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A new species of *Geogenia* Kinberg, 1867 from the south coast of KwaZulu-Natal, South Africa (Oligochaeta, Microchaetidae)

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ABSTRACT

Examining recently collected earthworms from a sugarcane farm in Port Shepstone, South Africa resulted in the discovery of a new species, *Geogenia minnehaha* sp. n. This species is similar to *G. tuberosus* (Plisko, 1998) but differs from it by the extended clitellum, the size and position of papillae, and the number and shape of spermathecae. The presence of an indigenous species in a sugarcane field is a new finding in South Africa, where little is known on earthworm communities in agricultural soils.

KEY WORDS: Afrotropical Region, *Geogenia,* earthworms, sugarcane fields, no-till agriculture, indigenous species.

INTRODUCTION

Earthworms are a major component of macrofauna in the soil community. Earthworms play an important role in soil ecosystems; they modify the soil and regulate resources in the soil, thereby acting as ecosystem engineers that indirectly benefit humans. They also have the most significant effect on soil fertility and structure (Dlamini *et al.* 2001). By converting large pieces of organic matter into rich humus in the form of casts, thereby improving soil fertility and quality, they influence the regulation of soil formation. Nutrients are released from the decomposition of organic matter, as well as chemicals such as nitrogen and phosphates, and are made available in an accessible form for plants and other organisms, thus contributing to healthy soil ecology (Edwards & Bohlen 1996). The soil structure is kept open by earthworm burrows, which create passageways that allow aeration and drainage to take place. This is important because soil microorganisms and plant roots need air and water.

In South Africa there are currently three indigenous earthworm families: Microchaetidae, Tritogeniidae and Acanthodrilidae (Acanthodrilinae). Species that belong to these families tend to have a restricted distribution and are found in natural, undisturbed biotopes, mostly in primary grasslands and forests. Although earthworms in South Africa have received much more attention than in other African countries, the knowledge of earthworms in this country still needs to be greatly expanded. Previous collections in sugarcane fields in South Africa have produced only introduced earthworm species.

The effects of agriculture on earthworm fauna have not been thoroughly investigated in South Africa (Dlamini *et al.* 2001; Haynes *et al.* 2003). Little is known about earthworm assemblages in agricultural soils and their effects, and indigenous earthworm species have not been found in sugarcane fields before. A recent sampling from the KwaZulu-Natal south coast, on no-till sugarcane fields on Minnehaha Farm, revealed the presence of indigenous species belonging to *Geogenia* Kinberg, 1867. In this paper the new species is described and illustrated. This is the first record of indigenous earthworms in sugarcane fields in South Africa.

Abbreviations: cl = clitellate, juv. = juvenile.

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MATERIAL AND METHODS

Specimens were collected from Minnehaha Farm in Port Shepstone, by digging and hand sorting. The earthworms were anaesthetised in a 20 % ethanol solution, fixed in 4 % formalin and then preserved in a 70 % ethanol solution. Some samples were isolated and preserved in an absolute ethanol solution for future molecular study. Descriptions are based on preserved material; studies of internal anatomy were conducted through dorsal dissections. Photographs were taken using a Leica EZ4HD photomicroscope. All studied material is deposited in the KwaZulu-Natal Museum (NMSA) Oligochaeta Collection.

TAXONOMY

Family Microchaetidae Beddard, 1895
Genus *Geogenia* Kinberg, 1867

Geogenia Kinberg, 1867: 97; Perrier 1886: 876; Reynolds & Cook 1976: 52; 1993: 22; Pickford 1975: 23; Brinkhurst & Jamieson 1971: 739.
Microchaeta [*partim*]: Rosa 1891: 382; 1898: 1; Beddard 1895: 675.
Geogenia (*Microchaeta* ?): Michaelsen 1899: 428.
Geogenia (*Microchaetus* ?): Michaelsen 1891: 38; 1899: 428; 1900: 462.
Microchaetus: Michaelsen 1899: 428 [redescription of *natalensis*]; [*partim*]: 1900: 448; 1908: 40; 1913*a*: 545; 1913*b*: 61; 1913*c*: 422; 1918: 331; Brinkhurst & Jamieson 1971: 739; Pickford 1975: 23 [*partim*]; Reynolds & Cook 1993: 6; Hodgson & Jamieson 1992: 112 [for *pentheri*]; Plisko 1995: 283; [*partim*]: 1991: 279; 1992: 338; 1993: 222; 1998: 250; 2002: 205; 2003: 281; 2005: 105; 2006: 34.

Type species: *Geogenia natalensis* Kinberg, 1867

Diagnosis: Holandric, testes and male funnels in 10, 11. Excretory system holoic, with V-shaped nephridial bladders. Gizzard single in segment 7. Dorsal blood vessel double in 4–9, being partly or fully separated when crossing segments, but simple after 10; in segment 8 broadly parted, in 9 enlarged, constituting a 'cordiform' organ. Calciferous glands not stalked, paired or encircling oesophagus, although always with dorsal or ventral vestigial grooves; in one or two segments. Spermathecae and spermathecal pores in pre-testicular, testicular or post-testicular segments. If only pre-testicular or post-testicular, then pores occur in fewer than four furrows. If in more than four furrows, pores occur anterior to testes segments, in testis and post-testicular intersegmental furrows. Two pairs of seminal vesicles; rarely only one anterior pair. Two, three or four anterior septa (4/5–8/9) variably thickened. Body length of most species 40–300 mm, some extending to 400 mm, and one species reaching 800 mm. Number of segments approximately 100–500.

Geogenia minnehaha sp. n.

Fig. 1

Etymology: Proper name in apposition, after Minnehaha Farm, the type locality;

Diagnosis: Body length: 57–325 mm, width: 2–3 mm. Clitellum saddle-shaped on 13–25, 26. Female pores in 14. Spermathecal pores in 12/13 and 13/14 intersegmental furrows. Papillae large on 9–15, 19–25, 26. Gizzard in 7, large, well developed. Calciferous glands in 9. One pair of spermathecae per segment. Seminal vesicles paired, in 10, 11 and 12. Intestine begins in 13.

Description:

External characters.

Holotype: Body 100 mm in length, 3 mm wide at tubercula. Segment number 135, slightly abscised. Paratypes: 57–325 mm in length, 3–4 mm wide. Segment number 81–551. Prostomium prolobous, small. Segmentation, preclitellar segments with secondary annulations: segment 1–3 simple, 1–2 with small horizontal grooves, segment 4–7 with two ringlets of equal size, 8–9 with second ringlet smaller; from 10 and postclitellar, simple and randomly annulated. Setae *ab* visible from 2, closely paired especially on papillae, large. Male pores not observed. Female pores minute on anterior part of segment 14 near *ab* setae. Spermathecal pores not observed but from inside traced to 12/13 and 13/14 intersegmental furrows. Clitellum saddle-shaped on 13–25, 26 (on one specimen extends to 26), segmented, dorsal borders well marked. Tubercula pubertatis on 15–18, flat elongated ridges. Genital papillae on 9–12, 13 or 9–15 and 19–26, paired or single, large nipple-shaped on *ab* setae.

Internal characters.

Septa 4/5, 7/8, 8/9 thickened but not muscular; 5/6, 6/7 thin; other septa thin. Gizzard well developed in 7, globular, muscular. Calciferous glands in 9, not stalked. Intestinal origin in 13. Dorsal blood vessel double in the anterior segments from 7; in 8 and 9 forms a heart-shaped structure (cordiform organ); simple in the posterior segments. Nephridia, one pair per segment, coiled loops of meganephridia. Holandric, male funnels are in separate sacs, closely paired, pairs close to seminal vesicles, both pairs iridescent in holotype. Seminal vesicles large in 10–12, one pair per segment, pairs in 10, 11 are very

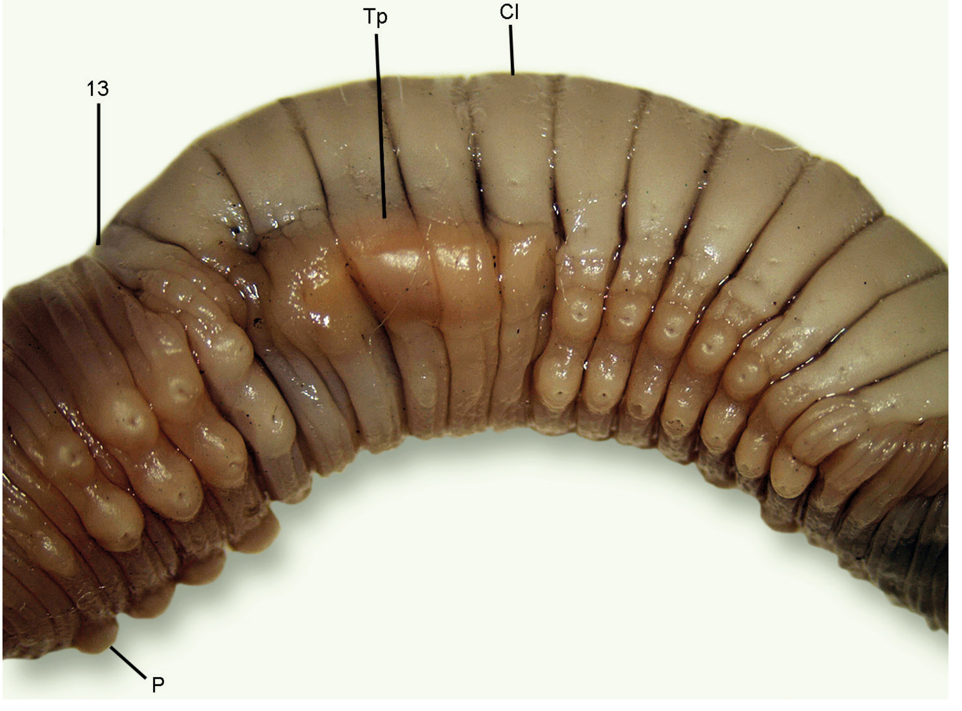

Fig. 1. *Geogenia minnehaha* sp. n., side view of the clitellar region. Abbreviations: Cl = clitellum; Tp = tubercula pubertatis; P = papillae of segment 9; 13 = segment 13, the start of the clitellum.

large but the one in 12 is highly reduced. Spermathecae in 12/13 and 13/14, one pair per segment, finger-shaped. Genital glands present on 9–13 or 9–14, with large setae.

Holotype: SOUTH AFRICA: *KwaZulu-Natal*: Port Shepstone, Minnehaha Farm, no-till sugarcane plots (30°40'03.2"S 30°14'59.2"E), 05.iii.2014, T. Nxele, P. Mukwevho, B. Mzobe, M. Neethling leg; Clitellate: (NMSA/OLIG. 06725).

Paratypes: Same locality and date as holotype: 3 cl, 5 juv. (NMSA/OLIG. 06716); 1 cl, 3 juv. in absolute ethanol, T. Nxele, P. Mukwevho, B. Mzobe, M. Neethling leg (NMSA/OLIG. 06724).

Remarks: This species is closely related to the species that occurs in Oribi Gorge Nature Reserve, which is in the near vicinity of Minnehaha Farm. This species is longer (reaching 325 mm with 551 segments), with an extended clitellum. The papillae are very large and nipple-shaped with setae in the middle; the number of spermathecae is reduced.

DISCUSSION

This species has not been found in the grassland that is adjacent to the sugarcane fields despite recent sampling within the grassland. However, the field where this species was found has not been tilled for over 20 years (Neethling pers. comm.) and this may be the reason for indigenous species occurring there. Studies by Dlamini *et al.* (2001) and Haynes *et al.* (2003) show that there are very few earthworm species found in sugarcane fields in South Africa, with all existing records being of introduced species. Most studies that look into earthworm species in agricultural fields have found that peregrine species dominate (Dlamini *et al.* 2001; Haynes *et al.* 2003; Simonsen *et al.* 2010). Tillage is generally known to affect earthworms more negatively than no-tillage, particularly the endogenic and anecic earthworms (Hutcheon *et al.* 2001; Peigne *et al.* 2009). In the present study, indigenous species dominated all samples. Further studies should be conducted to determine if the no-till strategy increases the presence of earthworms in sugarcane fields in South Africa or not. Future results may indicate that there may be more species to be discovered from agricultural land, and therefore more research is needed, particularly as earthworms make an important contribution to food security through their role in ecosystem services.

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