

vent them from breeding in relatively permanent water accumulations.

The fire barrels considered are concrete cylinders with inside measurements of 18 inches in diameter and 34 inches in height. The cylinders are filled approximately once a year with water from the Brownsville water mains. Evaporation in the barrels is at the rate of an inch or two a month. It was theorized initially that adults of *Psorophora ferox* and the two *Aedes* laid eggs at the water line and that the eggs hatched subsequent to the water levels being raised. However, it was learned that water had not been added to the barrels for at least six months. Consequently, the eggs must have dropped off the sides of the barrels or were laid directly in the water. Travis (1953) reported that eight percent of one lot of *Aedes sollicitans*, submerged in tap water within 24 hours after being laid, hatched within eight days, without an interval of drying.

The 40 fire barrels in the warehouse in question were filled with tap water Nov. 4, 1960,

and checked every few days the remainder of the month. No *Aedes* were detected until Nov. 22, when second and third instar *sollicitans* were collected in four barrels. There were only a few larvae in three of the barrels, while the fourth contained more than 100 specimens.

We are unable to advance an explanation as to why these flood-water mosquitoes chose to oviposit in fresh-water fire barrels, particularly in view of numerous roadside ditches in the vicinity which are subject to periodic inundation and which are typical of their normal breeding habitats.

#### References

BATES, M. 1949. The Natural History of Mosquitoes. The Macmillan Co., New York. 379 pp.

TRAVIS, B. V. 1953. Laboratory studies on the hatching of marsh-mosquito eggs. Mosq. News 13(3):190-198.

#### RELATION OF TEMPERATURE AND HUMIDITY TO WINTER SURVIVAL OF *Culex pipiens* AND *Culex tarsalis*<sup>1</sup>

G. ALLEN MAIL AND ROBERT A. MCHUGH

As an adjunct to studies of the overwintering habits of mosquitoes, observations were made on the survival of females of *Culex pipiens* and *Culex tarsalis* that were collected in a mine tunnel near Farmington, Utah, in January and in December, 1957, and subsequently placed under constant conditions of temperature and humidity. A previous study of this mine (Dow, Mail, and Richards, 1957) reported high mortality in the hibernating mosquitoes. Consequently, both lots of material used in the present study had probably consumed, when collected, more than the normal amount of hibernating fat.

The first series of observations was made on 46 *Culex pipiens* and 47 *Culex tarsalis* that were collected on January 16, 1957. The specimens of each species were divided into 3 aliquots and placed in three constant temperature cabinets held at 27° F., 37° F., and 47° F. The relative humidity in each cabinet was 35-40 percent. The percent mortality was observed at 5, 7, 9, 15, 21, 30, and 40 days. At each observation, the specimens were exposed briefly to higher temperatures to determine which ones were dead. At 27° F.,

37° F., and 47° F., all specimens of *C. pipiens* were found dead on the 21st, 9th, and 21st day, respectively; all specimens of *C. tarsalis* were found dead on the 40th, 40th, and 21st day, respectively. The estimated 50 percent survival period (Fig. 1) ranged from 4 to 23 days.

During the following December, further collections of *C. pipiens* and *C. tarsalis* were made in the same mine, and observations were begun in the same cabinets. In this part of the study, the temperatures used were 27° F., 32° F., and 37° F., and the air was specially humidified. The 27-degree cabinet was lined on the bottom and sides with slabs of ice from frozen ponds, and pieces of ice were loosely stacked in spaces not occupied by the mosquito cages. The relative humidity was kept at 84 percent. In the 32-degree cabinet, which had a relative humidity of 87 percent, shallow enameled pans filled with a concentrated solution of zinc sulfate were loosely stacked with one-inch-square wooden strips between them. In the 37-degree cabinet, with relative humidity of 86 percent, there were pans arranged as in the 32-degree cabinet but filled with water. The humidity was measured by a model HA-2 Friez<sup>2</sup> psychrometer which had to

<sup>1</sup> From the Encephalitis Section, Technology Branch, Communicable Disease Center, Public Health Service, U. S. Department of Health, Education, and Welfare, Greeley, Colorado.

<sup>2</sup> Use of trade names is for identification purposes only and does not constitute endorsement by the Public Health Service.

LEGEND

- *C. pipiens* at 35-40 percent rel. hum.
- *C. pipiens* at 84-87 percent rel. hum.
- *C. tarsalis* at 35-40 percent rel. hum.
- *C. tarsalis* at 84-87 percent rel. hum.

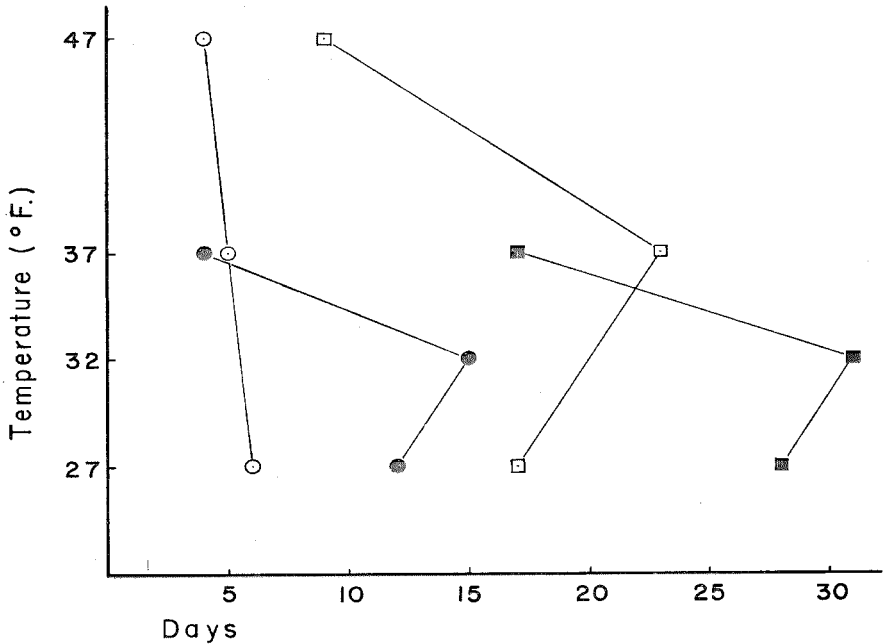


FIG. 1.—Approximate 50 percent survival period of overwintering *C. pipiens* and *C. tarsalis* held at different temperatures and relative humidities.

be left inside the cabinet for several hours before it was used for a reading; otherwise air passing through the apparatus was considerably warmed. All the containers of mosquitoes were examined daily for the first week, and weekly thereafter until all the specimens were dead. As in the previous series of observations, the specimens were exposed briefly to higher temperatures at each examination. The approximate 50 percent survival periods are shown in Figure 1. The maximum longevity which occurred in *C. tarsalis* at 27° F. and 32° F. was over 70 days.

Under the conditions of both of these tests, *C. tarsalis* survived longer than *C. pipiens*, especially

at the lower temperatures. At 47° F., there was a relatively small difference (5 days) between the two species in the 50 percent survival period, but at lower temperatures *C. tarsalis* had a 50 percent survival period 11 to 18 days longer than that of *C. pipiens* held in the same range of humidity. This finding, together with the previous observations of Dow *et al.* (*op. cit.*), suggests that *C. tarsalis* is adapted for overwintering at somewhat lower temperatures than is *C. pipiens*.

Comparison of the species at different humidities is complicated by the confounding of month of collection with level of humidity; that is, December specimens might be expected to live

longer than January specimens even if they were not held at a higher humidity. At 37° F., the 50 percent survival period of both species was shorter by at least one day at the higher humidities. At 27° F., however, the 50 percent survival period was 6 days longer at the higher humidity in *C. pipiens* and 11 days longer at the higher humidity in *C. tarsalis*. In general, the observations indicate that overwintering *C. tarsalis* survive longer than *C. pipiens* at any temperature between 27° F. and 47° F., and that the difference is greater at the lower

temperatures (27° F. to 37° F.). The tests also indicate that both species reach maximum survival under conditions of high humidity combined with temperatures at or slightly below freezing.

#### References Cited

Dow, R. P., MAIL, G. A., and RICHARDS, C. S. 1957. Observations on the overwintering of *Culex tarsalis* in northern Utah. Proc. 9th Ann. Meeting Utah Mosq. Abatement Assoc., 1956: 12-15.

## LIST OF ADVERTISERS

American Cyanamid Company.....	VI
California Mosquito Control Assn. ....	XII
Concession Supply Company .....	XII
Curtis Automotive Devices.....	I
Desplaines Valley Mosquito Abatement Dist.....	194
Florida Anti-Mosquito Assn. ....	XIII
Hausherr's Machine Works .....	X
H. D. Hudson Mfg. Co. ....	VII
Illinois Mosquito Control Assn. ....	189
New Jersey Mosquito Exterm. Assn. ....	XI
Richfield Oil Corp. ....	XI
Rohm & Haas Co. ....	IX
Schild-Bantam Co. ....	II, III
Sherwin-Williams Co. ....	XIV
D. B. Smith & Co. ....	X
Todd Shipyards Corp. ....	IV
Utah Mosquito Abatement Assn. ....	237
Velsicol Chemical Corp. ....	V
Willys Motors Inc. ....	VIII
Wyco International .....	XV