

# New Jersey Vector Surveillance

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## Introduction

The Vector Surveillance Program to monitor eastern encephalitis (EE) in New Jersey is currently entering its fifth year of study. The program is basically a research effort which has been designed to gather continuous data on the status of the mosquito vector populations and to define interactions which eventually lead to epidemic transmission. Information on the status of the mosquito vectors in key areas of the State and the presence or absence of virus is compiled during the mosquito season and mailed, in this report, to interested individuals throughout the country. In 1980, a bird bleeding program has been added to the study to help follow the course of virus in the natural cycle.

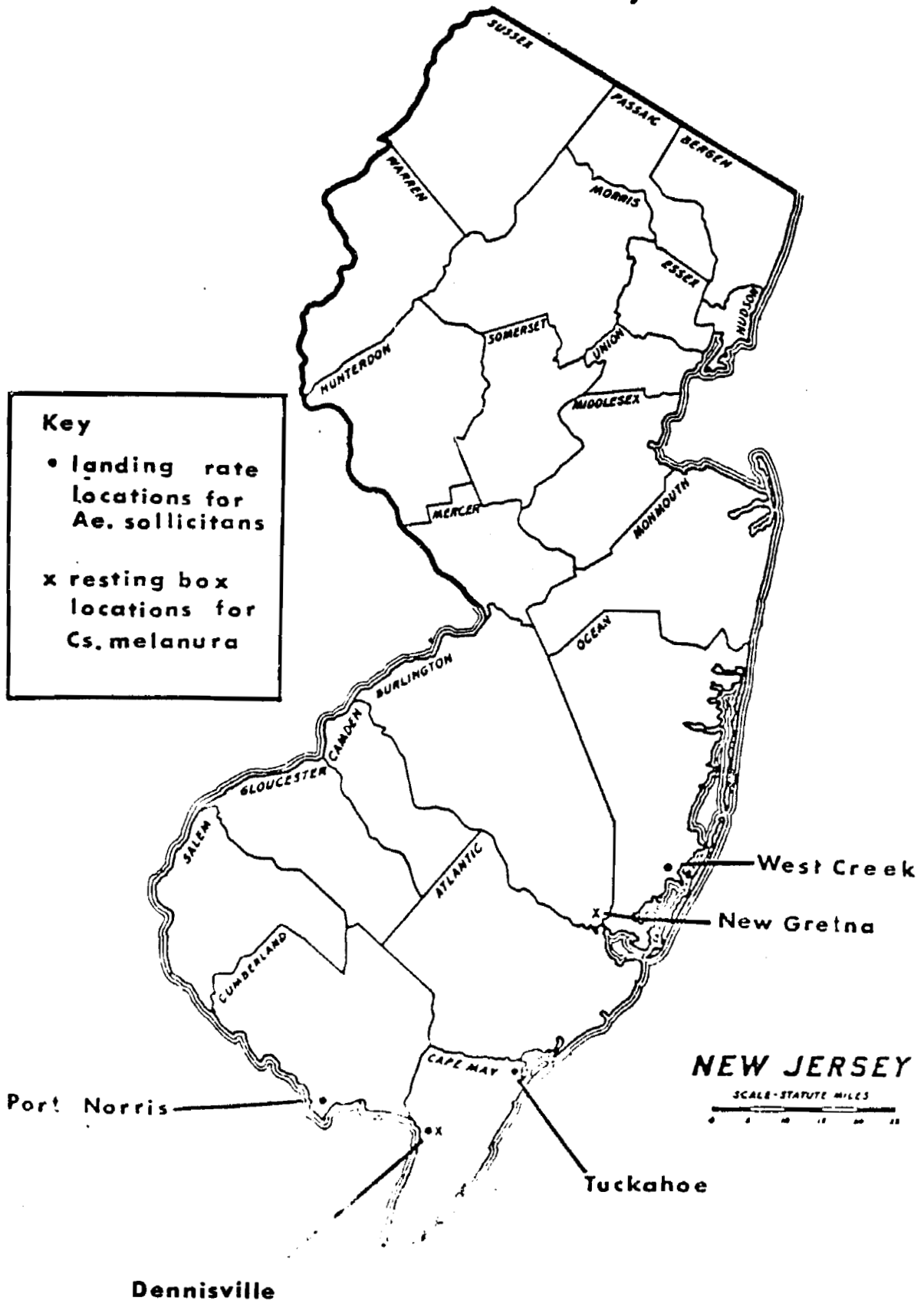
## Rationale of the Investigation

Arthropod-borne diseases are generally the culmination of a complex series of events involving the causal agent, the reservoir hosts and the arthropod vectors. In some cases, the basic cycle is relatively simple; in others, the cycle is quite complex. EE appears to be an extremely complicated disease entity involving a number of separate cycles and mosquito vectors. Although EE is widespread along the eastern coast of the U. S., southern New Jersey has long been a center of activity. The epidemiology of EE appears to vary considerably in different portions of the east coast range, thus, questions must be answered on a local basis.

The causal agent of EE is an alpha-virus that attacks the central nervous system in vertebrates. Wild birds serve as the reservoir hosts in nature and mosquitoes function as the major vectors. EE virus is often widespread in New Jersey during the summer months, but human cases are usually restricted to a narrow band of coastline in the southern portion of the State. Data suggest that two mosquito species, Culiseta melanura and Aedes sollicitans function as the primary vectors in the cycle. Cs. melanura is a fresh water mosquito that breeds in acid water and feeds mainly on avian hosts. The mosquito is frequently found carrying EE virus and is thought to be the major vector to birds. Ae. sollicitans is a salt marsh mosquito and is found in large numbers along the coast. The species is known to be an avid mammalian feeder and is thought to function as a major vector from birds to humans when EE virus becomes epizootic (epidemic in birds). Human cases of EE are classically contracted in areas where the habitats of these two species overlap. The southern coast of New Jersey contains many areas where vast acreages of salt marsh border the acid cedar swamp habitat.

Human cases of EE, however, are relatively rare in New Jersey and virus activity does not occur every year. In some years, the virus cannot be found in

# Vector Surveillance Study Sites



either birds or mosquitoes; in others, the virus reaches epizootic proportions in avians but does not manifest itself in humans. In epidemic years, the virus usually shows a logical progression, first appearing in birds, eventually infecting horses and ultimately reaching humans. Data suggest that Cs. melanura initiates an amplification of the virus in wild birds close to the salt marsh and Ae. sollicitans becomes the major vehicle for transfer to humans. Other mosquito species are undoubtedly involved, particularly in the horse cases that frequently occur inland, far from salt marsh mosquito flight patterns.

The Vector Surveillance Program is an attempt to monitor the events which lead to epidemic transmission and quantify the potential for transmission in any year. The information is now being used to forewarn health agencies in the State and implement vector control prior to outbreak conditions.

#### Methodology of the Survey

Three populations of Ae. sollicitans and two populations of Cs. melanura that have been monitored since 1976 form the baseline for assessing EE activity in the State. The study sites represent areas of high mosquito density as well as a history of EE activity. The locations of the study areas can be found on the accompanying map. In 1980, a fourth Ae. sollicitans site will be established in Atlantic County, close to Atlantic City. Low mosquito populations during the first part of this year have not allowed the program to pick the exact location with certainty.

A team of 2-3 researchers will visit each study site twice weekly from mid May to October to assess the status of the mosquito populations. Cs. melanura are monitored with a line of 25 resting boxes at each site to assess peaks and declines in the population from spring through fall. All Cs. melanura are saved for virus screening. The specimens are sorted into pools of blooded, non-blooded, black-blooded and gravid mosquitoes and are then sent to the New Jersey State Department of Health for testing. Virus in Cs. melanura is interpreted as an indirect indication of viremia in the local bird populations as well as the initiation of virus amplification by the epizootic vector.

Ae. sollicitans are monitored by a technique that combines population density with physiological age. Landing rates are taken at each of the study sites to assess nuisance levels and a subsample from the biting population is dissected to determine the percentage that has laid eggs and is seeking a subsequent blood meal. Multiplication of the landing rate by the parous rate of the population indicates the number of parous mosquitoes that are coming to bite per unit time. Since parous mosquitoes (mosquitoes which have laid eggs and thus fed on blood at least once) are the vectors in the immediate population, the parous landing rate is plotted and used as a vector potential index.

The vector potential index has proven to be extremely useful in comparing risk as the season progresses. Research has shown that the vector potential of Ae. sollicitans shows distinct peaks during the season with a usual buildup in late August and early September. Data suggest that the timing of the late-season vector potential peak may be a major factor in the transfer of virus from the epizootic cycle to the epidemic vector population. To date, there is only indirect evidence to support the hypothesis but whenever epizootic activity is documented, large numbers of Ae. sollicitans are collected for virus screening.

Ae. sollicitans are also collected at each site for blood meal analysis. The specimens are vacuum-aspirated from their resting sites with a gasoline powered

D-Vac unit and all blooded mosquitoes are saved for host identification using serological procedures. Seasonal shifts in host-seeking behavior have been described for other species and in some cases may play a major role in the transfer of virus from one cycle to the next. The serological study with Ae. sollicitans will attempt to determine if a similar shift takes place within the main endemic focus.

In 1980, a bird bleeding program has been added to the study to follow the sequence of virus buildup as the season progresses. Wild birds are being mist-netted and bled five days each week at the Cs. melanura study sites. The bloods are being processed by the New Jersey State Department of Health for both virus and antibody. Antibody levels in the local bird populations are useful indicators of virus activity, because they show which bird species are involved in the cycle and indirectly demonstrate the activity cycle of the mosquito vectors.

#### Summary of Findings in 1979

Eastern encephalitis was active in 1979 with both horse and human involvement. In early September, two horse cases were reported and a single human case was documented later in the month. Additional horse cases were reported in September, but the diagnoses were somewhat presumptive. One pheasant flock was also positive for EE very late in October.

Available data suggest that most of the active transmission took place in late August and the sequence of events follows a classical pattern for New Jersey. Low level virus activity was detected in Cs. melanura in early July and the virus reached epizootic proportions during August. In early September, the first horse cases appeared, one in a semicoastal area of the State and the second at an inland site. The human case was documented shortly thereafter and was apparently contracted at the New Jersey shore in late August. Data from the vector surveillance program showed that the epizootic was most intense on the eastern coast of the State (in direct contrast to the normal pattern where virus activity is normally greatest along the Delaware Bay). The human case was apparently contracted on the east coast, in Atlantic County (where mosquito control has been drastically reduced in recent years). The presumed date of transmission coincided exactly with the vector potential peak of the fourth Ae. sollicitans brood of the season. No infected Ae. sollicitans were collected during that period even though numerous specimens were processed for virus. Mosquitoes, however, were not collected from the county where the case was contracted until well after the brood has dissipated.

#### The Current Status of EE and its Mosquito Vectors

At the time of this writing, there has been no evidence of either Eastern encephalitis or Highlands J virus in any of the systems that are being tested. Cs. melanura populations on the eastern coast of the State appear to be about average and well below the levels documented last year (when epizootic activity was intense on the east coast). The Cs. melanura at New Gretna appear to be dropping at the present time, possibly as a result of the hot-dry weather conditions.

The population trend along the Delaware Bay is quite different and Cs. melanura appear to be increasing. The population levels are somewhat higher than average and sufficient Cs. melanura appear to be present to initiate epizootic activity in avians, should virus be introduced at this time. No virus, however, has been detected in the specimens that have been submitted to Trenton. To date 1500 Cs. melanura have been tested from the east coast and more than 1700 have been tested from the Delaware Bay.

Ae. sollicitans populations have been extremely low at most sites along the New Jersey coast this year and landing rates have been minimal for most of the season. A major brood emerged in late May but the mosquitoes dispersed widely and landing rates dropped quickly in most areas. A second emergence took place in early July but adult control measures kept the landing rates relatively low. Vector potential has been minimal thus far all summer, but the index rarely assumes importance until much later in the season.

More than 100 wild bird bloods have been submitted for virus tests from each of the Cs. melanura study sites. No antibody has been detected in any of the juvenile birds, confirming the absence of virus activity thus far this year. The incidence of antibody in adult birds is presently being analyzed to indicate which bird species might have been functioning in the cycle over the past year or two.

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