SELECTION FOR DIVERGENT EMIGRATION RATES
IN LABORATORY POPULATIONS OF
MUSCA DOMESTICA

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It is a truism that animal populations exist in environments that are discontinuous in both space and time. Ecologists have long recognized that environmental discontinuities are of great importance in the population dynamics of natural populations. As a corollary it follows that the rate of emigration of a species through its environment will be important to its population dynamics. The now classic case of the prickly pear cacti (Opuntia spp.) and the moth Cactoblastis cactorum that feeds on them in Australia effectively demonstrates this point (Dodd, 1959).

In spite of the recognition of the importance of environmental discontinuities and the movements of animals through the environment, most ecologists who have worked with laboratory populations have chosen to simplify their systems by eliminating spatial-temporal discontinuities. There are, however, several exceptions. Huffaker (1958) and Huffaker, Shea and Herman (1963), using laboratory predator-prey systems in which both predator and prey were mites, showed that the “stability of interaction was greater in the spatially more complex system” (Huffaker, Shea and Herman, 1963, p. 328).

Pimentel and his co-workers have also shown that environmental discontinuity can be important in laboratory predator-prey systems (1963) and, additionally, in competition experiments (1965). Moreover, as Pimentel has pointed out, an increase in population stability resulting from environmental discontinuity may give the species concerned the opportunity to evolve to become better adapted to the system, including other species present in it. Data for several laboratory systems give support to this hypothesis (Pimentel et al., 1963, 1965).

It is reasonable to hypothesize that if a species is placed in a discontinuous environment, it will evolve an emigration rate that promotes more effective use of the environment. Circumstantial but convincing evidence for this hypothesis has been assembled for natural populations by Southwood (1962). It is the purpose of this paper to provide evidence that laboratory populations might also evolve changes in their movements to better suit them to a discontinuous environment.

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METHODS

Two separate selection experiments were performed. In the earlier generations of the first experiment quantitative changes (such as the number of flies used to start a trial) were made while attempting to find suitable procedures. Therefore, a second experiment was carried out for six generations so that the early changes in the populations could be quantified.

Wild house flies were collected at the start of each experiment near Etna, New York. The single population (the first-generation offspring of the wild flies) with which each experiment was begun was divided into two populations by segregating those flies emigrating first from the flies which had not emigrated after a given length of time. In the first experiment the flies emigrating in the first 4 hours and the flies not emigrating in 12 hours were used to begin the high and low emigration rate populations, respectively. In the second experiment the flies emigrating in the first 2 hours and the flies remaining behind after 24 hours were used to start the high and low emigration rate populations, respectively. ("high emigration rate" will hereafter be abbreviated HER and "low emigration rate" will be abbreviated LER.)

Once the wild populations were divided they were thereafter kept separate. In each succeeding generation HER flies were selected by collecting those individuals emigrating in the first hour and destroying the remainder. Flies of the LER population were selected by saving only individuals not emigrating in 24 hours.

At the start of each selection trial all flies were from 24 to 36 hours old from emergence from the puparium. All flies were placed into the cage at least 24 hours before the start of the emigration trial.

Clear plastic refrigerator boxes (3.75 × 5.25 × 7.5 inches) were used as the cages between which emigration took place. A clear plastic tube was cemented into the end of each box so that boxes could be joined in pairs and flies allowed to move between them through the tubing. This tubing has an inside diameter of 0.25 inches, projected 1.125 inches from the end of the box, and was located 2.5 inches from the bottom of the box.

To prevent flies that had entered the collection box from returning to the box they had left, three nylon bristles were glued by one end over the entrance of the collection box. The flies could easily push by these bristles when entering the collection box, but tests showed them to be about 94 per cent effective in preventing movement in the opposite direction.

Ventilation in the boxes was provided by holes covered with bronze screen. An inverted vial of water with a cellu-cotton wick was placed in the lid of each box and a cube of table sugar was provided.

The paired boxes were placed on a white shelf which was lighted from above by 6-watt incandescent lamps arranged in a grid pattern. The level of illumination was 6.5 foot candles at the surface of the shelf.