FURTHER OBSERVATIONS ON *AEDES VEXANS* (MEIGEN) IN UTAH

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In 1967, Minson and Graham reported that *Aedes vexans* (Meigen) populations in Salt Lake County, Utah had shown progressive increases from 1963 through 1966. This increase was reported in terms of larval populations because data on adult populations remaining after control measures have been applied are not adequate for determining changes accurately. In addition, techniques have been developed for measuring changes in larval populations in the area that are more precise than those for measuring changes in adult populations.

Increases in population reported at the time were in the number of pools or sites producing this species, in the number of times individual pools contained larvae and as an increase in distribution in the county into areas not typical of the larval habitat of *A. vexans*.

Studies of mosquito populations were continued in 1967 as a routine part of the Salt Lake County Mosquito Abatement District's research program and further changes in populations of *A. vexans* were noted.

The procedure developed for measuring changes in larval populations was initiated in 1956 and modified as experience was obtained. Each year improvements have been made in the procedures but the period of most rapid improvement was at the beginning. By the end of 1958 pro-

cedures were standardized, and subsequent improvements were less important.

Briefly, the procedure for larval survey in the district requires that the inspectors, either graduate students in entomology or students under the direct supervision of entomology graduates, collect certain data for every positive larval source. Data are also collected for some negative sources. The data collected for positive sources include the following:

A. Ecological data pertaining to the source
   1. Associated vegetation—this includes several categories representing the various plant types in the area
   2. Water characteristics—permanent, temporary, fluctuating
   3. Water source—precipitation, irrigation, seepage
   4. Flow
   5. Shade (percent)
   6. Depth (average in inches)

B. Data concerning collection
   1. Area of source
   2. Number per dip
   3. Air and water temperature at source
   4. Instar
   5. Time

Time and space do not permit a complete discussion of the treatment of collected data by the district or of all of the procedures and techniques used to determine the accuracy of the data. A statistician is employed as a permanent consultant for the district and the data are placed on IBM punch cards and processed by the Univac 1108 at the University of Utah or the IBM 7040 at Brigham Young University.

Complications involved with parts of the data make it impractical to program everything for the computers and parts are still treated by hand. Not all of the collected data were used for this study.

The records which were collected permit accurate identification and location of mosquito sources and provide information as to which species is produced and how often during each year. Comparisons from year to year are also possible.

The trends in population changes from 1963 through 1966 continued in 1967. The number of positive sites for *A. vexans* increased from 368 in 1966 to 467 in 1967. This is about nine times the average number of positive sites for the 4-year period preceding the progressive increase (Fig. 1). The number of pools or sites producing *A. vexans* more than once per year also increased (Fig. 2) from 22 percent in 1966 to 33 percent in 1967 and is about three times the average of the 4-year period preceding the increase. The increase in distribution of sites in the county also continued to rise. Figure 3 compares the location and number of positive sites in 1959 at the beginning of this study with the present distribution. A notable change is in the number of pools extending along the Jordan River in the southern part of the district with an increase from an average of 20 sites from 1959 through 1966 to 70 in 1967.

A. vexans is produced only once per season in most of the larval sources where it is found in Salt Lake County. From 1959 through 1962 only 12 percent of the sites produced this species more than one time. This percentage has steadily increased to 37 percent in 1967. Assuming that there may be an apparent repeated occurrence of the species upon subsequent inspection due to incomplete control measures, we selected those pools which produced three or more times and found that only 11 sites had repeated positive inspections for any two seasons and none produced *A. vexans* three or more times a season for more than two years. At present, we do not have sufficient data to indicate in all cases whether the repeated occurrences are due to incomplete control. However, methods have been established this year to give this information.

Many of the pools with *A. vexans* also contain larvae of the other species, primarily *Aedes dorsalis* (Meigen), but this association has also changed during the period of population increase. In 1962, 31 percent of the positive sites for *A.*

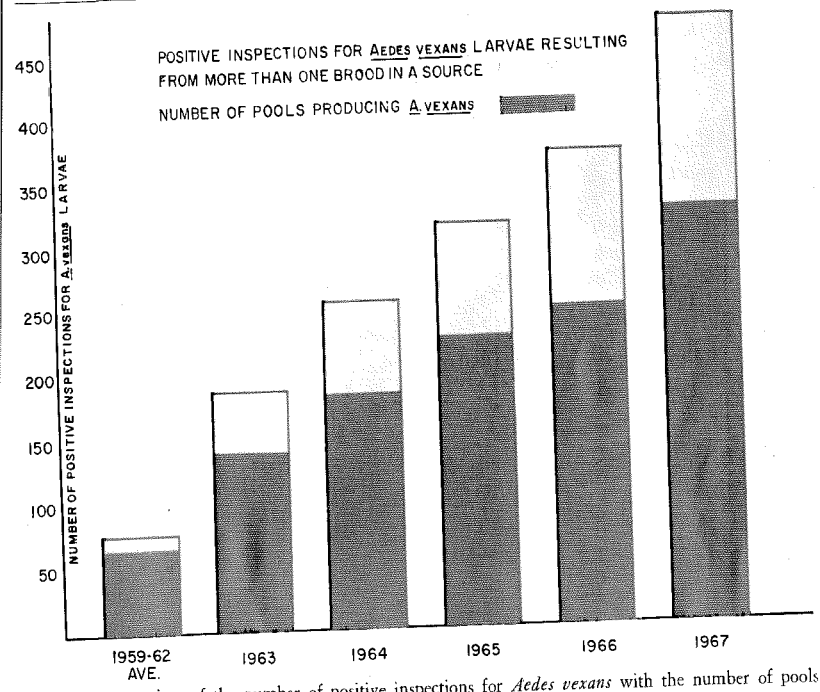
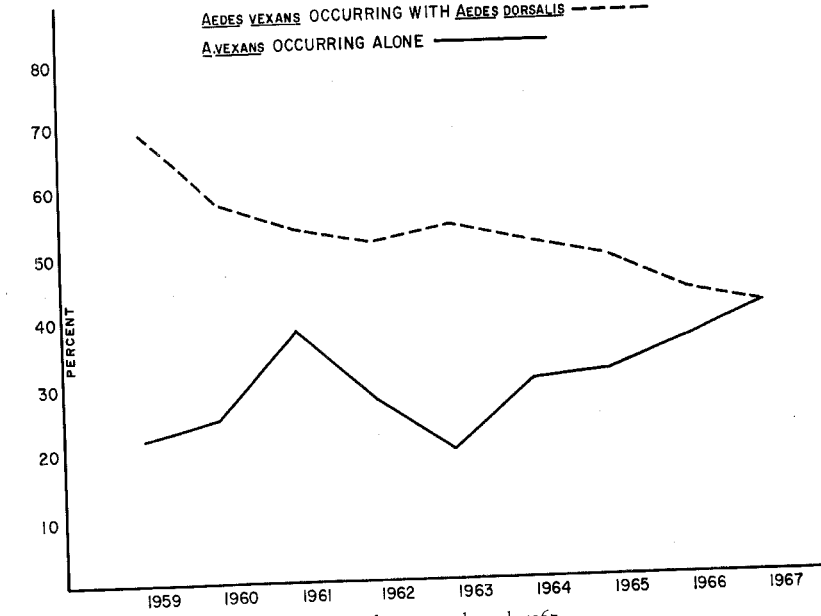


FIG. 1.—Comparison of the number of positive inspections for *Aedes vexans* with the number of pools producing this species, from 1959 through 1967.



season, from 1959 through 1967.

FIG. 2.—Comparison of pools containing *Aedes vexans* and *Aedes dorsalis* with pools containing only *Aedes vexans* from 1959 to 1967.

vexans contained only this species. This increased to 41 percent in 1967. Conversely, the sites containing both *A. vexans* and *A. dorsalis* decreased to 41 percent (Fig. 4).

A. dorsalis is the major problem during the initial spring production due to rain, snow melt, and spring runoff, accounting for as high as 95 percent of the total mosquito larval production in March and April, but *A. vexans* remains conspicuously absent until the first half of May. In the latter part of May and the first half of June there is generally a large increase in the production of the species. In 1967, *A. vexans* constituted 28 percent of the total positive larval inspection during this period.

The Salt Lake City Mosquito Abatement District borders the County District to the north and their records show an increase in larval production since 1965, when no *A. vexans* larvae were collected, to 16 positive inspections in 1967. The two districts vary somewhat in environment and collection procedures but evidence indicates a change in the larval populations in both districts.

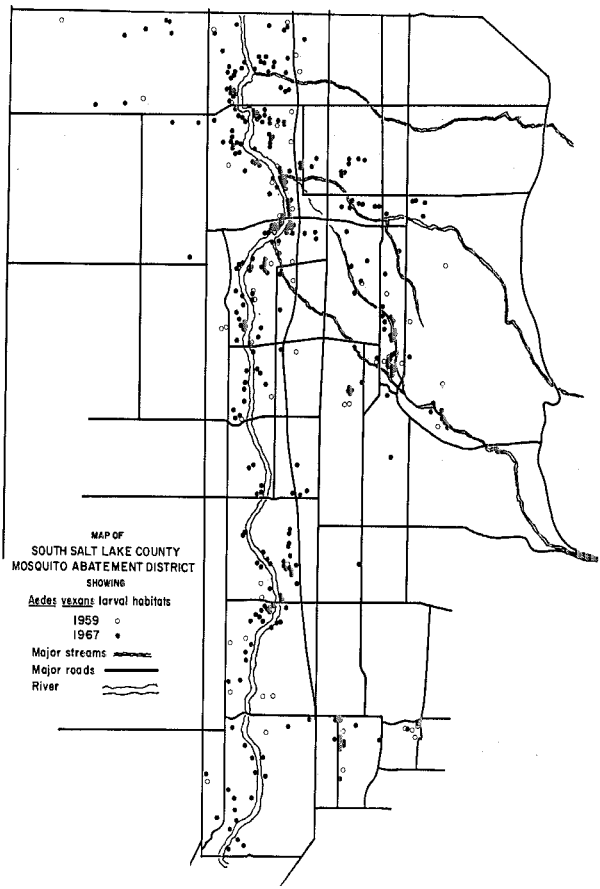


FIG. 3.—Map of South Salt Lake County showing the distribution of pools producing *Aedes vexans* in 1959 compared to the distribution in 1967.

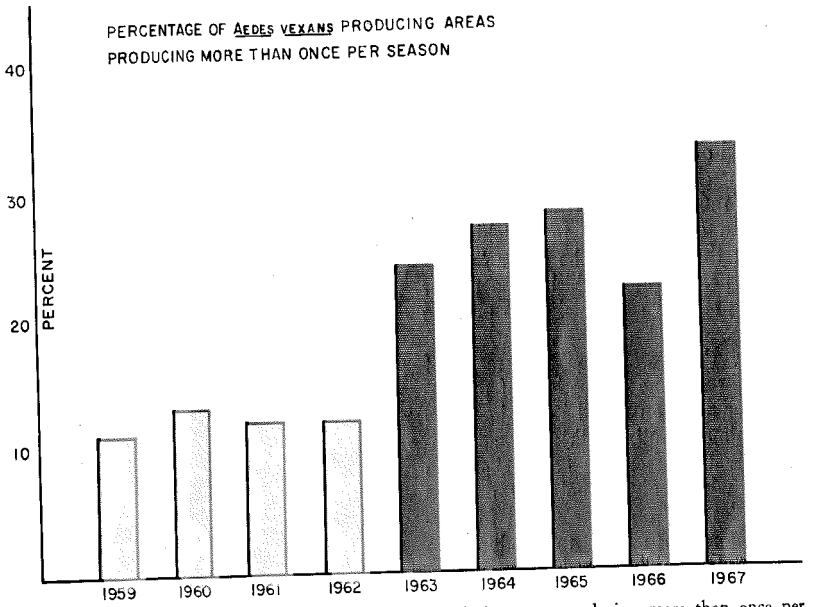


FIG. 4.—Comparison of percentages of *Aedes vexans* producing areas producing more than once per season, from 1959 through 1967. The dark bars indicate the years of population increase.

Adult population measurements in Salt Lake County and Salt Lake City Mosquito Abatement Districts did not reflect the increase until 1967 when the collections in both districts increased from an average of 28 adult *A. vexans* trapped in all New Jersey type light traps per season for 1965 and 1966 to 214 in Salt Lake County and 387 in Salt Lake City for all traps. Information obtained from the City District definitely indicates an increase in *A. vexans* activity in 1967 (Collett, 1967, personal communication).

DISCUSSION. Since 1962, *A. vexans* has increased significantly in the South Salt Lake County Mosquito Abatement District. The results show changes in distribution and increase in the number of pools invaded by this species. There is also a significant drop in the number of times the species occupies a pool once per season, perhaps indicating a change in oviposition preference or an actual change in available water due to human population pressure. Ross (1964) makes an interesting observation likening the *A. vexans* mosquito to the human population in its ability to spread and adapt to temperate regions.

There are definite conditions that must be present to stimulate *A. vexans* production. Accepting the fact that eggs are present in desirable sites ready for flooding, Clements (1963) indicates that practically all aedine eggs need some sort of hatching stimulus before larvae will emerge. It might be supposed that there has not been sufficient "conditioning" of the *A. vexans* eggs for them to hatch upon immediate flooding in the spring. Many potential sites remain inundated throughout the spring due to snow melt, rain, and spring runoff from nearby mountains. Horsfall (1956) cites an example of an area covered with water from January until June which possessed eggs but no hatching took place. A nearby site was not inundated until April and hatching

took place shortly afterwards. This could be one possible cause of the time lapse between production of *A. dorsalis* and *A. vexans* in the spring.

Though Horsfall (1956) and Clarke and Wray (1967) point out a minimum threshold of approximately 17° C (62° F) before hatching will take place, Breeland, *et al.*, (1965) question whether temperature is a critical factor for hatching or whether there needs to be just a "conditioning period" after which time proper hatching stimuli are sufficient to produce larvae.

While the reasons for appearance of *A. vexans* and the fluctuations of population over a season may be explained due to hatching stimuli, conditioning, and water fluctuation, facts are not available to explain why a given pool may produce the species only once per season for several seasons then start to produce the mosquito more than once during a season. There are obvious changes in water usage throughout the county. Changes due to new freeway systems, housing developments, shifting of water use on farms and control measures taken by agencies such as the mosquito abatement districts and flood control units, have definitely created new problems which cannot be ignored from the standpoint of mosquito ecology.

Earlier work on mosquito populations in Salt Lake County by Graham and Bradley (1962) demonstrated that greater numbers of mosquito species are produced when it occupies a larval habitat without other mosquito species being present than when other species are present. This could provide a larger population of adults which could suggest another reason for the more widespread appearance of *A. vexans* due to a correlation between the increase of *A. vexans* (see Fig. 4) occurring alone and the increase in production sites.

SUMMARY AND CONCLUSIONS. Studies of mosquito populations in the Salt Lake County Mosquito Abatement District from 1956 through 1967 show that *A. vexans* populations have steadily increased for a 5-year period from 1963 through 1967. The increase has been primarily noted in larval population but adult populations also were noted to have increased in 1967. The increases in population are due to:

1. The number of sites producing *A. vexans*.
2. The number of times individual sites produce more than once.
3. The number of times the species is able to occupy a larval site without other mosquito species being present
4. The distribution of the species in the county.

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