OVIPOSITION OF *CULEX PIPIENS* IN WATER AT DIFFERENT TEMPERATURES

B. I. GILLESPIE AND P. BELTON
Department of Biological Sciences
Simon Fraser University
Burnaby, B.C., Canada
V5A 1S6

ABSTRACT

At 20C air temperature, female *Culex pipiens* L. laid the greatest number of egg rafts at water temperatures between 20 and 25C. They laid very few at 15 or 35C even when given no alternative site. The possibility is discussed of manipulating temperature in a mosquito control programme.

INTRODUCTION

It was once thought that mosquitoes scattered their eggs indiscriminately but that in a given habitat, only certain species were able to survive. Field studies have failed to support this idea; in fact, larvae in a given breeding site correspond to the eggs found there (Bates 1940). It is more likely that the restriction of given species to a certain type of larval habitat results from selective oviposition (Wallis 1954).

Cx. pipiens L., from a recently colonised local population, was used in this study. The species was probably introduced into the Vancouver area early in this century. It now lays egg rafts in stagnant drainage ditches, sewage lagoons and a variety of temporary pools and artificial containers and it can be a pest in late summer when it enters houses and bites.

MATERIALS AND METHODS

Eggs were obtained as needed from a colony of *Cx. pipiens* maintained at Simon Fraser University since 1974. The colony was started from larvae collected at Richmond, B.C., by Angerilli (1977) and reared continuously since, using McLintock's method (1960).

When adults were needed for experiments, egg rafts were taken from the main colonies and the larvae were reared in 2000ml of distilled water in an enamel tray, 40 x 25 x 4.5 cm deep. Finely-ground Tetramin and ground baker's yeast was provided, using the quantities suggested by Gerberg *et al.* (1969).

The pupae were placed in emergence cages 18 x 12 x 16cm high. Adults were provided with a 10% sucrose solution and the RH was maintained at 60 to 65% by immersing a paper towel wick in a beaker of water.

Oviposition experiments were conducted in a windowless plywood cage of 182 x 61 x 122 cm. The two oviposition sites were at opposite ends of the cage. Each consisted of a bowl, 17 cm in diam and 8.5 cm deep, containing 1000 ml of distilled water, a heater with a thermostat, a thermometer, and a temperature probe leading to a chart recorder. The bowl rested on a cold water circulating chamber. With this arrangement we were able to set the temperature of the water above or below that of the room and could regulate it within 1C.

For each experiment 200 to 300 adults of each sex were introduced into the plywood cage. A 100 ml Erlenmeyer flask in front of each oviposition site contained 10% sucrose solution and was stoppered with cotton wicks. After 1 week a restrained, shaved guinea pig was placed in the cage on 4 consecutive nights so that the female mosquitoes could obtain blood meals.

Egg rafts were collected over the next 10 days. Each raft was counted as an oviposition event but the eggs in the rafts were not individually counted as their number was found by Wallis (1954) to be independent of the suitability of the water at the breeding site.

A set of experiments was run with both sites at constant water temperatures of 15, 20, 25, 30 and 35C, one experiment at each temperature. In another set, duplicate tests were run with each of the following different pairs of temperatures, 15 & 20, 15 & 25, 20 & 25, 20 & 30 and 25 & 30.

The data were changed to proportions of total rafts laid and were transformed using the arc sine square root, before the data were subjected to analysis of variance followed by a Student-Newman-Keuls multiple range test.

RESULTS

When the temperature of the water at the two oviposition sites was the same, their position had no statistically significant effect on the proportion of egg rafts laid. The total numbers of egg rafts laid at the 5 temperatures were:

Degrees C	15	20	25	30	35
Numbers	4	44	68	37	10

When the two oviposition sites were at different temperatures there was a similar trend for more rafts to be laid in the middle range of temperatures. To allow for differences in the total numbers of rafts laid in the replicated experiments, proportions of the rafts found at

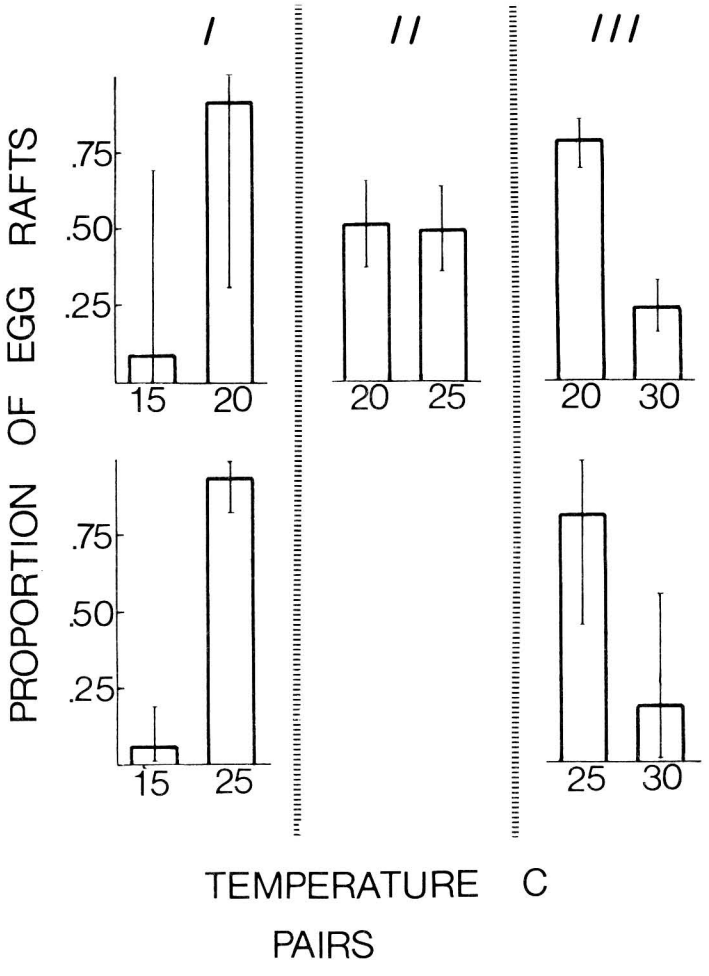

Fig. 1. Mean proportion of egg rafts laid at paired sites held at the temperatures indicated. Means and 90% confidence intervals (vertical lines at the top of each bar) were retransformed from arc sine square roots. Statistical analysis indicates three different responses: *I* where significantly more rafts were laid at the higher temperature, *II* where there was no significant difference in their numbers and *III* where significantly more were laid at the lower temperature.

each of the two temperatures were tested statistically. The results are shown in the bar graphs of figure 1. Differences between the pairs labelled *I* and *III* are all significant.

When the lower temperature was 15C, the higher temperature had the most egg rafts (fig. 1, *I*). When the temperatures were 20 and 25C the proportion of rafts laid at the two sites showed differences no greater than those found in the experiments with both sites at the same temperature (Fig. 1, *II*). When the higher temperature was 30C, the lower temperatures had the most rafts (Fig. 1, *III*).

DISCUSSION

Very few egg rafts were found in water at 15 and 35C. Wallis (1954) stated that *Culex* mosquitoes "do not oviposit in water that is unacceptable to them" and found no *Cx. pipiens* rafts in water with a salinity greater than 0.5%. Bellamy and Corbet (1974) found resorption of eggs by *Cx. tarsalis* in unfavourable conditions.

The simplest explanation for our results was a difference in the probability of oviposition at different temperatures. Rafts were seldom laid at 15 or 35C; the females evidently

resorbed their eggs or died without laying. Most rafts were laid at the intermediate temperatures of 20 and 25C.

Because these trends were similar, whether the mosquitoes had a choice or not, and because some rafts were always laid in the water having a less favourable temperature, it seems unlikely that the temperatures of the two oviposition sites were actually compared.

As the air temperature was maintained at 20 ± 1C, the mosquitoes may have been comparing air and water temperatures, laying most rafts at water temperatures up to 5C above air temperature. These results, however, do not rule out the possibility that they have an internal absolute thermometer to measure water temperature directly. Tests at different air temperatures would be needed to resolve this question.

It has been suggested that artificial pools could be used to determine the presence and abundance of disease-carrying mosquitoes (Belton 1967, Smith & Jones 1972). Oviposition surveys using small containers already offer an economical, rapid and sensitive method for determining the presence of adult *Aedes aegypti* in the field (Fay & Eliason 1966).

Knowledge of the favourable range of water temperatures shown here, could be used to increase oviposition in artificial pools. Heated pools have potential for use in an integrated control programme, either as a sensitive surveying method or perhaps as traps in which large numbers of immature stages could be eliminated with little hazard to the environment.

REFERENCES

Angerilli, N. P. D. 1977. Some influences of aquatic plants on the development and survival of mosquito populations. Ph.D. Thesis. Simon Fraser University.

Bates, M. 1940. Oviposition experiments with Anopheline mosquitoes. Ann.J.trop.Med. 20:569-583.

Belton, P. 1967. The effect of illumination and pool brightness on oviposition by **Culex restuans** (Theo.) in the field. Mosq.News 27:66-68.

Fay, R. W. and D. A. Eliason. 1966. A preferred oviposition site as a surveillance method for **Aedes aegypti.** Mosq.News 26:531-535.

Gerberg, E. J., T. M. Hopkins and J. W. Gentry. 1969. Mass rearing of **Culex pipiens** L. Mosq. News 29:382-385.

McLintock, J. 1960. Simplified method for maintaining **Culex pipiens** Linnaeus in the laboratory (Diptera: Culicidae). Mosq.News 20:27-29.

Smith, W. W. and D. W. Jones. 1972. Use of artificial pools for determining presence, abundance and oviposition preferences of **Culex nigripalpus** Theobald in the field. Mosq.News 32: 244-245.

Wallis, R. C. 1954. A study of oviposition activity of mosquitoes. Ann.J.Hyg. 60: 135-168.