Morphometric Studies in *Eudrilus Eugeniae* Populations from Different Locations in Lagos, Nigeria

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Abstract: Morphological variation was studied within earthworm species – *Eudrilus eugeniae* populations collected from 14 different locations within Lagos State in Nigeria. Mature earthworms were identified by the presence of the clitellum and position of clitellum assisted in specie identification. Morphometric data collected on the earthworms include body weight, length of clitellum, body size diameter, total number of segments and body volume. Results from the statistical analysis showed that the earthworms though of same species were separated into 3 distinct groups based on the morphometirc parameters and not soil type. These 3 distinct groups may represent different lineages within the earthworm - *Eudrilus eugeniae.* [Nature and Science. 2007;5(2):16-21].

Keywords: Earthworms, *Eudrilus eugeniae.* variation, clitellum

Introduction

The earthworm species, *Eudrilus eugeniae* commonly referred to as the West African night crawler, occurs all over the world but mostly in West African regions (Shagoti 1985, Segun 1998). It is largely found in West Africa from Ghana to Nigeria to West Cameroun and Gabon. It grows well at a temperature of more than 25^0C but best at 30^0C (Viljoen and Reinecke 1992), attaining maximum weight, length and number of segments in about 15 to 20 weeks (Rodriguez and Lapiere 1992). It ranges in size from about 10cm in length to huge specimens of over 12cm and size may depend on habitat (Segun 1998). The total number of segments in *Eudrilus eugeniae* varies from about 80 to over 100 with the location of a thick cylindrical collar – the clitellum between segments 13 – 20 (Pirrone 1985). It has a purple sheen and the posterior segments are evenly tapered to a point (Blackburn 1989).

Earthworms are becoming increasingly important as a common assay organism for soil fertility tests especially since they represent a major group in the terrestrial environments (Weeks and Svendsen 1996). They are known to contribute to soil processes through faecal excretion in form of casts, burrows, feeding and digestion (Tian *et al.* 2000). In the tropics, they are known to help in plant residue decomposition (Tian *et al.* 1995) and also convert plant residue into soil organic matter (Lavelle 1988).

There is a great taxonomic diversity among tropical earthworms with the dominant ones represented by the families Almidae, Glossoscolecidae, Megascolecidae, Ocnerodrilidae and Eudrilidae – to which *Eudrilus eugeniae* belongs (Segun 1998). Variability in terms of morphological measurements has been reported among different species of earthworms (Gregory and Herbert 2002, Heethoff *et al.* 2003, Sims and Gerard 1985). Variation in total body length as measured from the first to last segment was reported by Vitturi *et al.* 2000.

The aim of this study is to test for phenotypic differences within an earthworm species - *Eudrilus eugeniae* using quantitative measurements. The earthworms were sampled in 14 different locations with a view to using the traits measured to determine if different groups/lineages exist within the *Eudrilus eugeniae* population

Materials and Methods

Sexually mature earthworms as determined by the presence of the clitellum were collected from 14 different localities in the Lagos state of Nigeria (Figure 1). Fifteen specimens were collected from each study site. Most of the earthworms were sampled from under leaf litter and small logs in the early hours of the day (usually by 8am) by digging and handsorting. Collected specimens were identified according to Segun (1998). Samples were taken immediately with good quantity of soil from its habitat to the laboratory for further analysis.

Characteristics determined at the point of sampling include the colour of the earthworm and position of the clitellum. Other measurements determined in the laboratory using five worms per location include body weight, length of clitellum, diameter of posterior and anterior ends; total body length, body size diameter and total number of segments. Body volume was calculated according to Gregory and Herbert (2002) as follows: $\prod L\ (½d)^2$

Where L = total body length
d = body size diameter

Length measurements were taken with a metre rule to the nearest millimeter and body weight was measured to the nearest 0.01gram.

Test of means were performed by the least significant difference method using a pooled error variance. The integer values were combined with continuous data and analyzed by cluster analysis using Pearson correlations as distance and the average linkage method (Swofford and Olsen 1990) to represent the collection in a dendogram.

Results

Colour and position of clitellum and soil types from which the earthworms were collected are as presented in Table 1. It was observed that earthworms from University of Lagos (Unilag), Maryland, Ajah, Lekki, Suru-lere, Abule-Egba and Alausa appeared very dark in colour at the anterior (head) end and lighter at the posterior (tail) end. These earthworms were collected from soils which were clay/loam. Earthworms from Ikorodu, Badagry, Ogba and Mushin which were from loam/humus soil were purple in colour, while those from Ketu, Owode/Ajegunle and Bariga were collected from clay soil and appeared purple-grey in colour. There was also a consistency in the position of the clitellum for the earthworms in all locations.

Table 2 shows the results of body measurements across all locations sampled. Earthworms from Badagry and Mushin had the highest body size diameter of 5.22mm and 5.10mm respectively with body volume of 3091.28 mm^3 and 2861.10 mm^3. However, earthworms from Badagry and Ogba had the highest values for body weight. The earthworm with the highest number of segments was those from Mushin while those from Ajah and Bariga had the lowest number of 88 segments.

Results from the cluster analysis as presented in the dendogram in Figure 2 shows that earthworms were divided into three major cluster groups. Earthworms from Unilag (1) and Badagry(3) in addition to Ikorodu (2) were isolated and joined at the lowest cluster level which was close to coefficient of similarity of 0.0 for Unilag and Badagry and a value of 0.01 for Ikorodu. The earthworms from the other eleven locations clustered at level 3 indicating some similarity in the earthworms based on the characters used in the assessment. It was further observed that earthworms from Ajah (6) and Owode/Ajegunle (9) clustered together at the highest level of 0.44. Earthworms at the cluster level 3 had 3 sub-clusters with earthworms in the group designated "b" exhibiting high values in body sizes as measured by body volume and body length. The earthworms from Surulere (8) were in a distinct group "c", while those from other locations were in the group "a" and had low to medium values for body weight and length.

Table 1. Collection locality, soil type, position of clitellum and earthworm colour

Locality of collection and location number	Soil type	Colour	Clitellum position
Unilag (1)	Clay/Loam	Dark head/light tail	13 - 20
Ikorodu (2)	Loam/Humus	Purple	13 - 20
Badagry (3)	Loam/Humus	Purple	13 - 20
Maryland (4)	Clay/Loam	Dark head/light tail	13 - 20
Ketu (5)	Clay	Purple-Grey	13 - 20
Ajah (6)	Clay/Loam	Dark head/light tail	13 - 20
Lekki (7)	Clay/Loam	Dark head/light tail	13 - 20
Suru-lere (8)	Clay/Loam	Dark head/light tail	13 - 20
Owode/Ajegunle (9)	Clay	Purple-grey	13 - 20
Abule-Egba (10)	Clay/Loam	Dark head/light tail	13 - 20
Ogba (11)	Loam/Humus	Purple	13 - 20
Alausa(12)	Clay/Loam	Dark head/light tail	13 - 20
Bariga (13)	Clay	Purple-grey	13 - 20
Mushin (14	Loam/Humus	Purple	13 - 20

Table 2. Body size measurements in *E. eugeniae*

Location	Average body weight(g)	Length of clitellum (mm)	Average body size diameter (mm)	Body length (mm)	Avarege body volume (mm^3)	Average no. of sements	Diameter at anterior end (mm)	Diameter at posterior end (mm)
Unilag	0.53	3.26	4.12	129.0	1710.43	91	2.5	1.2
Ikorodu	0.93	5.02	5.00	115.0	2258.92	95	3.2	3.0
Badagry	1.07	6.18	5.22	144.0	3091.28	94	5.0	4.0
Maryland	0.90	3.92	4.10	127.0	1624.62	92	3.0	1.5
Ketu	0.87	2.10	4.10	130.0	1717.00	92	2.0	1.5
Ajah	0.75	5.00	4.00	130.0	1634.30	88	2.0	1.0
Lekki	0.84	4.50	4.00	125.0	785.70	92	3.0	1.5
Suru-lere	0.74	4.90	4.10	121.0	1598.30	89	2.1	1.1
Owode/Ajegunle	0.83	4.00	4.00	120.0	1508.60	92	2.0	1.0
Abule-Egba	0.79	5.10	4.25	120.0	1703.10	92	3.2	1.1
Ogba	1.26	3.20	4.40	145.0	2205.66	93	2.4	1.6
Alausa	0.45	2.10	4.00	125.0	1571.71	92	2.8	1.5
Bariga	0.95	4.90	4.40	150.0	2281.71	88	2.0	1.0
Mushin	0.96	4.00	5.10	140.0	2861.10	96	2.5	1.9

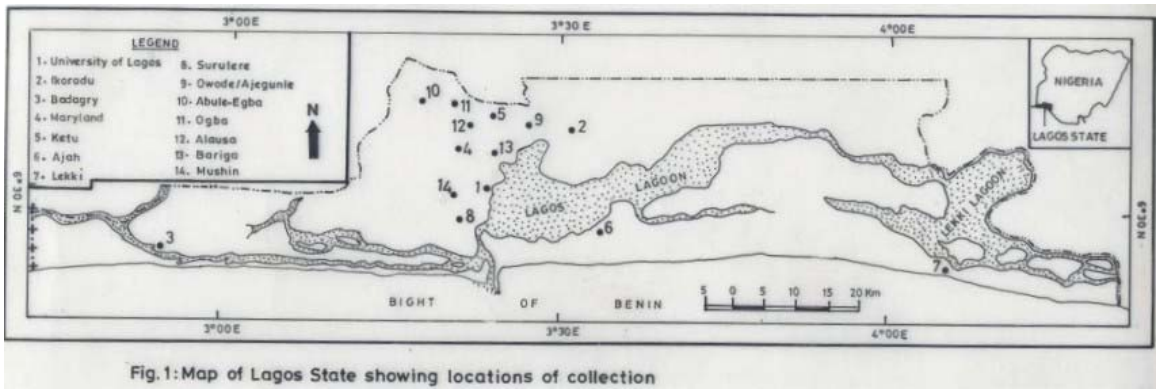

Fig. 1: Map of Lagos State showing locations of collection

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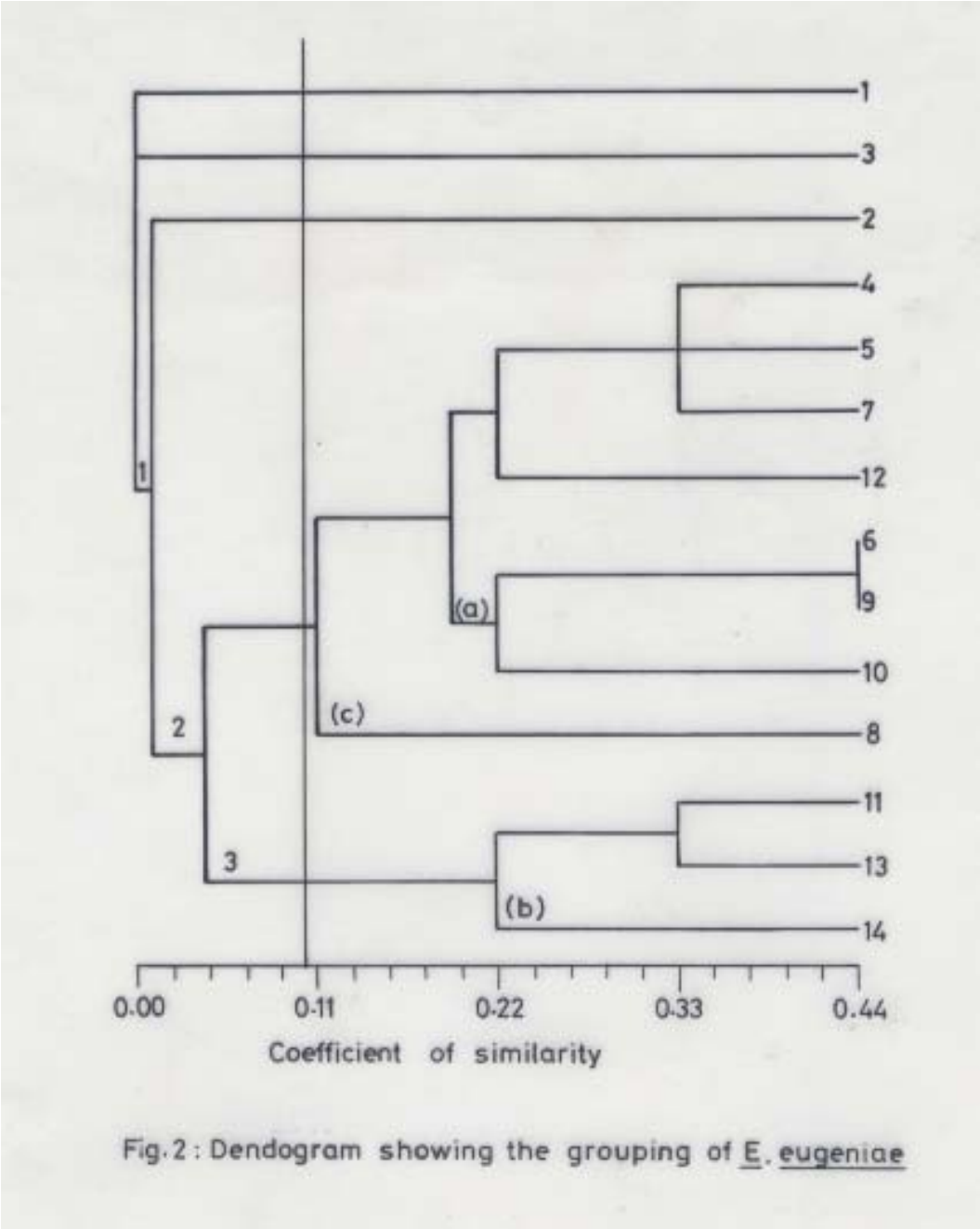

Figure 2. Dendogram showing the grouping of E. eugeniae

Discussions

One of the most important results from this study of the earthworm species is the separation of the collections into 3 major groups. The collections from Unilag and Badagry though in the same cluster were distinct from each other based on their coefficient of similarity. The collection in cluster 2 which was from Ikorodu was also isolated from every other cluster while the collections from the other eleven locations

were in cluster 3. Collections were studied based on body size characters, thus differences in clustering could be attributed to the body size measurements across locations. Sims and Gerard (1985) suggested that the environments inhabited by most earthworms were quite stable and these determined the time it takes to mature in some species. Also Satchel (1980) classified lumbricid earthworms into 2 distinct categories – the 'r' and 'k' selected species based on their body sizes and lifestyles. The 'r' selected species usually had small body sizes, shorter incubation and maturation times and inhabited stable surface environments. The k-selected species however had large body sizes, and inhabited stable environments. Even though the age of these earthworms were not determined in the study, they were all sexually mature at the time of collection as shown by the presence of the clitellum. Collections from Maryland, Ketu, Ajah, Lekki, Alausa and Owode/Ajegunle had small body sizes and were from a clay and/ loamy soil, thus having some relationship with r-selected species. Furthermore earthworms from Unilag and Bariga though they were collected from the clay/loam soil type they were quite varied in their body weights. Earthworms from Badagry and Ikorodu were from the loam/humus soil type which usually contains large amounts of decaying plant and animal materials which when used as food by the earthworms may have contributed to their large body sizes. Thus the soil type may not be a strict determinant of body size as collections from Bariga had high body size and it was from a clay soil.

From this study, it was further observed that soil type and body weight may not be the only factors in the grouping of the earthworms but in addition average body volume, body length and number of segments may have also helped in discriminating amongst earthworms from different locations. This is in line with extensive studies on the parthenogenic earthworm *Octolasion tyrtaeum* in different localities in Europe that have shown that it consists of distinct morphological and/or genetic lineages. Studies in Germany, on adult *O. tyrtaeum* showed that in some habitat specimens had large sizes, in some small and in some both sizes co-existed (Meinhardt 1974 as cited by Heethoff *et al.* 2003). This may have been the case with collections from Unilag, Ikorodu, Badagry and Suru-lere which tend to be distinct from each other and all the others. However, studies in Finland by Terhivuo and Saura (1993) showed that in a total of 238 *O. tyrtaeum* specimens from 8 locations using izozyme electrophoresis with 3 loci, a total of 24 clones were observed. However there was no correlation between body size and clonal affiliation. Thus it was concluded that variation was due to local environment rather than genetics. In another study by Heethoff *et al.* 2003 using adult *O. tyrtaeum* worms from Germany and Canada genetic distance was measured using mitochondrial cytochrome oxidase II (C011) sequences. Results showed that *O. tyrataeum* consisted of two morphologically and genetically distinct lineages.

This present study though preliminary and not on *O. tyrtaeum* but *E. eugeniae* using simple statistics on morphological measurements has shown that three different lineages which are morphologically distinct exist in the Lagos area of Southwestern Nigeria. Further study using larger sample sizes, wider sample area and other genetic parameters for a more effective discrimination of specimens is suggested.

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References

1. Blackburn, J.C. 1989. External anatomy of earthworms. *Sci.* **207**: 2572 – 2577.
2. Gregory, T.R. and P.D.N. Herbert. 2002. Genome size estimates for some oligochaete annelids. *Can. J. Zool.* **80**: 1485 – 1489.
3. Heethoff, M., K. Etzold and S. Scheu. 2003. Mitochondrial C011 sequences indicate that the parthenogenetic earthworms *Octolasion tyrtaeum* (Savigny 1826) constitutes of two lineages differing in body size and genotype. *Pedobiologia.* **47**: 9 – 13.
4. Lavelle, P. 1988. Earthworm activities and the soil system. *Biol. Fert. Soils.* **6**: 237 – 251.
5. Pirrone, S. 1985. The earthworm baits market in North America. *Heredity.* **59**: 1019 – 1029.

6. Rodriguez, A.C. and I.R. Lapeire. 1992. Increase in weight, length and number of segments of *Eudrilus eugeniae* (Oligochaeta: Eudrilidae) at 24^0C. *Rev. Biol.* **6**: 215 – 221.
7. Segun, A.O. 1998. Tropical Zoology 2nd edition. University Press, Ibadan. 283pp.
8. Shagoti, U.M. 1985. Analysis of developmental rates and body size in earthworms. *Heredity.* **80**: 29 – 40.
9. Sims, R.W. and R. Gerard. 1985. A review of the economic importance of earthworms. *Science.* **29**: 152 – 160.
10. Swofford, D.L. and G.J. Olsen. 1990. Phylogeny Reconstruction P411-501D.M. in Hills and C. Moritz (eds) Molecular Systematic. Sineaur Associates, Sunderland, MA.
11. Terhivuo, J. and A. Saura. 1993. Clonal and morphological variation in marginal populations of the parthenogenetic earthworms *Octolasion tyrtaeum* and *O. cyaneum* (Oligochaeta Lumbricidae) from eastern Fennoscandia. *Boll. Zool.* **60**: 87 – 96.
12. Tian, G., L. Brussard and B.T. Kang. 1995. Breakdown of plant residues with contrasting chemical compositions: Effect of earthworms and millipedes. *Soil Biol. Biochem.* **27**: 277 – 280.
13. Tian, G., J.A. Olimah, G.O. Adeoye and B.T. Kangi. 2000. Regeneration of earthworm populations in a degraded soil by natural and planted fallows under humid tropical conditions. *Soil. Sci. Soc. of America. J.* **64**: 222 – 228.
14. Viljoen, S.A. and A.J. Reinecke. 1992. The temperature requirements of epigeic earthworm species *Eudrilus eugeniae* (Oligochaete); a laboratory study. *Soil. Biol. Biochem.* **24**: 1345 – 1350.
15. Vitturi, R., M. S. Colomba, A. Pirrone and A. Libertini. 2000. Physical mapping of Rdna genes (TTAGGG)n telomeric sequence and other karyological features intwo earthworm of the family Lumbricidae(Annelida: Oligochaeta). Heredity 85: 203-207.
16. Weeks, J.M. and C. Svendsen. 1996. Neutral red retention by lysosomes from earthworm (*Lumricus rubellus*) coelomocytes: A simple biomarker of exposure to soil copper. *Env. Toxicol. Chem.* **15**: 1801 – 1805.