for eastern encephalitis is carried by a variety of wild birds. The virus is transmitted from bird to bird by mosquitoes and the cycle occurs at low levels every year. EE is one of the birds' natural diseases and the virus does not normally cause extensive mortality in the wild bird population. Non-native birds are an exception and they frequently die in large numbers when virus is active. The pheasant, which was introduced to this country from the Far East, is an excellent example for EE often kills off entire flocks of pen-raised pheasants before they can be released in game management areas.

The Cycles in Nature

A variety of mosquito species perpetuate EE in the wild bird population over a wide geographic area but the disease usually remains at a very low level in most years. This is termed the "enzootic cycle" or the maintenance cycle in nature. During a typical year of enzootic activity, EE virus is usually located if enough bird bloods or mosquito pools are screened but the incidence is low and remains low throughout the mosquito season.

In other years, EE virus is much more evident in the bird population and the levels usually peak during mid-summer. This is termed an "epizootic" or sharp increase in virus activity within the avian reservoir of the infection. When this occurs, outbreaks begin in pheasant flocks and horse cases begin to appear. The horse is particularly susceptible to EE and mortality is usually extensive. The advent of horse involvement signals the possibility of eventual human cases, for the virus has reached the point where it is no longer restricted to the avian cycle. The progression from enzootic cycling to epizootic cycling to eventual

epidemic transmission has been documented in enough instances to believe that this is the normal progression for the disease in nature. The sequence of events which takes place during each of these steps, however, is not altogether clear.

The Epizootic Cycle

Numerous epidemiological investigations have suggested that epizootics in wild birds are usually restricted to limited foci rather than broad geographic areas. During years when virus is particularly active, a number of active foci may occur over a wide geographic range but most of the intensive bird to bird transmission is thought to take place in relatively small pockets. Virus tests suggest that these pockets correspond to the breeding habitat of the mosquito, Culiseta melanura. This mosquito feeds almost exclusively on birds and has been shown to be an efficient vector of EE virus. Whenever virus is active, it can be found in Cs. melanura. In almost all cases, Cs. melanura appears to be responsible for the epizootic cycle in nature which occurs within its moist woodland habitat.

Culiseta melanura habitat is widespread in New Jersey and relatively large local populations can be found in most of the counties. Pheasant outbreaks are also widespread thus Cs. melanura is thought to be responsible for most of the transmission to pheasants. Without exception, a local population of Cs. melanura has found each time that a pheasant outbreak has been reported. Most of the pheasant flocks in New Jersey are now vaccinated against EE.

Horse Cases

The mosquito vector to horses is less clear for horses also contract EE over a broad geographic range. In most cases, local populations of Cs. melanura can be found in close proximity but the mosquito does not normally accept mammalian blood. Some workers feel that Cs. melanura is capable of transferring the virus directly to the horse from the epizootic bird cycle. Others feel that an additional mosquito vector is involved and that Cs. melanura is responsible only for the bird cycle. Aedes vexans is most often cited as a likely vector from birds to horses but only circumstantial evidence has been gathered to date. Since horse cases are widespread in the State it will be difficult to verify the hypothesis. Ae. vexans is a brooded mosquito and is relatively short lived. There is no way to predict where the next horse case will appear and by the time that a case is reported, the cycle is usually over and the vector population has died off.

Human Cases

Human cases of eastern encephalitis are less frequent than horse cases but the epidemiology of the epidemic cycle is easier to investigate. This is due to the geographic distribution of human cases which is restricted to a narrow band of coastline in the southern portion of the State. Human cases have reappeared in the same areas with enough frequency to define the epidemiology of transmission.

The coastline of southern New Jersey is characterized by extensive areas of salt marsh wetlands. These flood at periodic intervals and produce large broods of Aedes sollicitans, the New Jersey salt marsh mosquito. Each brood moves into the upland for a bloodmeal, but the mosquitoes must return to the salt marsh wetlands to deposit their eggs. This produces a series of synchronous waves of mosquitoes as they shuttle back and forth from their breeding habitat for their "feeding grounds."

The coast of southern New Jersey is also characterized by extensive areas of cedar swamp and swamp maple woodlands. In many areas, acid water drainage from the pine barrens in southern New Jersey has created large blocks of this habitat on the upland edge of the salt marsh boundary. Large populations of Cs. melanura build up in this habitat if the swamps remain wet for the entire season.

Epidemiology of Transmission

Aedes sollicitans must pass through the cedar swamp habitat to reach the upland. The mosquito is a voracious blood feeder which readily accepts human blood but in nature the majority of the population feeds on a wide variety of wild animals. Ae. sollicitans is the most efficient vector of EE virus that has ever been tested in the laboratory and the mosquito is considered to be a major vector of the disease to humans.

The conditions for transfer of virus from birds to humans are ideal in New Jersey in years when epizootic cycling takes place. When Cs. melanura creates an epizootic in the swamps which border the salt marsh, Ae. sollicitans has the opportunity to pick up virus as it passes through the habitat on its way to the upland. Those mosquitoes which do feed on birds have a short trip and quickly return to the marsh to deposit their eggs. These same mosquitoes, including any which picked up the infection, would return to the upland in quest of a second bloodmeal. Transfer of the virus to humans would take place if the Ae. sollicitans that became infected located a human host to feed upon during its second trip.

Unanswered Questions

The events which lead to epizootic cycling and eventual epidemic transmission probably require an intricate set of circumstances where all aspects become coordinated by proper timing. The density of the Cs. melanura population in the early season is probably critical to eventual epizootic cycling later in the year and the introduction of the virus via infected birds which have migrated North may also be critical in its timing. Rains must restore the water levels in the cedar swamps to provide Cs. melanura with continuous breeding habitat from early spring to late fall. An Ae. sollicitans population of sufficient magnitude must also be introduced at the proper time to acquire virus from the birds. If all of these events occurred, the temperatures at the moment would have to be high enough to allow the mosquitoes to age at a rate where incubation of the virus and length of the gonotrophic cycle allowed the infected mosquitoes to live long enough to make the transfer.

All of these events took place in proper order in 1959 as well as four separate years since that time. On several occasions, most notably 1975, the cycle was aborted before it progressed to humans. Whether this was due to the magnitude of the Cs. melanura population, timing of rains, emergence of an Ae. sollicitans brood or temperature is not known. These are some of the questions which the Vector Surveillance Program is trying to answer. Mosquito control has become more efficient since the last outbreak of EE in New Jersey and mosquito control may have been solely responsible for aborting the potential outbreak in 1975. As New Jersey becomes more crowded, however, more and more people are building their homes within the narrow band of coastline where virus activity appears to be most intense. If virus ever becomes active again, mosquito control will be called upon to alleviate the situation. Control, however, will have to be directed toward the source if it is to be effective. The New Jersey State Mosquito Control Commission is trying to identify that source through vector surveillance.

Results for the Period August 22-23, 1977

Data from this week's collections show that the vector potential ratings of the Ae. sollicitans populations remain quite high at most of the sites. The main brood is now more than 2 weeks old but landing rates remain relatively high in most areas. The repeated emergences that occurred at most sites have undoubtedly been responsible for this extended nuisance by adding fresh mosquitoes to a population that was already above normal. Repeated emergences, however, have also produced above normal vector potential ratings for most of the period.

The data from the past two weeks also show how the State Airspray Program can be used to suppress vector potential. The West Creek area received 3 separate airsprays during the period. The Ocean County Mosquito Commission's light trap records, landing rate counts and truck trap records showed that the brood was well above normal. The landing rates are now low and the area has a vector potential rating of less than 3, the lowest of any of the sites under study.

The Tuckahoe site, a wildlife management area, was not treated and the brood was allowed to age unchecked. Vector potential at Tuckahoe last week was the highest ever recorded at 31.5. This week, the rating climbed even higher with landing rates of 75/min and a vector potential of 50.8. Estimating the landing rates at the Tuckahoe site was difficult because the numbers of mosquitoes made counting impossible. The figure of 75/min was used for the calculations but the rates were probably much higher.

The most impressive point in the Tuckahoe data is the number of parous mosquitoes in that large biting population. More than 50 mosquitoes which come to bite each minute had fed on blood before. A large proportion of these mosquitoes will probably live to feed 3 or more times before natural mortality eliminates the population. The human health hazard would be severe if human pathogens were known to be active but the animal health hazard is a reality now. Dog heartworm

is the best example for it is widespread in southern New Jersey and Ae. sollicitans can function as an efficient vector. Any dog continually exposed in this area would receive an incalculable number of bites from mosquitoes that are capable of harboring the parasite. Avoiding infection under these circumstances would be highly unlikely.

Data from the Delaware Bay coast of New Jersey shows a similar trend. The Dennisville site received 2 State Airsprays. The vector potential of the Ae. sollicitans has dropped but not to the low levels at West Creek. The Port Norris site only received 1 State Airspray and the vector potential rating increased to 27.2 during the past week. These data indicate that repeated treatments may be necessary to totally suppress the vector potential of a large brood during a health emergency.

Culiseta melanura

The recent rains have apparently restored some of the Cs. melanura habitat. Males were observed in the resting boxes last week and increased numbers of females were present at most sites in this week's collections. The resting boxes at the New Gretna site averaged 1.7 Cs. melanura, the highest collections in nearly 2 months. At Dennisville the collections climbed from 6.4 to 8.3 Cs. melanura per box. The other sites remain low but some Cs. melanura are now present in areas where they were undetectable earlier in the summer.

The Status of Culex tarsalis in New Jersey

A third Cx. tarsalis was detected in a light trap collection this week by the Ocean County Mosquito Commission. The specimen was taken on Long Beach Island, nearly 20 miles from the two previous recoveries. This third specimen is the strongest evidence yet that Cx. tarsalis is now breeding in the State. Each of the county mosquito commissions is carefully examining their light trap and resting box collections to determine if the species is more widespread than suspected.

The Ocean County Mosquito Commission in cooperation with the Experiment Station is presently establishing a special trapline in the area of the collections to pinpoint local populations and locate the breeding sites. If additional specimens are found, the survey will be extended to other counties.

List of Personnel:

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Cooperating County Mosquito Control Superintendents:	Frederick Lesser, Ocean County Brian Gooley, Burlington County Judy Hansen, Cape May County Joseph Mason, Atlantic County Patrick Slavin, Cumberland County William Fisher, Salem County
State Mosquito Control Coordinator:	Kenneth W. Bruder
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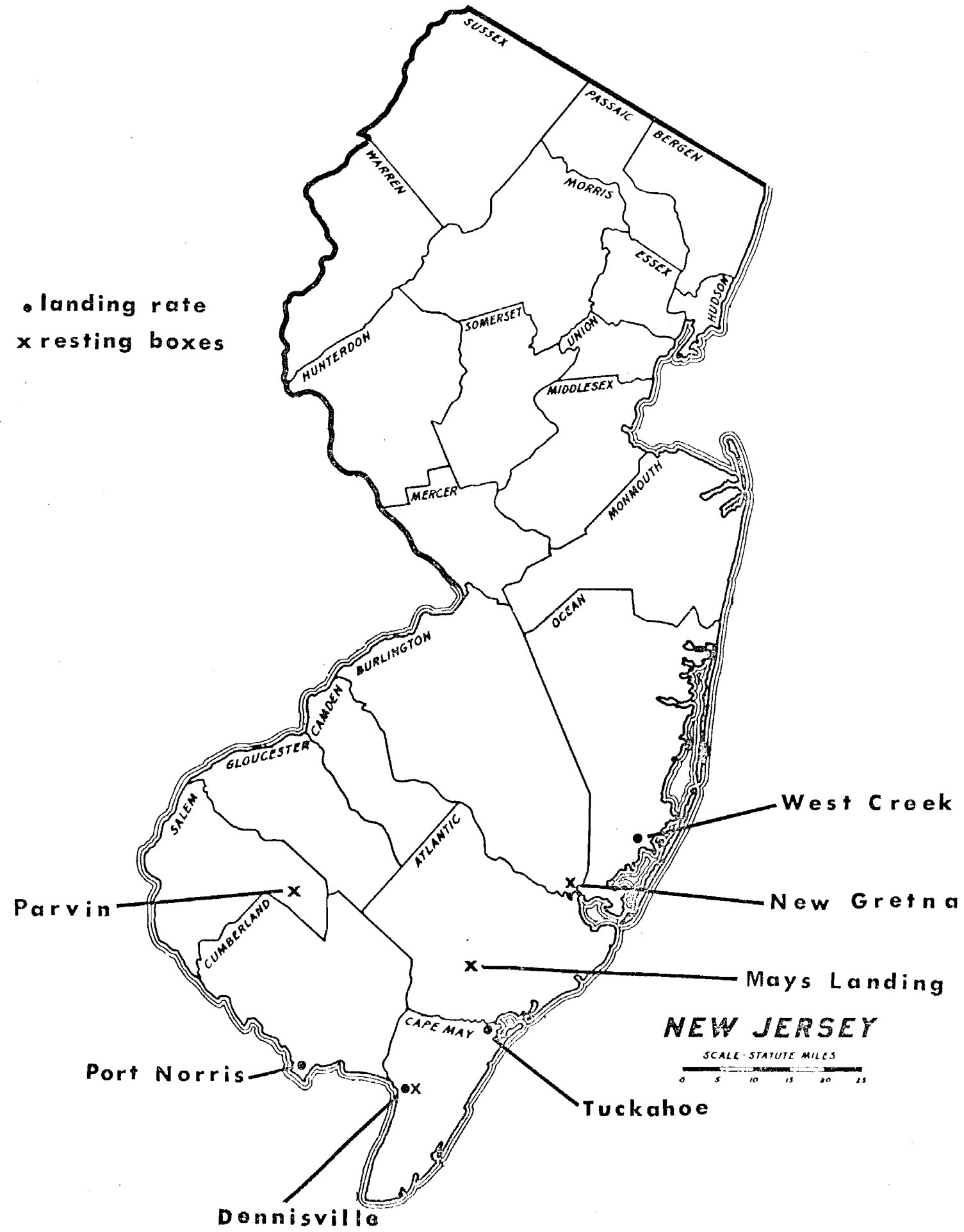
Study Sites

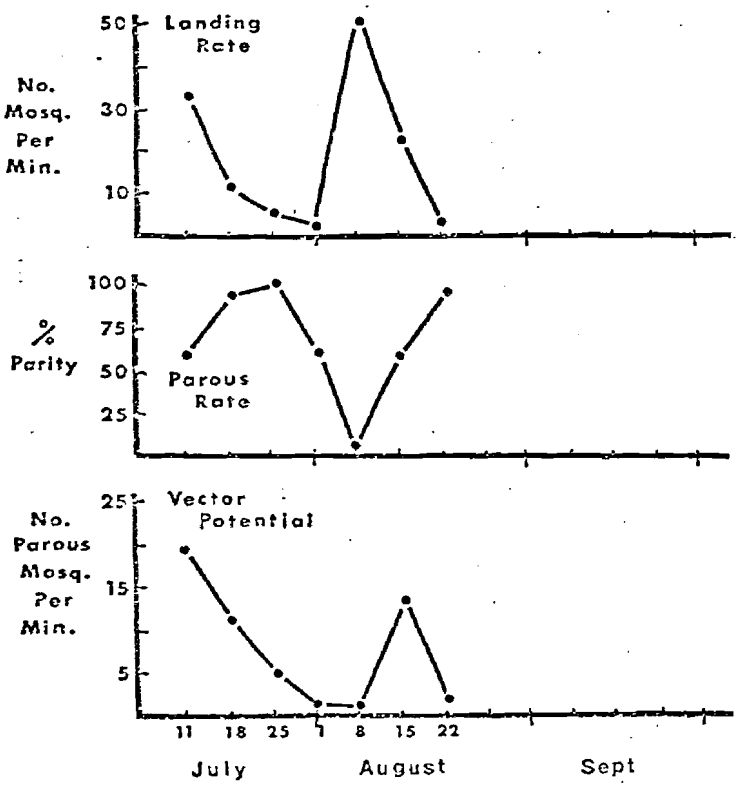

• landing rate
x resting boxes
SUSSEX
PASSAIC
BERGEN
WARREN
MORRIS
ESSEX
HUDSON
SOMERSET
UNION
HUNTERDON
MIDDLESEX
MERCER
MONMOUTH
OCEAN
BURLINGTON
CAMDEN
GLOUCESTER
SALEM
ATLANTIC
CUMBERLAND
CAPE MAY
West Creek
New Gretna
Parvin
Mays Landing
Port Norris
Tuckahoe
Donnisville
NEW JERSEY
SCALE - STATUTE MILES
0 5 10 15 20 25

Aedes sollicitans

SITE WEST CREEK
COUNTY Ocean
COLLECTION DATA
Date Aug. 22, 1977
Landing Rate 3/min
Parous Rate 95%
Vector Potential 2.9
(Parous Landing Rate)

REMARKS: This area has the lowest vector potential of the sites examined in these studies.

CUMULATIVE RECORD



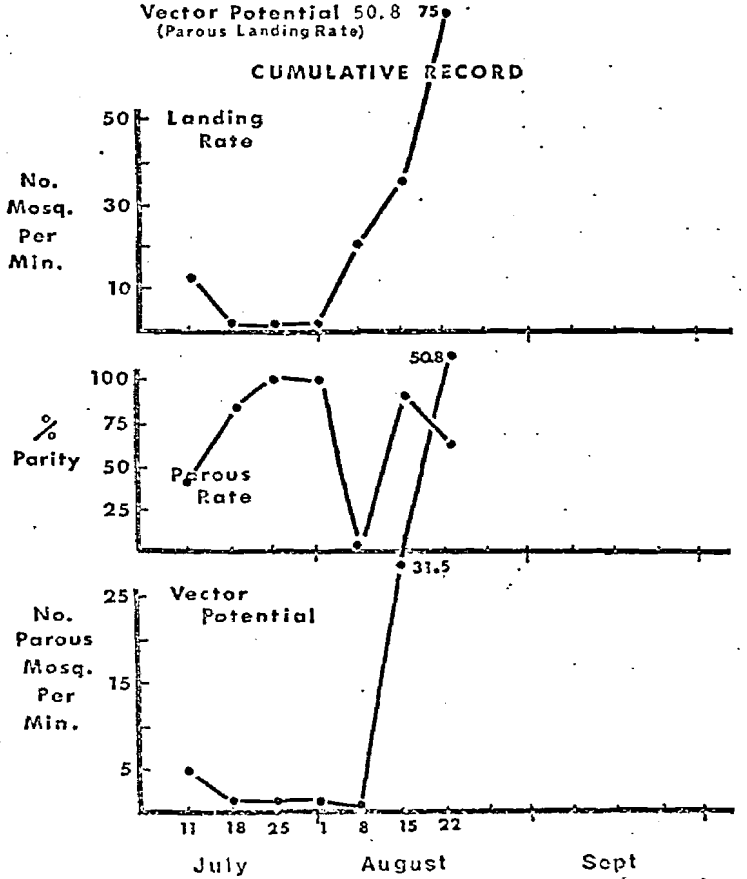
NOTES: Approximately 4000 acres in the West Creek area received a State Airspray with Dibrom + HAN on August 18, 1977. 30 Ae. sollicitans from this population were submitted for virus assay.

Aedes sollicitans

SITE TUCKAHOE
COUNTY Cape May
COLLECTION DATA
Date Aug. 22, 1977
Landing Rate 75/min
Parous Rate 65%
Vector Potential 50.8
(Parous Landing Rate)

REMARKS: The vector potential of this population has actually increased since last week. The peak is unbelievably high.

CUMULATIVE RECORD



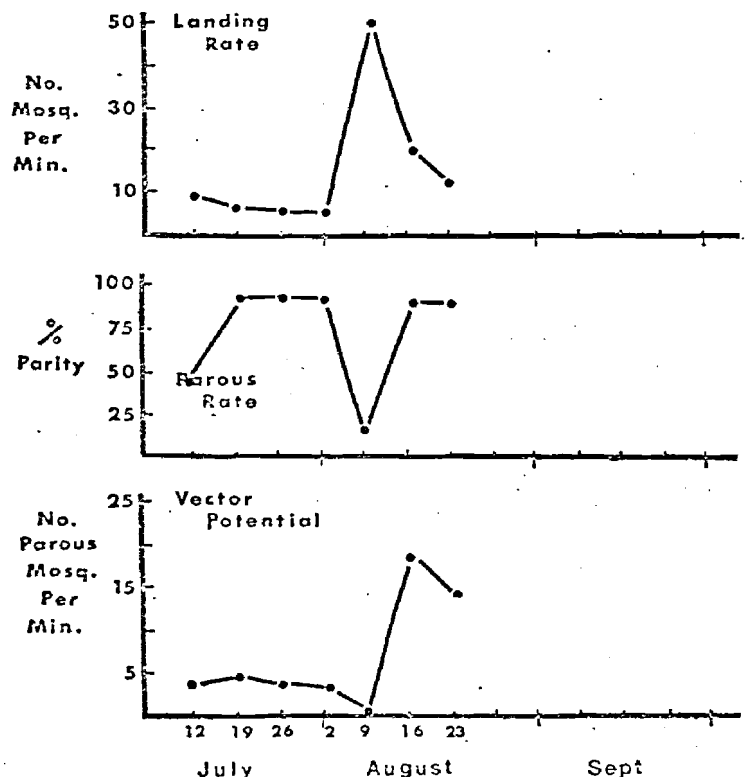
NOTES: This population did not receive a State Airspray and demonstrates the potential of an uncontrolled brood of Ae. sollicitans. 200 Ae. sollicitans from this population were submitted for virus assay.

Aedes sollicitans

SITE DENNISVILLE
COUNTY Cape May
COLLECTION DATA
Date Aug. 23, 1977
Landing Rate 12/min
Parous Rate 90%
Vector Potential 10.8
(Parous Landing Rate)

REMARKS: Landing rates have diminished over the past week but vector potential remains fairly high.

CUMULATIVE RECORD



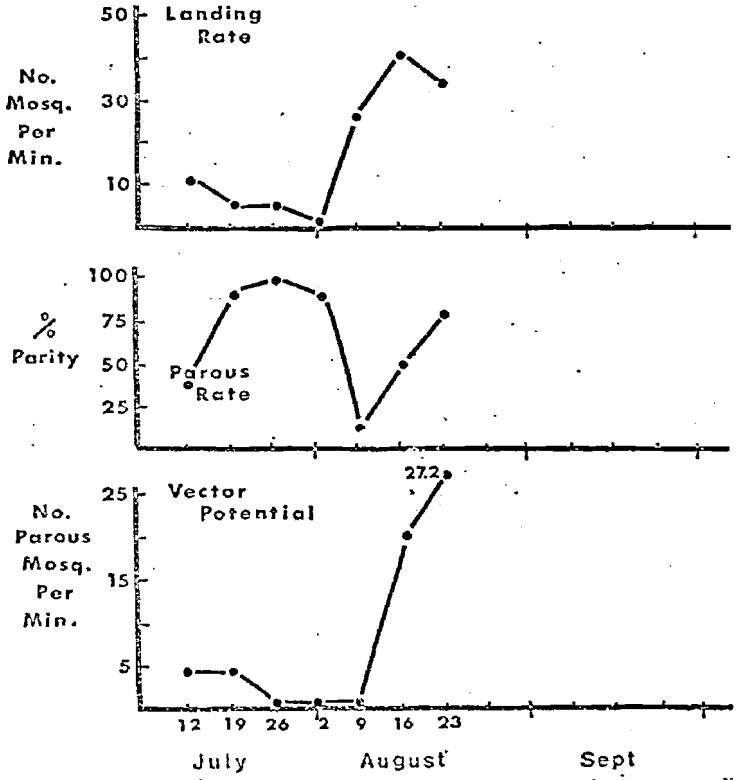
NOTES: Approximately 5000 acres in the Dennisville area received a State Airspray with Dibrom + HAN on August 18, 1977. 100 Ae. sollicitans from this population were submitted for virus assay.

Aedes sollicitans

SITE PORT NORRIS
COUNTY Cumberland
COLLECTION DATA
Date Aug. 23, 1977
Landing Rate 34/min
Parous Rate 80%
Vector Potential 27.2
(Parous Landing Rate)

REMARKS: Parity has increased and vector potential is very high at the moment.

CUMULATIVE RECORD



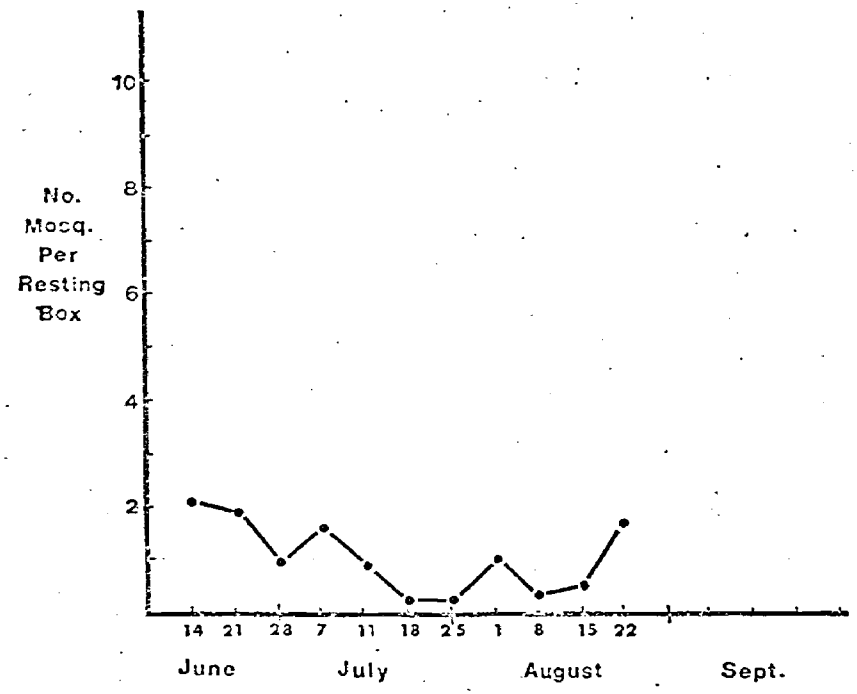
NOTES: This area did not receive a State Airspray but surrounding areas were treated with malathion ULV on August 19.

Culiseta melanura

SITE NEW GRETNA
COUNTY Burlington
COLLECTION DATA
Date Aug. 22, 1977
No. Boxes
Examined: 23
Total C.mel. 38
C.mel./Box 1.7

REMARKS: Cs. melanura collections increased by 3-fold over the past week.

CUMULATIVE RECORD



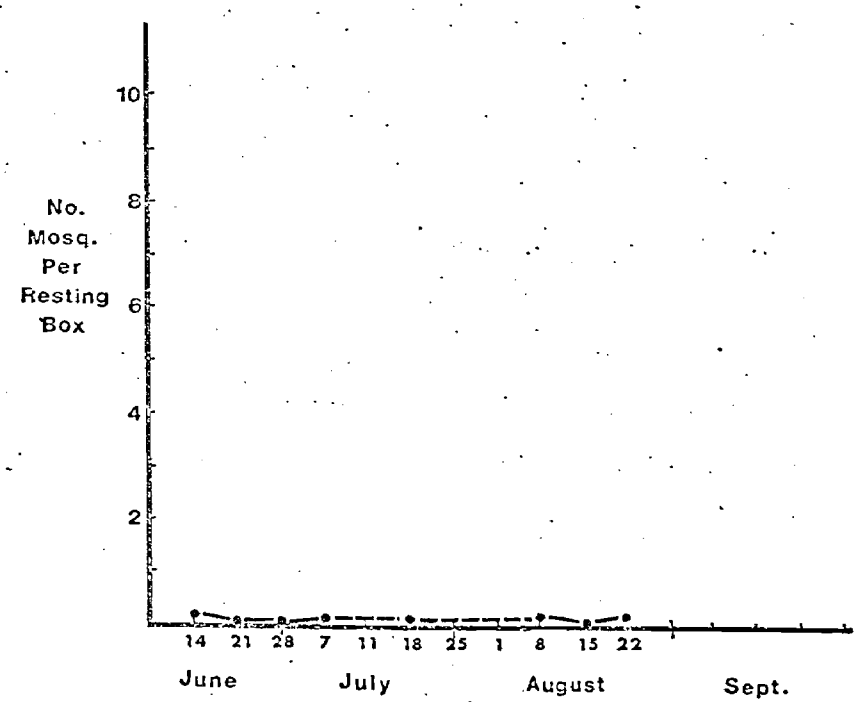
NOTES: Submitted 23 blooded and 15 nonblooded Cs. melanura for virus assay.

Culiseta melanura

SITE MAYS LANDING
COUNTY Atlantic
COLLECTION DATA
Date Aug. 22, 1977
No. Boxes
Examined: 20
Total C.mel. 2
C.mel./Box 0.1

REMARKS: Cs. melanura still barely detectable at this site.

CUMULATIVE RECORD



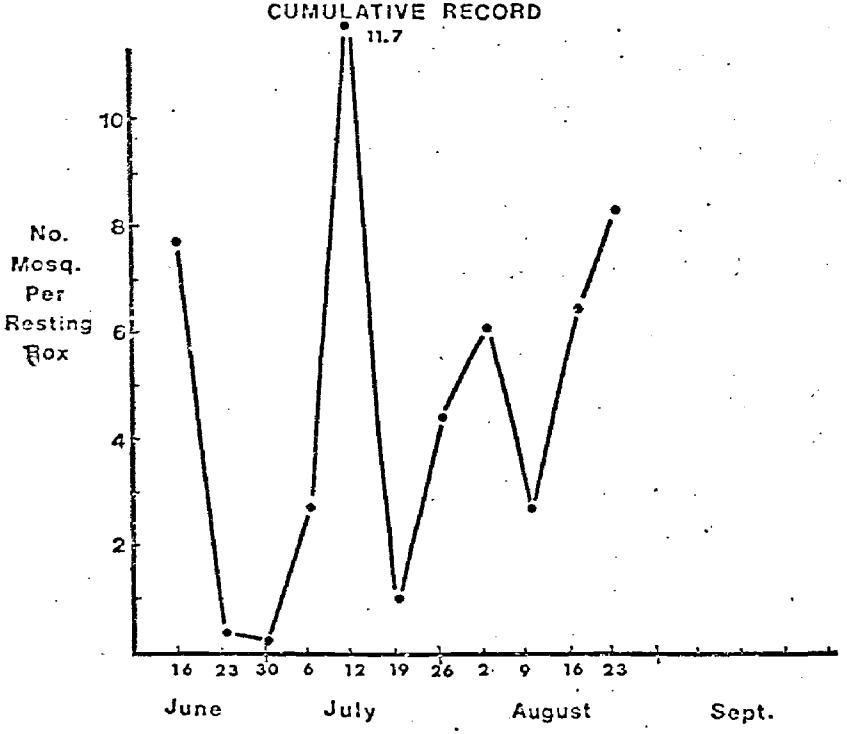
NOTES: Submitted 2 nonblooded Cs. melanura for virus assay.

Culiseta melanura

SITE DENNISVILLE
COUNTY Cape May
COLLECTION DATA
Date Aug. 23, 1977
No. Boxes
Examined: 25
Total C.mel. 208
C.mel./Box 8.3

REMARKS: This population is still increasing. Parity recorded at 20% which indicates that numerous freshly emerged mosquitoes have been added during the past week.

CUMULATIVE RECORD



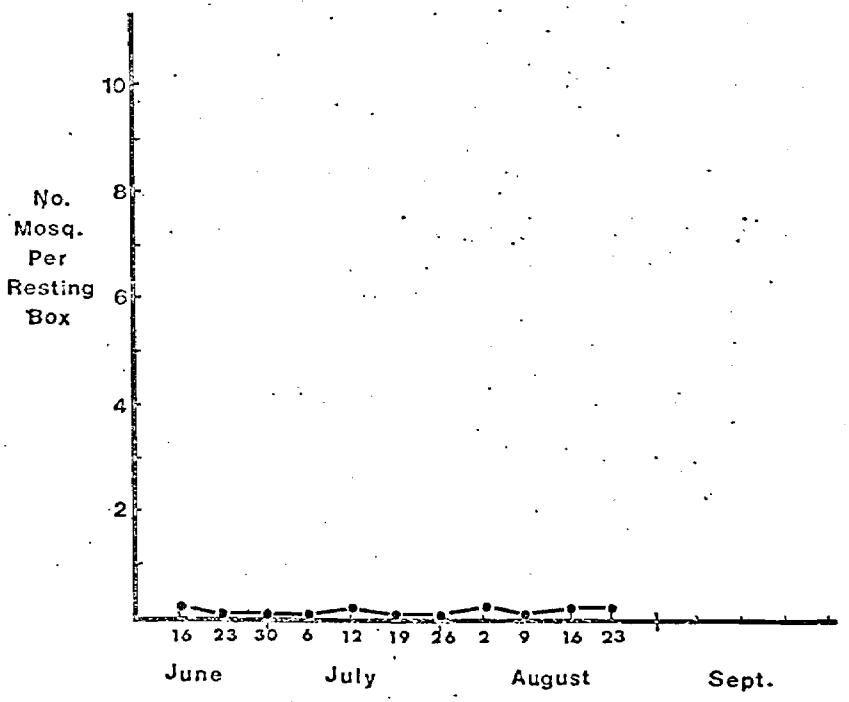
NOTES: Submitted 49 blooded and 159 nonblooded Cs. melanura for virus assay.

Culiseta melanura

SITE PARVIN
COUNTY Salem
COLLECTION DATA
Date Aug. 23, 1977
No. Boxes
Examined: 20
Total C.mel. 3
C.mel./Box 0.15

REMARKS: Cs. melanura remains very low at this site.

CUMULATIVE RECORD



NOTES: Submitted 2 blooded and 1 nonblooded Cs. melanura for virus assay.

Data From Vineland Diagnostic Laboratories

Culiseta melanura tested for EE virus during 1977

Date Collected	Area	No. Tested	Initial Screening	Confirmation of Positive Pools
7/25/77	New Gretna	5 blooded	Negative	
		3 nonblooded	Negative	
7/26/77	Dennisville	19 blooded	Negative	
		186 nonblooded	Negative	
8/01/77	New Gretna	32 blooded	Negative	
		16 nonblooded	Negative	
8/02/77	Dennisville	37 blooded	Negative	
		116 nonblooded	Negative	
8/02/77	Parvin	7 blooded	Negative	
8/08/77	New Gretna	5 blooded	Negative	
		3 nonblooded	Negative	
8/08/77	Mays Landing	3 nonblooded	Negative	
8/09/77	Dennisville	10 blooded	Negative	
		39 nonblooded	Negative	
8/15/77	Warren Grove	2 blooded	Negative	
		1 nonblooded	Negative	
8/15/77	New Gretna	4 blooded	Negative	
		8 nonblooded	Negative	
8/16/77	Dennisville	40 blooded	Negative	
		110 nonblooded	Negative	
8/22/77	New Gretna	23 blooded		
		15 nonblooded		
8/22/77	Warren Grove	2 blooded		
		3 nonblooded		
8/22/77	Mays Landing	2 nonblooded		
8/23/77	Dennisville	49 blooded		
		159 nonblooded		
8/23/77	Parvin	2 blooded		
		1 nonblooded		

Specimens Submitted for Virus Assay

Aedes sollicitans

Date Collected	Area	No. Tested	Initial Screening	Confirmation of Positive Pools
8/15/77	West Creek	100	Negative	
8/15/77	Tuckahoe	381	Negative	
8/16/77	Dennisville	100	Negative	
8/16/77	Port Norris	175	Negative	
8/22/77	West Creek	30		
8/22/77	Tuckahoe	200		
8/23/77	Dennisville	100		
8/23/77	Port Norris	365		