

Description of a new earthworm species, *Nsukkadrilus funmie* (Eudrilidae: Oligochaeta: Annelida) from Nigeria

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A new eudrilid earthworm species, *Nsukkadrilus funmie* sp.n. is described from Ogoja (eastern Nigeria). The species belongs to the *Eudrilus-Hippopera-Nsukkadrilus* group of genera. It is differentiated from *Eudrilus* by possessing penial setae and intestinal gizzards and from *Hippopera* by possessing intestinal gizzards. Although classified as *Nsukkadrilus* because it conforms to Sims' (1987) diagnosis of that genus, the new species bears three features which separate it from the only congener and type species, *N. mbae*. Firstly, it bears externally a pair of papillae in each of segments XVII and XVIII; the male pores open through the anterior papillae; and the penial setae penetrate separately through the posterior papillae. Secondly, paired longitudinal membranous pouches on the ventral parietal in the juvenile fuse into a single median pouch associated with the ovospermathecae in the adult. Thirdly, in the new species the form of the ovospermathecae is different from those of *N. mbae*. In spite of these morphological differences the new species is located within *Nsukkadrilus* until more evidence indicates otherwise.

About 50 eudrilid species belonging to 22 genera have been described or recorded from Nigeria, (Beddard 1890, 1891, 1897; Michaelsen 1910, 1915; Taylor 1949; Clausen 1963; Sims 1971, 1985, 1987; Segun 1976, 1977, 1980; Segun & Owa 1990; Owa, 1993, 1994a,b,c, 1995). *Nsukkadrilus mbae* Segun 1977, described from Nsukka, (eastern Nigeria) resembles *Eudrilus* Perrier, 1871 and *Hippopera* Taylor, 1949. However, penial setae and intestinal gizzards found in *Nsukkadrilus* distinguish this genus from the other known genera.

To study the taxonomy and distribution of Nigerian eudrilid earthworms and their possible use as indicators of soil properties, a series of nation-wide earthworm surveys were embarked upon during the rainy seasons of 1984–90. During one of the trips to Ogoja in 1986 the material studied in this paper was collected. The species generic position has been evaluated and included in the genus *Nsukkadrilus*. The separation of penial setae from male pores resembles the separation of the prostatic pores from the male pores in *Hippopera*. The separation is indicated externally by two pairs of genital papillae in segments XVII (male) and XVIII (penial setal). A second character reminiscent of *Hippopera* is the presence in juvenile worms of a pair of longitudinal pouches along the ventral parietal. These fuse medially into an unpaired membranous pouch in the adults. The ventral pouch in *Hippopera nigeriensis* Taylor, 1949 is muscular and embedded in the ventral body wall. Contrary to the characters of *Eudrilus*, the new species bears penial setae and intestinal gizzards. Considering all of these observations a decision was taken to describe a new species within the genus *Nsukkadrilus* even though the only other congener and type species, *N. mbae*, lacks a coelomic pouch, and in it the penial setae penetrate through the male pores.

Method

The earthworms were collected by digging and hand-sorting from fallow farm lands at Ogoja. They were preserved in 5% formalin, which was renewed after 24–48 h.

Taxonomy

Nsukkadrilus funmie n. sp.

(Figures 1–6, Table 1).

Type locality: Ogoja (6°37'N; 8°45'E), altitude 76 m a.s.l., eastern Nigeria, close to Nigerian boundary with southern part of Cameroon Republic; mean annual rainfall 1779 mm; mean number of raindays 90; mean annual temperature 27°C; mean maximum temperature 33°C; ecological zone: forest-savanna mosaic; soil classification: loamy sand (Barbour, Oguntoyinbo, Onyemelukwe & Nwafor 1982).

Material: Of the three adult and two immature specimens collected in August, 1986, one adult specimen is deposited at the Natural History Museum, Obafemi Awolowo University, Ile-Ife, Nigeria, with field no. ANN.EUD.OGOJA.86.2. Other syntypes are kept in the Department of Biological Sciences, Ogun State University, Ago-Iwoye, Nigeria.

Description

External characters (Figure 1)

Length of the earthworms is 85–139 mm. Widest diameter, posterior to the clitellar region, is 3.1–3.5 mm. Number of segments is 139–179. Clitellar segments are longer (each about 1.5 mm) than the adjacent segments (about 1 mm). The segments are secondarily triannulated; the second annulus of each segment is slightly wider than the adjacent annuli.

Prostomium is epilobous, small, penetrating half of peristomium (Figure 1C).

Preserved specimens are light-yellow in the pre-clitellar region. The body wall is so translucent that the nerve chord, the ventral and sub-neural blood vessels, and the unequally long cuprostate gland are visible through it.

Setal arrangement is eudrilline. Setae a and b are widely paired, whereas c and d are closely paired (ab > cd).

The clitellum, on segments XIII–XVII, is saddle-shaped, with the lowest margins reaching down to the level of setal lines a. The mid-ventral surfaces of segments X–XVIII are tumid.

Male pores are paired, passing through small flat-topped papillae in segment XVII. A second pair of papillae through

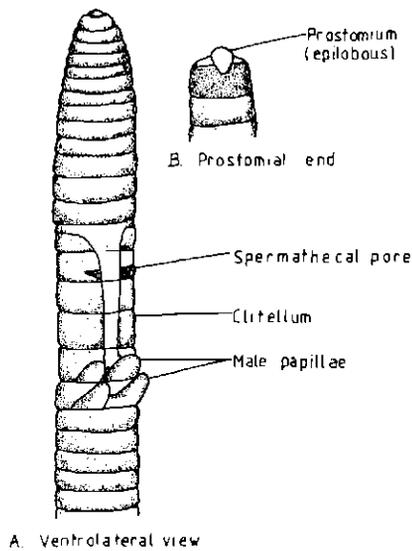


Figure 1 *Nsukkadrilus funmie* n. sp.: external diagnostic features.

which the penial setae pass occurs on segment XVIII. Both pairs of papillae are between setal lines a and b.

The common female and spermathecal (i.e. ovospermathecal) pores are paired on mid-segment XIV, between setal lines a and b.

Nephridiopores are paired near the anterior borders of segments, behind intersegmental furrows, between setal lines c and d. The first pair occurs on segment III.

Dorsal pores are absent.

Internal characters

The septa 5/6–10/11 are muscular. Septa 11/12–12/13 are thin. Others are membranous.

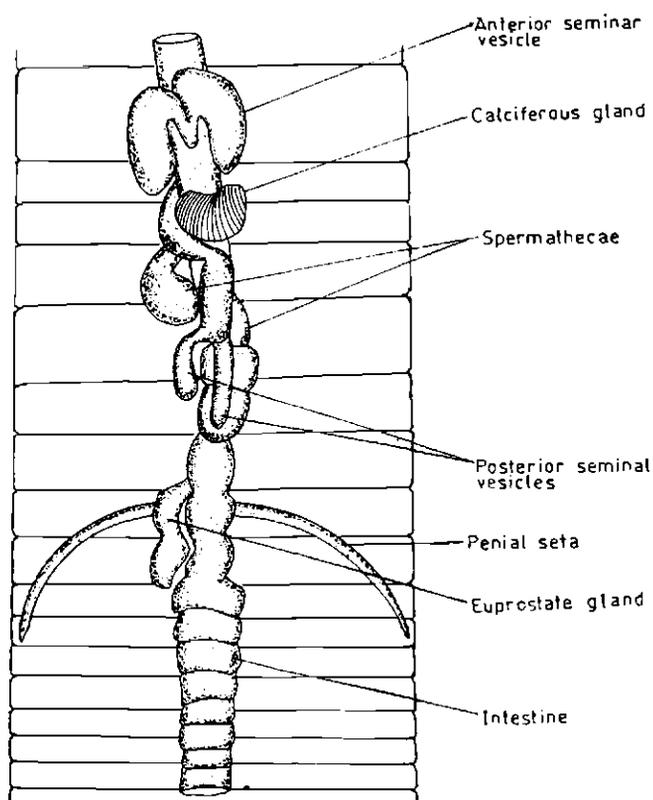


Figure 2 *Nsukkadrilus funmie* n. sp.: some viscera in situ.

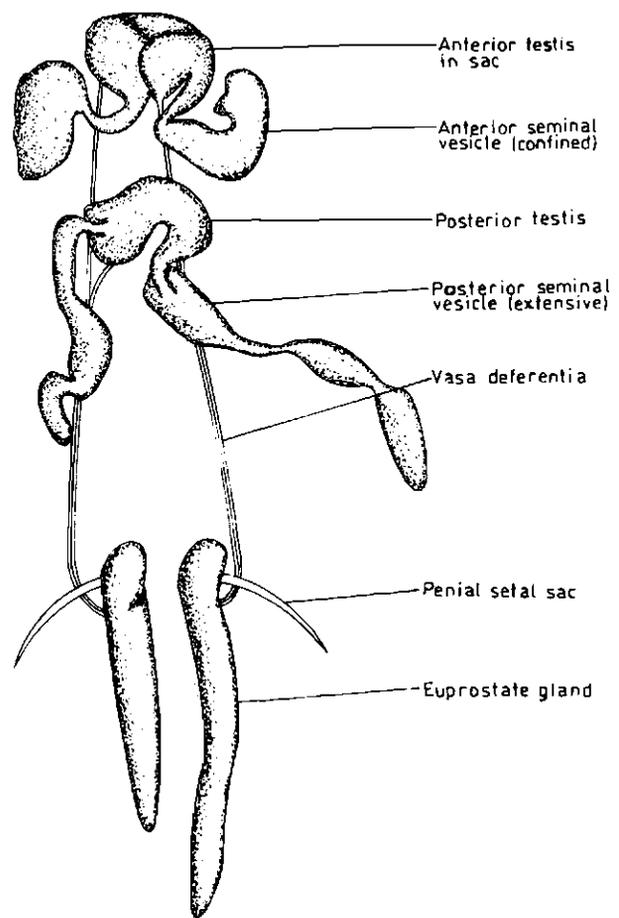


Figure 3 *Nsukkadrilus fenmie* n. sp.: male reproductive system.

Pseudohearts in segments VI–XI.

The mouth opens through the peristomium into a buccal cavity which occupies segment I–II. A muscular pharynx occurs in segments III–IV. Oesophageal gizzard is absent. Two unpaired, ventral oesophageal sacs occur in segments X and XI (none in IX). Each sac is maize-grain-shaped. Paired dorsolateral oesophageal ('calciferous') glands occur in segment XII, under the posterior seminal vesicles (Figure 2). The oesophagus is narrow in the gonadal segments. Eight (8) intestinal gizzards occur in segment XX–XXVII. Beyond the gizzards the intestine narrows gradually backwards; no chloragogenous cells were noted.

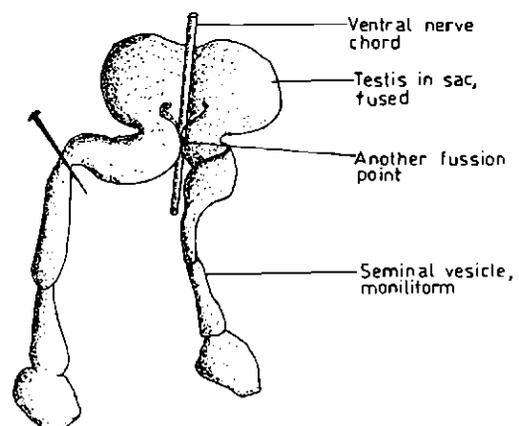


Figure 4 *Nsukkadrilus fenmie* n. sp.: double fusion of a (posterior) seminal vesicle.

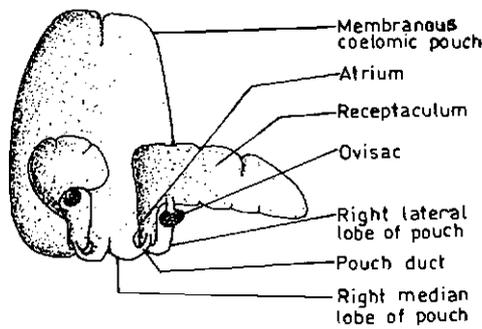


Figure 5 *Nsukkadrilus fenmie* n. sp.: ovospermathecal systems of an immature specimen.

The male system is holandric with two 'pairs' of testes in segments X and XI. The 'pairing' is only conceptual since an unpaired, median but transversely oriented testis sac is actually found (Figures 3–4). The testis sac is under the gut and the ventral nerve chord (Figure 4). A pair of ducts arising from the lateral sides of the testis sacs fuses medially above the nerve chord, thus forming a circum-neural ring (Figure 4). Each duct connects with the corresponding seminal vesicle. The anterior pair of seminal vesicles in segment XI rises to a supra-enteric position and is folded into two compact structures (Figures 2–3). The posterior pair are strongly constricted along their lengths and thus appear beaded. The left and right seminal vesicles are not similar in size, length or form; the posterior pair reaches the levels of segments XV–XVI (Figures 2–3).

At ventro-lateral ends of the testis sac, vasa deferentia commence. The anterior and posterior pairs of vasa deferentia meet in segment XII; the adjacent pairs pass backwards, towards the euprostate glands. Passing under the penial setae, the vasa deferentia penetrate the euprostate glands at points below the ectal apices of the gland (Figure 3).

The euprostate glands are tuber-like structures with rather blunt anterior, and pointed posterior ends (Figure 3). Seen through the wall of each euprostate gland are many longitudinal tubules. The left and right glands are not identical in length and position. In one specimen, for example, one gland extends to segment XXIII and the other to XXV.

A pair of strong bow-shaped penial setae is located in setal sacs. Their retractor muscles originate at about segment XXI. The setae pass over the vasa deferentia in segment XVIII to

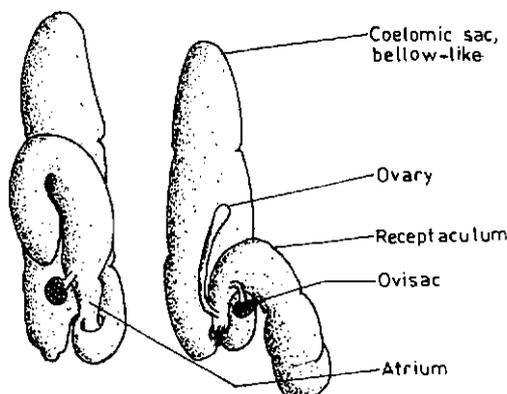


Figure 6 *Nsukkadrilus funmie* n. sp.: ovospermathecal systems of an immature specimen.

pass through the paired papillae of that segment. Thus the penial setal pores are separated from the male pores.

The ovarian and spermathecal systems (conceptually) fuse together to form a pair of ovospermathecae. Either ovospermathecal pore in segment XIV opens into a conical spermathecal atrium with wider ental than ectal ends (Figures 5–6). The muscular atrium opens into a tubular, finger-like receptaculum which may be reflexed, looped or elongated.

A small spherical ovisac is connected by a short but thick stalk-like duct to the junction of the atrium and the receptaculum (Figures 5–6). The ovary was not identified with certainty. The structure labelled in Figure 6 as ovary is most probably the ovary. Regularly occurring in all specimens, it is elongated. Doubts about its identity are due to (a) its nephridium-like tubular structure, (b) no recognisable eggs in it and (c) being not obviously connected to the spermathecal system. Rather it appears to share a common ectal duct (and pore) with the atrium. On the other hand its origin in segment XIII suggests that it could be an ovary. The opening between setal lines a and b does not conform with external observation of nephridiopore between setal lines c and d in that segment.

In the juvenile specimens a pair of membranous balloon coelomic pouches in segments XII–XIV was observed (Figure 6). In the adult, however, the left and right pouches fuse medially to form a single pouch (Figure 5). On the posterior border of each pouch are lateral and median lobes. The median lobes narrow abruptly into short ducts connected with the ectal ends of the spermathecal atrium (Figures 5–6). The pouches were empty and their function is unknown. These pouches could possibly serve as sperm reservoirs.

Excretion is by metanephric, meganephric, and exonephric holonephridia.

Remarks

The ovospermathecal form. It is pertinent to recall that in describing the type species *N. mbae*, Segun (1977, and his Figure 2) described and illustrated an 'ovary enclosed within an ovarian vesicle from which an ovarian duct passes into segment XIV to enter into the wider ovospermathecal duct'. In the new species a similar structure is not found. As stated earlier the homologous structure is nephroid and opens close to the external pore of the atrium. Segun (1977) also described and illustrated the spermathecal atrium which is balloon-shaped and septate. For easy comparison, it is necessary to harmonise terminologies. What is labelled ovospermathecal atrium in Figures 5–6 of the present article was referred to as spermathecal duct by Segun. What Segun (1977) called atrium is here called spermathecal receptaculum in recognition of its long-term sperm storage function. The term atrium usually refers to a duct or hollow structure which serves for transient fluid passage (but not storage). Adopting the homologisation, it means that the spermathecal receptaculum is balloon-shaped on top of the atrium in *N. mbae* (cf. Segun, 1977, Figure 2). In the new species *N. funmie*, the balloon-shaped membranous pouches are along the ventral parietal and are connected to the ectal ends of the spermathecal atria.

Other differences between *N. mbae* and *N. funmie* are shown in Table 1.

Table 1 Diagnostic differences between *N. mbae* Segun, 1977 and *N. funmie* sp. n.

Character	<i>N. mbae</i>	<i>N. funmie</i>
a External papilla: no. of pairs	1 on XVII	2 on XVII, XVIII
b Penial setae protruding through	papillae on XVII	papillae on XVIII
c Lowest margins of clitellum on setal lines	d	a
d Male pores located	within aa	within ab
e Intestinal gizzards in	XX–XXV (6)	XX–XXVII (8)
f Testis sacs	separate	fused medially
g Ovarian duct penetrates atrium	near ental end	near ectal end
h Ovisac located	within calyx-like cup	spherical, without cup
i Spermathecal atrium	tubular	funnel-shaped
j Spermathecal receptaculum	balloon-shaped	tubular
k Ventral coelomic pouch	absent	present

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