

## First Record of Genus *Phaeopholus* Roelofs, 1873 (Coleoptera: Curculionidae: Hyperinae) in Taiwan

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**Abstract.** *Phaeopholus* Roelofs, 1873 is a small genus composed of four species, known to be widely distributed in East Asia, but there is no formal record in Taiwan. This paper provides the first record of genus *Phaeopholus* in Taiwan, with two new distribution records for *P. ornatus* Roelofs, 1873 and *P. major* Roelofs, 1879. The partial COI sequences of both species and the photograph of habitus and male genitalia are provided.

**Keywords:** Hyperini, new faunistic record, weevil, DNA barcode

### Introduction

The weevil genus *Phaeopholus* was established by Roelofs (1873) and traditionally belonged to the tribe Hyperini (Alonso-Zarazaga & Lyal, 1999; Alonso-Zarazaga et al., 2017). However, considering that the habitat preference of *Phaeopholus* is different from other members of Hyperini, Skuhrovec (2007) questioned the rational of this phylogenetic placement. Moreover, his morphological phylogenetic analysis suggested that this genus is closely related to Cepurini, rather than Hyperini. Although its phylogenetic placement is still controversial, most entomologists still treat it as a member of Hyperini (Legalov, 2011; Alonso-Zarazaga et al., 2017).

This genus currently consists of 4 species, including two species widely distributed in Japan and the Okinawa archipelago (*P. ornatus* Roelofs, 1873 and *P. major* Roelofs, 1879), and two species endemic to Fujian, China (*P. fuscocupreus* Voss, 1958, and *P. proximus* Voss, 1958) (Legalov, 2011; Alonso-Zarazaga et al., 2017). This genus can be distinguished from other Hyperini species by the combination of the following characters: body outline usually subglobular; rostrum elongate, at least twice as long as pronotum; antennal club elongate, four-segmented; elytra with interstriae slightly convex basally, without protruding tubercles; humeral angle rounded, contiguous with pronotal base (Oberprieler et al., 2014).

Although *Phaeopholus* has been widely recorded in East Asia, there is no formal record of this genus in Taiwan. During the examination of Taiwanese Curculionidae from field surveys and the museum collections, we found specimens of *Phaeopholus ornatus* and *P. major* from Taiwan for the first time. Herein, we provide the first formal record of genus *Phaeopholus* along with two new regional records in Taiwan. The partial COI gene sequences and illustration of habitus and male genitalia are also provided.

### Materials and methods

The specimens were examined with a SMZ 800N stereomicroscope. The photograph was taken with a Olympus E-M5 Mark II digital camera with Olympus M. Zuiko Digital ED 60mm F2.8 Macro lens and edited using Photoshop CS6 and Helicon focus 6. Species identification follows the description of Roelofs (1879) and the key of Voss (1958), with the type series comparison of *P. ornatus* Roelofs, 1873 and *P. major* Roelofs, 1879. The specimens examined in this paper are deposited in the W.-Z. Tseng's private collection, Taichung, Taiwan (WZPCC), National Museum of Natural Science, Taichung, Taiwan (NMNS), Taiwan Agricultural Research Institute, Wufeng, Taichung, Taiwan (TARI), and Royal Belgian Institute of Natural Science, Brussels, Belgium (RBINS).

The total genomic DNA was extracted using FavorPrep™ tissue genomic DNA extraction mini kit (Favorgen, Pingtung, Taiwan) following the manufacturer's protocols. The partial sequence of cytochrome c oxidase subunit I (COI) gene was amplified by polymerase chain reaction (PCR) with primer-pair LCO1490/HCO2198 (Folmer et al., 1994). All the PCR products were purified and sequenced at National Yang Ming Chiao Tung University Cancer Progression Research Center (Taipei, Taiwan). Sequences

were translated into amino acid and checked for stop codon in Geneious 11.0.5 (Kearse et al., 2012). All sequences are deposited in Genbank.

## Results

### *Phaeopholus ornatus* Roelofs, 1873

#### 絢麗圓葉象鼻蟲

(Figs 1–2, 5A–C)

**Type material examined. Lectotype: JAPAN:** 1♂, unknown, date unknown, W. Roelofs leg. (RBINS). **Paralectotype: JAPAN:** 1♂, unknown, date unknown, W. Roelofs leg. (RBINS); 2 ex, same data as lectotype (RBINS); 1♀, Hiller, Tokio, date unknown, W. Roelofs leg. (RBINS).

**Other materials. TAIWAN:** 1ex, Hueisun (惠蓀), Renai Township, Nantou County, 6. IX. 1987, S.-C. Tsaur leg. // NMNS ENT 7932-2015 (NMNS); 1ex, Dahanqiao (大漢橋), Fuxing Township, Taoyuan County, 21. IV. 1991, I.-S. Hsu leg. // NMNS ENT 7932-2013 (NMNS); 1ex, Jiabaotai (佳保台), Heping Township, Taichung County, 16. V. 1993, I.-S. Hsu leg. // NMNS ENT 7932-2006 (NMNS); 4ex, Yulao (宇老), Jianshi Township, Hsinchu County, 19. VI. 1993, I.-S. Hsu leg. // NMNS ENT 7932-2009; 7932-2010 (NMNS); 1ex, Meifeng (梅峰), Renai Township, Nantou County, 9. IV. 1998 – 19. V. 1998, C.-S. Lin & W.-T. Yang leg. // NMNS ENT 3243-599 (NMNS); 1ex, Chunyang (春陽), Renai Township, Nantou County, 19. II. 2002 – 12. III. 2002, C.-S. Lin & W.-T. Yang leg. // NMNS ENT 5237-630 (NMNS); 1ex, Meifeng (梅峰), Renai Township, Nantou County, 12. III. 2002 – 9. IV. 2002, C.-S. Lin & W.-T. Yang leg. // NMNS ENT 4912-24 (NMNS); 2ex, Chunyang (春陽), Renai Township, Nantou County, 9. IV. 2002 – 7. V. 2002, C.-S. Lin & W.-T. Yang leg. // NMNS ENT 5237-3273; 5237-3295 (NMNS); 2ex, Chunyang (春陽), Renai Township, Nantou County, 11. VI. 2002 – 9. VII. 2002, C.-S. Lin & W.-T. Yang leg. // NMNS ENT 5240-382; 5240-1099 (NMNS); 1ex, Kenting National Park (墾丁國家公園), Hengchun Township, Pingtung County, 16. II. 2005 – 17. II. 2005, C.-S. Lin & W.-T. Yang leg. // NMNS ENT 4810-373 (NMNS); 1ex, Chiupeng (九棚), Manzhou Township, Pingtung County, 20. XII. 2009 – 9. I. 2010, M.-L. Jeng & T.-R. Chen leg. // NMNS ENT 7104-383 (NMNS); 1♂, Hushan Hiking Trail (虎山親山步道), Xinyi District, Taipei City, 30. VII. 2017, W.-Z. Tseng leg. // WZPCC\_00111 (WZPCC); 1♂, Shueiyuandi (水源地), 25°10'43.7844"N 121°27'56.0556"E, Tamsui District, New Taipei City, 16. IV. 2018, W.-Z. Tseng leg. // WZPCC\_00215 (WZPCC); 1♂, Shueiyuandi (水源地), 25°10'39.6048"N 121°28'1.5348"E, Tamsui District, New Taipei City, 16. IV. 2018, W.-Z. Tseng leg. // WZPCC\_00216 (WZPCC); 2♂♂3♀♀, Shueiyuandi (水源地), 25°10'39.0396"N 121°28'2.1864"E, Tamsui District, New Taipei City, 29. IV. 2018, W.-Z. Tseng leg. // WZPCC\_00220 – WZPCC\_00224 (WZPCC).

**Diagnosis.** Body length less than 3 mm (more than 3.5 mm in *P. major* and *P. fuscocupreus*); pronotum with median furrow (absent in *P. proximus*); upper margin of pronotum weakly sinuated (Figs 5A–B) (strongly sinuated, truncate medially and laterally in *P. major* and *P. fuscocupreus*); black longitudinal tubercle on the base of interstria III and V and black transverse mark between base of interstria II–V (black mark only shows on base of interstria III in *P. proximus*); pronotum and venter with metallic green scales, (Fig. 5C) (grey scales in *P. major*; light brown, lustrous metallic in *P. proximus*; dark brown, lustrous metallic in *P. fuscocupreus*); pedon apex in dorsal view broaden, rectangular (rounded in *P. major*), apodeme of penis as long as pedon, (Figs 2A–B) (longer than pedon in *P. major*).

**Distribution.** China (Fujian province); Japan (Honshu, Shikoku, Kyushu, Okinawa, Tokunoshima Island and Izu Island); South Korea (Kojima & Morimoto, 2004; Kojima & Kaga, 2011; Alonso-Zarazaga et al., 2017); Taiwan (new record).

**GenBank accession number.** WZPCC\_00216: MW806916.

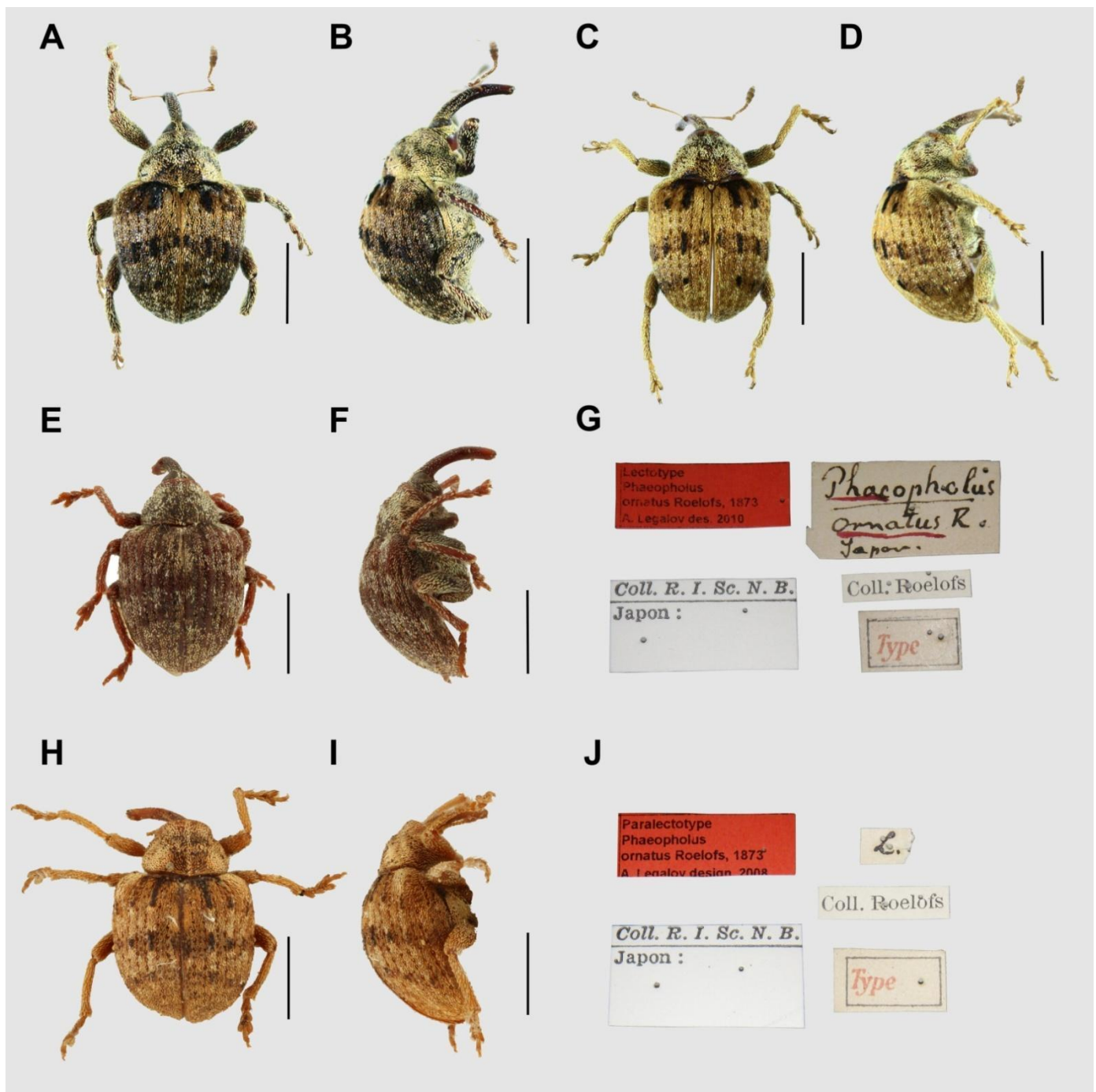


Figure 1. Habitus of *Phaeopholus ornatus* Roelofs, 1873. A: male, dorsal view, B: male, lateral view. C: female, dorsal view, D: female, lateral view. E: Lectotype, male, dorsal view, F: Lectotype, male, lateral view, G: Lectotype, labels. H: Paralectotype, male, dorsal view, I: Paralectotype, male, lateral view, J: Paralectotype, labels. Scale bar: 1mm.

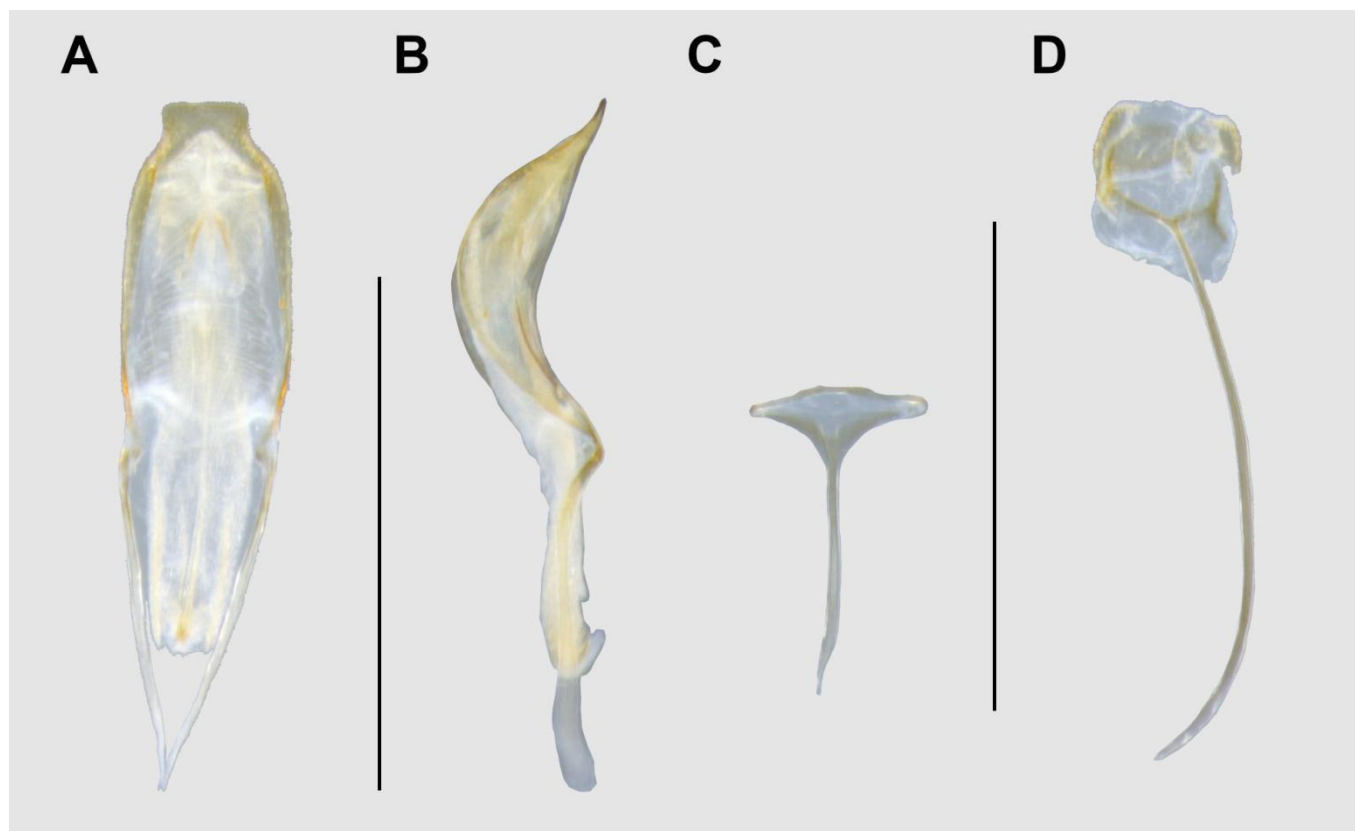


Figure 2. Male genitalia of *Phaeopholus ornatus* Roelofs, 1873. A: penis, dorsal view, B: penis, lateral view. C: tegmen ring, dorsal view, D: tegmen ring, lateral view. Scale bar: 1mm.

***Phaeopholus major* Roelofs, 1879**

巨圓葉象鼻蟲

(Figs 3–4, 5: D–F)

**Type material examined. Lectotype:** JAPAN: 1♀, Hiller, Tokio, date unknown, W. Roelofs leg. (RBINS).

**Other materials. TAIWAN:** 1♀, Hewangshan (合望山), Renai Township, Nantou County, 30. IV. 1989, C.-C. Lo leg. // NMNS ENT 7932-2014 (NMNS); 1♂, Bilu (碧綠), Xiulin Township, Hualien County, 26. V. 1991, C.-L. Li leg. // NMNS ENT 7932-2012 (NMNS); 1♀, Meifeng (梅峰), Renai Township, Nantou County, 10. XII. 2002 – 7. I. 2003, C.-S. Lin & W.-T. Yang leg. // NMNS ENT 6096-12 (NMNS); 1♀, Kenting National Park (墾丁國家公園), Hengchun Township, Pingtung County, 13. V. 2004 – 14. V. 2004, C.-S. Lin & W.-T. Yang leg. // NMNS ENT 4409-1474 (NMNS); 1♂, Kenting National Park (墾丁國家公園), Hengchun Township, Pingtung County, 16. II. 2005 – 17. II. 2005, C.-S. Lin & W.-T. Yang leg. // NMNS ENT 4810-392 (NMNS); 1♂, Meifeng (梅峰), Renai Township, Nantou County, 17. X. 2006 – 14. XI. 2006, C.-S. Lin & W.-T. Yang leg. // NMNS ENT 7512-84 (NMNS); 1♀, Machia (瑪家), Pingtung County, 25. V. 2016, Y.-T. Chung leg. // WZPCC\_00480M (TARI); 1♀, Wuchihshan (五指山), Zhudong Township, Hsinchu County, 9. XII. 2008, S.-F. Yu leg. // WZPCC\_00483M (TARI).

**Diagnosis.** Body length more than 3.5 mm (less than 3.5 mm in *P. ornatus* and *P. proximus*); upper margin of pronotum strongly sinuated, truncate medially and laterally (Figs 5D–E)(weakly sinuated in *P. ornatus* and *P. proximus*); pronotum and venter with grey scales (Fig. 5F)(metallic green in *P. ornatus*; light brown, metallic lustrous in *P. proximus*; dark brown, lustrous metallic in *P. fuscocupreus*); pedon apex in dorsal view rounded (broader in *P. ornatus*), apodeme of penis 1.5× longer than pedon, (Figs 4A–B (as long as pedon in *P. ornatus*)).

**Distribution.** Japan (Honshu, Shikoku, Kyushu and Tsushima Island); South Korea (Kojima & Morimoto, 2004; Kojima & Kaga, 2011; Alonso-Zarazaga et al., 2017); Taiwan (new record).

**GenBank accession number.** WZPCC\_00480M: MW806915.

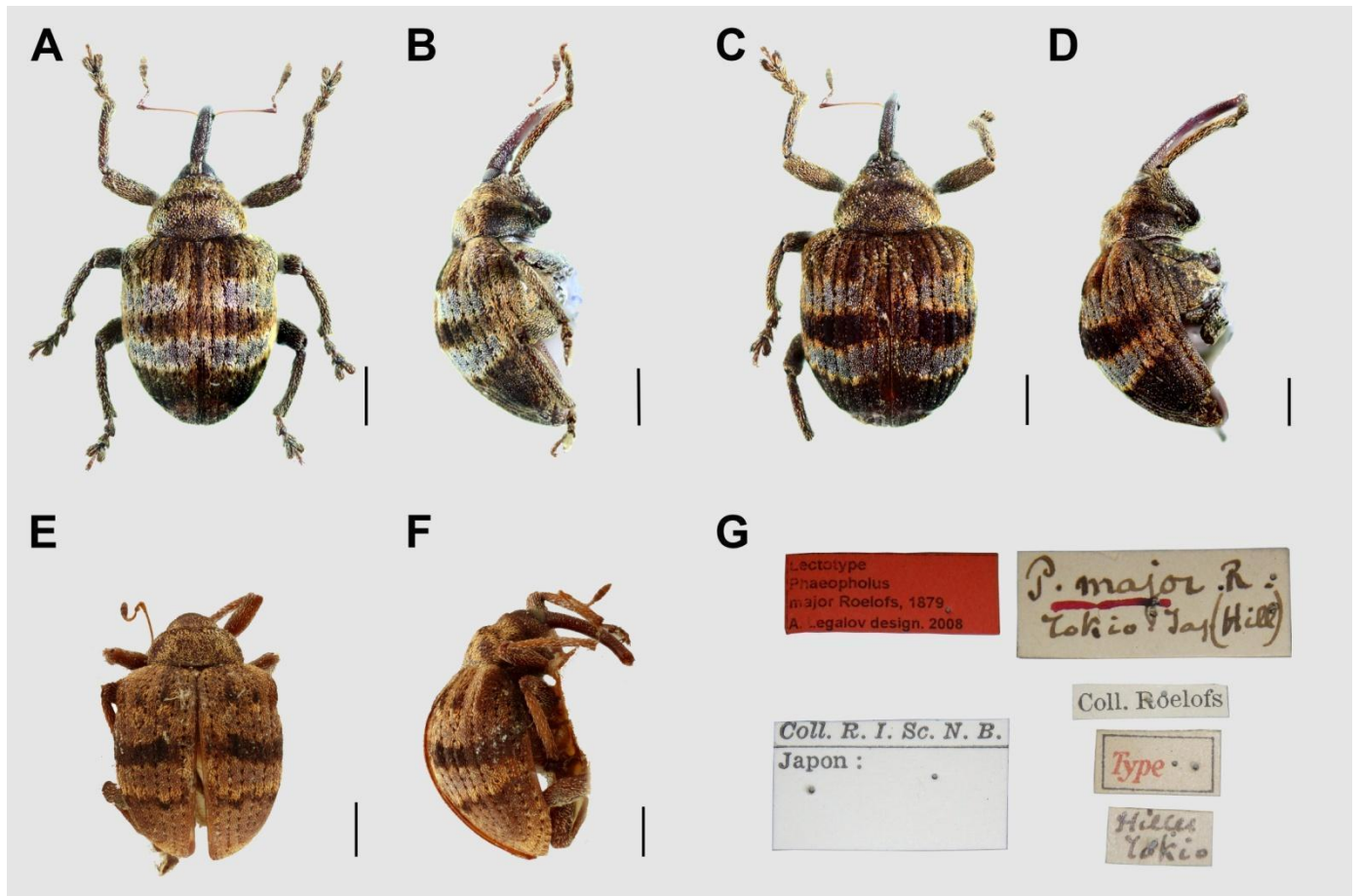


Figure 3. Habitus of *Phaeopholus major* Roelofs, 1879. A: male, dorsal view, B: male, lateral view. C: female, dorsal view, D: female, lateral view. E: Lectotype, female, dorsal view, F: Lectotype, female, lateral view, G: Lectotype, labels. Scale bar: 1mm.



Figure 4. Male genitalia of *Phaeopholus major* Roelofs, 1879. A: penis, dorsal view, B: penis, lateral view. C: tegmen ring, dorsal view, D: tegmen ring, lateral view. Scale bar: 1mm.

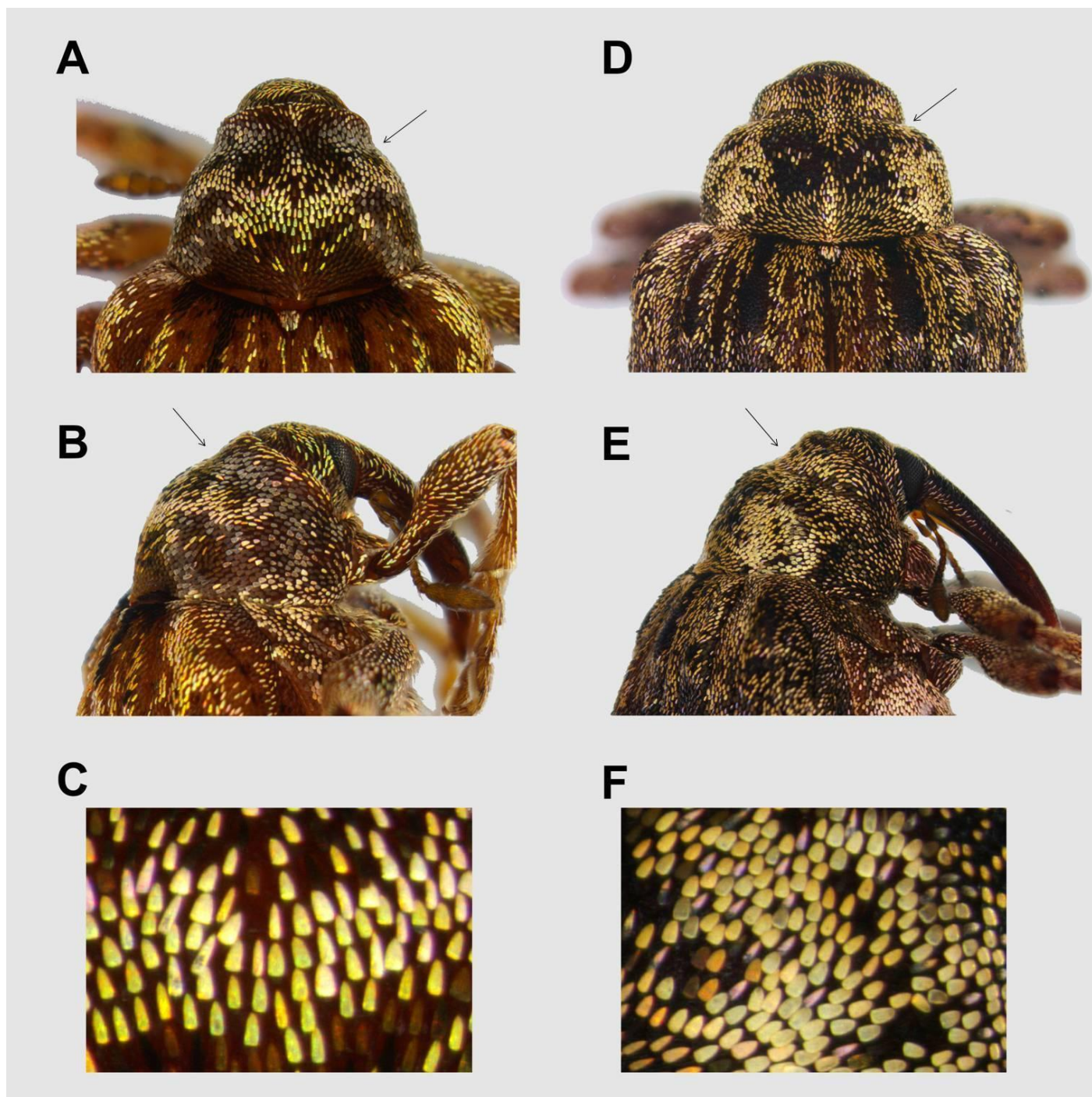


Figure 5. Diagnostic characters of *Phaeopholus* in Taiwan. A–C: *Phaeopholus ornatus* Roelofs, 1873. A: pronotum, dorsal view, B: pronotum, lateral view, C: pronotal scales. D–F: *Phaeopholus major* Roelofs, 1879. D: pronotum, dorsal view, E: pronotum, lateral view, F: pronotal scales.

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## 臺灣新紀錄圓葉象鼻蟲屬記述（鞘翅目：象鼻蟲科：葉象鼻蟲亞科）

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**摘要:** 圓葉象鼻蟲屬 (*Phaeopholus* Roelof, 1873) 先前已知廣泛分布在東亞地區，然而臺灣尚無正式的分布紀錄。本研究提供本屬於臺灣的新分布紀錄，並鑑定出兩物種絢麗圓葉象鼻蟲 (*P. ornatus* Roelofs, 1873) 及巨圓葉象鼻蟲 (*P. major* Roelofs, 1879)，本文亦提供兩物種的部分粒線體遺傳資訊與標本形態及雄性生殖器照片。

**關鍵詞:** 葉象鼻蟲族、新紀錄、象鼻蟲、生命條碼