

Animal biology and pathology / Biologie et pathologie animales

Life cycle of the earthworm *Octodrilus complanatus* (Oligochaeta, Lumbricidae)

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Received 25 January 2007; accepted after revision 27 March 2007

Presented by Pierre Buser

Abstract

The earthworm *Octodrilus complanatus* (Dugès, 1828) is a large-sized species often found in grasslands and pastures, with a wider distribution area in Europe and North Africa. In order to determine the characteristics of its life cycle, earthworms of this species were cultured from hatching until they reached maturity. Development rates, cocoon production, and incubation period were recorded under controlled conditions. On average, individuals of *O. complanatus* reared in isolation from hatching reached maturity at day 150 and body weight at maturity ranged between 6 and 8 g. The cocoon incubation period was 66 days, and only one individual hatched from each cocoon, with a mean hatchability of 55%. Reproductive rate showed by *O. complanatus* after mating was of 52 cocoons per earthworm per year. The results showed that the life cycle of *O. complanatus* was characterized by both low growth rates and low fecundity. Specific features in life history traits of *O. complanatus* were compared with those of species of the genus *Octodrilus* and other related earthworms. **To cite this article:** F. Monroy et al., *C. R. Biologies 330* (2007).

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Keywords: Earthworms; *Octodrilus complanatus*; Life history; Growth rate; *k*-Selected species

1. Introduction

Earthworms account for the main part of the faunal biomass found in soil ecosystems and they act as key species of the decomposition and nutrient cycling processes [1]. However, in spite of their ecological importance and the high number of described species, there is still a lack of knowledge about the general biology and ecology of most earthworms. In the soil sys-

tem, large-sized earthworm species play an important role in determining the soil structure and composition through their burrowing activity and surface cast deposition, both in natural and cultivated ecosystems [2,3]. *Octodrilus complanatus* (Dugès, 1828), a large-sized earthworm found often in grasslands and pastures, is a holarctic species of the family Lumbricidae, with a wide distribution area in Europe and North Africa [4]. Large populations of this earthworm species are abundant in maize fields of northwestern Spain (pers. obs.); so the knowledge of both its life cycle and reproductive potential are important in order to evaluate the magnitude of its effects on agroecosystems.

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2. Materials and methods

Mature individuals of *Octodrilus complanatus* were obtained by soil sorting from a maize field in Cesantes (Galicia, Spain) and kept in 1-L plastic containers filled with field-collected soil and fed with cow manure added to the surface. Soil moisture content was maintained at 25% with tap water twice a week. Cocoons were hand-sorted weekly from these initial stocks, measured their weight and size, and then incubated at $20 \pm 2^\circ\text{C}$ until hatching. Hatchlings were kept individually in 250-mL plastic vessels with soil, and fed with cow manure *ad libitum*; the vessels were maintained in a scientific incubator at $20 \pm 2^\circ\text{C}$. The weight of the earthworms and their sexual maturation were recorded weekly; we considered that earthworms attained sexual maturation when the clitellum was fully developed. Results were analyzed by the Student's *t* test. Data are shown as means \pm SE.

3. Results

The growth of *O. complanatus* followed a sigmoid curve, with a slow initial phase (1.03 ± 0.03 g of weight in 75 days) and a rapid phase until sexual maturation (5.1 ± 0.2 g of weight in 75 days) (Fig. 1). Earthworms matured sexually after 150 days with a mean weight of 6.1 ± 0.2 g, and the stationary growth phase was reached after 210 days, with a mean weight of 8.2 ± 0.2 g. The growth rate of earthworms was significantly higher before than after sexual maturity, 43.9 ± 1.8 and 27.6 ± 2.8 mg day⁻¹, respectively (*t* Student test; $t = 5.74$, d.f. = 29, $P < 0.0001$).

Cocoon production started 34 ± 3 days after mating and their reproduction rate was 0.82 ± 0.14 cocoons per earthworm per week. Cocoons were characterized by a

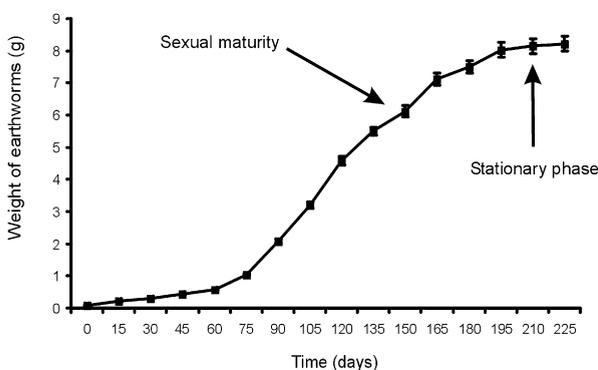


Fig. 1. Growth of *Octodrilus complanatus* at $20 \pm 2^\circ\text{C}$ and fed *ad libitum* with cow manure (means \pm SE, $n = 30$). Time to reach sexual maturity and stationary phase of growth are remarked.

mean mass of 92 ± 4 mg and a size of 6.9 ± 0.1 mm (length) and 4.8 ± 0.3 mm (wide). Incubation time (at 20°C) of these cocoons was 66 ± 2 days (range 50 to 70; $n = 30$), but hatchability was only 55% under culture conditions. Only a single hatchling emerged from each cocoon, with a mean biomass of 82 ± 3 mg (range 60 to 100 mg; $n = 30$).

4. Discussion

In laboratory conditions, *O. complanatus* showed an unexpectedly high growth rate according to their ecological type, characterized by lower growth rates and maturation time [5–7]. This unexpected growth was probably due to the increased food availability and temperature, since Lee [3] reported an optimal thermal range for European lumbricids between 10 – 15°C ; these results are supported by lower growth rates in *Lumbricus terrestris* at 10 – 15°C than at 20°C , as reported by Butt et al. [6]. Apparently, there is a contradiction between the high rates of growth and reproduction that we found at 20°C in this work and the halt in reproduction that this species experiences during summer. In fact, analysis of mature individuals of *O. complanatus* obtained from field populations revealed that in summer the ovaries were not well developed; the size of the seminal vesicles was smaller than during the rest of the year, and the spermathecae were empty, showing a reduced diameter [8,9]. These characteristics were the result of the combination of low moisture conditions and high temperatures, which does not occur in laboratory conditions. Therefore, there is need for further research on variation of the life traits of this species in a range of temperatures and moistures, in order to apply our knowledge to field conditions.

The life cycle of *O. complanatus*, showed in Fig. 2, is more similar to those of other large anecic or endogeic earthworms, like *Lumbricus terrestris*, *L. friendi*, and *Allolobophora caliginosa* (*k*-selected species) than to the life cycles of epigeic earthworms like *Eisenia fetida*, *E. andrei*, *Eudrilus eugeniae* and *Perionyx excavatus*, with shorter sizes, fast growth and higher reproductive rates (*r*-selected species) [10]. Thus, similar growth rates were found by Butt [5] and Butt et al. [6] for *L. terrestris* (6 g of weight in five months at 20°C), even though they were higher than the growth rates of *Allolobophora longa*, *Octolasion cyaneum*, and *Allolobophora carpathica*, other deep-burrowing species [5,7]. The rate of cocoon production (52 cocoons per earthworm per year) places *O. complanatus* together with species like *L. terrestris*, *A. longa*, *A. carpathica* and *O. cyaneum* (38, 18, 10 and 32 cocoons per earth-

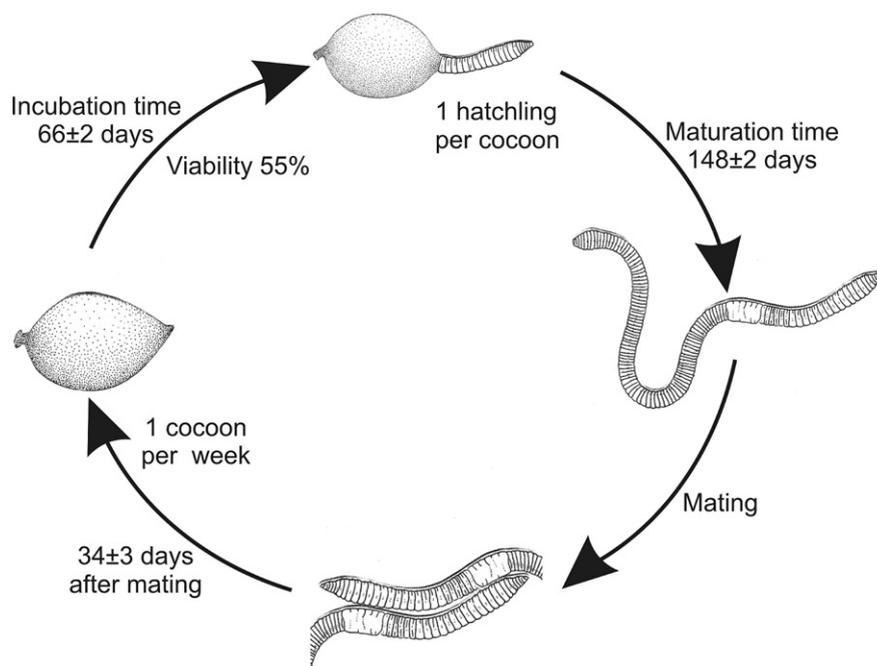


Fig. 2. Life cycle of *Octodrilus complanatus* reared in its parent soil and fed ad libitum with cow manure at a temperature of 20 °C.

worm per year, respectively); however, the cocoon incubation time, over 60 days, and hatchability (55%) were slightly lower than those recorded in *L. terrestris* and *O. cyaneum* and similar to *A. longa*'s ones [5,7].

Acknowledgements

This research was funded by a Spanish CICYT (CGL2006-11928) grant. F. Monroy and M. Aira are currently supported by 'Isidro Parga Pondal' fellowships from the Xunta de Galicia (Spain).

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