

Occurrence of the Earthworm *Dendrodrilus rubidus* (Savigny, 1826) at High Elevations in Taiwan

台灣高海拔山區新紀錄種蚯蚓[紅叢林蚓] *Dendrodrilus rubidus* (Savigny, 1826)

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Abstract

This paper describes the lumbricid earthworm *Dendrodrilus rubidus* (Savigny, 1826) as a newly recorded species in Taiwan. It was collected at the elevations of 2600–3000 m in the Central Mountain Range. It is originated from Europe and its cosmopolitan distribution is largely due to human transportation.

摘要

本文描述一採自台灣高海拔山區之新紀錄種蚯蚓[紅叢林蚓] *Dendrodrilus rubidus* (Savigny, 1826)。其為原產於歐洲之蚯蚓，屬於正蚓科 (Lumbricidae) 叢林蚓屬 (*Dendrodrilus*)。此種蚯蚓廣泛分布於全球寒帶及溫帶地區，熱帶及亞熱帶地區之分布紀錄多為人為夾帶所致。

Key words: *Dendrodrilus rubidus*, earthworm, Taiwan

關鍵詞：紅叢林蚓、蚯蚓、台灣

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Introduction

Dendrodrilus rubidus (Savigny, 1826) is a Palearctic earthworm originated from Europe and is globally distributed except in tropical lowlands (Blakemore 2002). According to Gates (1972), the presence of this wide-ranging species on some oceanic islands such as Hawaii obviously resulted from human introduction, and man has been transporting *D. rubidus* together with plants or soils probably for many years. All tropical localities for which elevations were recorded are above 4000 ft (Gates 1972). The optimal temperature for its growth is 18°C; mortality is high at 25°C (Gates 1972). To date on the subtropical island of Taiwan, this earthworm was found at elevations higher than 2500 m.

According to Lee (1985) and Hale *et al.* (2005), *D. rubidus* is a litter dwelling (epigeic) earthworm that deposits its cocoon near the soil surface. Individuals of *D. rubidus* reared in isolation can produce viable cocoons (Evans and Guild 1947; Cluzeau *et al.* 1992). Its reproductive organs show various stages of degeneration with spermathecae varying from two pairs in IX–X (quadrithecal) to absence (athecal) (Gates 1972; Blakemore 2002),

and seminal vesicles from poorly developed with abortive spermatogenesis to well-developed showing all stages of spermatogenesis (Casellato and Rodighiero 1972). Polyploidy, male sterility and absence of spermathecae are common (Gates 1972). Chromosome numbers range from 34 (diploid) to 120 (hypo-octoploid) (Gates 1972). For most parthenogenetic oligochaetes reported so far, their eggs are produced through premeiotic doubling of chromosomes (Christensen 1980, 1984, 1994). To date, only *Dendrobaena octaedra* (Savigny) reported by Omodeo (1955) and *D. rubidus* by Jaenike *et al.* (1982) are known to be ameiotic parthenogens. Due to parthenogenetic polymorphism, morphs are numerous with *rubidus*, *tenuis*, *norvegicus*, and *subrubicundus* recognized as four major morphs or subspecies (Blakemore 2002). Parthenogenesis is commonly recorded in widely distributed peregrine species (Lee 1985). It is a trait that may enhance the establishment of new populations (Hendrix and Bohlen 2002). This trait may facilitate reproduction at very low densities, and may also contribute to the rapid expansion of a population once a well-adapted morph arrives in a particular location (Tiunov *et al.* 2006).

The following description is based on 139 preserved specimens deposited at the Taiwan Endemic Species Research Institute, Jiji, Nantou, Taiwan. Soil pH of the collection sites was

measured with a pH meter (Multi 350i, WTW GmbH, Weilheim, Germany) after shaking 30 g of soil suspended in 30 ml of ddH₂O for 12 h.

Dendrodrilus rubidus (Savigny, 1826)

Enterion rubidum Savigny, 1826: 182.

Allolobophora tenuis Eisen, 1873: 44.

Allolobophora norvegica Eisen, 1873: 48.

Allolobophora subrubicunda Eisen, 1873: 51.

Helodrilus (Dendrobaena) rubidus – Michaelsen, 1900: 490.

Dendrobaena rubida – Gates, 1958: 6; 1972: 92; – Reynolds, 1973: 108; 1974: 94.

Dendrodrilus rubidus rubidus – Easton, 1983: 479.

Materials examined.—One mature (clitellate) specimen (dissected) collected 20 October 1999 from Mt. Hohuan (elev. 3000 m) along Rt. 14A near the border between Nantou and Hualien counties by C. F. Tsai, S. C. Tsai, H. P. Shen, T. J. Lin, and C. Y. Chang (coll. no. 1999-17-Shen); 115 mature specimens collected 14 September 2005 at Yakou Lodge (elev. 2700 m), Taitung County by H. P. Chen and H. S. Fang (coll. no. 2005-31-Shen); four mature and three immature specimens collected 16 March 2006 from the High Altitude Experimental Station of Endemic Species Research Institute at Mt. Hohuan by H. H. Lin, and H. L. Chang (coll. no. 2006-1-Shen); six mature and an immature specimens collected 17 January 2008 at the entrance of a hiking trail to the East Peak of Mt. Hohuan (elev. 3000 m) by T. J. Lin, R. C. Jang and M. H. Shen (coll. no. 2008-1-Shen); eight mature (one dissected) and

an immature specimens collected 27 June 2011 at Sungyuan Lodge (elev. 2600 m), Hualien County by D. H. Chen and C. Y. Chang (coll. no. 2011-21).

Description.—Length (clitellates) 21–43 mm, diameter 2.02–2.89 mm. Segment number 78–111. Prostomium epilobous. First dorsal pore 5/6. Clitellum XXV–XXXI, XXVI–XXXI or XXVI–XXXII, saddle-shaped, setae present. Tubercula pubertatis XXVII–XXIX, XXVIII–XXX or XXIX–XXX, occasionally absent. Setae lumbricin (eight setae per segment), widely paired, aa: ab: bc: cd = 2: 1: 2: 1. Male clefts paired in lateral margin of XV (Fig. 1A). Female pores in XIV, each lateral to seta b. Spermathecal pores absent. Live worms with dark red dorsum, pale ventrum and orange clitellum.

Septa 5/6–9/10 and 11/12 slightly thickened. Calciferous sacs in X. Gizzard large in XVII.

Intestine origin in XV. Esophageal hearts VII–XI. Nephridia holoic. Spermathecae absent. Accessory glands absent. Holandric. Seminal vesicles paired in XI and XII, the last pair extending to XIII (Fig. 1B), small, follicular. Ovaries in XIII. Prostate glands absent.

Remarks.— According to Gates (1972), *D. rubidus* inhabits in soil with pH of 5.0–6.2. It is an acid-tolerant (pH range: 3.7–4.7) and also an ubiquitous species (pH range: 3.7–>7.0) (reviewed by Lee 1985). In this study, the soil pH values of Mt. Hohuan areas where this species was collected were 6.33–7.48.

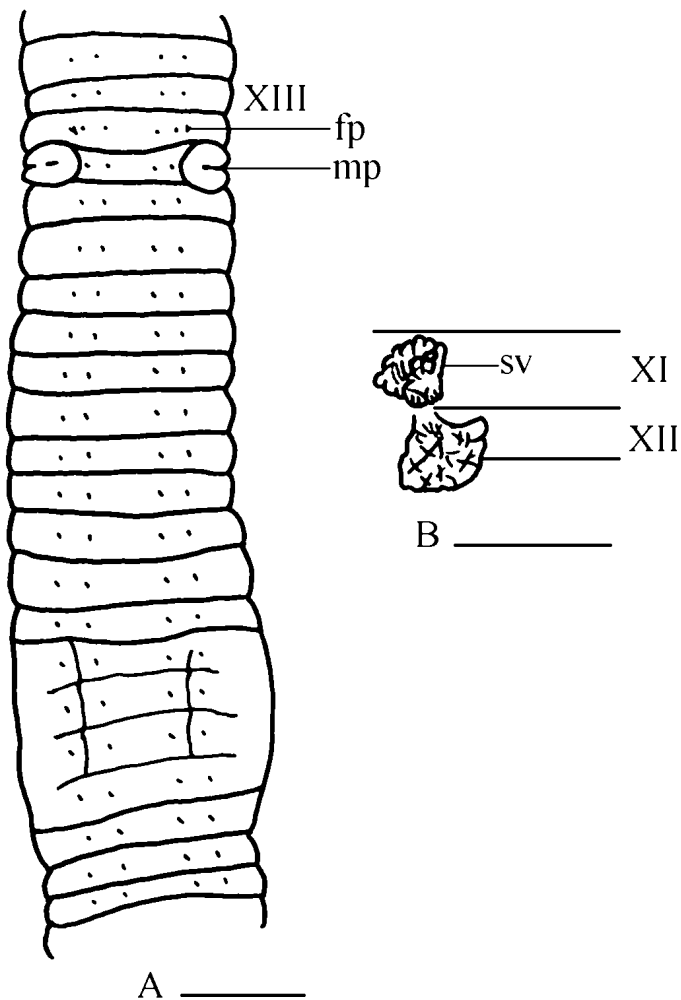


Fig. 1. *Dendrodrilus rubidus* (Savigny): A, ventral view of preclitellar and clitellar region (fp, female pore; mp, male pore); B, dorsal view of right seminal vesicles (sv); scale bar 1 mm.

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