

SURVEILLANCE FOR WESTERN EQUINE ENCEPHALITIS IN UTAH¹

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During 1958, northern Utah experienced a serious outbreak of western equine encephalitis in man and horses (Jenkins and Donath, 1959), which caught health authorities and mosquito abatement districts by surprise. As a result of this experience, a strong need was felt for a surveillance program that would predict, or at least determine at an early date, possible future outbreaks of the disease. California experienced a similar outbreak of WEE in 1952 (Longshore, 1953) and subsequently developed a surveillance program under the auspices of the Bureau of Vector Control of the State Department of Health, working in cooperation with mosquito abatement districts (Anonymous, 1956, Loomis, 1959).

A superficial appraisal of the surveillance program in California quickly convinced concerned people in Utah that a similar program was not possible in Utah because funds and personnel were not available in the Health Department or any other branch of state government to coordinate a statewide program. The Salt Lake City and South Salt Lake County Mosquito Abatement Districts assumed the responsibility of developing and maintaining a coordinated surveillance program for northern Utah since no other agencies appeared to be willing or able to do so. The Utah State Department of Health maintains records of human cases reported to them by physicians and has a laboratory for confirmation of suspected cases. The state veterinarian, working under the Department of Agriculture, keeps records of the number of cases in horses reported by

veterinarians. These reports are probably incomplete. Both agencies have been helpful and cooperative with the mosquito abatement districts in every possible way. The United States Public Health Service maintains sentinel flocks of chickens in Utah to obtain information on transmission rates of WEE and Saint Louis encephalitis in chickens and reports this information to the mosquito abatement districts.

These procedures of the United States Public Health Service, the Utah State Department of Health, and the Utah State Department of Agriculture record what has happened in regard to transmission rates and human and horse cases. The mosquito abatement districts have been primarily concerned with the development of techniques to predict transmissions and numbers of human and horse cases of WEE well in advance of their actual occurrence. These techniques are based on the assumption that a direct relationship exists between changes in populations of the vector, *Culex tarsalis* Coquillett, and changes in the transmission rate of WEE. The authors are not of the opinion that the relationship is this simple but this is the best operating assumption that can be made at the present level of knowledge of this mosquito-borne disease.

The first step in developing a surveillance program was to determine the factors responsible for the outbreak in Utah in 1958. Several analyses have been made of the unusual weather factors which may have contributed (Graham and Anderson, 1958, Rees and Collett, 1959, Rees *et al.*, 1959, Graham *et al.*, 1960). There is still no certain answer to the question of what weather factors create conditions favorable to transmission of WEE, but at present the best information indicates that above normal precipitation early in the year either

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as snow pack in the mountains or above normal precipitation in May or June followed by a long, hot, dry period of forty to fifty days in late June, July, and August may be contributing factors. Loomis (1953) indicated a relationship between the 1952 outbreak of encephalitis in California and the snowpack in the Sierras.

Changes in populations of the vector, *C. tarsalis*, probably have a direct influence on changes in the incidence of the disease. The outbreak of WEE in Utah was accompanied by a large increase in *C. tarsalis* populations (Rees *et al.*, 1959). A direct relationship between population levels of the vector and the transmission of the WEE virus is difficult to demonstrate since vector populations were probably higher in the years before control operations began, including many years without significant numbers of cases of the disease, than in 1958 in areas included in mosquito abatement districts. The factors responsible for changes in populations of *C. tarsalis* may

possibly cause other changes that make transmission of WEE more probable. Loomis (*op. cit.*) reported above normal populations of *C. tarsalis* associated with the 1952 outbreak of encephalitis in California.

Larval survey data, biting counts, and light trap collections are presently used to obtain information on mosquito populations in Utah. Larval survey data should give earlier indications of unusual mosquito populations than biting counts or light trap collections, not only because larvae appear before adults, but also because control operations apparently delay increases in adult populations.

The larval survey techniques used in Utah have been described elsewhere (Graham, 1959), but mention should be made here that all pools with larvae are recorded in the survey and the number of pools is used as an index. Several years of experience, careful study, and the application of statistical techniques were necessary to de-

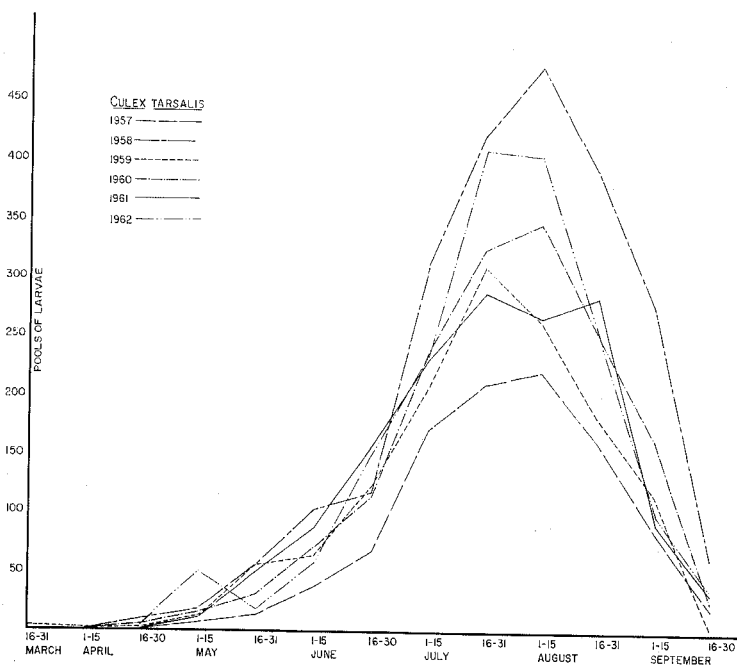


FIG. 1.—Pools with larvae of *Culex tarsalis* in South Salt Lake County from 1957 through 1962.

velop adequately standardized procedures. Both larval survey procedures and light trap collections were in effect before, during, and since the 1958 outbreak.

The number of pools with larvae of *C. tarsalis* in 1958 was greater than in other years (Figure 1) in the South Salt Lake County Mosquito Abatement District. Graham and Bradley (1962) reported on the importance of larvae of mosquito species being able to occupy larval habitats without other mosquito species being present. When the pools with only *C. tarsalis* larvae are compared (Figure 2) for several

and were almost all males. Other traps remained low in 1962.

The number of *C. tarsalis* females taken in light traps is compared each year with 1958 (Figure 4). The same light trap locations are used each year for this purpose.

There are some indications that increases in mosquito populations in Utah may occur over a period of two or more years. This is not definitely demonstrated, but is considered in the surveillance program as a possible factor.

This program has been in operation since 1959 and so far has indicated accurately

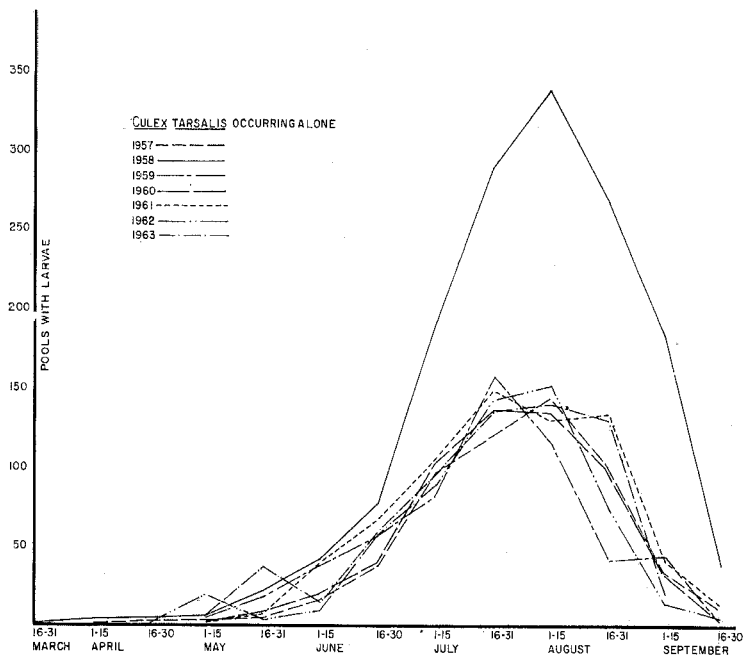


FIG. 2.—Pools with only *Culex tarsalis* larvae in South Salt Lake County from 1957 through 1963.

years, the increase in 1958 is more pronounced.

Figure 3 shows the relationships of light trap catches of *C. tarsalis* in 1958 and other years in the Salt Lake City Mosquito Abatement District. In 1962 large numbers of the species were trapped, but more detailed analysis showed that most of them were taken late in the season in one trap

each year that outbreaks of WEE would not occur. More testing and improvement is desirable and probably necessary but the surveillance program, while not yet adequately tested, represents the best techniques that can be applied at this time in Utah.

Plans have been made to act on the basis of the factors mentioned for the surveil-

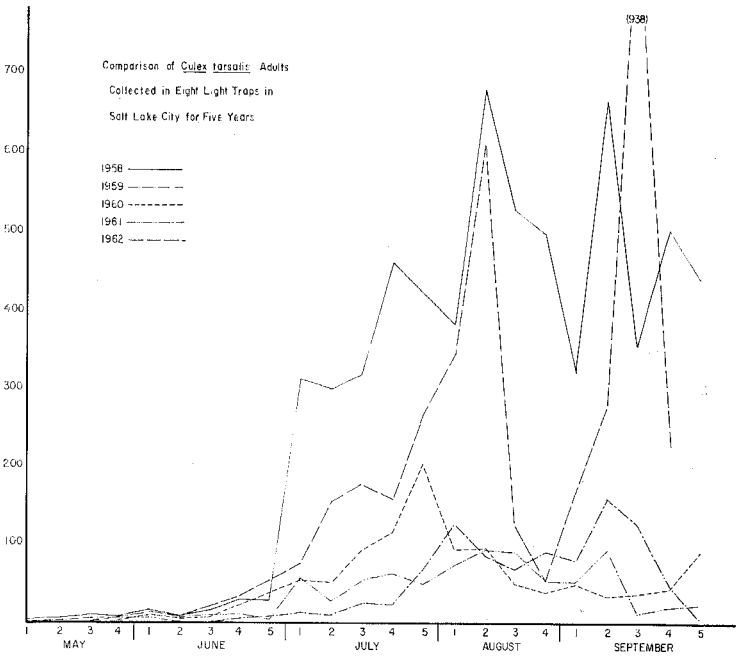


FIG. 3.—Numbers of *Culex tarsalis* taken in eight traps in Salt Lake City from 1958 through 1962.

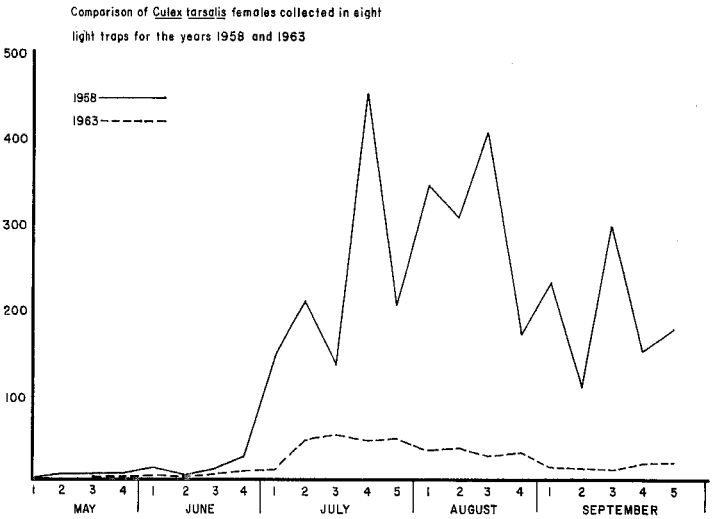


FIG. 4.—Numbers of female *Culex tarsalis* taken in eight traps in Salt Lake City in 1958 and 1963.

lance program. When early weather conditions indicate the possibility of an outbreak, health authorities will be notified and mosquito abatement districts alerted. If this is followed by above normal larval population increases in *C. tarsalis*, control operations will be intensified and concentrated on this species. If this is followed by light trap catches and biting counts that further indicate a large increase in population of the vector, control efforts will be further intensified and possibly other mosquito species will be ignored if necessary to bring as much effort as possible against this species.

SUMMARY AND CONCLUSIONS. After the western equine encephalitis outbreak in Utah in 1958, the Salt Lake City and South Salt Lake County Mosquito Abatement Districts developed a coordinated surveillance program for the disease using information from the State Health Department, the State Agriculture Department, United States Public Health Service, the United States Weather Bureau, and their own records of mosquito populations. The factors evaluated to predict outbreaks of WEE are weather conditions and larval and adult populations of *C. tarsalis*. The surveillance program has not yet been adequately tested, but is the best possible with present knowledge and conditions. Many years of testing will be necessary for complete confidence in the surveillance procedures. To date, the program has indicated accurately that outbreaks would not occur. In the event that surveillance indicated the probability of an encephalitis outbreak, control efforts against *C. tarsalis* would be intensified.

Literature Cited

ANONYMOUS, 1956. Encephalitis surveillance program continued in 1956 season. California Vector Views. 3(10):52.

GRAHAM, JAY E., 1959. The relation of detailed larval surveys to control efficiency in Salt Lake County, Proceedings of the 46th Annual Meeting of the New Jersey Mosquito Extermination Association: 119-121.

GRAHAM, JAY E., and ANDERSON, R. D. 1958. A seasonal history of mosquito larval populations in Salt Lake County, Utah. Unpublished paper, 6th Annual Meeting Entomological Society of America.

GRAHAM, JAY E., BRADLEY, I. E., and COLLETT, G. C. 1960. Some factors influencing larval populations of *Culex tarsalis* and western equine encephalitis in Utah. Mosquito News 20(2):100-103.

GRAHAM, JAY E., and BRADLEY, I. E. 1962. The effects of species on density of mosquito larval populations in Salt Lake County, Utah. Mosquito News 22(3):239-247.

JENKINS, A. A. and DONATH, R. 1959. The 1958 encephalitis outbreak in northern Utah. 1. Human aspects. Mosquito News 19(4):221-222.

LONGSHORE, W. A., 1953. The epidemiology and public health significance of encephalitis in California. Proceedings and Papers 21st Annual Conference California Mosquito Control Association: 55-59.

LOOMIS, EDMUND C., 1953. Population trends of *Culex tarsalis* in the Central Valley of California. Proceedings and Papers California Mosquito Control Association: 73-76.

LOOMIS, EDMUND C., 1959. The function of larval surveys in the California encephalitis surveillance program. Proceedings and Papers 27th Annual Conference California Mosquito Control Association: 66-67.

REES, DON M., and COLLETT, G. C. 1959. Factors influencing the encephalitis outbreak in Utah in 1958. Proceedings and Papers 27th Annual Conference California Mosquito Control Association: 88-97.

REES, DON, OGDEN, L. T., COLLETT, G. C., and GRAHAM, JAY E. 1959. The 1958 encephalitis outbreak in northern Utah. 3. Mosquito populations in relation to the outbreak. Mosquito News 19(4):227-231.

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