A New Record of the Octochaetid Earthworm *Dichogaster affinis* (Michaelsen, 1890) from the Centro-western Taiwan

台灣新紀錄種蚯蚓乳突重胃蚓 *Dichogaster affinis* (Michaelsen, 1890)

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Abstract

This paper describes the octochaetid earthworm *Dichogaster affinis* (Michaelsen, 1890) as a new record from the centro-western Taiwan. It is a small earthworm with two gizzards, belonging to the family Octochaetidae. *D. affinis* is quadriprostatic and has a pair of female pores in XIV and genital markings in 7/8-9/10. It is easily distinguishable from other two congeneric species in Taiwan, *Dichogaster saliens* (Beddard, 1892) that is biprostatic and *Dichogaster bolaui* (Michaelsen, 1891) that is quadriprostatic but has a single female pore and no genital marking. Occurrence of *D. affinis* in Taiwan reported herein constitutes the island as the northernmost range of this cosmopolitan species in East Asia.

摘　要

本文描述一台灣新紀錄種蚯蚓乳突重胃蚓 *Dichogaster affinis* (Michaelsen, 1890)。其爲小型蚯蚓，屬於八毛蚓科 (Octochaetidae) 重胃蚓屬 (*Dichogaster*)，具有兩對前列腺及一對雌性生殖孔，且在 7/8 至 9/10 體節間有生殖乳突。在台灣其餘兩種同屬物種爲*Dichogaster saliens* (Beddard, 1892) 及*Dichogaster bolaui* (Michaelsen, 1891)，前者僅具一對前列腺，後者具有兩對前列腺但僅有一個雌性生殖孔且不具生殖乳突。*D. affinis*的發現使得台灣成爲此種廣布種蚯蚓在東亞分布的北界。

Key words: *Dichogaster affinis*, earthworm, Taiwan

關鍵詞：乳突重胃蚓、蚯蚓、台灣

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Introduction

Dichogaster affinis (Michaelsen, 1890) is a cosmopolitan earthworm widely distributed in the tropical and temperate regions around the world (Easton 1984). It has been reported from India (Stephenson 1917; Gates 1972), Burma (= Myanmar) (Stephenson 1931a; Gates 1972), Thailand (Gates 1939, 1972), Cambodia, Laos, Vietnam (Blakemore 2006), Hainan Island (Chen 1938), Sumatra, Flores (Horst 1893), Australia (Blakemore 2002), New Caledonia (Gates 1972), Pacific Islands (Easton 1984), Mexico (Rosa 1891), Central America, Brazil, Africa, Madagascar (Gates 1972), and Canary Islands (Talavera 1992). Its transoceanic distribution suggests it to have been widely transported by man. It is parthenogenetic and has been considered as one of the potentially invasive earthworms originated from West Africa (Hendrix and Bohlen 2002).

The following description is based on seven specimens deposited at the Endemic Species Research Institute, Jiji, Nantou, Taiwan. They were fixed in a 10% formalin-water solution and preserved in a 70% ethyl alcohol-water solution. Soil pH of the collection sites was measured using a pH meter (Multi 350i, WTW GmbH, Weilheim, Germany) after shaking 30g of soil suspended in 30 ml of water for 1 hr.

Dichogaster affinis (Michaelsen, 1890)

Benhamia affinis Michaelsen, 1890: 29. Fig. 20.
Benhamia mexicana Rosa, 1891: 394.
Benhamia floresiana Horst, 1893: 34.
Dichogaster affinis - Michaelsen, 1900: 336, 345. - Stephenson, 1917: 413; 1931b: 201. - Gates, 1942: 128; 1958: 618; 1961: 57; 1972: 278. - Easton, 1984: 119. - Talavera, 1992: 341. - Hendrix and Bohlen, 2002: 8.
Dichogaster sinuosus Stephenson, 1931a: 74; 1931b: 200.
Dichogaster sinicus Chen, 1938: 420. (= *Dichogaster sinensis* Chen, 1938: 376, 421, Fig. 18).

Material examined. -Two mature (clitellate, one dissected and one amputated) specimens collected from Tienshen Temple, Huben Village, Linnei Township, Yunlin County, Taiwan on 14 August 2007 (coll. no. 2007-52-Shen; soil pH: 7.1), and two mature and one immature specimens collected from Budhi Shrine of White Horse Mountain, Huben Village, Linnei Township, Yunlin County, Taiwan on 16 August 2007 (coll. no. 2007-66-Shen; soil pH: 7.17) by Y. H. Lin, Y. P. Li, C. H. Chang and H. P. Shen; two mature (one amputated)

specimens collected from Dakeng, Huben Village, Linnei Township, Yunlin County, Taiwan on 13 September 2007 by T. J. Lin, Y. P. Li, H. I. Tsai and H. P. Shen (coll. no. 2007-81-Shen; soil pH: 5.35).

Description. - Small earthworms, length (mature) 23-33 mm, weight about 0.064g, diameter 1.6-2.1 mm. Segment number 103-131. Prostomium epilobous. First dorsal pore in 5/6. Setae lumbricin (eight setae per segment), small and closely paired on ventrum, aa: ab: bc: cd = 3: 1: 3: 1, ab not visible externally in XVII-XIX. Clitellum XIII-XXI (Fig. 1A), saddle-shaped, 2.0-3.68 mm in length, 1.6-2.1 mm in width, dorsal pore present in 13/14. Spermathecal pores two pairs in 7/8 and 8/9, medio-ventral, in line with setae ab (Fig. 1A). Female pores paired on a raised pad in XIV, each pore anterior to seta a. Genital markings round, medio-ventral, in 7/8-9/10, each about 0.3 mm in diameter. Male pores paired in XVIII, in bracket-shaped seminal grooves connecting prostatic pores in XVII to prostatic pores in XIX (Fig. 1A). Specimens unpigmented.

Septa weakly developed. Two muscular gizzards in VII and VIII, displaced posteriorly to IX and X, each barrel-shaped, yellowish white in color. Intestine enlarged in XVII. Esophageal hearts in XI-XIII. Calciferous glands three pairs in XV-XVII, digiform; the first two pairs transparent with comb-like streaks, the last pair yellowish white and slightly lobed. Nephridia meroic, saccular, four rows on each side. Spermathecae small, two pairs in VIII and IX (Fig. 1B). Ampulla oval about 0.2 mm long, with a wide, stout, short duct. Diverticulum small, short-stalked with a bulbous seminal chamber. Ovaries paired in XIII. Accessory glands absent.

Holandry: testes paired in X and XI, small, round. Seminal vesicles lacking or vestigial in XI and XII. Prostate glands two pairs in XVII and XIX, long, tubular with penial setae close to the short, muscular ducts (Fig. 1C).

Remarks. - There are three peregrine species of octochaetid earthworms that have been reported so far from Taiwan: *Dichogaster bolaui* (Michaelsen, 1891) by Kobayashi (1941), *Dichogaster saliens* (Beddard, 1892) by Shen and Tsai (2007), and *D. affinis* by this study. They all occurred in coastal plains at elevations less than 300m, but are easily distinguishable. *D. bolaui* and *D. affinis* are quadriprostatic while *D. saliens* is biprostatic. *D. bolaui* has a single female pore in XIV and no genital marking, while *D. affinis* has paired female pores on a raised pad in XIV and medio-ventral genital markings in 7/8-9/10. Occurrence of *D. affinis* in Taiwan reported herein constitutes the island as the northernmost range of this species in East Asia.

According to Talavera (1992), *D. affinis* is an anthropochorous species frequently found in avocado and banana groves, and also in gardens and parks with exotic plants; its preferred habitat is alkaline soils (pH > 7). In this study, two localities where the specimens of *D. affinis* were collected were the yards beside the temples with introduced plants or trees, and the pH values of the soils were 7.1-7.2. However, the other locality, Dakeng of Huben Village, was a small valley where the soil pH was 5.35.

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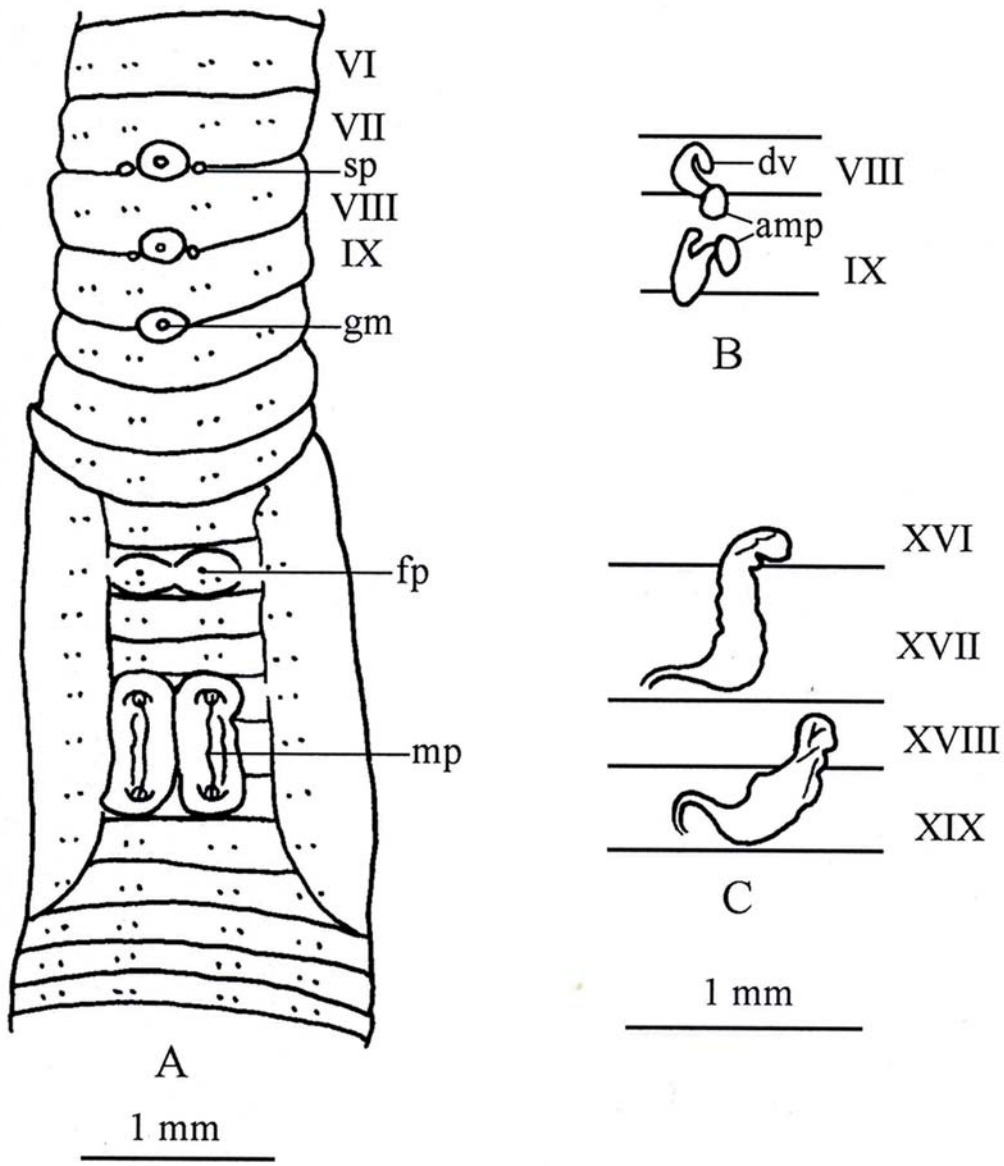

Fig. 1. *Dichogaster affinis* (Michaelsen): A, ventral view of pre-clitellar, clitellar and male pore regions (fp, female pore; mp, male pore; gm, genital marking; sp, spermathecal pore); B, dorsal view of right spermathecae (amp, ampulla; dv, diverticulum); C, dorsal view of right prostate glands.

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