Phenotypic Plasticity of Sexual Behavior at Different Temperatures in a Drosophilid: *Phorticella striata*

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ABSTRACT

Phenotypic plasticity is the capability of a genotype to produce different phenotypes in different environments. The effects of changes in ambient temperature on reproductive fitness traits such as mating latency, copulation duration and mating success were studied in the Mysore and Ahmedabad populations of *Phorticella striata* at four ambient temperatures: - 15°C, 22°C, 29°C and 36°C. Between the two populations the difference in mating latency was insignificant. However, the difference in copulation duration was significant between the two strains. The differences in mating latency and copulation duration at the four temperatures were also significant. Both populations exhibited long mating latency and short copulation duration at 15°C and short mating latency, long copulation duration at 22°C and 29°C. At 36°C flies did not mate at all. The greatest mating success (%) was observed at 22°C in both the Mysore and Ahmedabad populations. At 15°C, and 29°C mating success was low. Chi-square test showed that the difference in mating success between the two populations was insignificant at different temperatures. Mating latency, copulation duration and mating success are independent events in the sexual process. These traits need not be expressed similarly by the same species under different situations. Thus, the present study heralds the phenotypic plasticity of sexual behavioral traits under various ambient temperatures. Our findings strengthen the support for the adaptive nature of temperature - mediated plasticity in sexual behavior.

Key words: Phenotypic plasticity, Sexual behavior, *Phorticella striata*, *Drosophila*, mating latency, copulation/mating duration, mating success.

INTRODUCTION

Phenotypic plasticity, the capacity of a given genotype to produce different phenotypes in different environments, is of growing interest among evolutionary biologists (Via and Lande, 1985; Scheiner and Lyman, 1989; Scheiner, 1993; Via, 1993; Schlichting and Pigliucci, 1998; Karan et al. 1999; Lerman and Feder, 2001; Sisodia and Singh, 2002; West and Packer, 2002;
Temperature-dependent plasticity related to sexual traits has been demonstrated in numerous species. For example, in lions, West and Packer (2002) demonstrated temperature-dependent phenotypic plasticity in the lion’s mane, which has significance in sexual selection. In the leopard gecko (Eulepharis macularis), embryonic temperature determines adult sexuality (Gutzkke and Crews, 1998). Temperature-dependence has also been demonstrated in the courtship of male guppies, Poecilia reticulata (Laudien et al., 1980). In most ectotherm species, plasticity also results in a smaller body size when ambient temperature increases (Atkinson and Sibly, 1997; James et al. 1997). In flies, D. melanogaster reared at 18°C outlived flies reared at 28°C during the adult stage (Alpatov and Pearl, 1929; Burcombe and Hollingsworth, 1970; Lints and Lints, 1971). Latitudinal clines which are known in several Drosophila species (Karan et al. 1998) show smaller flies in warmer climates. Sexual isolation as a by product of adaptation to different temperature and humidity regimes was observed in D. melanogaster (Kilias et al. 1980). Furthermore, changes in the photoperiod can cause changes in mating behavior in two mutant strains of D. melanogaster (Crossley, 1974). David et al. (2006) showed phenotypic plasticity of body size in a natural population of Drosophila melanogaster. All these illustrations stress that the parallelism between the effects of plasticity and genetic variation is an argument for an adaptive interpretation. This emphasizes the fact that phenotypic plasticity is also a target of natural selection.

Phorticella striata (Nirmala and Krishnamurthy, 1975) is a drosophilid insect described from Karnataka, India. The species was named for the characteristic striations on its head, mesonatum and scutellum. (Phorticella flies are adorned with two prominent chalky white stripes, well marked by a dark hue on either side of the head and thorax and another pair arranged laterally on the thorax). Like Drosophila, this species also has all the characteristics of a good laboratory tool for analyzing genetic and evolutionary problems. Yenisetti and Hegde studied re-mating (2002), size related mating and reproductive success (2003) in Phorticella striata and observed some results that may have interesting evolutionary significance. But, except for these maiden attempts, no work has been done on the behavioral genetics, cytogenetics and evolutionary genetics of this species. Different species adapt to different evolutionary strategies, and the principles of natural selection can be understood by utilizing species belonging to different taxa for such studies.

Various aspects of sexual behavior, such as mating latency (time elapsed between introduction of male and female until initiation of copulation), copulation duration (mating duration) and mating success (number of pairs mated within a given interval), are good estimates of the reproductive fitness of both sexes. The expression of these genetically controlled traits is influenced by environmental factors. Information regarding the influence of ambient temperatures on sexual behavioral traits, such as mating success, mating latency and copulation duration, in drosophilid flies is lacking. We therefore studied the effect of temperature on the sexual behavior in two geographical populations of Phorticella striata, revealing the phenotypic plasticity of sexual behavioral traits under different temperatures.

**MATERIALS AND METHODS**

To study the effect of different temperatures on various aspects of sexual behavior, such as mating latency, copulation duration and mating success, the following two populations were used: a) Brindavan Gardens, Mysore, Karnataka, India and b) Ahmedabad, Gujarat, India. These locations are separated by about 2000 km.

Mysore is located in the South Indian state of Karnataka. The city extends from 12°18′ N to 76°42′ E. It is located about 770 m above sea level. The climate in Mysore is a temperate, with temperatures ranging from 21°C to 34°C in summer, from 12°C to 30°C in winter. The city gets an average of 86 cm of rain annually, most of it during the monsoon season from June to October.

Ahmedabad is located in the northern part of Gujarat state in western India. It is located at 23° 03′ N 72° 5 8 E. The average elevation is 53 m. There are three main seasons in a typical year—summer, monsoon and winter. The weather is hot from March to June, and summer temperatures range from 23°C to 43°C. From