

FIELD OBSERVATIONS ON THE HABITATS AND SEASONAL ABUNDANCE OF MOSQUITO LARVAE IN SCOTTS BLUFF COUNTY, NEBRASKA (DIPTERA, CULICIDAE)

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Irrigation mosquitoes create a major vector problem in the western United States. A knowledge of the biology of these mosquitoes is essential for developing the most effective prevention and control measures. In order to understand more clearly the relationship between irrigation and mosquito production, studies were begun during the 1953 season on the biology and seasonal abundance of the immature stages in Scotts Bluff County, Nebraska. The investigations were made under actual field conditions, and in practically every habitat studied, a mixture of species was encountered. Scotts Bluff County was selected for study because much of the farm land is irrigated and heavy production of mosquitoes occurs during the summer months. *Culex tarsalis*, one of the commonest mosquitoes in the area, is believed to be the primary vector of encephalitis in the far west. Several other species in the area have been found to be naturally infected with encephalitis.

METHODS. Some preliminary field observations were made during April to determine when mosquito development would start and which species would appear first. Beginning May 1, intensive collections and observations were started at forty-seven stations established in the vicinity of Mitchell, Nebraska. The stations were selected to obtain as complete a sample of mosquito larval populations as possible during the summer breeding season, and included representative types of aquatic situations occurring in Scotts

Bluff County. The stations were inspected once each week, and larval populations were sampled by dipping with a pint-size white enamel dipper. The number of dips varied according to the size of the station. The average number of larvae or pupae per dip was recorded, and samples were collected for later identification or rearing in the laboratory. Associations of the pupae were made with the adults of each reared species.

RESULTS. A total of 40,617 fourth-instar larvae and pupae of 12 species was identified from the various stations. Of this number, *Culex tarsalis* Coquillett made up 46 percent, *Aedes dorsalis* (Meigen) 25 percent, *Culiseta inornata* (Williston) 17 percent, *Aedes vexans* (Meigen) 10 percent, and *Aedes nigromaculis* (Ludlow) 1 percent. The remaining seven species, *Aedes triseriatus* (Say), *Culex pipiens* Linn., *Culex restuans* Theobald, *Culex salinarius* Coquillett, *Culex territans* Walker, *Anopheles walkeri* Theobald, and *Uranotaenia sapphirina* (Osten-Sacken) comprised only 1 percent of the collections (Table 1). Five species thus constituted 99 percent of the larvae and pupae collected. Due to the relative importance of these species, information concerning each is summarized in Table 2.

Seepage areas and temporary surface pools were found to be the most important mosquito-producing habitats in Scotts Bluff County. Collections of surface water occurred principally in depressions within the pastures and hay meadows that were irrigated. Many of these fields had not been leveled or graded, and because of irregular topography the fields were irrigated by wild flooding. Water applied in quantity enough to cover the high spots caused excessive ponding to occur in the

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TABLE 1—Percentage of fourth instar larvae and pupae collected from each type of habitat, Scotts Bluff County, Nebr., May–October 1953

Species	Seepage Areas	Surface Pools	Roadside Borrow Pits	Slough Along River	Concrete Structures	Tree Holes	Weed-Clogged Ditches	Percent of Total
<i>Aedes dorsalis</i>	3	54	68	—	—	—	x	25
<i>Aedes vexans</i>	3	20	15	93	—	—	13	10
<i>Aedes nigromaculis</i>	—	3	4	—	—	—	—	1
<i>Aedes triseriatus</i>	—	—	—	—	—	100	—	x
<i>Culex tarsalis</i>	66	21	7	7	100	—	40	46
<i>Culex restuans</i>	x	—	—	—	—	—	—	x
<i>Culex pipiens</i>	—	—	—	—	—	—	1	x
<i>Culex salinarius</i>	x	—	—	—	—	—	4	x
<i>Culex territans</i>	x	—	—	—	—	—	—	x
<i>Culiseta inornata</i>	27	2	6	—	—	—	41	17
<i>Anopheles walkeri</i>	x	—	—	—	—	—	—	x
<i>Uranotaenia sapphirina</i>	x	—	—	—	—	—	—	x
Total number larvae	23,481	13,339	3,244	220	27	35	271	40,617

x indicates less than 1 percent.

low areas. The water in the seeps came primarily from unlined irrigation canals. Soon after water was diverted into the canals in the spring, it began to appear in the seepage areas, where it remained until the canals were shut off in the late fall.

Culex tarsalis Coquillett: *Culex tarsalis* was given particular emphasis during this study because of its abundance and importance as a vector of encephalitis. Information concerning this species has been given in a previous paper (Edmunds, 1955), and will be reviewed only briefly.

Culex tarsalis was commonly found in association with *Culiseta inornata* in seepage areas, and with *Aedes dorsalis* and *Aedes vexans* in temporary surface pools. Information on seasonal occurrence and predominant breeding sites is given in Table 2.

Aedes dorsalis (Meigen) was frequently found in association with *Culex tarsalis*,

Aedes vexans, and *Aedes nigromaculis* in temporary surface pools. Information on seasonal occurrence and breeding sites is given in Table 2.

Culiseta inornata (Williston): Larvae of *Culiseta inornata* were the first to appear in the area around Mitchell, Nebraska during 1953. On April 21, the first egg rafts of this species were collected from a small sheltered pool. Numerous egg rafts were collected from the same area but from a different pool on April 30. It was the only larval species found in the field during November.

Egg rafts of *Culiseta inornata*, collected in the field, during April and May were found to contain from 148 to 292 eggs, with an average of 204. The growth period from hatching to adult emergence, in permanent seepage areas, was 28 days at an average air temperature of 55.4° F.

TABLE 2—Collections of the five most common mosquito larvae in irrigated areas of Scotts Bluff County, Nebraska

Species	Seasonal Occurrence			Predominant Breeding Sites *				
	First	Peak	Last	1	2	3	4	5
<i>C. tarsalis</i>	5-7	7-11	10-29	S	TSP	RB	D	CS
<i>C. inornata</i>	4-21	7-11	11-26	S	P			
<i>A. dorsalis</i>	6-3	6-15	10-8	TSP	RB	S		
<i>A. vexans</i>	6-3	6-15	9-13	TSP	S			
<i>A. nigromaculis</i>	6-3	7-14	9-13	TSP				

S = seeps; TSP = temporary surface pools; RB = roadside borrow pits; D = ditches; P = ponds; CS = concrete structures.

Aedes vexans (Meigen): In general *Aedes vexans* developed in the same surface pools as *Aedes dorsalis* and *Aedes nigromaculis*, and achieved its highest populations at about the same time as these two species. In late August, however, *Aedes vexans* attained a high peak in larval populations which *Aedes dorsalis* and *Aedes nigromaculis* did not reflect. This was due to its breeding in overflow waters along the margins of the North Platte River. In these flood water pools *Aedes vexans* developed in large numbers and in almost pure cultures.

Aedes vexans was commonly found in association with *Aedes dorsalis* and *Aedes nigromaculis* in temporary surface pools.

OTHER SPECIES. The larvae of *Culex pipiens*, *Culex restuans*, *Culex salinarius*, and *Culex territans* were collected in very small numbers, generally in shaded seepage areas in association with *Culex tarsalis*. *Aedes triseriatus* was collected only from tree holes. *Anopheles walkeri* and *Uranotaenia sapphirina* were found breeding in only one habitat, a seepage area exposed to sunlight and containing mostly sedge (*Carex* spp.).

DISCUSSION. In Scotts Bluff County, large numbers of *Aedes dorsalis*, *Aedes vexans*, *Aedes nigromaculis*, and *Culex tarsalis* were produced in temporary surface pools that occurred in irrigated pastures and hay meadows. *Aedes dorsalis* was the dominant species found in these pools. Keener and Edmunds (1954) found that this species composed 81 percent of the larvae in temporary pools studied in the vicinity of Mitchell, Nebraska during 1952. Exten-

sive seepage areas were formed early in the summer soon after irrigation began. The rising water levels of the seepage areas resulted in the production of large numbers of *Aedes* mosquitoes; however, *Culex tarsalis* soon appeared in most of the seepage areas and persisted there as the dominant species throughout most of the summer. In a previous study in the North Platte River Valley (Mitchell Field Station, 1952), *Culex tarsalis* made up 74 percent and *Culiseta inornata* 12 percent of all the fourth instar larvae from seepage areas in the North Platte River Valley, Nebraska.

Thompson (1953) found first instar larvae of *Culiseta inornata* hatching as early as April 11, 1950 in south central Nebraska. The writer first found egg rafts of *Culiseta inornata* on April 21, 1953, and breeding was continuous until freezing weather in late November.

Keener (1952) in studies of the hibernation of adult *Culex tarsalis* in cellars in western Nebraska, noted that in the spring of 1951 the hibernating *Culex tarsalis* adult females appeared to have left hibernation during the week ending April 28. In the spring of 1953 the writer attempted to determine the earliest date at which *Culex tarsalis* larvae hatched under natural conditions in the field. In Scotts Bluff County, a sample which contained first instar *Culex tarsalis* larvae was made from a seepage area near Mitchell, Nebraska on May 7.

Prevention and control of mosquitoes in Scotts Bluff County must take into account both the seepage areas and irrigated pas-

tures. Emphasis should be given to the elimination of habitats associated with irrigation. Measures to prevent seepage from canals should be utilized where needed and drains should be provided for the removal of surplus water.

SUMMARY. Twelve species of mosquitoes were found breeding in Scotts Bluff County, Nebraska during 1953. Listed in order of abundance they were: *Culex tarsalis*, *Aedes dorsalis*, *Culiseta inornata*, *Aedes vexans*, *Aedes nigromaculis*, *Aedes triseriatus*, *Culex pipiens*, *Culex restuans*, *Culex salinarius*, *Culex territans*, *Anopheles walkeri*, and *Uranotaenia sapphirina*. The first five species constituted 99 percent of the larvae and pupae collected.

During 1953 *Culex tarsalis* was found developing from May 7 to October 29, *Aedes dorsalis* from June 3 to October 8, *Culiseta inornata* from April 21 to November 26, *Aedes vexans* and *Aedes nigromaculis* from June 3 to September 13.

Most of the mosquito production occurred in seepage areas and temporary surface pools associated with irrigation. In the seepage areas *Culex tarsalis* was the most abundant mosquito and was com-

monly found in association with *Culiseta inornata*. In the temporary surface pools *Aedes dorsalis* was dominant and was generally associated with *Aedes vexans* and *Aedes nigromaculis*. Permanent control of mosquitoes in Scotts Bluff County will involve the elimination of seepage areas and surface pools on irrigated pastures.

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