THE EFFECT OF GENETIC DRIFT ON MATING PROPENSITY, COURTSHIP BEHAVIOUR, AND POSTMATING FITNESS IN DROSOPHILA SIMULANS

by

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Introduction

In Drosophila, homozygosity for a significant portion of the genome, caused for example by full-sib inbreeding, typically results in lowered mating propensity (Maynard Smith, 1956; Connolly et al., 1974). Thus, inbred males are usually at a competitive disadvantage with outcrossed males (Sharp, 1982, 1984). Similarly, inbreeding or homozygosity for whole chromosomes causes a decrement in other components of fitness, such as viability and fertility (Dobzhansky & Spassky, 1953; Maynard Smith, 1956; Temin, 1966), and male virility (Brittnacher, 1980). Little is known, however, about behavioural correlates of mating propensity, and about the correlation between pre- and postmating components of fitness.

We studied courtship, mating rates, fertility, and productivity (number of offspring) in two lines of Drosophila simulans which had undergone genetic drift and in the highly outcrossed base population from which they originated (Ringo, 1986). Both of the drift lines, which had lost most of the genetic variation of the base population, were chosen for their low mating propensities in contrast to the high mating propensity of the base population.

Materials and methods

Stocks.

Three lines of Drosophila simulans, elsewhere designated Base (B), Chetverikov (C), and Mayr (M) (Ringo, 1986), were used. The genetically heterogeneous base population (B)
from which the other two lines were derived was constructed from many field-collected stocks in 1979 (Wood & Ringo, 1982). Each of the other lines was founded by a single pair, maintained in a large population cage, and passed through a 'bottleneck' every six months for three years (Ringo, 1986; Ringo et al., 1985). Passage through a bottleneck consisted of choosing a fertile breeding pair at random from the population. The average size of the B population, and of the other two lines in stationary phase (the period of no change following exponential growth) was about 8000 adults. C and M experienced a reduction in genetic variation of approximately 81 percent owing to reduced effective population size (Falconer, 1981).

Subjects for the experiments reported here were taken from sublines established from large (N ~ 300) samples of each line. The sublines were maintained in 250-ml bottles on cornmeal-malt-molasses-yeast medium at 25°C.

The subjects were 3-d-old virgins housed until testing in single sex groups of 20-50. Lightly etherized imagoes were sexed within 8 h of eclosion.

Mating propensity.

The mating propensities of each of the three lines were measured in "no choice" tests, i.e., tests in which only two lines were present (SPIETH & RINGO, 1983). For each test, 10 females were aspirated into a Plexiglas mating cell (ELENS & WATTIAUX, 1964), after which 10 males were aspirated into the cell. The test was performed at 23 ± 2°C under overhead fluorescent lights; the cumulative number of copulating pairs was counted once every minute for 20 min. Thirty replicates were performed for each of the nine combinations of lines.

Courtship behaviour in single pairs.

Elements of courtship behaviour were recorded for single pairs placed in small Plexiglas mating cells (WOOD et al., 1980). A single male and a single female were aspirated into a mating cell and the behaviour of the male was recorded for the following 5 min using an event recorder. Four components of behaviour were recorded: the latency between introduction of a pair into the mating cell and the first instance of courtship (latency), the amount of time spent orienting (orient), the amount of time spent scissoring (scissor), and the amount of time spent vibrating (vibrate). Each test was replicated ten times.

Postmating fitness.

Productivity was measured by placing female individuals of each line (B, C, or M) with the consistently fertile F1 hybrid males from M X C and C X M crosses: MC (M = dam) and CM (C = dam). In each replicate, one female was housed with two males of one type in a 35-ml culture vial and observed for 1 h to determine copulation rate within that time. Each female was transferred to a fresh culture vial 24 h later and the males were discarded; 24 h later the female was removed. Both vials were checked for larvae 72 h after initial pairing; if larvae were not detected, the female was dissected to check for insemination. The number of offspring counted 15 d after initiating the experiment was the measure of productivity. Forty replicates were performed for each parental line, 20 with each male type.

For males, the virility (the number of females inseminated) and productivity (number of offspring produced 15 d after initiating the experiment) of each type was measured by placing one set of males with CM females and one set with MC females. In each replicate, one male was placed in a vial with 10 females of one type. For the first hour, the number of matings was recorded. After 24 h, the females were transferred individually to separate 35-ml culture vials. The vials were checked for larvae 48 h after transfer; if larvae were not present, the females were dissected to determine whether they had been inseminated.