

A CONTRIBUTION ON THE NATURAL HISTORY OF
ALLOLOBOPHORA MINIMA MULDAL
(LUMBRICIDAE)¹

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Much of what is known concerning life histories of terrestrial Oligochaeta has been derived from laboratory investigations or is based upon a very few species. As late as 1947, Evans and Guild found it necessary in initiating investigations on the relationship of earthworms to soil fertility, to undertake a series of studies on the fundamental biology of earthworms. In their preliminary paper (Evans and Guild, 1947) these authors stated: "In spite of their natural abundance in soils of widely varying types and their supposed value in the economy of nature, extremely little is known of their biology. So, in order to plan experiments on their effects on soil fertility and to interpret the results of these experiments, detailed biological studies were found necessary."

The observations reported here were made during an extended study of the distribution and natural history of Michigan earthworms and, in this instance, are concerned with the species *Allolobophora minima* Muldal, an earthworm not previously reported from North America. This species was described by Muldal (1952) on the basis of material collected in Hertshire, England. There, it occupied a forest soil of moist clay with a heavy cover of matted grass and ivy; it was also found in rough pasture soil under rotting hay. The only North American record is from a single location, namely, a narrow ravine along the Huron River shore about one mile northwest of the city of Ann Arbor in Section 17, Ann Arbor Township, Washtenaw County, Michigan. This population of *A. minima* is nearly confined to a strip of heavy clay loam soil bordering a small intermittent stream which flows through the ravine. Other narrow valleys along the same river were found to have similar vegetation and stream conditions, but none had this clay loam deposit nor individuals of *A. minima*.

The abundance of individual worms remained high throughout the two years this area was kept under observation; as many as 30 specimens having been collected from a single shovelful of soil. Conditions of moisture and temperature are exceptionally stable in this habitat. Seepage occurs throughout the year and in addition, a heavy deposit of leaf litter is present. The soil was never found to be frozen beneath this litter accumulation and soil temperatures above 20° C were not encountered.

Individuals of *Allolobophora minima* are rather small, seldom exceeding 6 cm. in length, most often measuring from 4 to 5 cm. when fully clitellate. They are about 1.5 mm. wide at the clitellum which is slightly opaque and gives a whitish-gray cast to this region of the body. The worm is unpigmented and appears quite delicate due to the thinness of the body wall and its transparency.

A. minima is a true soil species. Its burrows seldom reach the surface but ramify throughout the soil to a depth of at least 12 in. No pattern is evident in the tunneling except for occasional enlargements or chambers which will be described later. In cultures it has been observed to cast on the soil surface. When the soil is dry, small pellets are formed which measure from 0.5 to 1.0 mm. in length and about 0.25 mm. in width. Under moist or wet conditions, the

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casts form shapeless masses when deposited on the surface. More commonly casting takes place in the lower soil in which case the fecal material resembles a short cone with a small depression at the blunt apex. In the laboratory, *A. minima* was never observed feeding on the soil surface and it is probable that this worm obtains nearly all of its nourishment from organic material which is nearly consolidated with the soil proper.

Clitellate specimens and viable cocoons were taken during all seasons of the year although the latter were more commonly encountered in the spring and summer months. Individuals placed in culture frames so that their activities could be observed constantly, were found in copulation on two occasions. Inasmuch as conditions for observation were rather poor, it could only be determined that they were partially curled about one another anteriorly and that the antero-ventral surfaces were apposed. As described for *Lumbricus terrestris*, the anterior end of each worm was directed toward the clitellar region of the other.

One specimen collected in May, 1952, was found to have spermatophores. These were attached, one on each side, at the level of setal lines *ab* between the 20th and 21st segments. Sections of these structures showed that they were filled with sperm and attached to the worm apparently by means of a band of cuticle. The function of spermatophores for the Oligochaeta is still a matter of conjecture.

The method of deposition of cocoons by this species is rather unusual and a similar process has not been described for any species of earthworm as far as I am aware. *A. minima* produces very small cocoons which measure from 1.5 to 2.0 mm. in length and from 1.25 to 1.75 mm. in width. Tiny projections of approximately equal length extend from either end (fig. 4). The color of the cocoon while the young worm is present varies from pale green to yellow-green and becomes yellow-amber when empty. For the most part, cocoons of the Lumbricidae are merely deposited in the burrows or under debris on the surface of the ground. Cocoon deposition by *Allolobophora minima*, however, is profoundly different. This worm evacuates a small cavity in its burrow of from 5 to 7 mm. in diameter. Within this space the cocoon is deposited, not freely, but encased in a thick layer of rather homogenous soil. Figure 1 shows such a case as found in the soil. Its surface is seen to be covered with slight bumps giving the structure the appearance of a spherical mass of earthworm castings. In the center of this soil mass (fig. 2), a single cocoon is found. Figure 3 demonstrates the relative sizes of the cocoon and the protective earthen capsule. The actual formation of this structure was never observed and it can only be assumed that it represents a deposit of castings placed about the cocoon for protection.

None of the cocoons encountered in this study contained more than one developing individual. After emerging, the young worm burrows directly to the outside of the earthen capsule. The newly hatched worm measures about 14 mm. in length.

During the summer of 1952, specimens of *A. minima* were found in aestivation in the upper soil particularly where the latter had become somewhat dry. Aestivation takes place within a slight enlargement of the burrow which then resembles the chamber evacuated for the cocoon. As with other species of earthworms, the condition is recognizable by the fact that the individual coils into a tight ball and is quite pinkish in color. The addition of moisture will reactivate the aestivating worm almost immediately. No specimens showing either anterior or posterior regeneration were ever collected in the two years this population was under investigation.

Other species of earthworms collected in the same habitat were: *Allolobophora caliginosa*, *Lumbricus rubellus*, *L. terrestris*, *Eisenia rosea*, and *Bimastos tenuis*. Muldal reported *A. caliginosa*, *L. rubellus*, *E. rosea*, and *Allolobophora chlorotica* as associated species in the British collections. It is to be expected that

Allolobophora minima will be found at other points in North America when more extensive collecting has been done. This worm is, however, one of the more demanding species with regard to its habitat requirements, apparently restricted to situations with a high moisture stability. Whether *A. minima* is a species which has been recently imported from Eurasia or represents a relict species from a previous circumpolar distribution of the Lumbricidae cannot presently be determined.

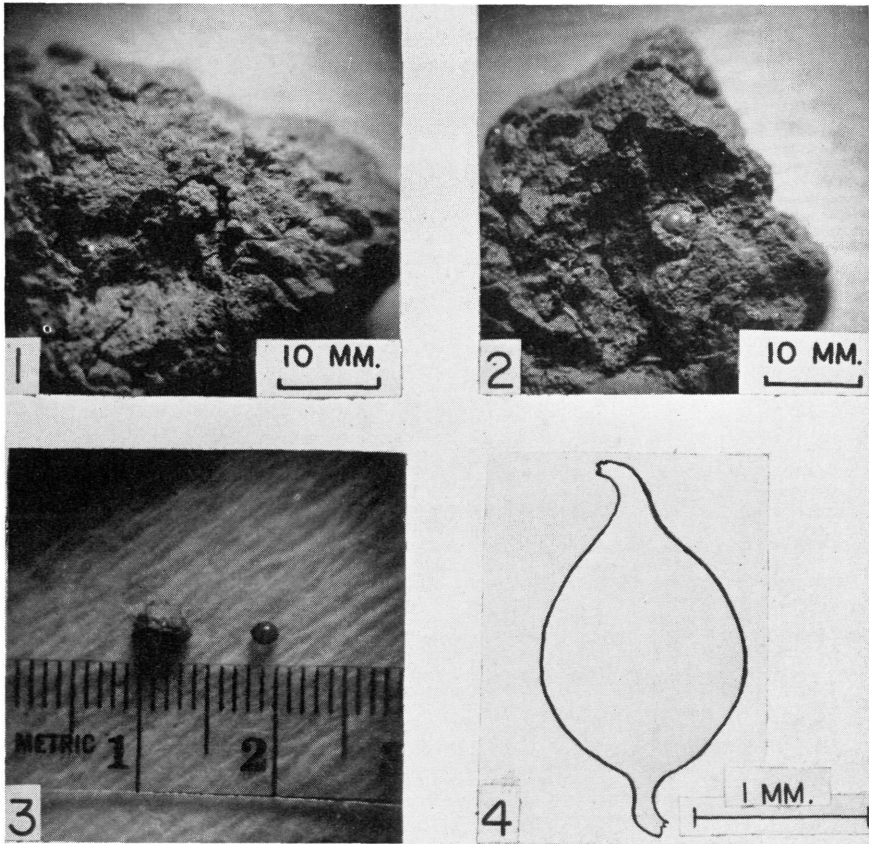


FIGURE 1. Earthy capsule which surrounds cocoon of *A. minima*, shown partially exposed within the soil mass.
 FIGURE 2. Cocoon of *A. minima* with portion of earthy capsule removed.
 FIGURE 3. Earthy capsule and cocoon of *A. minima*. Structure on left is capsule before removal of coon. An example of latter is shown on the right.
 FIGURE 4. Sketch of cocoon of *A. minima*.

SUMMARY

Salient features of the life history and biology of *Allolobophora minima* Muldal are presented. This species is a true soil form, apparently restricted to heavier soils with a high moisture stability. Viable cocoons are found throughout the year. These cocoons are encased in a capsule of soil, the latter apparently composed of cast material placed about the cocoon for protection. Cocoon and soil

capsule are placed in a small chamber evacuated in the burrow. Only one embryo develops in each cocoon. Aestivation is typical and induced by dry soil conditions. No naturally regenerating individuals were observed in two years of field study. *A. minima* has not been reported previously from North America.

LITERATURE CITED

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