Earthworms (Annelida: Oligochaeta) of Sao Tomé

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Abstract
During a soil zoology expedition to Sao Tomé Island, among other members of the soil fauna, earthworms were collected. During this collecting trip some 170 earthworm specimens belonging to 18 species were gathered of which two, Dichogaster (Diplothecodrilus) coeruleoviridis and Dichogaster (Diplothecodrilus) zicsii, proved to be new to science. In addition, a small sample from the same locality was also examined and Dichogaster (Dichogaster) thomeana Cognetti, 1910 was removed from synonymy of Dichogaster (Dichogaster) greeffi Michaelsen, 1902.

Keywords: Africa, Dichogaster, earthworms, Oligochaeta, Sao Tomé new species.

Introduction
Sao Tomé is a volcanic island in the gulf of Guinea, some 200 km off the West African coast. Together with Annobon, Principé, and Bioko islands it belongs to the Cameroon volcanic line. The origin of the island chain is somewhat debated but the newest data favour a linear mantle upwelling zone origin contrary to a single hotspot hypothesis (Meyers et al. 1998), so the age of the islands does not necessarily correspond with the position in the volcanic line. It has been shown that most of the islands are of Miocene age, and Sao Tomé is dated about 15 million years (Akaa et al. 2001). The island was unpopulated until the 16th century, when Portuguese colonists settled and introduced Angolan slaves. Since then, owing to agriculture, the lowland regions of the island have been heavily disturbed and many species have been introduced, but the region of the central volcano remained relatively untouched and harbours a number of autochthonous species.

The first earthworm record from Sao Tomé was a new species, Dichogaster greeffi Michaelsen, 1902. Since then, only one paper has dealt with the earthworm fauna of this interesting island, reporting five species: D. greeffi Michaelsen, 1902; Dichogaster pinguis Cognetti, 1910; Dichogaster feae Cognetti, 1910; Dichogaster thomeana Cognetti, 1910; and Eudrilus eugeniae (Kinberg, 1867) (Cognetti 1910). Later on D. pinguis was placed in the genus Benhamia Michaelesen, 1889 (Csuzdi and Zicsi 1994) and D. thomeana has been synonymized with D. greeffi (Csuzdi 1995).
In 2000, as a member of the joint expedition of the Hungarian Public Television and the Hungarian Academy of Sciences organized by the late Prof. Dr János Balogh, I had the opportunity to collect earthworms in different parts of the island including the most natural central volcano region. This collection, together with a smaller sample from Dr John Measey (IRD France), resulted in some 170 earthworm specimens, distributed among 18 species and six families.

**Materials and methods**

Earthworms were collected by digging and searching under the bark of fallen logs. The animals were killed in 75% ethanol, preserved in 4% formol and after several days transferred into 75% ethanol. The penial setae were removed by dorsal dissection of the specimens and mounted in Euparal for light microscopic study. Setae of the species of taxonomic importance were also investigated using a Hitachi SN-2600N scanning electron microscope. For SEM studies they were glued on aluminium stubs using double-sided carbon tape and sputter-coated with gold.

All the material is deposited in the Oligochaeta collection of the Hungarian Natural History Museum. Abbreviations used in the text: L., length; D., diameter.

**Systematics**

*Family ACANTHODRILIDAE* Claus, 1880
*Subfamily BENHAMIAINAE* Michaelsen, 1897

*Genus Dichogaster (Dichogaster)* Beddard, 1888

*Dichogaster* Beddard 1888, p 251.
*Dichogaster*: Michaelsen 1900, p 334, part.
*Dichogaster*: Omodeo 1955, p 224, part; Omodeo 1958, p 61, part.
*Dichogaster (Dichogaster)*: Csuzdi 1996, p 354.

*Dichogaster (Dichogaster) greeffi* Michaelsen, 1902

(Figures 1–3)

*Dichogaster greeffi* Michaelsen 1902, p 20.
*Dichogaster greeffi*: Cognetti 1910, p 83.
*Dichogaster (Dichogaster) greeffi*: Csuzdi 1995, p 109, part.

**Material examined**

AF/5066 three ex. Sao Tomé, OBO National Park, leg. J. Measey, October 2002.

**Diagnosis**

L. 90–95 mm, D. 4–4.5 mm, number of segments 125–132. Colour alive unknown, conserved brownish. First dorsal pore in 13/14. Clitellum 13–20, prostatic pores in segment 17, 19, spermathecal pores in 7/8, 8/9 (Figure 1). Spermatheca skittle-shaped, duct short muscular, diverticula acinous (Figure 2). Calcifeeous glands three pairs in 15–17, but the first pair is very small. Meronephridia six or seven on each side of the intestine. Penial setae uniform, the fully adult seta 1.3–1.4 mm long and in the middle 0.02 mm wide.
The ectal third of the seta slightly undulated and the tip is sharply hooked. Each seta bears a characteristic ornamentation of large slightly abutting scales (Figure 3).

**Dichogaster (Dichogaster) thomeana** Cognetti, 1910

*Figures 4–6*

**Dichogaster thomeana** Cognetti 1910, p 100.

**Dichogaster (Dichogaster) greeffi**: Csuzdi 1995, p 109, part.

**Dichogaster (Dichogaster) greeffi**: Csuzdi 2000, p 55.

**Material examined**

AF/5003 four ex. Sao Tomé, on the volcano around Lago Amélia, 1450 m asl, from fallen logs, leg. Cs. Csuzdi, 30 August 2000.

**Diagnosis**

L. 55–60 mm, D. 2.5–3 mm, number of segments 117–126. Colour alive purplish brown, conserved pale. First dorsal pore in 12/13. Clitellum 13–20, prostatic pores in segment 17, 19, spermathecal pores in 7/8, 8/9 (Figure 4). Spermatheca ampulla barbell-shaped, duct long muscular, diverticula empty, unilocular with long duct (Figure 5). Calciferous glands three pairs in 15–17, the first pair is slightly smaller than the others. Meronephridia four to five on each side of the intestine. Penial setae uniform, the fully adult seta 1.7–1.8 mm long and in the middle 0.04 mm wide. The seta is slightly curved and the spoon-shaped tip is reclinate. Each seta bears a characteristic ornamentation which are large serrated sculptures on the ental part becoming large thorns towards the ectal part (Figure 6).
Remarks

This species was synonymized with *D. (D.) greeffi* by Csuzdi (1995) on the basis of the original description of the three juvenile specimens of *D. (D.) thomeana* and on examination of the type material of *D. (D.) greeffi* housed in the Michaelsen collection, Hamburg. The slight differences in the spermathecae and penial setae were attributed to the juvenile stage of Cognetti’s specimens. SEM study of the penial seta of the new material revealed that its tip is spoon-shaped and reclinate which is markedly different from the sharply hooked seta of *D. (D.) greeffi*. Relying upon this observation I conclude that the two names refer to completely different species and *D. (D.) thomeana* should be removed from synonymy.

Figure 3. *D. (D.) greeffi*, penial seta: (a) whole seta; (b) middle part of the seta with the characteristic ornamentation; (c) tip of the seta.

Figure 4. *D. (D.) thomeana*, ventral side of the clitellum.
Genus *Dichogaster (Diplothecodrilus)* Csuzdi, 1996
*Dichogaster (Diplothecodrilus)* Csuzdi 1996, p 355.

*Dichogaster (Diplothecodrilus) feai* Cognetti, 1910
(Figure 7)

*Dichogaster feae* Cognetti 1910, p 104.
*Dichogaster feai*: Omodeo 1958, p 64.
*Dichogaster (Dichogaster) feai*: Csuzdi 1995, p 111.

**Material examined**

AF/5038 one ex. Sao Tomé, Monte Café 860 m asl, near to the waterfall, from fallen logs, leg. Cs. Csuzdi, 26 August 2000. AF/5059 four ex, AF/5060 12 praeadult ex. Sao Tomé,

Figure 5. *D. (D.) thomeana*, spermatheca.

Figure 6. *D. (D.) thomeana*, penial seta: (a) whole seta; (b) middle part of the seta with the characteristic ornamentation; (c) tip of the seta.
Remarks

This species was previously known only from the original description. Based on it Csuzdi (1996) placed *D. feai* into the subgenus *Dichogaster*. The well-preserved new material revealed that the first dorsal pore is located in 5/6 and the spermatheca is subdivided, possessing a simple or sometimes bifurcated diverticulum, proving that this species belongs...
to the subgenus *Diplothecodrilus*. The moderate number of meronephridia (six to seven per side) also corroborates this fact.

**Dichogaster (Diplothecodrilus) pinguis** Cognetti, 1910
(Figure 8)

*Dichogaster pinguis* Cognetti 1910, p 86.
*Benhamia pinguis*: Csuzdi and Zicsi 1994, p 218.
*Benhamia pinguis*: Csuzdi 1995, p 107.

Figure 8. *D. (Dt.) pinguis*, penial seta: (a) tip of the seta: (b) middle part of the seta.
Material examined

AF/5046 one ex. Sao Tomé, on the volcano around Lago Amélia, 1450 m asl, leg. Cs. Csuzdi, 30 August 2000. AF/5067 one ex. Sao Tomé, OBO National Park, leg. J. Measey, January 2002.

Remarks

This species was transferred to *Benhamia* Michaelsen, 1889 based on the investigation of the softened and somewhat macerated type specimen (Csuzdi and Zicsi 1994). In the present collection we found two preadult exemplars of this species. A thorough examination of the excretory system revealed that this species belongs to the genus *Dichogaster*, and shows high affinity with *D. (Dt.) feai* but there are important differences; the greater body size, the presence of extremely thickened dissepiments in 11/12, 12/13, and 13/14 and the more numerous meronephridia (9–10 on each side). There are differences also in the penial setae. In case of *D. (Dt.) pinguis* they are smooth, without any remarkable sculpture, 2.2–2.4 mm long and in the middle 0.007 mm wide (Figure 8). In *D. (Dt.) feai* the penial setae are somewhat smaller, 1.8–2 mm long and 0.003 mm wide, and furnished with several minute spines (Figure 7).

While *D. (Dt.) feai* has been collected from rotting logs and alive possesses a greenish brown colour, *D. (Dt.) pinguis* was caught by digging and it is bright blue alive (J. Measey, personal observation).

*Dichogaster (Diplothecodrilus) zicsii* sp. nov.

(Figures 9–11)

Material examined

Holotype: AF/5057 Sao Tomé, Monte Café, near to the waterfall, 860 m asl, in fallen logs, leg. Cs. Csuzdi, 26 August 2000. Paratypes: AF/5058 six ex. Locality same as that of the holotype.

Derivatio nominis

The new species is named in honour of my mentor, Prof. Dr András Zicsi, the recognized earthworm taxonomist.

![Figure 9. D. (Dt.) zicsii sp. nov., ventral side of the clitellum.](image-url)
Diagnosis

L. 18–27 mm, D. 1.2–2 mm, number of segments 88–103. Colour purple on dorsal and pale on ventral. First dorsal pore in 6/7 closed. Clitellum 13–20, prostatic pores 17, 19, spermathecal pores 7/8, 8/9. Spermathecae elongated skittle-shaped, with long duct and bifid diverticula. Penial setae are of two types, larger about 0.4 mm long and 0.008 mm wide with spatula-like tip, smaller about 0.3 mm long and 0.006 mm wide with a sharply pointed tip.

Figure 10. *D. (Dt.) zicsii* sp. nov., penial setae: (a) whole setae; (b) tip of the setae; (c) ornamentation of the larger seta.

Figure 11. *D. (Dt.) zicsii* sp. nov., spermatheca.
External characters

Holotype: L. 22 mm, D. 1.5 mm, number of segments 98. Paratypes: L. 18–27 mm, D. 1.2–2 mm, number of segments 88–103. Colour pale, anterodorsally with purple pigments. Prostomium pro-epilobous with a small line cutting through the first segment. First dorsal pore in 6/7 closed. Setae all ventral, setal arrangement after the clitellum aa:ab:bc:cd:dd = 11:3:10:2.5:60. Clitellum extends over segments 13–20, annular with a barbell-shaped male field. Prostatic pores paired on 17, 19 in the setal line b. Male pores externally not visible, they are on 18, deep in the seminal groves. Female pores paired on 14 near to the setae a-a (Figure 9). Spermathecal pores paired in 7/8, 8/9 near to the setae b. Porophores absent.

Internal characters

No septa notably thickened. Oesophageal gizzards two, in segments 5 and 6. The three pairs of calciferous glands are of about equal size, located in segments 15–17. Excretory system meronephridial, with two to three meronephridia on each side. Paired hearts are present in segments 10, 11, and 12.

Testes are paired in 10 and 11 enclosed into free sperm mass filling the cavity of the segments. Seminal vesicles lacking, ovary small in segment 13. Seminal duct convoluted, discharging through a small muscular atrium in segment 18. Two pairs of small prostatic glands are present in 17 and 19, confined into their own segment and each provided with a penial setal sack containing two different types of penial setae. The larger one is about 0.4 mm long and 0.008 mm wide with spatula-like tip and minute serrated ornamentation. The smaller one is smooth, about 0.3 mm long and 0.006 mm wide with sharply pointed tip (Figure 10). There are two pairs of spermathecae in segments 8 and 9. Each has an elongated skittle-shaped ampulla and an equally long duct. The lower part of the ampulla bears a small, sometimes bifid diverticulum (Figure 11).

Remarks

Dichogaster (Diplothecodrilus) zicsii, bearing two types of penial setae, belongs to the bolaui species group (Csuzdi 1996) and shows affinities with D. (Dt.) bolaui (Michaelsen, 1891) and D. (Dt.) amphibiotica Dahl, 1957 but differs from both species in the paired female pores, in the shape and ornamentation of the penial setae and furthermore in the presence of a muscular thickening at the end of the male duct.

Dichogaster (Diplothecodrilus) coeruleoviridis sp. nov.
(Figures 12–14)

Material examined

Holotype: AF/5004 Sao Tomé, on the volcano around Lago Amélia, 1450 m asl in fallen logs, leg. Cs. Csuzdi, 30 August 2000. Paratypes: AF/5005 six preadult ex. Locality same as that of the holotype. AF/5039 two preadult ex. Sao Tomé, Monte Café, near to the waterfall, 860 m asl in fallen logs, leg. Cs. Csuzdi, 26 August 2000.

Derivatio nominis

The name of this species refers to its characteristic bluish green colour.
Diagnosis

L. 20–30 mm, D. 2–2.5 mm, number of segments 106–108. Colour dark with bluish green bands. First dorsal pore in 5/6. Clitellum 13, 14–19, 20. Prostatic pores paired on 17, 19 spermathecal pores 7/8, 8/9. Spermathecae with long duct and a subdivided ampulla. The ental part narrow, slightly bent, provided with a unilocular diverticulum, the ectal part roof-shaped. Penial setae all similar, about 1.4 mm long and 0.02 mm wide, tip hooked and

Figure 12. *D. (Dt.) coeruleoviridis* sp. nov., ventral side of the clitellum.

Figure 13. *D. (Dt.) coeruleoviridis* sp. nov., penial seta: (a) whole seta; (b) tip of the seta; (c) middle part of the seta with the characteristic ornamentation.
smooth, and under the tip the setae have a characteristic ornamentation of scattered thorns and a series of protruding dents.

**External characters**

Holotype: broken, its tail is missing. L. 25 mm, D. 2.5 mm. Paratypes: L. 20–30 mm, D. 2 mm, number of segments 88–103. Colour alive dark brown, with bluish green bands, preserved yellowish. Prostomium pro-epilobous. The first dorsal pore occurs in the intersegmental furrow 5/6. Setae are closely paired, all ventral, setal formula after the clitellum aa:ab:bc:cd:dd=12:1.5:6.5:2:40. The clitellum extends over segments (13), 14–19 (20), provided with an almost rectangular male field. Prostatic pores paired on 17, 19 in the setal line b. Male pores externally not visible, they are on segment 18, in the seminal groves. Female pores paired on 14 anterior to setae a-a (Figure 12). Two pairs of spermathecal pores are present in furrows 7/8, 8/9 near to the setae b. Porophores absent.

**Internal characters**

There are no septa notably strengthened. Oesophageal gizzards two, in segments 5 and 6. Three pairs of calciferous glands of about equal size, situated in segments 15–17. Excretory system meronephridial, with five meronephridia on each side of the intestine. Paired lateral hearts are present in segments 10, 11, and 12. Testes are paired in 10 and 11 enclosed into perioesophageal sperm sacs. Two pairs of small seminal vesicles present in 11 and 12, and a pair of large racemose ovaries pendent from the posterior face of the septum 12/13. Seminal duct convoluted forming a big bow in segment 15, discharging through a small thickened ectal part, as wide as the prostatic duct, in segment 18. The two pairs of prostatic glands are moderately large occupying two to three segments. Each prostate accompanied by a penial setal sac containing three to four setae of the same type. The penial setae are about 1.4 mm long and 0.02 mm wide with a somewhat hooked tip. The bent part is smooth without any sculpture, below the elbow it has a characteristic ornamentation of scattered thorns and five protruding denticles (Figure 13). Two pairs of spermathecae present in segments 8 and 9. Each consists of a long duct and subdivided ampulla. The lower part of the ampulla is narrow, slightly curved and at the junction with the duct bears a small, sometimes bifurcating diverticulum (Figure 14).

**Remarks**

The new species, regarding the shape of spermatecae, shows affinities with *D. (Dt.) oxtobyae* Csuzdi, 2000 but differs in the length and shape of the penial setae. It appears to
be close to D. (Dt.) mundamensis (Michaelsen, 1897) also, but differs in several characters, for example in the length, shape, and ornamentation of penial setae, and shape of the spermathecae. The characteristic colour and the looping of the vasa deferentia in segment 15 are unique features of this species.

**Dichogaster (Diplothecodrilus) annae** (Horst, 1893)

Benhamia annae Horst 1893, p 32.  
Benhamia parva Michaelsen 1896, p 31.  
Benhamia travancorensis Fedarb 1898, p 433.  
Dichogaster curgensis Michaelsen 1921, p 54.  
Dichogaster curgensis var. unilocularis Stephenson 1931a, p 69.  
Dichogaster cheranganiensis Černosvitov 1938, p 298.  
Dichogaster silvestris cacaois Righi 1968, p 376.  
Dichogaster servi Righi and Ayres 1975, p 311.  
Dichogaster (Diplothecodrilus) annae: Csuzdi 1995, p 112.

**Material examined**

AF/5040 three ex., AF/5042 one ex. Sao Tomé, Monte Café, at the waterfall, 860 m asl, leg. Cs. Csuzdi, 26 August 2000.

**Dichogaster (Diplothecodrilus) bolaui** (Michaelsen, 1891)

Benhamia bolavi Michaelsen 1891, p 9.  
Benhamia malayana Horst 1893, p 35.  
Benhamia octonephra Rosa 1895, p 2.  
Benhamia rugosa Eisen 1896, p 136.  
Benhamia bolaui pacifica Eisen 1900, p 209.  
Dichogaster bolaui var. decanecephra Michaelsen 1915, p 191.  
Dichogaster lageniformis Friend 1916, p 262.  
Dichogaster bolaui var. malabaricus Stephenson 1920, p 257.  
Dichogaster hatomaana Ohfuchi 1957, p 259.  
Dichogaster (Diplothecodrilus) bolaui: Csuzdi 1995, p 112.

**Material examined**

AF/5011 three ex. Sao Tomé, N-E from Monte Mario towards Pico Cao Grande, oil palm plantation, leg. Cs. Csuzdi, 30 August 2000. AF/5018 one ex. Sao Tomé, 14 km S of Neves, cocoa plantation, leg. Cs. Csuzdi, 29 August 2000.

**Dichogaster (Diplothecodrilus) modiglianii** (Rosa, 1896)

Benhamia modiglianii Rosa 1896, p 510.  
Benhamia nana Eisen 1896, p 127.  
Benhamia papillata Eisen 1896, p 135.  
Benhamia kafuruensis Michaelsen 1896, p 34.  
Benhamia papillata var. hawaiiensis Eisen 1900, p 212.  
Dichogaster doveri Stephenson 1931b, p 276.  
Dichogaster (Diplothecodrilus) modiglianii: Csuzdi 1995, p 114.
Material examined

AF/5012 one ex. Sao Tomé, N-E from Monte Mario towards Pico Cao Grande, oil palm plantation, leg. Cs. Csuzdi, 30 August 2000.

**Dichogaster (Diplothecodrilus) mundamensis** (Michaelsen, 1897)
*Benhamia mundamensis* Michaelsen 1897, p 11.
*Dichogaster mansfeldi* Michaelsen 1915, p 197.
*Dichogaster (Diplothecodrilus) mundamensis*: Csuzdi 1995, p 114.

Material examined

AF/5006 two ex. Sao Tomé, on the volcano around Lago Amélia, 1450 m asl in fallen logs, leg. Cs. Csuzdi, 30 August 2000. AF/5013 one ex. Sao Tomé, N-E from Monte Mario towards Pico Cao Grande, oil palm plantation, leg. Cs. Csuzdi, 30 August 2000.

**Family EUDRILIDAE** Claus, 1880

*Eudrilus* Perrier, 1871

**Eudrilus eugeniae** (Kinberg, 1867)

*Lumbricus eugeniae* Kinberg 1867, p 98.
*Eudrilus boyeri* Beddard 1886a, p 302.
*Eudrilus erudiens* Ude 1893, p 71.
*Eudrilus jullieni* Horst 1890, p 225.
*Eudrilus lacazii* Perrier 1872, p 77.
*Eudrilus roseus* Michaelsen 1892, p 224.
*Eudrilus sylvicola* Beddard 1887, p 372.
*Eudrilus eugeniae*: Michaelsen 1900, p 402
*Eudrilis eugeniae*: Cognetti 1910, p 112.
*Eudrilus eugeniae*: Sims 1987, p 386.

Material examined

AF/5008 one ex. Sao Tomé, N-E from Monte Mario towards Pico Cao Grande, oil palm plantation, leg. Cs. Csuzdi, 30 August 2000. AF/5019 two ex. Sao Tomé, 14 km S of Neves, cocoa plantation, leg. Cs. Csuzdi, 29 August 2000. AF/5027 two ex. Sao Tomé, Sao Joao dos Angolares, leg. Cs. Csuzdi, 27 August 2000. AF/5034 nine ex. Sao Tomé, Monte Café near to the waterfall, 860 m asl, leg. Cs. Csuzdi, 26 August 2000. AF/5069 four ex. Sao Tomé, OBO National Park, leg. J. Measey, October 2002.

**Family GLOSSOSCOLECIDAE** Michaelsen, 1900

*Pontoscolex* Schmarda, 1861

*Pontoscolex* Schmarda 1861, p 11.
*Pontoscolex*: Michaelsen 1900, p 424,
*Pontoscolex*: Michaelsen 1918, p 233.
*Pontoscolex*: Righi 1984, p 160.

**Pontoscolex (Pontoscolex) corethrurus** (Müller, 1857)

*Lumbricus corethrurus* Müller 1857, p 113.
Urochaeta hystrix Perrier 1872, p 142.
Urochaeta dubia Horst 1885, p 7.
Urochaeta australiensis Beddard 1891, p 278.
Pontoscolex corethrurus: Beddard 1892b, p 127.
Pontoscolex hawaiensis Beddard 1895, p 660.
Pontoscolex corethrurus: Michaelsen 1918, p 234.
Pontoscolex (Pontoscolex) corethrurus: Righi 1984, p 163.

Material examined
AF/5009 one ex. Sao Tomé, N-E from Monte Mario towards Pico Cao Grande, oil palm plantation, leg. Cs. Csuzdi, 30 August 2000. AF/5016 one ex. Sao Tomé, Monte Café above the waterfall, 900 m asl, leg. Cs. Csuzdi, 26 August 2000. AF/5026 two ex. Sao Tomé, Sao Joao dos Angolares, leg. Cs. Csuzdi, 27 August 2000.

Family MEGASCOLECIDAE Rosa, 1891

Amynthas Kinberg, 1867

Amynthas corticis (Kinberg, 1867)
Perichaeta corticis Kinberg 1867, p 102.
Megascolex diffringens Baird 1869, p 40.
Amynthas corticis (sic lapsus): Sims and Easton 1972, p 235.
Amynthas corticus: Easton 1981, p 49.
Amynthas corticis: Easton 1982, p 726.
Amynthas corticis: Blakemore 2003, p 14 (for complete synonymy).

Material examined
AF/5007 three ex. Sao Tomé, on the volcano around Lago Amélia, 1450 m asl, leg. Cs. Csuzdi, 30 August 2000. AF5015 two ex. Sao Tomé, Monte Café above the waterfall, 900 m asl, leg. Cs. Csuzdi, 26 August 2000. AF/5021 six ex. Sao Tomé, 14 km S of Neves, cocoa plantation, leg. Cs. Csuzdi, 29 August 2000. AF/5032 five ex., AF/5037 four ex. Sao Tomé, Monte Café at the waterfall, 860 m asl, leg. Cs. Csuzdi, 26 August 2000.

Amynthas morrisi (Beddard, 1892)
Perichaeta morrisi Beddard 1892a, p 166.
Pheretima morrisi: Michaelsen, 1900, p 287.
Amynthas morrisi: Sims and Easton 1972, p 236.
Amynthas morrisi: Blakemore 2003, p 22 (for complete synonymy).

Material examined
AF/5020 12 ex. Sao Tomé, 14 km S of Neves, cocoa plantation, leg. Cs. Csuzdi, 29 August 2000. AF/5030 three ex. Sao Tomé, Sao Joao dos Angolares, leg. Cs. Csuzdi, 27 August 2000.
2000. AF/5035 one ex. Sao Tomé, Monte Café at the waterfall, 860 m asl, leg. Cs. Csuzdi, 26 August 2000.

*Amynthas rodericensis* (Grube, 1879)

*Perichaeta rodericensis* Grube 1879, p 554.
*Pheretima rodericensis*: Michaelsen 1900, p 299.
*Amynthas rodericensis*: Sims and Easton 1972, p 235.
*Amynthas rodericensis*: Blakemore 2002, p 186 (for complete synonymy).

**Material examined**

AF/5014 four ex., AF/5017 four ex. Sao Tomé, Monte Café above the waterfall, 900 m asl, leg. Cs. Csuzdi, 26 August 2000. AF/5036 five ex. Sao Tomé, Monte Café at the waterfall, 860 m asl, leg. Cs. Csuzdi, 26 August 2000.

**Family OCNERODRILIDAE** Michaelsen, 1900

*Nematogenia* Eisen, 1900

*Nematogenia panamaensis* (Eisen, 1900)

*Ocnerodrilus (Nematogenia)* lacuum panamaensis Eisen 1900, p 127.
*Nematogenia panamaensis*: Michaelsen 1900, p 376.
*Nematogenis panamaensis*: Gates 1962a, p 257.
*Nematogenis panamaensis*: Blakemore 2002, p 88 (for complete synonymy).

**Material examined**

AF/5010 one ex. Sao Tomé, N-E from Monte Mario towards Pico Cao Grande, oil palm plantation, leg. Cs. Csuzdi, 30 August 2000. AF/5022 six ex. Sao Tomé, 14 km S of Neves, cocoa plantation, leg. Cs. Csuzdi, 29 August 2000. AF/5025 18 ex. Sao Tomé, 14 km S of Neves, cocoa plantation, on the bank of a small stream, leg. Cs. Csuzdi, 29 August 2000. AF/5029 six ex. Sao Tomé, Sao Joao dos Angolares, leg. Cs. Csuzdi, 27 August 2000.

**Gordiodrilus** Beddard, 1892

*Gordiodrilus* Beddard 1892c, p 93.
*Gordiodrilus*: Gates 1942, p 75.
*Gordiodrilus*: Gates 1962b, p 351.
*Gordiodrilus*: Jamieson 1963, p 305.

**Gordiodrilus paski** Stephenson, 1928

*Gordiodrilus paski* Stephenson 1928, p 1.
*Gordiodrilus unicus* Stephenson 1931a, p 79.
*Gordiodrilus peguanus* Gates 1942, p 85.
*Gordiodrilus paski* Jamieson 1962, p 519.
*Gordiodrilus paski*: Jamieson 1963, p 305.
Material examined

AF/5023 two ex. Sao Tomé, 14 km S of Neves, cocoa plantation, leg. Cs. Csuzdi, 29 August 2000. AF/5024 nine ex. Sao Tomé, 14 km S of Neves, cocoa plantation, on the bank of a small stream, leg. Cs. Csuzdi, 29 August 2000. AF/28 two ex. Sao Tomé, Sao Joao dos Angolares, leg. Cs. Csuzdi, 27 August 2000. AF/5041 one ex. Sao Tomé, Monte Café near to the waterfall, 860 m asl, leg. Cs. Csuzdi, 26 August 2000.

Family MONILIGASTRIDAE Claus, 1880

_Drawida_ Michaelsen, 1900

_Drawida_ Michaelsen 1900, p 114.
_Drawida_: Gates 1935, p 1.
_Drawida_: Easton 1981, p 37.
_Drawida_: Easton 1984, p 111.

_Drawida barwelli_ (Beddard, 1886)

_Moniligaster barwelli_ Beddard 1886b, p 94.
_Moniligaster bahamensis_ Beddard 1893, p 696.
_Drawida barwelli_: Michaelsen 1900, p 116.
_Drawida bahamensis_: Michaelsen 1900, p 118.
_Drawida barwelli_: Easton 1984, p 112.
_Drawida barwelli_: Blakemore 2002, p 69 (for complete synonymy).

Material examined

AF/5031 three ex. Sao Tomé, Sao Joao dos Angolares, leg. Cs. Csuzdi, 27 August 2000.

Discussion

Earthworms are low dispersers and due to their intolerance of salt water they were thought to be lacking from true volcanic islands (Sims 1980). The rich earthworm fauna, including six endemic species, found in Sao Tomé seems to contradict this widely accepted opinion (Omodeo 1963; Sims 1980; Csuzdi 1994) and together with a previous report of James (1996) indicates that a small-scale over-water dispersal could not be excluded.

Except for _D. pinguis_ all the endemic species of Sao Tomé live in fallen trunks, indicating that rafting tree trunks, at least over small distances, might be an important factor for over-water dispersals, even in the case of earthworms. Sea-level lowering that occurred several times during the Tertiary and Quaternary might have facilitated dispersal events.

In the first account of the earthworm fauna of Sao Tomé (Cognetti 1910), apart from the four endemic species only one peregrine worm, the widely introduced tropical _Eudrilus eugeniae_, was reported. In the present survey, some hundred years later, 18 species are reported including six endemic ones. All the six species thought to be autochthonous to the island were collected in the more natural central volcano region. In the coastal plains that are converted mostly to plantations (cocoa, oil palm etc.) and arable fields, only widely introduced peregrine species have been collected, demonstrating the fragility of the endemic earthworm fauna.
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