

THE 1958 ENCEPHALITIS OUTBREAK IN NORTHERN UTAH.

3. MOSQUITO POPULATIONS IN RELATION TO THE OUTBREAK

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INTRODUCTION. In referring to western equine encephalitis (WEE), Hess and Holden (1958) state: "There seems to be little question that *Culex tarsalis* is the primary vector in the sylvan transmission cycle as well as in the endemic chain of infection in the western United States. . . . Species other than *C. tarsalis* are, however, considered to be of secondary importance." It is justifiably concluded by these same authors that: "With a given mosquito infection rate, the chances for human infection will be correlated directly with the vector's biting or attack rates on man. These attack rates are obviously related, in turn, to mosquito population densities." It appears, therefore, that *C. tarsalis* mosquitoes in Utah are the most important vectors to man of WEE virus, and that an increase in the population density of infected *C. tarsalis* mosquitoes would increase the rate of biting on man, with an accompanying increase in the number of people acquiring this disease.

In this paper, the *C. tarsalis* mosquito population in northern Utah in 1958, when an epidemic of encephalitis occurred, is compared with populations of this species during the years immediately preceding the outbreak. In addition, consideration is given to climatologic factors that may have influenced the *C. tarsalis* population in northern Utah during these same years.

Mosquito larval records from the South Salt Lake County Mosquito Abatement District and mosquito light trap collection

records from the Salt Lake City and the Weber County Mosquito Abatement Districts were used in preparing this report.

The climatologic data were obtained from the U. S. Weather Bureau and the U. S. Geological Survey.

LARVAL COLLECTIONS. Larval collection records presented in Figure 1 show the numbers of different mosquito-producing habitats found during the 1956-1958 mosquito breeding seasons that contained larvae of the three principal species of mosquitoes. It is evident that there was a significant and successive build-up each year in the number of pools containing *C. tarsalis* larvae. The increase in the number of pools in 1958 over the previous 2 years started in April and more than doubled in May and June, then continued during the remainder of the season far above the numbers reported in the other 2 years. The increase in the number of pools containing *C. tarsalis* larvae in 1958 was approximately 230 percent over 1957 and 440 percent over 1956. This increase in number of pools of *C. tarsalis* larvae was greatest during July and August.

The number of pools containing *A. dorsalis* in 1958 was somewhat greater than in 1956 and 1957, but this increase was nowhere near that observed for *C. tarsalis*. The number of pools containing *C. inornata* during the encephalitis transmission season (July-August) was not much greater in 1958 than in 1956 and 1957, although there was a marked increase in May and June over the previous 2 years.

LIGHT TRAP COLLECTIONS. Six New Jersey type mosquito light traps were operated 2 nights each week at the same location in the Salt Lake City District from May through mid-October during 1956-1958. In Weber County, 6 traps

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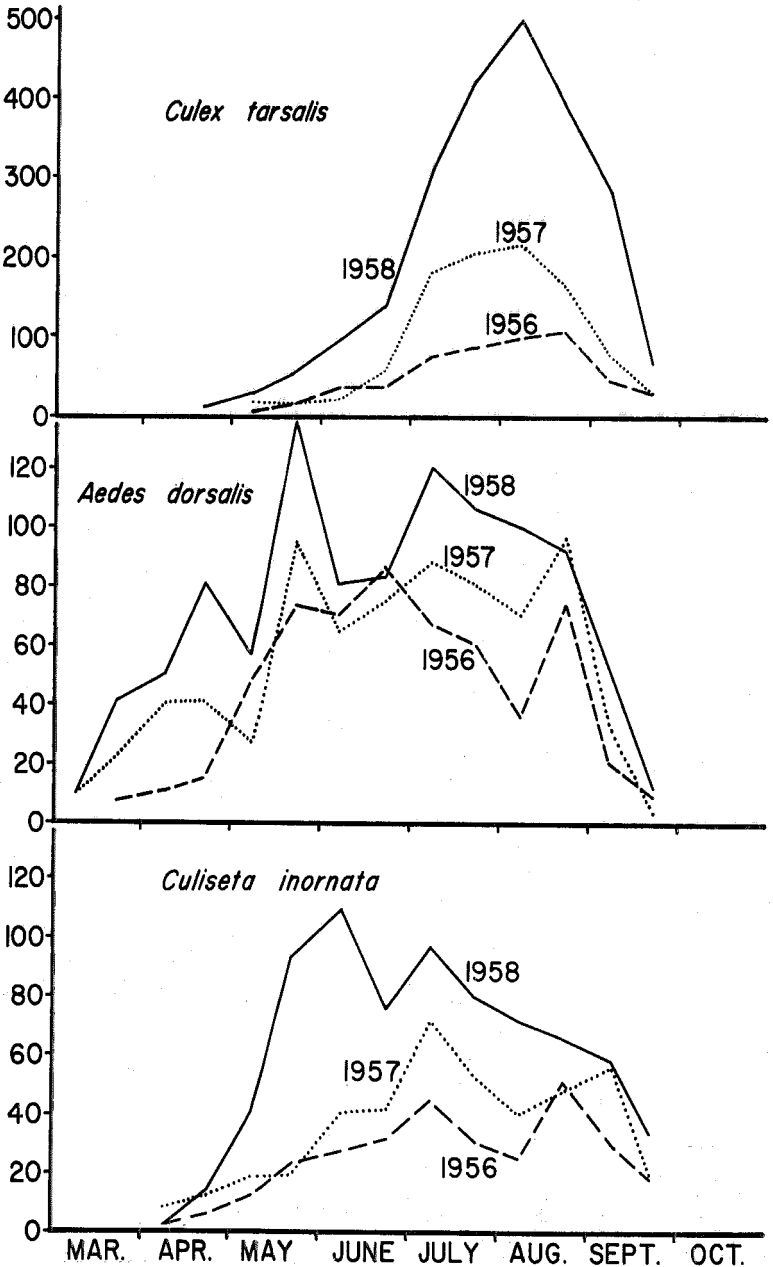


FIG. 1.—Numbers of habitats in South Salt Lake County Mosquito Abatement District that contained larvae of *Culex tarsalis*, *Aedes dorsalis*, and *Culiseta inornata* during the 1956, 1957, and 1958 mosquito breeding seasons.

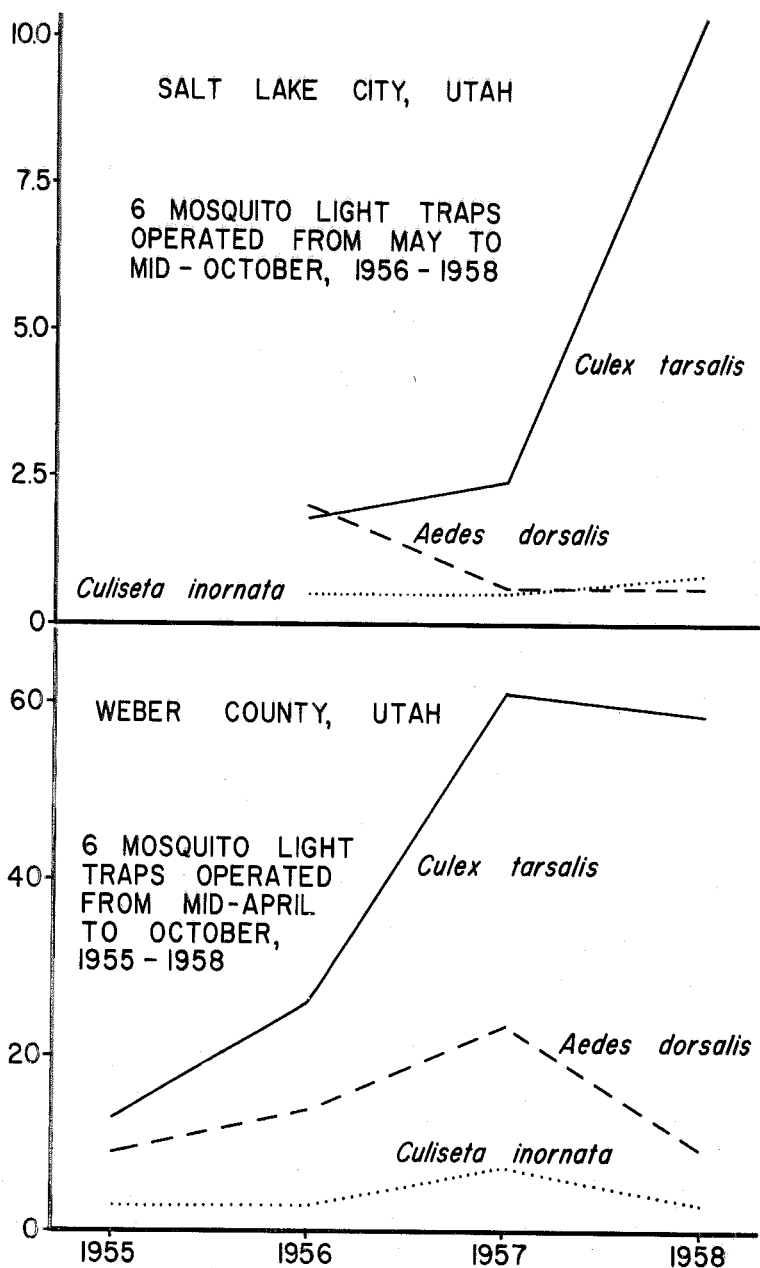


FIG. 2.—Average numbers of adult mosquitoes collected per trap night in 2 areas of northern Utah during the 1955, 1956, 1957, and 1958 seasons.

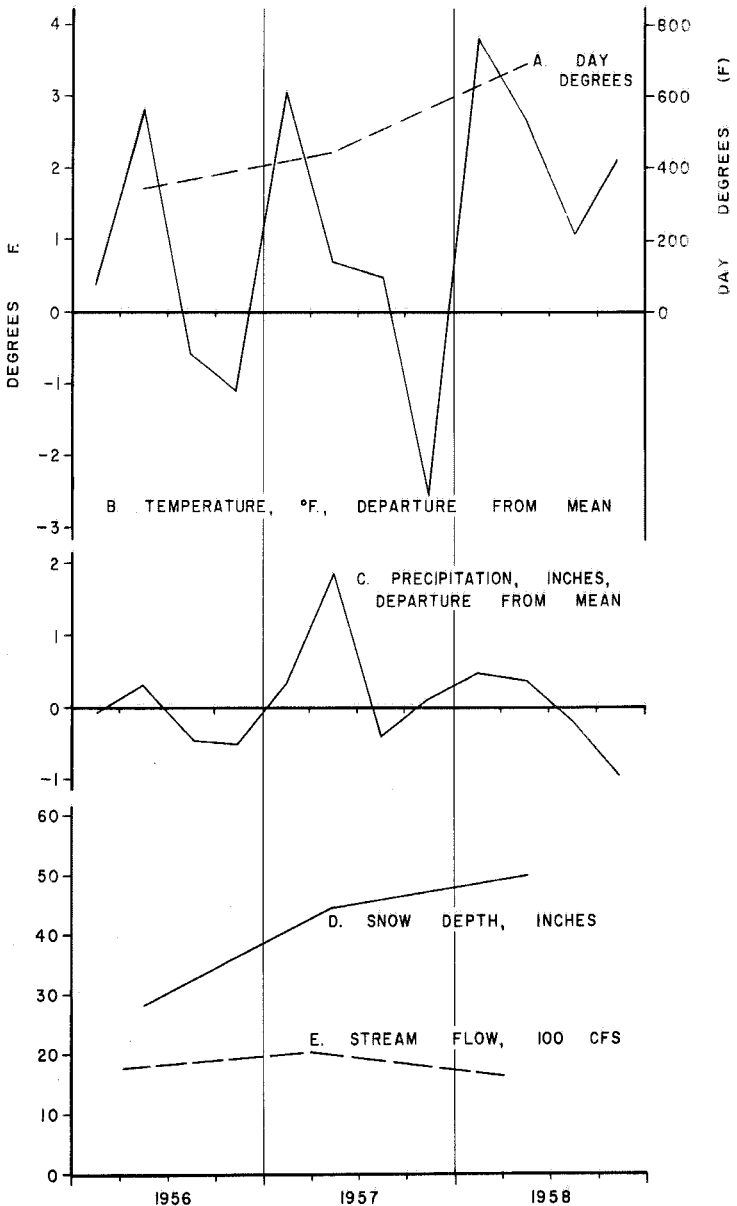


FIG. 3.—Comparative weather data for northern Utah during 1956–1958: (A) Day degrees F. above normal (algebraic sum of daily deviations from long-term means) for first 9 months of each year, Corinne, Box Elder County, Utah; (B) Departures from long-term mean temperatures, degrees F., Corinne, Utah; (C) Departures from long-term mean precipitation, inches, Corinne, Utah; (D) Average daily snow depth, April–June, Brighton, Salt Lake County, Utah; (E) Average daily flow of Bear River in hundreds of cubic feet per second for first 6 months of each year, Collingston Station, U. S. Geological Survey, Water Resources Division, Box Elder County, Utah.

were operated 7 nights each week at the same locations from mid-April through September during 1955-1958. The average number of adult *C. tarsalis*, *A. dorsalis*, and *C. inornata* collected per trap night is shown in Figure 2. The *C. tarsalis* population in the Salt Lake City District in 1958 was more than 4 times the average for the previous 2 years, which is in line with the larval data from the South Salt Lake County District. The increase first appeared in July, reached a peak in August, and then slowly declined in September. Thus, in 1958 there was a tremendously greater number of *C. tarsalis* present during the encephalitis transmission season than during the previous non-epidemic years. In contrast to the *C. tarsalis* population, light trap collections of *A. dorsalis* and *C. inornata* during 1958 showed no increases over the previous years.

In Weber County, high *C. tarsalis* populations were recorded in both 1957 and 1958, the average numbers being 2 to 3 times those of the previous 2 years (Fig. 2). The populations of *A. dorsalis* and *C. inornata*, as recorded by the Weber County light traps, increased slightly in 1957 when compared with the previous seasons, but decreased in 1958.

CLIMATOLOGIC DATA. The average temperature for the first 9 months of 1958 was considerably above that of the same period during the previous 2 years, as reflected by the day degrees above the long-term average (Fig. 3, A). This increase was apparent during each of the first 3 quarters of the year (Fig. 3, B). Thus 1958 provided milder winter conditions and an earlier, warmer spring than the previous years, factors which should favor high production of *C. tarsalis*; furthermore, the higher summer temperatures may well have provided more favorable conditions for encephalitis transmission.

Precipitation was above normal during the first quarter and below normal during the third quarter in both 1957 and 1958 (Fig. 3, C). In both years there was, therefore, adequate water for spring mosquito breeding and a dry summer, which many workers believe is favorable for encephalitis transmission.

The average snow depth during the period April-June showed a progressive increase from 1956 through 1958 (Fig. 3, D). This would indicate an abundant supply of water for irrigation in 1958. This usually encourages excessive use of irrigation water, which again favors the production of *C. tarsalis*.

The stream flow data (Fig. 3, E) do not reflect any significant changes in 1958. This is undoubtedly due to the fact that the excess water is stored and the stream flow regulated by the various impoundments on the Bear River above Collingston, before it reaches the area of the 1958 outbreak.

In summary, the year 1958 in northern Utah was characterized by an unusually warm and wet winter and spring, followed by a hot dry summer with an abundance of irrigation water. It may well be that these are the weather conditions which are most important in providing favorable conditions for outbreaks of western equine encephalitis.

SUMMARY. On the basis of adult and larval collections, populations of *C. tarsalis* in northern Utah were much greater in 1958 than in the previous 2 years. This same year was characterized by an unusually warm and wet winter and spring, followed by a hot, dry summer with an abundance of irrigation water.

Reference Cited

- Hess, A. D., and Holden, Preston. 1958. The natural history of the arthropod-borne encephalitides in the United States. *Ann. N. Y. Acad. Sci.* 70 (art. 3):294-311.