# DISTRIBUTION OF POTENTIAL MOSQUITO VECTORS IN THE IMPERIAL VALLEY, CALIFORNIA, 1971–72

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ABSTRACT. Adult mosquito populations were monitored at five localities in the Imperial Valley, California, from November, 1971 to October, 1972. *Culex tarsalis* and *Culiseta inornata* were found to be widely distributed in the areas sampled, while *Culex erythrothorax* and *Anopheles franciscanus* were limited to permanent pond habitats. SLE virus was isolated from pools of *C. tarsalis* and *C. erythrothorax* in August, 1971. It is suggested that *C. erythrothorax* may be an important vector of arboviruses in the permanent pond habitat, while *C. tarsalis* is the most widely distributed vector.

Studies at the Finney Lake area in the central Imperial Valley have established the presence of western equine encephalitis (WEE), Saint Louis encephalitis (SLE) and California encephalitis (CEV) virus through isolations from adult mosquitoes, suggesting this area is a possible focal point of arbovirus activity (Work *et al.*, 1969; Knudsen *et al.*, 1971). Most viral isolates have been from *Culex tarsalis* Coquillett, 1896, but *C. erythrothorax* Dyar, 1907 and *Culiseta inornata* (Williston, 1893) have also yielded viruses. While the presence of these viruses is well documented, the Finney Lake area is not necessarily representative of the entire valley. The question of the distribution of potential mosquito vectors elsewhere in the valley remains unanswered, as does the possibility of other foci of arbovirus activity. In an effort to answer these questions five ecologically distinct mosquito collecting sites were selected in the northern Imperial Valley.

MATERIALS AND METHODS. All sites were close to either the Highline or Coachella Canal (Fig. 1), the main sources of irrigation water in the valley. Collection sites were roughly 6.4 to 9.6 km apart in a line running approximately parallel to the border between agriculturally developed acreage and open desert, with the exception of the first site, a permanent pond more than 9.6 km from the nearest farmland. Two additional sites of permanent ponds were sampled. Both were near agriculture, but at site 4 the traps were set about 1 km. from the pond itself, while at site 5 traps were set both adjacent to and distant from the pond. The final two sites represented an area without permanent water (site 3) and an area with semipermanent pools (site 2).

Mosquito collections were made concurrently at each site once a month, from November 1971 until October, 1972. No collections were made in July, 1972. Sites were monitored by two CDC miniature light traps, supplemented with dry ice, and located about 90 meters or more apart. Traps were operated for two consecutive nights and the results tabulated as mosquitoes per trap-night.

Mosquitoes were processed using methods described by Sudia and Chamberlain (1967) with modifications. Collections were identified and pooled by species and site in groups of 50 or fewer. Specimens of *C. inornata* were pooled in lots of 25 or fewer. Engorged specimens were removed for precipitin testing. Only a portion of the mosquitoes collected was processed for virus isolation. Virus isolation attempts were made by grinding each mosquito pool in 1.8 ml of 25 percent normal rabbit serum in 0.5 M phosphate buffered saline containing penicillin and streptomycin. This suspension was centrifuged at 4° C, 2500 rpm for 20 minutes and the supernate injected intracerebrally

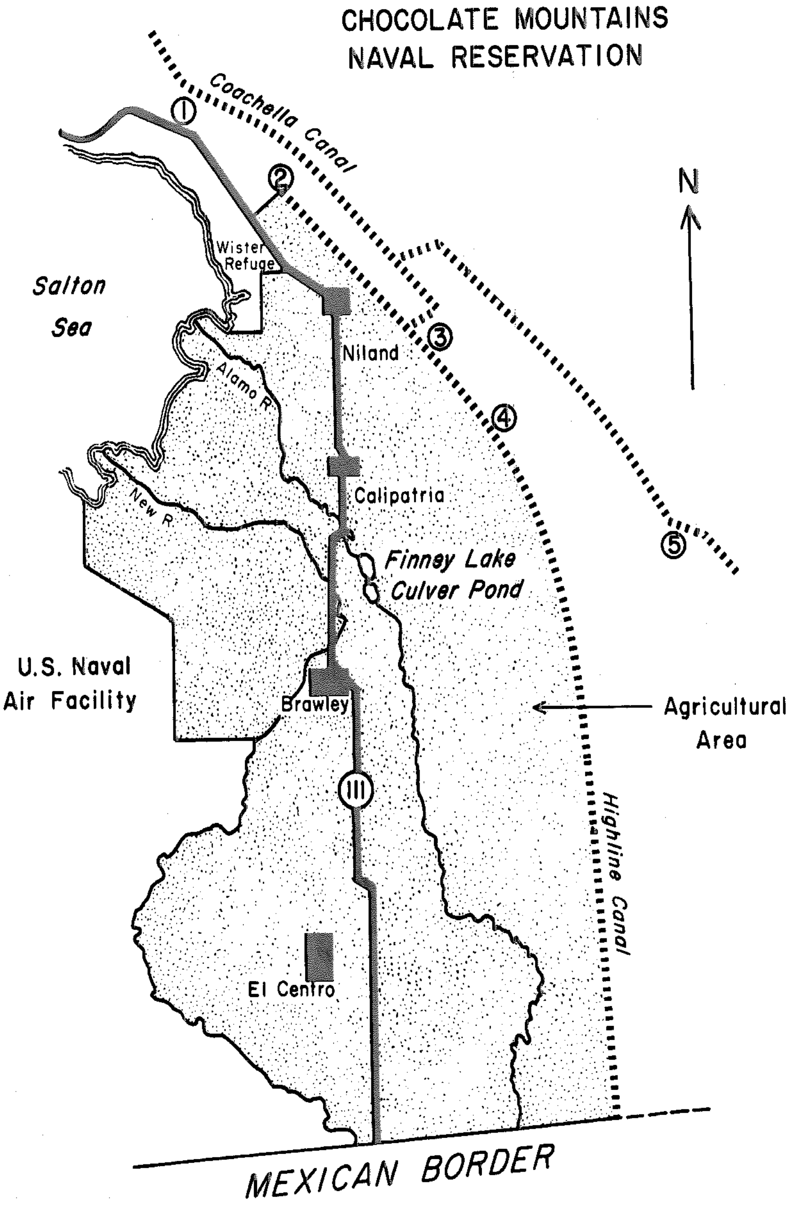


Fig. 1.—Collection sites sampled by CDC miniature light traps with dry ice, Imperial Valley, California, 1971–72.

into 2 to 4 day old suckling mice.[1] Viral isolates were identified by hemagglutination-inhibition tests (Clarke and Casals, 1958).

RESULTS AND DISCUSSION. Four mosquito species were commonly found at these collecting sites: *C. tarsalis, C. erythrothorax, Culiseta inornata* and *Anopheles franciscanus* McCracken, 1904 (Fig. 2). Other less frequently collected species included: *Aedes dorsalis, A. nigromaculis, A. taeniorhynchus, A. vexans, C. pipiens quinquefasciatus* and *Psorophora confinnis.*

*Culex tarsalis* was by far the most common species captured. Each site had significant numbers of this species at some time during the study, indicating the general distribution of this species throughout the valley. Greatest numbers were not observed simultaneously at all sites, but rather occurred independently throughout the spring and summer. Few adults were taken in the colder months. SLE was isolated from three pools of this species taken from site 5 in August, and from a single pool collected at site 4 in August, both permanent pond habitats near farmland.

Like *C. tarsalis, Culiseta inornata* was widely distributed throughout the areas sampled. Unlike *C. tarsalis,* it was found most frequently during the colder months. The greatest numbers were collected in November at all sites. Subsequent collections yielded decreasing numbers through the winter and spring, until few were collected in the summer months. October's collections showed resumed activity. No viruses were isolated from this species.

*Anopheles franciscanus* was found only in habitats that had permanent water nearby. Collections from sites 1 and 5 frequently yielded large numbers, while collections from sites 2 and 3, far from permanent water, did not. Collections at site 4 were far enough from the pond that this species was rarely collected there in large numbers. Greatest numbers were collected in the spring and early summer; very few were taken in the coldest months. Few pools of this species were assayed for virus, and no virus was isolated.

The distribution of *C. erythrothorax* was similar to that of *A. franciscanus* but more restricted, being found only at sites 1 and 5 near permanent seepage ponds. Practically no *C. erythrothorax* were found at sites away from permanent ponds. As with *C. tarsalis,* peak populations were not found simultaneously at all sites, but rather occurred at different times during the spring and summer. Largest numbers were taken in the spring months, as with *A. franciscanus,* and none in the winter months. Diurnal feeding on man by this species was frequently noted. SLE was isolated from a pool of this species collected in August at site 5.

When the restricted distribution of *A. franciscanus* and *C. erythrothorax* were first noticed, experiments were designed to determine the distribution of these species within each collection site. At site 5 a trap was located adjacent to the seepage pond, while a second was located approximately 2.4 km away from the pond in a creosote bush forest. Table 1 presents the results of four consecutive light trap collections made at these two sites between June 14 and 17, 1972. The trap closest to the pond consistently caught more *C. erythrothorax,* whereas the trap in the creosote forest invariably caught more *A. franciscanus.* A similar experiment was conducted at site 4 with similar results.

These data suggest that the primary vector of arboviruses in the Imperial Valley, *C. tarsalis,* is widespread and its distribution is not restricted to the permanent pond habitat. The isolation of SLE from *C. tarsalis* is not surprising, since this species is recognized as the principal vector of SLE and WEE in the western United States (Reeves and Hammon, 1962). The

[1] In conducting the research described in this report, the investigators adhered to the "Guide for Laboratory Animal Facilities and Care," as promulgated by the Committee on the Guide for Laboratory Animal Facilities and Care of the Institute of Laboratory Animal Resources, National Academy of Sciences—National Research Council.

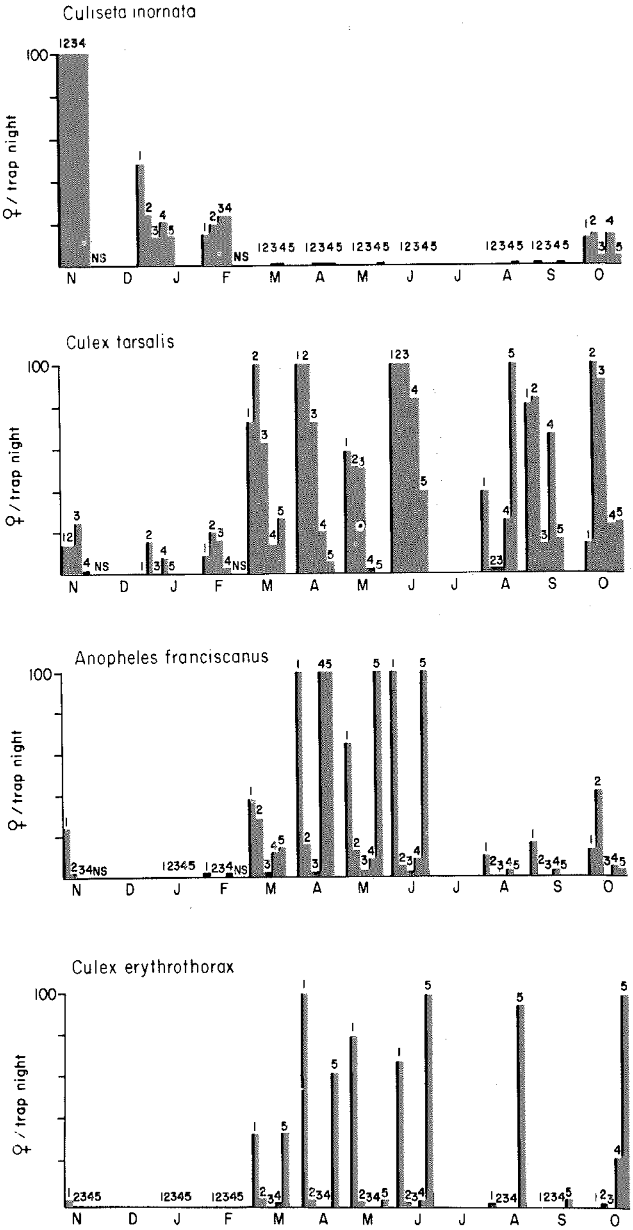


Fig. 2.—Seasonal and geographical distribution of adult female mosquitoes as sampled by CDC miniature light traps with dry ice, sites 1 through 5, Imperial Valley, California, 1971–72. NS=Not Sampled.

TABLE 1.—Numbers of mosquitoes collected on four consecutive nights, CDC miniature light traps with dry ice at Site 5, Imperial Valley, California, 14 to 17 June, 1972.

| Area | *A. franciscanus* | *C. tarsalis* | *C. erythrothorax* |
|---|---|---|---|
| Cresote Forest | 1106 | 11 | 8 |
| | 323 | 150 | 250 |
| | 779 | 1 | 2 |
| | 1072 | 3 | 13 |
| Pond | 2 | 80 | 1282 |
| | 0 | 7 | 350 |
| | 1 | 7 | 117 |
| | 73 | 290 | 5121 |

restriction of isolates to collections from the permanent pond habitats near agriculture is noteworthy however, suggesting that this type of habitat may be most capable of supporting arbovirus transmission, while other habitats may not, even though the primary vector mosquito may be present.

With the exception of annoyance at a military installation reported by Blakeslee *et al.* (1962), *C. erythrothorax* has generally been dismissed as of little public health importance. Evidence is accumulating to refute this assumption. California encephalitis virus has been isolated from this mosquito species in Utah (Crane *et al.*, 1970), and SLE and WEE have been isolated from it elsewhere in the Imperial Valley (Knudsen *et al.*, 1971). The isolation of SLE from this species here further suggests the importance of this species as a possible vector of arboviruses. Recent studies on the feeding patterns of *C. erythrothorax* also support its vector potential. Tempelis (1970) found that adults from one area had fed almost exclusively on mammals while those from another area had fed almost exclusively on birds, while Gunstream *et al.*, (1971) found in southeastern California 42 percent had fed on mammals and 58 percent on birds. Potentially this mosquito is exposed to both avian and mammalian viruses by its feeding. While the limited distribution of this species prevents it from being a major health hazard in surrounding areas, it may be significantly involved in the focal maintenance of arboviruses. Its demonstrated anthropophilic feeding makes it a potential vector of arboviruses to people entering these marsh habitats as well.

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# SUSCEPTIBILITY OF AQUATIC VERTEBRATES AND INVERTEBRATES TO THE INFECTIVE STAGE OF THE MOSQUITO NEMATODE *REESIMERMIS NIELSENI*

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ABSTRACT. The nematode parasite of mosquito larvae, *Reesimermis nielseni*, is presently under consideration as a possible biological control agent of mosquitoes. This nematode has effectively suppressed field populations of mosquitoes in several areas of the United States. Safety tests evaluating possible effects of this nematode on nontarget aquatic organisms which might be exposed to the introduced nematode are reported herein.

The nematode *R. nielseni* is apparently quite host-specific. Neither trout, top minnows, nor any of 16 invertebrates tested supported development of the nematode. Little or no significant damage to aquatic organisms, other than mosquitoes, is anticipated after field introduction of *R. nielseni*.

A nematode parasite of mosquito larvae, *Reesimermis nielseni* Tsai and Grundmann, is receiving considerable attention as a possible biological control agent of culicine and anopheline mosquitoes (Anonymous, 1972). This nematode can be mass produced in labortory cultures of the southern house mosquito, *Culex pipiens quinquefasciatus* Say, (Petersen and Willis, 1972a). Moreover, preparasitic larvae of the infective stage have effectively suppressed developing field populations of *Anopheles* mosquitoes in California and Louisiana (Petersen, *et al.*, 1972; Petersen and Willis, 1972b).

Safety to organisms other than the target pest, in addition to production feasibility and field efficacy, must also be determined to insure the successful development of a biological control agent (Ignoffo, 1967; 1973). An evaluation of possible effects of *R. nielseni* in mammals is currently underway and should be completed within 6 months (Ignoffo, *et al.*, 1973). The evaluation of the possible effects of *R. nielseni* in representative aquatic organisms which might be exposed to artifically introduced preparasitic larvae is reported here. The studies were the combined efforts of the Fish Pesticide Research Laboratory, U. S. Department of Interior, BSFW, Columbia, Missouri; the Gulf Coast Mosquito Research Laboratory, Agr. Res. Serv., U. S. Department of Agriculture, Lake Charles, Louisiana; and Biological Control of Insects Research Laboratory, Agr. Res. Serv., USDA, Columbia, Missouri.

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## SUSCEPTIBILITY OF VERTEBRATES

Eggs, yolk-sac fry, and swim-up fry of