

IS BODY SIZE A SEXUALLY-SELECTED TRAIT IN *DROSOPHILA HYDEI* MALES? Sofija Pavković-Lučić and V. Kekić. Institute of Zoology, Faculty of Biology, University of Belgrade, 11000 Belgrade, Serbia

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Darwin (1871) contrasted sexual selection (struggle for mating success) with natural selection (struggle for survival and reproduction after mating). Nowadays, sexual selection is recognized as a special form of natural selection and defined as selection that arises from differences in mating success (Arnold, 1994). Large body size in males has emerged as a correlate of mating success across a range of insect taxa (Thornhill and Alcock, 1983). However, investigations with a number of *Drosophila* species have indicated that the relationship between body size and male mating success is quite complex and may not be as strong as originally believed (Markow et al., 1996). Larger male body size was associated with mating success in *D. ananassae* (Singh and Singh, 2003), *D. buzzatii* (Santos, 2002), *D. malerkotliana* (Naseerulla and Hegde, 1992), *D. melanogaster* (Partridge et al., 1987; Markow, 1988; Taylor and Kekić, 1988; Pitnick, 1991; Pavković-Lučić, 2006), *D. mojavensis* (Markow and Ricker, 1992), *D. nigrospiracula* (Markow, 1988), *D. simulans* (Markow and Ricker, 1992), *D. subobscura* (Monclus and Prevosti, 1971; Steele, 1986), and *D. testacea* (James and Jaenike, 1992). In contrast with these reports, detailed studies exist in which a correlation between body size of males and their mating success was not determined, as in *D. littoralis* (Aspi and Hoikkala, 1992), *D. mojavensis* (Markow, 1982), *D. montana* (in a sample from the year 1989, Aspi and Hoikkala, 1992), *D. nigrospiracula* (Polak and Markow, 1985), *D. pseudoobscura* (Markow and Ricker, 1992; Markow et al., 1996), *D. silvestris* (Boake and Konigsberg, 1998), *D. simulans* (Markow et al., 1996), and *D. willistoni* (Basso da Silva and Valente, 2001). Studies also exist showing that smaller males are more successful in matings, e.g., in *D. montana* (in a sample from the year 1988, Aspi and Hoikkala, 1992) and in *D. subobscura* (Monclus and Prevosti, 1967; Steele and Partridge, 1988).

There is not much information about the sexual selection of *D. hydei* during pre-copulatory periods of their reproductive behavior. As far as we know, only T. A. Markow (1985) reported on a comprehensive laboratory investigation of male and female reproductive behavior and its consequences for individual fitness in *D. hydei*. Among other things, mating success of males was tested in competitive conditions (two males and one female), where it was observed that males with larger bodies (greater thorax length) in a majority of cases were more successful in matings than were smaller males.

D. hydei has some specific characteristics of reproductive behavior that make it significantly different from other *Drosophila* species. For example, whereas in *D. melanogaster* sexual maturation of males and females lasts equally long, in *D. hydei* the males mature 5-6 days after females and most of them start to mate when they are at least 9 days old (Markow, 1985). In addition, whereas in *D. melanogaster* a majority of females may remate after 5 - 7 days (Markow, 1985; McRobert et al., 1997), *D. hydei* females are capable of mating even with four different males in the course of 24 hours (Markow, 2002). Also, whereas in *D. melanogaster* copulation lasts about 20 min (MacBean and Parsons, 1967; Pavković-Lučić and Kekić, 2006), in *D. hydei* it is very quick and lasts only 1 min (Sturtevant, 1915). For all of these reasons, a couple of *D. hydei* flies in copula is not easy to observe, since they very quickly detach from each other and escape. The possibility of catching a couple of *D. hydei* flies in copula using an aspirator is about 0.80, whereas in *D. melanogaster* it is greater than 0.98.

The work presented here was conducted in a weekend settlement on the banks of Lake Stara Tisa near the village of Bačko Gradište in Serbia. To attract fruit flies, a mash of seasonal fruits (about 10 kg of mixed apples, plums, and grapes, with small amount of sugar to stimulate fermentation) was put in a 15-liter barrel. The barrel was located near a weekend house below an extension of the roof, where it was protected from sunshine and rain. This specific habitat turned out to be very attractive for domestic *Drosophila* species, particularly for *D. melanogaster* (ca. 95% of individuals), but also for *D. hydei* (Kekić, 1997; 2002).

Flies were collected by aspirator in the early morning, during their maximal sexual activity, on the 9th and 10th of August 2004. Altogether, we collected 15 pairs in copula. After the accomplishment of their sexual activity, we collected all other *D. hydei* flies we could find at the moment in our barrel, i.e., a total of 17 males and 11 females.

All collected flies were preserved in 70% ethanol until their body size was measured. In *Drosophila*, body size is often approximated as wing or thorax length, and wing length being proposed as a more convenient measure when flies can be killed (Robertson and Reeve, 1952). Wing length of mating and non-mating flies was measured as length of the third longitudinal vein, from the anterior cross vein to the distal edge

(Partridge et al., 1987). For 15 males captured *in copula*, the mean wing length was $X \pm S. E. = 84.87 \pm 0.95$ (in terms of measurement units, 1 mm = 48 measurement units). A random sample of 17 non-copulating males had a mean wing length of $X \pm S. E. = 84.35 \pm 1.02$. This difference of mean wing length between copulating and control males was not significant ($t = 0.37$, $df = 30$, $P = 0.718$). The difference of mean wing length between mating and non-mating females likewise was not significant (*in copula*: $X \pm S. E. = 91.20 \pm 0.90$; single: $X \pm S. E. = 89.45 \pm 2.35$; $t = 0.69$, $df = 24$, $P = 0.448$).

At first glance, previous results suggest that the size of the body of *D. hydei* males does not influence their success in mating under natural conditions. However, as we saw in the above-described laboratory experiment of Markow (1985), the F : M sex ratio was 1 : 2 and such competition exist when between males exists, i.e., when the female has a choice, the body size of males could be crucial for this decision. In our field study, the total number of caught males (both copulating and non-copulating) was greater than that of caught females, the sex ratio being 1:1.23. Unfortunately, we have no information on the age structure of non-copulating males and females, i.e., about their sexual maturity, enabling us to conclude with certainty whether real competition among males did exist, thereby providing objective conditions for sexual selection.

Anyway, body size (wing length) itself may not be the direct target of sexual selection in *D. hydei* under natural conditions, where some other traits (morphological, physiological, or behavioral) could be more important for mating success of *D. hydei* males. To our knowledge, dimorphism of body color is not involved in sexual selection in this species, as it is uniform and 'does not differ' among the sexes (see the review of Wittkopp et al., 2003). Afterwards, sexually dimorphic hydrocarbon molecules often are involved in sexual selection in *Drosophila*, being found in species of the *melanogaster* (Ferveur, 1997) and *obscura* groups (Noor and Coyne, 1996). On the other hand, it is known that the *repleta* group of *Drosophila* species (to which *D. hydei* belongs) shows very small quantitative differences of odor profiles between the sexes (Markow and O'Grady, 2005). It is possible that postmating sexual selection occurs in this species, if exaggerated ejaculate characters such as the giant sperm found in *D. hydei*

(Pitnick and Miller, 2000) can be considered to be "ornaments", like some external morphological traits (Markow, 2002). Rapid female remating in *D. hydei* may result in overlapping ejaculates in the female reproductive tract, so that ejaculate traits which enhance fertilization are favored by sexual selection.

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