

SHORT COMMUNICATION

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## Size-assortative mating in the earthworm *Eisenia fetida* (Oligochaeta, Lumbricidae)

Received: March 22, 2004 / Accepted: August 9, 2004 / Published online: October 6, 2004

**Abstract** In many species of simultaneous hermaphrodites, body size correlates with fecundity, and larger partners are preferred to small ones. Since sperm exchange is usually reciprocal, small individuals may be rejected by larger partners resulting in size-assortative mating. We studied the mating patterns in a natural population of the simultaneous hermaphroditic earthworm *Eisenia fetida* (Oligochaeta, Lumbricidae). We found that size-assortative mating processes existed, with variance in body weight within pairs lower than between pairs in mating earthworms. This non-random mating pattern probably reveals the existence of mate selection in this species, which lives at elevated densities with high availability of potential mates.

**Key words** Earthworms · *Eisenia fetida* · Mate selection · Simultaneous hermaphrodites · Size-assortative mating

### Introduction

In animals, the mating pattern depends on population density, availability of mates, mating preferences and competition over number of mates (Jennions and Petrie 1997). Mate selection on body size has been proposed as a major force for the mating patterns found in nature (Ridley 1983). In particular, mating strategies of simultaneous hermaphrodites may depend on body size because the fecundity of the female function is normally limited by the available energy invested in egg production, while the fecundity of the male function is normally limited by the availability of eggs (Charnov 1979). In fact, in many species of simultaneous hermaphrodites, body size correlates with fecundity, and larger partners are preferred to smaller ones (Vreys and Michiels 1997; Lüscher and Wedekind 2002). Since sperm

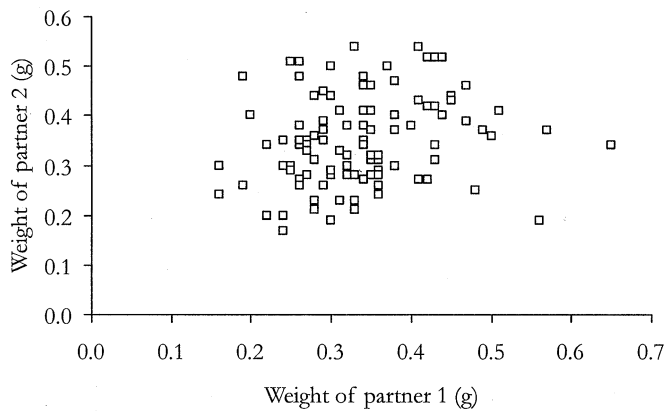
exchange is usually reciprocal, small individuals may be rejected by larger partners resulting in size-assortative mating (Ridley 1983).

Earthworms are a widespread group of simultaneously hermaphroditic animals with reciprocal insemination (Edwards and Bohlen 1996). In some species of earthworms occurring at high densities, size-assortative mating may be predicted because availability of mates is high, but mating is costly (Michiels et al. 2001). Size-assortative mating has been studied only in one species of earthworm, *Lumbricus terrestris* Linnaeus 1758 (Clark 1941; Michiels et al. 2001). In an experimental study, earthworms preferred same sized mates to differently sized ones, suggesting a precopulatory mate assessment (Michiels et al. 2001). No further studies on size-assortative mating have been conducted in earthworms. *Eisenia fetida* (Savigny 1826) is an earthworm that lives in manure heaps in high densities (up to 3,000 individuals/m<sup>2</sup>), thus offering considerable potential for exercising mate choice. Moreover, the mating process is expected to be costly because they spend a long time in copulation (Grove and Cowley 1926), and in addition the mucus and sperm production as well as the constriction movements between partners are energy draining. The aim of this study was to test the occurrence of size-assortative mating in the earthworm *E. fetida* in a natural population.

### Materials and methods

Pairs of mating earthworms ( $n = 104$ ) were collected in a dung heap of cow manure from a small farm near the University of Vigo (42°9'N, 8°41'W), in the northwest of Spain. Individuals were collected by the hand-sorting method (Edwards and Bohlen 1996) in June 2000. Each partner was weighed (fresh weight) in the laboratory and within-pair weights were compared using a one-way ANOVA with pair number as a factor to test the occurrence of assortative mating by size. The correlation of within-pair weight was derived from the intraclass correlation coefficient ( $r_i$ ) (Lessells and Boag 1987).

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**Fig. 1.** Relationship between the body weight of the partners in mating pairs of earthworms collected in a natural population of *Eisenia fetida* in spring ( $n = 104$  pairs). Partners' weights were randomly assigned as partner 1 or 2

## Results

Body weight of adult mating earthworms ranged from 0.16 to 0.65 g, with a mean value of  $0.34 \pm 0.09$  g. The average weight proportion of within pairs earthworms was 1 : 1.32, and the maximum difference in weight between partners was 0.19 : 0.56 g (1 : 2.95).

The analysis of the collected set of mating earthworms revealed that the variance in body weight within pairs was lower than between pairs (ANOVA  $F_{103,104} = 1.49$ ,  $P = 0.021$ ). The intraclass correlation coefficient showed a value  $r_i = 0.20$  indicating assortative mating by size. The weight of the partners within a pair was similar and showed a positive relationship (Fig. 1).

## Discussion

This is the first study of mating patterns in the earthworm *E. fetida*. We found size-assortative mating in a natural population of this species and these non-random mating patterns probably reveal the existence of mate selection. Ridley (1983) predicted that assortative mating by size in simultaneous hermaphrodites occurs in species with reciprocal fertilisation and in which larger individuals lay more eggs. *E. fetida* shows reciprocal sperm exchange during copulation (Grove and Cowley 1926; Domínguez et al. 2004) and larger individuals within mating pairs produce more cocoons (Meyer and Bouwman 1997). In another study of mate choice in earthworms, *L. terrestris* showed preference for same-size partners in experimental conditions, while assortative mating in the field was found in some samples,

but not in others (Michiels et al. 2001). The differences between the mating preferences and mating patterns can be attributed to the burrowing behaviour of *L. terrestris*, since this species lives in permanent burrows and mating choice is limited to the neighbourhood (Michiels et al. 2001). However, *E. fetida* is an epigeic species living at high densities in temporary accumulations of organic matter (e.g. manure heaps), so there is no apparent limitation on choice of mate partners. An interesting open question is how *E. fetida* assess the body size of the partner. Grove and Cowley (1926) suggested the existence of some kind of precopulatory behaviour or courtship in *E. fetida*, since they observed the occurrence of short and repeated touches between partners before mating attachment. Alternatively, it has been proposed that assortative mating could be constrained by physical incompatibility of the copula among partners of different sizes (Ridley 1983; Michiels et al. 2001). However, we found differences between partners as large as 1 : 3. Although *E. fetida* showed size-assortative mating, the low intraclass correlation coefficient also indicates within-pair high variability in body weight. The within-pair variability can be due to the simultaneous assessment of several traits by the partners (Gibson and Langen 1996). More studies are required to discover whether earthworms select partners by traits other than size.

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