

THE DISPERSAL OF MOSQUITOES BY RAILROAD TRAINS INVOLVED IN INTERNATIONAL TRAFFIC

E. G. CAMPOS,¹ H. A. TREVINO,¹ AND L. G. STROM²

The Quarantine Division of the United States Public Health Service has maintained entomological surveillance of international points of entry into the United States since the early thirties. Principal objectives have been the formulation and implementation of measures to prevent the introduction of arthropods of known or suspected public health importance into this country by international carriers. Mosquitoes have received particular attention. Light traps are operated, natural daytime resting places examined, and larval surveys conducted in strategic areas, in an effort to detect and control exotic vector species which enter by natural means or by improperly disinfested carriers. This surveillance is also concerned with the detection and eradication of such known vectors as *Aedes aegypti* around international entry points, which might become infected from incoming travelers.

Entomological inspections have been primarily concerned with aircraft and surface vessels, since they are responsible for the bulk of international traffic. The value of this program has been demonstrated by numerous exotic arthropod interceptions, as reported by Hughes (1949) and Hughes and Porter (1956). The role played by other modes of international carriers such as trains and automotive vehicles in the dispersal of insects has not been so well clarified.

Brownsville, Texas, is of considerable quarantine importance, with international entry possible by aircraft, surface vessel, train or by automobile and truck. A mild climate and abundant surface water pro-

vide a situation favorable to the establishment of imported mosquitoes. The large and diverse local mosquito fauna makes the discovery of newly-arrived species difficult.

An effort has been made to evaluate the importance of railroad trains in transporting mosquitoes and other insects of public health significance. In February 1958, sporadic inspections of railroad trains were begun on their arrival at Matamoros, Mexico, from the interior of that country, and prior to their admission to the United States. Matamoros, Mexico, is situated on the Rio Grande River, directly across from Brownsville. One train arrives daily with varied products particularly from the States of Nuevo Leon, Durango, Tamaulipas, Oaxaca, Morelos, San Luis Potosi, Chihuahua, Coahuila and Veracruz. Trains from Mexico also enter the United States at Laredo, Eagle Pass, Presidio and El Paso in Texas.

A primary interest in inspecting the railroad cars in Matamoros has been the search for *Aedes aegypti*. Recent surveys for this yellow fever vector by personnel of the Foreign Quarantine Division, Public Health Service, have failed to demonstrate its presence in and immediately adjacent to international points of entry along the Texas-Mexico border.

The trains in question arrive in Matamoros during the night and are held until the following morning for inspection of the cars and contents by U. S. Department of Agriculture entomologists. Upon being cleared, the trains enter the United States, with the Port of Brownsville their usual destination. Our search for mosquitoes has been in cooperation with Department of Agriculture entomologists.

The mosquitoes have been taken with aspirators or small sweep nets. As the

¹ Biologists, Entomology Program, Quarantine Station, Public Health Service, U. S. Department of Health, Education and Welfare, Brownsville, Texas.

² Deceased, formerly Station Entomologist.

box cars are dark, a strong flashlight has always been necessary. Few mosquito recoveries were made from cars of pineapple, bananas or baled cotton, as they are loaded to the roof and difficult to search adequately. Cars of lead bars also produced few mosquitoes, even though they could be examined carefully. A large percentage of the mosquitoes reported on in this study were taken in cars loaded from one-third to one-half full of barite or fluorspar ore. This may well have been due to the fact that these materials are light in color and provide a background against which the mosquitoes can be seen easily. When mosquitoes were found in a car, the point of origin of the latter was ascertained and recorded for reference, if needed.

During the period of Feb. 1958 thru Dec. 1960, 4,436 box cars in 113 trains were inspected for mosquitoes and 3,162 adults were collected alive. Of the total, 98.7 percent were *Culex quinquefasciatus*. Other species taken included *Aedes vexans*, *Anopheles quadrimaculatus*, *Culiseta inornata*, *Anopheles crucians*, *Mansonia titillans*, *Uranotaenia lowii*, *Culex erraticus*, *Culex tarsalis*, and *Psorophora confinis* (Table 1.). The *Culex quinquefasciatus* determinations were confirmed by a study of genitalia slides of the males which were taken.

The numbers of mosquitoes caught have little quantitative significance, since

only samples were taken from the box cars harboring many specimens. However, these data indicate there is considerable movement of certain mosquito species from the interior of Mexico into the United States in railroad box cars. No *Aedes aegypti* or species not already established in the Brownsville area have been collected.

The transmission of *Culex quinquefasciatus* into the Rio Grande Valley from Mexico is of possible public health significance. The frequency with which St. Louis encephalitis virus has been isolated from the species, in the southern United States, together with population studies, indicates it is an important vector. St. Louis encephalitis virus was obtained from two pools of *C. quinquefasciatus* collected in the early fall months during the 1954 epidemic in Hidalgo County and a single isolation was accomplished the following January (Sullivan, *et al.*, 1957). Wiseman, *et al.*, (1959) reported eight isolations from pooled *C. quinquefasciatus* during the 1957 outbreak in Cameron County. Although Texas State Department of Health entomologists and virologists have made regular collections of mosquitoes in the Rio Grande Valley as part of state-wide encephalitis studies, with the single exception noted above, no virus isolations have been obtained from mosquitoes during inter-epidemic periods. Thus, the possibility exists that

TABLE 1.—Mosquitoes taken from railroad box cars entering the United States from Mexico during the period from February, 1958 through December, 1960

Species	1958	1959	1960	Total
	2,106 rr cars	1,577 rr cars	753 rr cars	
<i>Culex quinquefasciatus</i>	586	2,034	501	3,121
<i>Aedes vexans</i>	10	1	3	14
<i>Anopheles quadrimaculatus</i>	4	5	5	14
<i>Culiseta inornata</i>	0	0	4	4
<i>Anopheles crucians</i>	0	2	0	2
<i>Mansonia titillans</i>	0	2	0	2
<i>Uranotaenia lowii</i>	0	2	0	2
<i>Culex erraticus</i>	0	0	1	1
<i>Culex tarsalis</i>	0	1	0	1
<i>Psorophora confinis</i>	1	0	0	1
Total	601	2,047	514	3,162

the encephalitis viruses are introduced into the area by infected arthropods or vertebrates, and do not exist in an endemic state. Several of the larger pools of *C. quinquefasciatus* collected from railroad box cars in 1960 have been shipped to the Texas State Department of Health Laboratory for virus studies, with negative results.

Anopheles quadrimaculatus were taken in numbers sufficient to indicate that there is some international dispersal of the species by railroad box cars. Even though there has been a decline to the point of disappearance of malaria in the United States and much of Mexico, sporadic cases continue to occur. Two cases were brought to our attention in Cameron County in September, 1960. The malaria potential is of concern to public health workers, especially in areas such as the Lower Rio Grande Valley of Texas, with large populations of *A. quadrimaculatus*.

Of interest was the recovery of but a single *Culex tarsalis*. The species is frequently intercepted on aircraft arriving in Brownsville from Mexico.

SUMMARY. Inspections of railroad box cars have been conducted upon their arrival in Matamoros from the interior of Mexico, just prior to their admittance into the United States. From February 1958, through December 31, 1960, 4,436 cars in 113 trains were examined and 3,162 adult mosquitoes were collected alive. They were primarily *Culex quinquefasciatus*, with nine other species represented by small numbers.

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BIOCHEMICAL STUDY OF A MALATHION-TOLERANT STRAIN OF *Aedes Aegypti*

F. MATSUMURA AND A. W. A. BROWN

University of Western Ontario, London, Canada

A malathion-tolerant strain has been developed by larval selection with malathion applied to a colony of *Aedes aegypti* from Penang, Malaya (Brown and Abedi, 1960). This strain attained a 5-fold increase in malathion-tolerance, but simultaneously acquired a cross-resistance to DDT and DDD in excess of 30 times the normal.

Malathion-resistance, as first studied in the house fly, has been found to involve an increase in the detoxification of malaoxon (March, 1959), and a concomitant decrease in the enzyme alioesterase (Op-

penoorth, 1959). Later, the strong and specific malathion-resistance developed in a strain of the mosquito *Culex tarsalis* has been found to involve a marked increase in carboxyesterase activity detoxifying malathion, and a smaller increase in phosphatase activity detoxifying malaoxon (Matsumura and Brown, 1961). The aim of this study was to ascertain whether these or other biochemical mechanisms were associated with the malathion-tolerance of the Penang strain of *Aedes aegypti*.

The malathion-tolerant Penang strain