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Habronyx (*Habronyx*) *pyretorus* (Cameron) (Hymenoptera: Ichneumonidae: Anomaloninae)— A Newly Recorded Darwin Wasp Parasitizing the Giant Silk Moth *Saturnia pyretorum* Westwood in Taiwan

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ABSTRACT

The Darwin wasp species *Habronyx* (*Habronyx*) *pyretorus* (Cameron, 1912), a solitary parasitoid of the giant silk moth *Saturnia pyretorum* Westwood, 1847, is recorded from Taiwan for the first time. The occurrence of this Darwin wasp species in Taiwan was initially revealed through online citizen science on social media, and all materials were subsequently reared from the mentioned host. As its host was artificially introduced from China to Taiwan, *H. pyretorus* is considered co-introduced with its host. In this study, *H. pyretorus* is redescribed based on Taiwanese specimens, and for the first time, its parasitism rate on wild populations of *S. pyretorum*, the duration before eclosion, and its adult lifespan are recorded.

Key words: parasitoid wasps, introduced species, redescription, parasitism rate, taxonomy

Introduction

The giant silk moth *Saturnia pyretorum* Westwood, 1847 [四黑目天蠶蛾、楓蠶、樟蠶] (**LEPIDOPTERA: SATURNIIDAE**) is a univoltine species that emerges from January to March, spinning cocoons on the branches of their host plants and entering estivation at the pupal stage in Taiwan. Its larvae feed on *Liquidambar formosana* [楓香; fragrant maple], *Cinnamomum camphora* [樟樹; Comphor tree], *Prunus campanulata* [山櫻花], or *Zelkova serrata* [櫸] (Wang, 1994).

Saturnia pyretorum was first introduced to Taiwan (Nantou and Taichung) from Hainan, China, in 1909 during the Japanese era, primarily for sericultural purposes such as the production of fishing lines, fishing nets, and medical sutures (Shiraki, 1913; Chu, 2013). Further introductions occurred in 1924 to Tainan, Changhua, Taichung, and Miaoli to support the development of a large-scale

sericulture industry (Chu, 2013). Because rearing techniques at the time required outdoor cultivation of caterpillars on fragrant maple trees, *S. pyretorum* successfully established wild populations in Taiwan (Chu, 2013).

Up to the present, *S. pyretorum* has been widespread in low- to mid-elevation areas of central and northern Taiwan, where it is commonly observed and reared by citizen scientists. Despite its establishment, research on the parasitoid wasps associated with this moth in Taiwan has been limited. To date, only two egg parasitoids, *Mesocomys albitarsis* (Ashmead, 1904) (**HYMENOPTERA: EUPELMIDAE**) and *Ooencyrtus kuvanae* (Howard, 1910) (**HYMENOPTERA: ENCYRTIDAE**), and two pupal or hyper- parasitoids, *Xanthopimpla konowi* Krieger, 1899 and *Theronia zebra diluta* Gupta, 1962 (**HYMENOPTERA: ICHNEUMONIDAE: PIMPLINAE**), have been recorded in Taiwan (Koidsumi and Shibata, 1940; Peigler, 1994; Chen *et al*., 2009).

In recent years, the growth of citizen science platforms (e.g., iNaturalist) and social media (e.g., Facebook) has facilitated the documentation of new parasitoid-host interactions (e.g., Shimizu *et al.*, 2023) through the increasing investigation scale and number of observations. Thus, the interactions involving *S. pyretorum* may be elucidated.

Based on online observation records and collaborations with citizen scientists, we report the first record of *Habronyx* (*Habronyx*) *pyretorus* (Cameron, 1912) (**HYMENOPTERA: ICHNEUMONIDAE: ANOMALONINAE**) in Taiwan. It is a large-sized Darwin wasp, belonging to a genus with 49 known species (Yu *et al*., 2016), and was reported emerging from pupae of *S. pyretorum* and *Dendrolimus houi* (Lajonquiere, 1979) (the junior synonym of *Dendrolimus grisea* (Moore, 1879)) [雲南松毛蟲] (**LEPIDOPTERA: LASIOCEMPIDAE**) as a solitary koinobiont endoparasitoid (Cameron, 1912; Peigler, 1985, 1994; He *et al*., 1996; Huang, 2003; Lin *et al*., 2023). In this study, we redescribe *H. pyretorus* based on Taiwanese specimens and, for the first time, record its parasitism rate on wild populations of *S. pyretorum*, the duration before adult eclosion, and its adult lifespan. These findings aim to improve understanding of the parasitoid-host interactions involving artificially introduced species in Taiwan.

Materials and Methods

Specimen and occurrence data sampling

The occurrence of *H. pyretorus* in Taiwan was first reported in April 2023 on the Facebook group "姬繭風—臺灣的姬蜂總科 Ichneumonoidea of Taiwan" (https://www.facebook.com/share/p/15UYdeV8WC/ and https://www.facebook.com/share/p/19GZLfxjmt/). Specimens were obtained through direct contact with the citizen scientists, and additional materials were subsequently reared from collected pupae of the host *S. pyretorum*.

The voucher specimens used in this study were deposited in the following collections or institutes: National Museum of Natural Science, Taichung, Taiwan (NMNS); Taiwan Agricultural Research Institute, Taichung, Taiwan (TARI); National Taiwan Museum, Taipei, Taiwan (NTM); Kanagawa Prefectural Museum of Natural History, Odawara, Kanagawa, Japan (KPMNH); private collection of Hsuan-Pu Chen (CHPC).

Morphological examination and terminology

The morphological terminology follows Broad *et al.* (2018) (the wing vein terminology is specified as Figure 1E), and the method of measurements and abbreviations mostly follows Gauld (1976) and Shimizu *et al.* (2018). The abbreviations and indices used in this study are listed and defined as follows:

Head: **OD** = diameter of lateral ocellus; **OOL** = ocello-ocular line, minimum distance between lateral ocellus and eye; **POL** = postero-ocellar line, minimum distance between lateral ocelli; **POD** = post-ocellar distance (shortest distance between posterior margin of lateral ocellus and anterior margin of occipital carina);

Fore wing: **BI** (brachial index) = length of shortest distance between CU and AA at distal end of first subdiscal cell (fh in Figure 1E) / length of shortest distance between CU and AA at proximal end of first subdiscal cell (ij in Figure 1E); **CI** (cubital index) = length of CU in postnervulus (fg in Figure 1E) / length of 2cu-a in postnervulus (gh in Figure 1E); **DBI** (disco-brachial index) = length of CU between 1cu-a

and 1m-cu&M (fi in Figure 1E) / length of 1m-cu&M between CU and 2rs-m (df in Figure 1E); **ICI** (intercubital index) = length of 2rs-m (bd in Figure 1E) / length of M between 2m-cu and 2rs-m (de in Figure 1E); **MI** (Marginal index) = length of RS (bc in Figure 1E) / length of 2r&RS (ab in Figure 1E);

Hind wing: **NI** (nervellar index) = length of CU in nervellus (no in Figure 1E) / length of cu-a (op in Figure 1E); **RI** (radial index) = length of RS between R and rs-m (kl in Figure 1E) / length of rs-m (lm in Figure 1E);

Legs: **TI** (trochanteral index) = length of hind trochanter measured medio-ventrally / length of hind trochantellus measured medio-ventrally;

Metasoma: **T** = metasomal tergites; **DMI** (dorsal metasomal index) = length of T2 in lateral profile / length of T3 in lateral profile; **PI** (petiolar index) = distance between base of T1 and anterior margin of spiracle / distance between posterior margin of spiracle and apex of T1.

For description, values in parentheses indicate the mean and standard deviation. Cuticular microsculpture terminology follows Eady (1968), and male genitalia terminology follows Dal Pos *et al*. (2023). Specimens were examined and measured using a LEICA S8APO stereomicroscope (Leica Microsystems, Germany) with an XFCAM autofocus CCD (Jet Measurements, Taiwan). Images were captured with a LEICA DMC5400 camera mounted on a LEICA Z16 APO microscope, utilizing the LAS V4.13 auto-stacking system (Leica Microsystems, Germany), or using a SONY A7 II camera equipped with SONY SEL50M28 FE 50 mm F2.8 Macro lens (SONY, Japan). Line drawings were created using the Procreate application (Savage Interactive, Australia). All figures were edited and arranged into figure plates using Adobe Illustrator CC and Photoshop CC (Adobe Systems Inc., USA). The Latin abbreviation 'ibid.' (*ibidem*), meaning "in the same place," was used to condense locality data in the materials examined section.

Observations of parasitism rate and adult lifespan

The second author collected 94 pupae of *S. pyretorum* from Shengxing Station [勝興車站], Sanyi Township, Miaoli County (ca. 24.388049°N, 120.782040°E), on 17 January 2024. The pupae were removed from their cocoons and collectively maintained in BugDorm-1 Insect Rearing Cages (L30 × W30 × H30 cm; MegaView Inc., Taiwan) at room temperature (25°C) for recording parasitism rate. Since *H. pyretorus* is a solitary endoparasitoid wasp, the parasitism rate was calculated by the number of eclosed wasp individuals divided by the total number of collected *S. pyretorum* pupae. After eclosion, adults *H. pyretorus* were provided with honey water to measure their adult lifespan.

Results

Taxonomy

Family ICHNEUMONIDAE Latreille, 1802

Subfamily ANOMALONINAE Viereck, 1918

Genus *Habronyx* Förster, 1869

Chinese vernacular name: 軟姬蜂屬

Diagnosis. According to the key of Gauld (1976), this genus (the nominotypical subgenus) can be separated from other Anomaloninae genera in having the combination of the following characters: ventral margin of clypeus pointed medially (Figure 1A); eyes without pubescent (Figure 1A); pronotum with distinct transverse groove dorsally (Figure 1B); lower anterior corner of pronotum without teeth (Figure 1C); notauli distinct (Figure 1D); posterior transverse carina at mesosternum interrupted or vestigial anterior to mid coxa; fore coxa smooth without carina at ventral side; mid tibia with two distinct tibial spurs (Figure 2A); TI > 1.5; fore wing 2r-m straight and basad to 2m-cu, MI < 1.5 (Figure 1E); hind wing with distal abscissa of CU present (Figure 1E); metasoma DMI > 1.45 (Figure 2A); T3 with epipleuron not separated by longitudinal crest below the spiracle (Figure 2A); T3 longer then deep in lateral view (Figure 2A); volviceps of penisvalva with dorsal membranous structure (Figure 1G).

Chinese vernacular name. The Chinese vernacular name was first proposed by Chao (1976) and widely used in China. This study thus follows the existing name.

***Habronyx* (*Habronyx*) *pyretorus* (Cameron, 1912)**

Chinese vernacular name: 樟蠶軟姬蜂

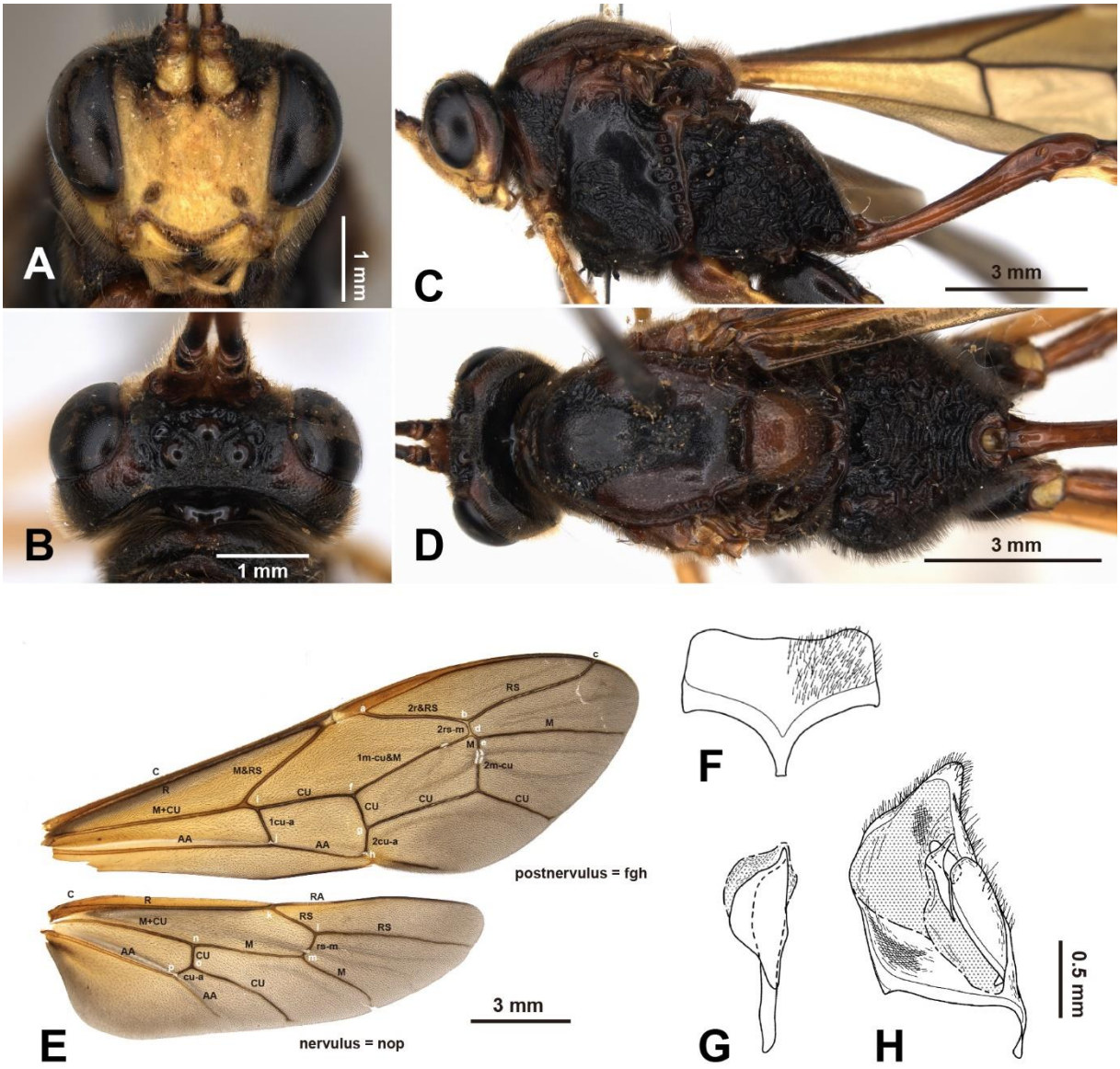

Fig. 1. Taiwanese specimens of *Habronyx pyretorus* (Cameron, 1912). **A**, head in anterior view; **B**, head in dorsal view; **C**, mesosoma in lateral view; **D**, mesosoma in dorsal view; **E**, wings, with wing vein terminology of Broad *et al*. (2018) labeled; **F**, abdominal sternite IX; **G**, penisvalva; **H**, gonostyle. **A–E**, female (CHP01413; NMNS ENT 8951-20); **F–H**, male (CHP01414; NMNS ENT 8951-21). Measurements of wing indices: BI = fh/ij; CI = fg/gh; DBI = fi/df; ICI = bd/de; MI = bc/ab; NI = no/op; RI = kl/lm. Photographed by Hsuan-Pu Chen.

(Figures 1–3)

Anomalon pyretorum Cameron, 1912: Entomologist 45: 195; Packard, 1914: Mem. Natl. Acad. Sci. 12: 268.

Exochilum chinense Morley, 1913: A revision of the Ichneumonidae based on the collection in the British Museum (Natural History) with descriptions of new genera and species 2: 74. Synonymized by Townes *et al.*, 1961: 312.

Habronyx (*Habronyx*) *pyretorus* Gauld, 1976. Bull. Br. Mus. Nat. Hist. 33: 37; Peigler, 1994: J. Res. Lepid. 33: 31; Huang, 2003: Fauna of insects in Fujian province of China 7: 259.

Habronyx pyretorum Townes *et al.*, 1961. Mem. Amer. Ent. Inst. 1: 312; Peigler, 1985: Nachr. ent. Ver. Apollo, Frankfurt 5: 98; Gupta, 1987: Mem. Amer. Ent. Inst. 41: 629; He *et al.*, 1996. Economic Insect Fauna of China 51: 416. Incorrect subsequent spelling.

Material examined. Non-type materials: TAIWAN. HSINCHU [新竹]: Jianshi Township, Jianshi [尖石], 1♂, 4. II. 2024, Yu-Chien Lin leg., reared from *Saturnia pyretorum* pupa, eclosed

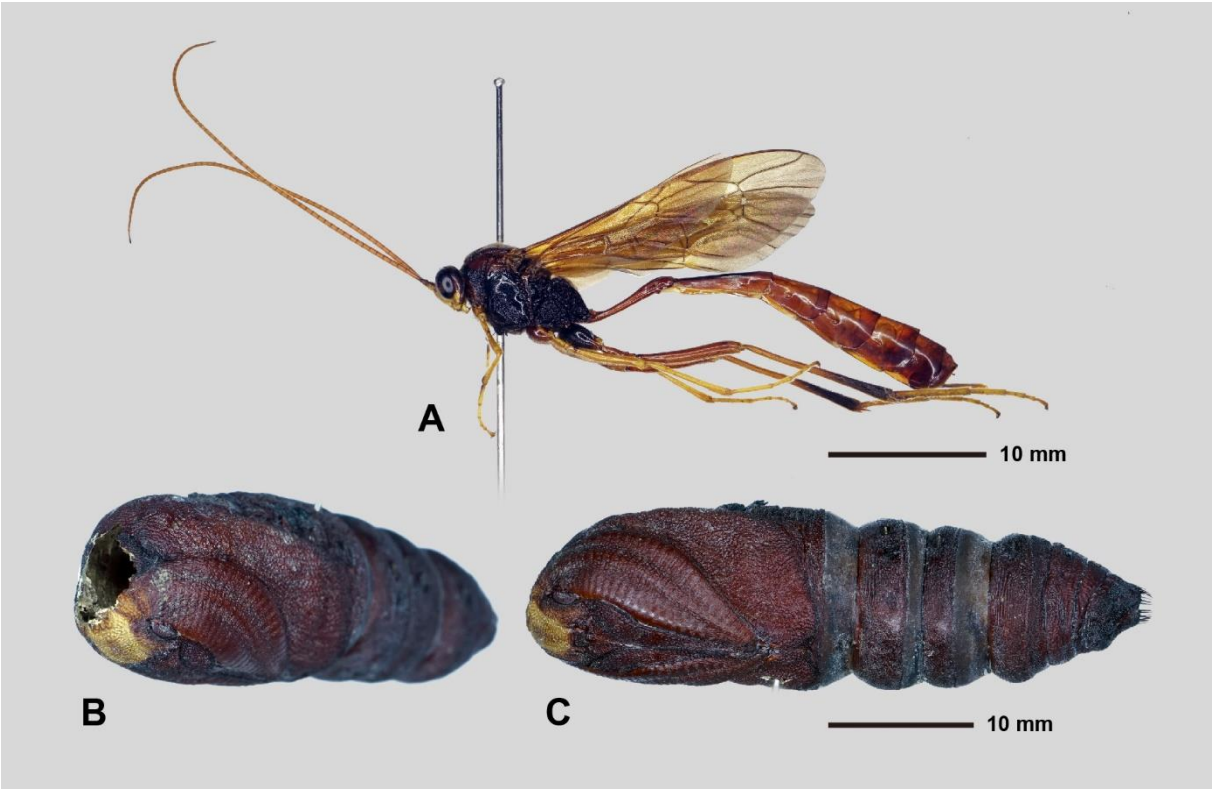

Fig. 2. Taiwanese specimens of *Habronyx pyretorus* (Cameron, 1912) and pupae of its host *Saturnia pyretorum* Westwood, 1847. **A**, lateral habitus of female (CHP01413; NMNS ENT 8951-20); **B**, the pupae of *S. pyretorum* with *H. pyretorus* eclosed, leaving an eclosion opening; **C**, the pupae of *S. pyretorum* with *H. pyretorus* eclosed. Photographed by Hsuan-Pu Chen.

on 12. IV. 2024, (NTM, NMNS ENT 8951-21 (CHP01414)); MIAOLI [苗栗]: Sanyi Township, Shengxing station [勝興車站], 3♂3♀, 17. I. 2024, Huai-Wen Fan leg., reared from *Saturnia pyretorum* pupae, eclosed on 25. III. 2024 (CHPC, CHP01415), 2. IV. 2024 (KPMNH, CHP01416), 10. IV. 2024 (TARI, CHP01417), 3. IV. 2024 (KPMNH, CHP01418), 2. IV. 2024 (CHPC, CHP01419), 11. IV. 2024 (NMNS, NMNS ENT 8951-20 (=CHP01413)) respectively; ibid, 1♀, 27. I. 2023, Yu-Chien Lin leg., reared from *Saturnia pyretorum* pupa, eclosed on 13. IV. 2023 (TARI, CHP01192); ibid, 1♀, 27. I. 2023, Kuan-Ting Lin leg., reared from *Saturnia pyretorum* pupa, eclosed on 06. IV. 2023 (NTM, SWC2024-2103); West Lake Resortopia [西湖渡假村], 1♂1♀, 28. I. 2023, Hsuan-Jou Yang leg., reared from *Saturnia pyretorum* pupae, both eclosed on 8. IV. 2023 (NMNS, NMNS ENT 8951-18–19 (=CHP01156–1157)).

Diagnosis. As a member of the large-sized species within the subgenus *Habronyx* that parasitize macromoths, this species is most similar to *H. heros* (Wesmael, 1849) and *H. insidiator* (Smith, 1874), but can be distinguished by the following characters: the gena is not strongly convex in dorsal view (Figure 1B; strongly convex in *H. insidiator*); the tarsal claws are pectinate (simple in *H. insidiator*); the frons bears distinct foveae without a longitudinal carina (Figure 1B; with a longitudinal carina in *H. heros*); and the scutellum is polished and evenly punctate (Figure 1D; rugose in *H. heros*) (He *et al*., 1996). Other morphologically similar species have never been reported as parasitoids of *Saturnia pyretorum*.

Redescription based on Taiwanese specimens

Female (n=5). Head (Figures 1A, 1B): polished and evenly punctate with long seta, except middle area of face and clypeus sparsely punctate, malar space finely coriaceous, ocellar area rugose-punctate, and area between ocellar area and frons strongly rugose with deep fovea; area between lateral ocelli and eyes with distinct fovea; head 2.1–2.5 (2.2 ± 0.13) × as wide as long; occipital carina complete; OD = 0.3–0.4 (0.3 ± 0.04) mm, POL/OD = 1.4–2.2 (1.7 ± 0.33), OOL/OD = 1.2–1.7 (1.5±0.21), POD/OD = 0.4–0.9

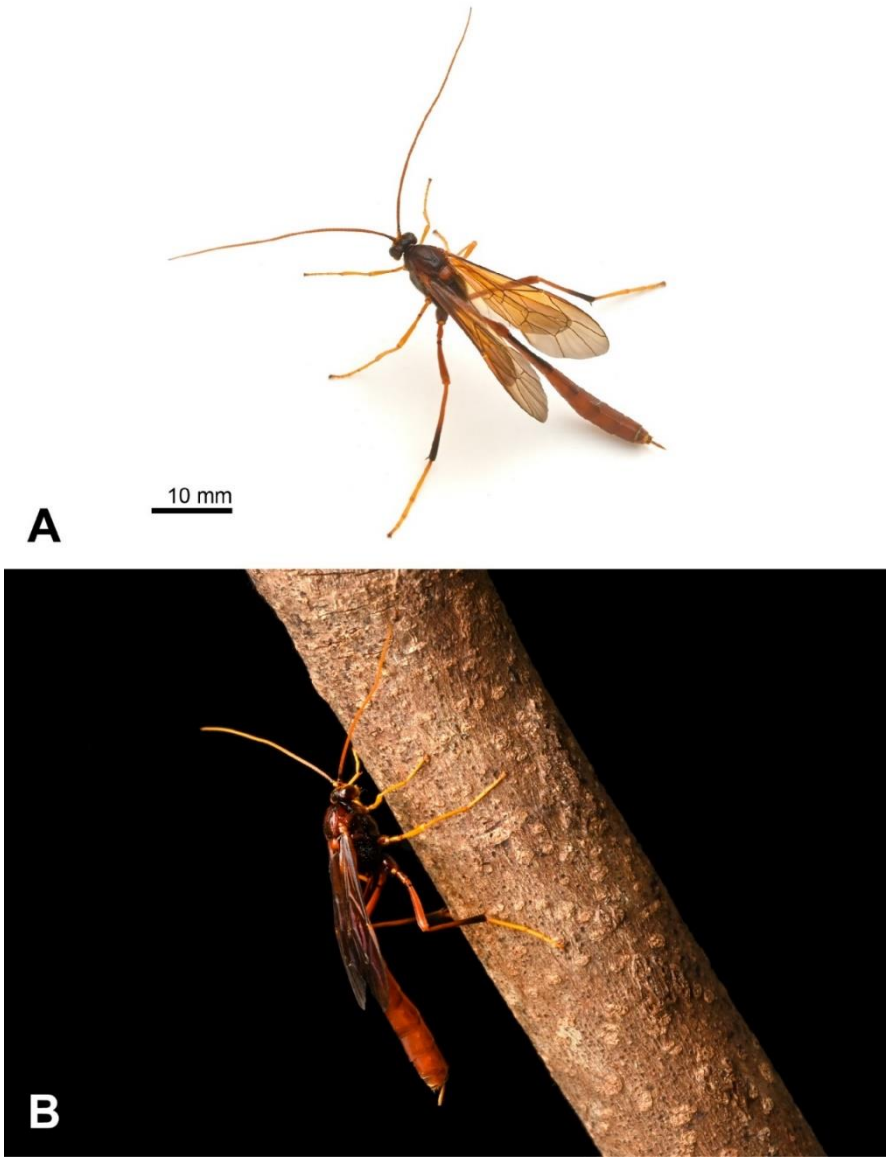

Fig. 3. The live photographs of Taiwanese *Habronyx pyretorus* (Cameron, 1912) (NTM, SWC2024-2103). **A**, live individual photographed against a white background; **B**, *in situ* live individual. Photographed by Shipher Wu.

(0.6 ± 0.18); face 1.6–1.7 (1.6 ± 0.05) × as wide as high; clypeus 2.1–2.8 (2.3 ± 0.24) × as wide as high, rounded with median tooth at ventral margin; mandible bidentate, with both teeth about equal in length; flagellum with 60–64 segments.

Mesosoma (Figures 1C, 1D, 2A): polished; pronotum coarsely punctate on dorsal surface, finely punctate at dorsal area and rugose at middle and ventral area on lateral surface; mesoscutum finely punctate, 1.2–1.5 (1.3 ± 0.09) × as long as wide; notauli distinct and crenulate depression with rugae and fovea, with circular fovea at area where notauli meeting; scutellum evenly punctate, convex in lateral profile, without lateral carina; mesopleuron finely punctate at dorsal half and rugose at ventral half; mesopleural furrow distinctively crenulate; epicnemial carina present and extend dorsally 0.5 mesopleural height; metapleuron and propodeum rugose-reticulate.

Wings (Figure 1E): Fore wing length 17.0–20.5 (19.3 ± 1.40) mm; pterostigma long and parallel, MI = 1.2–1.4 (1.4 ± 0.09); areolet absent, ICI = 1.0–1.4 (1.1 ± 0.17); DBI = 0.7–0.8 (0.8 ± 0.03); BI = 1.7–2.0 (1.8 ± 0.13); 1cu-a postfurcal (far distad M&RS), straight and inclivous; CI = 1.3–2.0 (1.5 ± 0.29); hind wing length 13.0–15.0 (13.7 ± 0.97); RI = 1.9–2.8 (2.1 ± 0.38); NI = 1.2–1.7 (1.4 ± 0.21); anal cell developed basal-posteriorly; distal hamuli 15–22.

Legs (Figures 1C, 2A): coxae polished,

evenly punctate with long setae; TI = 1.3–2.0 (1.5 ± 0.27); hind femur 0.6–0.7 (0.7 ± 0.01) × as long as hind tibia; hind first tarsomere 2.2–2.4 (2.3 ± 0.09) × as long as second tarsomere, 0.5× as long as hind tibia; hind second tarsomere 1.7–1.9 (1.8 ± 0.05) × as long as third tarsomere; tarsal claws without pectens

Metasoma (Figures 1C, 2A): polished and evenly punctate with setae; T1 4.3–5.0 (4.7 ± 0.26) × as long as maximum width, PI = 3.7–6.0 (4.4 ± 0.93); DMI = 1.4–1.7 (1.6 ± 0.13); exposed ovipositor sheath 0.3 × as long as hind tibia.

Coloration (Figures 1-3): head and antenna yellow, except gena, vertex, temple, teeth of mandible, and dorsal surface of scape black; mesosoma black, except lateral lobes of mesoscutum, scutellum, tegula, subtegular ridge, and dorsal-posterior corner of pronotum reddish-brown or tinged with reddish-brown; wings yellowish-brown with infumate tint at apical margin; wing vein blackish-brown, pterostigma reddish-brown; legs with fore and mid coxae and hind femur reddish-brown, hind coxa and apical half of hind tibia black, other parts of fore and mid legs yellowish-brown, basal half of hind tibia and hind tarsus yellowish-brown tinged with reddish-brown or black; metasoma reddish-brown, sometimes tinged with blackish-brown; ovipositor yellow; male genitalia blackish-brown. Alive coloration similar to specimens.

Male (n=5). Similar to female, with differences in measurements: head 2.2–2.6 (2.3 ± 0.14) × as wide as long; OD = 0.3 mm, POD/OD = 1.4–2.1 (1.9 ± 0.28), OOL/OD = 1.3–1.9 (1.6 ± 0.3), POD/OD = 0.5–0.8 (0.6 ± 0.1); face 1.4–1.6 (1.5 ± 0.07) × as wide as high; clypeus 1.8–2.5 (2.3 ± 0.28) × as wide as high; flagellum with 58–64 segments; mesoscutum 1.2–1.3 (1.3 ± 0.03) × as long as wide; fore wing length 17.0–20.0 (18.8 ± 1.10) mm; MI = 1.4; ICI = 0.8–1.6 (1.1 ± 0.30); DBI = 0.7–0.8 (0.8 ± 0.03); BI = 1.7–1.9 (1.8 ± 0.08); CI = 1.1–1.6 (1.4 ± 0.17); hind wing length 12.0–14.0 (13.2 ± 0.84) mm; RI = 1.9–2.5 (2.2 ± 0.25); NI = 1.1–1.3 (1.2 ± 0.09); distal hamuli 14–19; TI = 1.3; hind femur 0.6–0.7 (0.7 ± 0.02) × as long as hind tibia; hind first tarsomere 2.0–2.3 (2.1 ± 0.09) × as long as second tarsomere, 0.5× as long as hind tibia; hind second tarsomere 1.5–1.8 (1.6 ± 0.12) × as long as third tarsomere; metasomal T1 4.3–5.6 (4.8 ± 0.48) × as long as maximum width, PI = 3.9–4.8 (4.4 ± 0.37); DMI = 1.6–1.9 (1.7 ± 0.11).

Genitalia (Figures 1F–H): gonostyle strongly tapered and pointed ventro-apically, convex at dorsal margin, with dark pigmentation at median and dorso-basal area in inner side; gonossiculus slenderly elongated ventro-apically; cuspis rounded apically; valviceps stout and pointed apically, with membranous sac-like structure having fine sculptured dorsally; valvura short, parallel and straight; abdominal sternite IX (hypopygium) nearly rectangular, with apical margin weakly concave with indistinct median convex.

Distribution. China (Hong Kong [type locality], Guandong, Guizhou (Cameron, 1912; Chao, 1976; Yang and Wu, 1981; He *et al*. 1996)); Taiwan (New record: Hsinchu, Miaoli (this study)).

Bionomics. This species is a solitary endoparasitoid of the giant silk moth *S. pyretorum*, eclosing from its host pupae by breaking the pupa at the position of the host's head using its strong mandibles (Figs. 2B, 2C). According to the investigation in this study, the duration from collecting to eclosion takes at least 68–86 days (n= 11) (Table 1). Adult wasp excretes yellowish-brown meconium in the hosts' pupa and lives 15–20 days (n= 4) (Table 1) by rearing at room temperature (25°C) and feeding with honey water. Among 94 collected pupae of *S. pyretorum* from the second author, 6 individuals of *H. pyretorus* were successfully eclosed, indicating at least 6.4% (6 / 94) of parasitism rate in this species from wild *S. pyretorum* population in Taiwan. Live photos of this species are shown in Figure 3.

Lin *et al*. (2023) reported that *H. pyretorus* was reared from the pupae of the pine moth *Dendrolimus grisea* (= *D. houi*). However, they did not provide any images of voucher specimens, and their identification was based solely on comparisons with *Habronyx* species from Fujian rather than with other congeners. Additionally, they erroneously listed *Dictyoploca japonica* (Moore, 1872) (**LEPIDOPTERA: SATURNIIDAE**) as a host of *H. pyretorus* by citing Huang (2003), although Huang (2003) only mentioned *S. pyretorum* as its host. Given that the morphologically similar species *Habronyx heros* (Wesmael, 1849) has been

Table 1. Sample information of collection, eclosion, and death date. The values in parentheses represent the durations from collection to eclosion and adult lifespan. Abbreviations: F, female; M, male; N/A, no data.

Specimen ID	Sex	Date of collection of *S. pyretorum* pupa	Date of eclosion of *H. pyretorus* adult	Date of death of *H. pyretorus* adult
CHP01156	F	28. I. 2023	8. IV. 2023 (70 days)	N/A
CHP01157	M	28. I. 2023	8. IV. 2023 (70 days)	N/A
CHP01192	F	27. I. 2023	13. IV. 2023 (76 days)	N/A
SWC2024-2103	F	27. I. 2023	06. IV. 2023 (69 days)	N/A
CHP01413	F	17. I. 2024	11. IV. 2024 (86 days)	N/A
CHP01414	M	4. II. 2024	12. IV. 2024 (69 days)	N/A
CHP01415	M	17. I. 2024	25. III. 2024 (68 days)	N/A
CHP01416	F	17. I. 2024	2. IV. 2024 (76 days)	17. IV. 2024 (15 days)
CHP01417	M	17. I. 2024	10. IV. 2024 (84 days)	24. IV. 2024 (15 days)
CHP01418	M	17. I. 2024	3. IV. 2024 (77 days)	22. IV. 2024 (20 days)
CHP01419	F	17. I. 2024	2. IV. 2024 (76 days)	19. IV. 2024 (18 days)

reported parasitizing *Dendrolimus* species and has a distribution overlapping with some of the collecting sites in Lin *et al*. (2023) (Yu *et al*., 2016), we question the reliability of the host record of *H. pyretorus* on *D. grisea*.

Chinese vernacular name. A published Chinese vernacular name of this species, "樟蠶軟姬蜂" [*Habronyx* of camphor tree silk moth], was first proposed by He *et al.* (1996), based on the specific name of its host in China. Although the most commonly used vernacular name for *S. pyretorum* in Taiwan is "四黑目天蠶蛾", since the Chinese vernacular name "四黑目天蠶蛾軟姬蜂" would result in excessive length and reduced usability, we retain the existing name.

Remarks. The specific name "*pyretorus*" ("*pyretorum*" in original combination) is an adjective used as a substantive in the genitive case and derived from the specific name of its host *Saturnia pyretorum* (Article 11.9.1.4 of ICZN; ICZN, 1999). Since "*pyretorum*" is a neuter adjective, by following the Article 34 of ICZN, it should be mandatorily changed to the masculine "*pyretorus*" in agreement with the gender of the generic name "*Habronyx*" (ICZN, 1999).

Although the type specimen of *H. pyretorus* was unavailable for this study, the Taiwanese specimens perfectly align with the descriptions and host information provided by Cameron (1912) and He *et al*. (1996). They were also keyed to *H. pyretorus* using the key of He *et al*. (1996) to *Habronyx* species parasitizing common economic pests. Therefore, we consider the identification presented herein to be plausible.

Discussion

The application of online citizen science platforms and social media over the past decade has greatly facilitated large-scale citizen science projects and enhanced communication between professional researchers and amateur enthusiasts across various fields, thereby expanding both the scope and impact of such initiatives (e.g., Dickinson *et al.* (2012), Kobori *et al.* (2016), Chandler *et al.* (2017), Shimizu *et al.* (2023)). Although *S. pyretorum* was artificially introduced to Taiwan over a century ago, no records of its large-sized parasitoid wasps had been reported in Taiwan until this study, which was first revealed through online citizen science via social media. A similar case involves the discovery of the braconid *Meteorus stellatus* Fujie, Shimizu & Maeto, 2021 in Taiwan, which uncovered new host records and revealed interactions with a predatory natural enemy (Shimizu *et al.*, 2023). These cases underscore the significant impact of online citizen science on advancing natural history research.

No previous specimen of *H. pyretorus* has been identified from major natural history collections in Taiwan (NMNS, NTM, TARI) through the examinations of authors. Since its host, *S. pyretorum*, was artificially introduced to Taiwan, it is presumed that *H. pyretorus* was co-

introduced to Taiwan along with its host. However, we cannot determine whether this species was introduced recently, as the absence of specimens in insect collections in Taiwan may be attributed to sampling bias; museum collections typically rely on Malaise traps or light traps, whereas some Anomaloninae species are usually active in the canopy and can be easily collected by aerial net manually (Watanabe and Shimizu, personal communication). Chang and Shen (1986) reported the presence of pupal parasitoids of *S. pyretorum* in Taiwan; specifying the voucher specimens and confirming whether these parasitoids are *H. pyretorus* could help clarify the introduction history of this species.

Population genetic studies (Yeh *et al.*, 2022) and historical records (Chu, 2013) have revealed multiple dispersal events of *S. pyretorum* from China to Taiwan. Therefore, to clarify the potential origin of *H. pyretorus* in Taiwan, future population genetic studies are necessary to provide foundational knowledge for the risk management of artificially introduced species and their associated parasitoids.

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樟蠶軟姬蜂（膜翅目：姬蜂科：腫跗姬蜂亞科)—寄生四黑目天蠶蛾的臺灣新紀錄姬蜂

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摘　要

本研究首次報告樟蠶軟姬蜂（*Habronyx (Habronyx) pyretorus* (Cameron, 1912)）於臺灣之分布記錄。本種為四黑目天蠶蛾（*Saturnia pyretorum* Westwood, 1847）的寄生蜂，其在臺灣的觀察記錄最初經由社群媒體上的公民科學家揭示，後續經由人工飼育寄主確認取得標本。由於其寄主係自中國引入臺灣，因此推測樟蠶軟姬蜂亦可能隨寄主一同引進。本文基於臺灣產標本重新描述樟蠶軟姬蜂，並首次記錄本種對四黑目天蠶蛾野外族群之寄生率、羽化前發育時間及成蟲壽命。

關鍵詞：寄生蜂、引入種、重新描述、寄生率、分類學