

REDESCRIPTION OF *ALLOLOBOPHORA MULDALI*
OMODEO 1956

(LUMBRICIDAE: OLIGOCHAETA)

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The present state of oligochaete taxonomy requires that specific diagnoses embody rather extensive descriptions. Reliance on too few anatomical features not only renders determination of conspecificity difficult but limits the possibilities for establishment of interspecific relationships at generic level. The earthworm to be considered in this paper was originally described as *Allolobophora minima* Muldal 1952 on the basis of material collected in Hertshire, England. The species has been renamed as *Bimastos muldali* Omodeo 1956 (p. 179, footnote) because of preoccupancy by *A. minima* Rosa 1884. Gates (1958) has indicated that the transfer to *Bimastos* is presently unacceptable. He has, at the same time raised the question of possible conspecificity of *A. norvegica* Friend 1913, *A. icenorum* Pickford 1926, and *A. muldali*. Too little evidence is available to permit a clear decision on this point. Murchie (1955, 1956) reported *A. muldali* for Michigan and presented the salient features in the life history of this species.

Muldal's original description is incomplete (Gates, 1958) and appears, in some respects, to be inapplicable to Michigan specimens described here (extent of the gizzard, position of last hearts, location of first dorsal pore). Inasmuch as these characters are subject to misinterpretation, and in view of substantial similarity on so many other points, I believe it advisable to consider the British and American representatives identical. I should like to express my appreciation to Dr. B. I. Roots, Royal Free Hospital School of Medicine, London, England, for notes on British material and to Dr. G. E. Gates for his valuable suggestions on analytical procedures.

Allolobophora muldali (Omodeo) 1956

Allolobophora minima Muldal 1952: 463

Allolobophora minima Murchie 1955: 241

Bimastos muldali Omodeo 1956: 179

Allolobophora muldali Gates 1958: 39

Length 40-60 mm, average 48 mm. Diameter anterior to clitellum 1.2-2.0 mm. Colorless; clitellum opaque, whitish. Somites 87-97, average 95. Prostomium epilobous $\frac{1}{2}$. First dorsal pore $\frac{1}{2}$. Clitellum on XXVII-XXXIII, extending midventrally from seta *a* distance equal to *ab*. Tuberculae pubertates absent. Tail region truncate with midventral groove passing anteriorly at least 6 somites. First nephropore in III; here, and in succeeding somites, at anterior edge of somite, dorsal to *b* distance equal to $\frac{2}{3}$ *ab*. Setae closely paired; *aa* = 7*ab*, *ab* = *cd*, *bc* = 4.5 *ab*, *dd* = $\frac{1}{2}$ μ . Genital setae not modified.

Male pore on XV, between *b* and *c*, slightly closer to *c*, near top of cleft in porophore. Tumescence of male porophore extends ventrad from setal line *c* to include *ab*; covers XV and parts of XIV and XVI. Female pore on XIV; slightly anterodorsal to *b*. Midventral portion of XI-XVI may be somewhat glandular.

Esophagus from $\frac{1}{2}$ V through X; well-developed esophageal pouches in X. Calciferous gland XI-XIV; lamellae 30-38 in number beginning at $\frac{10}{41}$. Crop in XV; esophageal valve to gizzard. Gizzard including XVI and XVII. Typhlosole begins in XX; maximum height $\frac{1}{2}$ inner diameter of intestine. Typhlosole continues, with gradually diminishing height, to terminal segments. Septa $\frac{2}{4}$ and $\frac{7}{4}$ somewhat thickened; $\frac{8}{4}$ much thickened. Pharyngeal gland masses extend into IX. Nephridia vesiculate. Hearts VI-XI; extraesophageal vessels arise in XII; subneural trunk present. Longitudinal muscle bundles of pinnate type.

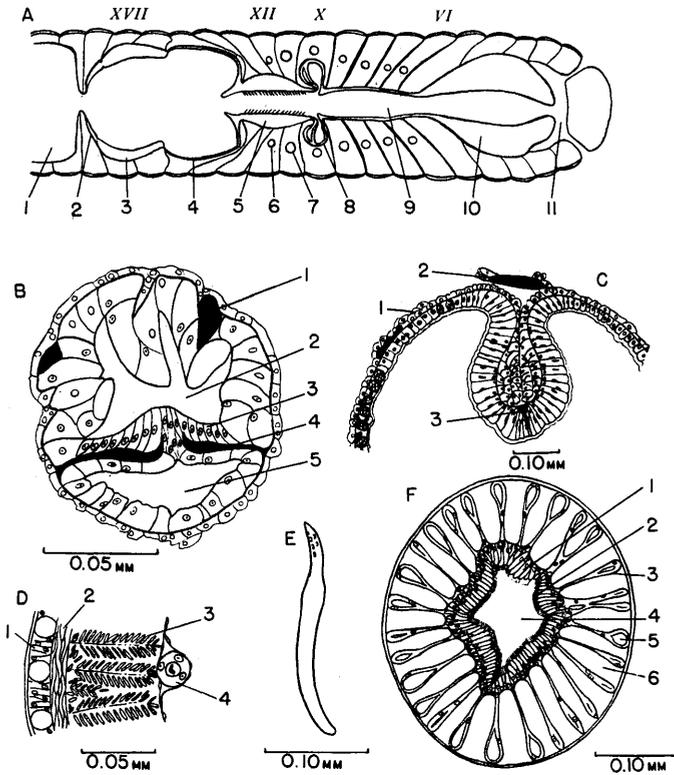


FIGURE 1

- A. Diagram of frontal section through *Allolobophora muldali* showing relationship of parts of digestive tract.
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|---|-----------------------------|
| (1) Intestine | (6) Extra-esophageal vessel |
| (2) First segment of intestine which shows gizzardlike thickening of wall | (7) Last lateral heart |
| (3) Gizzard | (8) Esophageal pouch |
| (4) Crop | (9) Esophagus |
| (5) Calciferous gland | (10) Pharynx |
| | (11) Buccal cavity |
- B. Section of esophageal pouch in X.
- | | |
|--|---|
| (1) Minor vessel in anterior wall | (4) Anterior extension of interlamellar sinus |
| (2) Lumen of anterior portion of pouch | (5) Lumen of posterior portion of pouch |
| (3) Epithelium of calciferous gland extending into pouch | |
- C. Portion of intestine showing typhlosole
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|------------------------|
| (1) Chloragogen layer |
| (2) Dorsal vessel |
| (3) Typhlosolar vessel |
- D. Portion of body wall in cross section; anterior part of segment XIII
- | | |
|---------------------------|---|
| (1) Epithelial layer | (3) Longitudinal muscle layer, pinnate type |
| (2) Circular muscle layer | (4) Male gonoduct with contained sperm |
- E. Seta *a* of XV
- F. Cross section of calciferous gland in XII
- | | |
|-------------------------|--------------------------|
| (1) Ciliated epithelium | (4) Lumen |
| (2) Cilia | (5) Intralamellar tunnel |
| (3) Lamella | (6) Interlamellar sinus |

Two pair of testes and funnels free in X and XI; no postseptal epididymal looping of male gonoduct. Male ducts of each side internal to muscle layers; join in XII. No atrium; glandular development of XIV, XV, and XVI external to circular muscle layer. Seminal vesicles 2 pair, in XI and XII from $\frac{1}{11}$ and $\frac{1}{12}$. One pair of ovaries and funnels in XIII; up to 5 ova in single strand from each ovary. Paired ovisacs in 14, from $\frac{1}{4}$ dorsomedian to funnel. Seminal receptacles absent.

Discussion

The extraesophageal vessels in this earthworm, as is the case with many lumbricids, might be misidentified as a pair of lateral hearts (fig. 1A-6). They arise from the dorsal vessel in XII, pass ventrad as would the hearts, but near the midlateral aspect of calciferous gland each vessel turns directly forward into segment IX where it bends dorsad and enters the esophageal region. From their point of origin, the extraesophageals neither give nor receive branches until segment VIII is reached. Dr. Roots has indicated (personal communication) a similar condition in British specimens.

Muldal described the gizzard as extending into XVIII. Michigan earthworms of *muldali* do show a thickened gizzardlike wall in this region, however, the nature of the epithelium and the absence of cuticular lining indicate that this should be considered, at most, a transition zone (fig. 1A-2).

A pair of well-developed, fingerlike esophageal pouches arises from the dorso-lateral aspect of the gut in X. These project downward, nearly the full depth of the esophagus (fig. 1A-8). Frontal sections reveal each pouch to be formed of two chambers. The antermost of these (fig. 1B-2) opens dorsally into the esophagus proper; the posterior chamber communicates dorsally with the intralamellar tunnels of the calciferous gland. These chambers join at the ventral (distal) end of the pouch forming a continuous, U-shaped passage from the esophagus to the intralamellar tunnels. The calciferous gland itself extends from $\frac{1}{11}$, without constriction, to $\frac{1}{15}$.

Lamellae of the calciferous gland branch repeatedly so that the total count will vary depending upon the level examined (fig. 1-F); thirty-four may be taken as an average with variation from 30 to 38. Interlamellar sinuses are large (fig. 1F-6); they are continuous with circulatory elements of the esophageal pouch. Paired vessels arise in X, XI, and XII from the dorsal vessel and supply the pouch and calciferous gland.

Muldal described and figured "pits" along the ventral edge of the clitellum at $\frac{2}{29}$ - $\frac{3}{32}$, in line with setae *ab*. Fully clitellate worms collected in Michigan show similar depressions. These pits should not, in my estimation, be considered as related in any way with the formation of tuberculae pubertates but rather as artifacts resulting from clitellar development at the intersegmental furrows.

Whitish iridescence on the sperm funnels is construed as an indication of biparental reproduction by lumbricid worms. This condition obtains for *Allolobophora muldali*; in addition, histological sections reveal sperm on the funnels and in the lumen of the gonoduct as well (fig. 1D-4). Copulation has been observed (laboratory cultures) and individuals bearing spermatophores collected (Murchie, 1956).

None of the cocoons seen by the writer has had more than one developing embryo. Constancy of this condition, plus possible obligatory biparental reproduction may be suggested as mechanisms acting to restrict distribution of *Allolobophora muldali*. The specimens upon which this study is based, were taken from a substantial but restricted population located in a wooded ravine along the Huron River shore northwest of Ann Arbor, Michigan. Evidence of endemism, on the basis of presently known populations, permits us to judge only that *muldali* is a soil species, requiring stable soil-moisture conditions. Intra-generic affinities and geographic origin of this earthworm species, as is the case with most lumbricids, remain uncertain.

A portion of this work was accomplished during the tenure of a Summer Faculty Research Fellowship awarded the writer by the Horace H. Rackham Graduate School of the University of Michigan.

LITERATURE CITED

- Gates, G. E.** 1958. On endemicity of earthworms in the British Isles with notes on nomenclature, taxonomy, and biology. (Oligochaeta; Lumbricidae). *Ann. Mag. Nat. Hist.* 1: 33-44.
- Muldal, S.** 1952. A new species of earthworm of the genus *Allolobophora*. *Proc. Zool. Soc. London* 122: 463-465.
- Murchie, W. R.** 1955. A contribution on the natural history of *Allolobophora minima* Muldal (Lumbricidae). *Ohio Jour. Sci.* 55: 241-244.
- . 1956. Survey of the Michigan earthworm fauna. *Papers Mich. Acad. Sci., Arts, & Lett.* 41: 53-72.
- Omodeo, P.** 1956. Contributo all revisione dei Lubricidae. *Arch. Zool. Italiano* 41: 129-212.
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