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Research article

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First record of the genus *Temnothorax* Mayr, 1861 (Formicidae: Myrmicinae) in Hong Kong, with descriptions of two new species

Matthew T. HAMER [1,*], Roger H. LEE [2] & Benoit GUÉNARD [3]

[1,2,3] School of Biological Sciences, The University of Hong Kong, Kadoorie Biological Sciences Building, Pok Fu Lam Road, Hong Kong SAR, China.
[2] Science Unit, Lingnan University, 8 Castle Peak Road, Tuen Mun, Hong Kong SAR, China.

[*] Corresponding author: matt.hamer@hotmail.co.uk
[2] Email: rogerlh86@gmail.com
[3] Email: zeroben@gmail.com

[1] urn:lsid:zoobank.org:author:8584FD7B-DE94-407E-9B54-651707B30256
[2] urn:lsid:zoobank.org:author:522632A6-65EE-4E11-A420-EB4F8DBD98CE
[3] urn:lsid:zoobank.org:author:3885FFD6-3FE4-428A-88BD-C5E88F2BC315

Abstract. The ant genus *Temnothorax* Mayr, 1861 (Myrmicinae, Crematogastrini) is diverse with 498 species described. Species are distributed predominately within the northern hemisphere with species richness decreasing closer to the tropics; contrary to other ant genera overall. In Southeast Asia, richness is relatively low and knowledge on the genus remains fragmentary, likely due to poor sampling efforts compared to temperate regions. Here, using specimens from recent sampling efforts, *Temnothorax* is reported for the first time from the Hong Kong Special Administrative Region. Two new species, *T. barrettoi* Hamer & Guénard sp. nov. and *T. haveni* Lee, Hamer & Guénard sp. nov., are described based on qualitive morphological characters, with additional morphometric data also gathered. An updated key, as well as a distributional checklist of *Temnothorax* species from mainland China is provided. We suggest that the two new species are likely arboreal based on our collections, however, further arboreal sampling is necessary to confirm this hypothesis. We hope this study may spurn effort to generate further information on sub-tropical Chinese *Temnothorax* species.

Keywords. Ants, China, Oriental Realm, Sino-Japanese Realm, new species.

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Introduction

The genus *Temnothorax* Mayr, 1861 comprises small, inconspicuous ants. Currently the genus includes 498 described species and subspecies globally, making it the fifth most diverse within Myrmicinae Lepeletier de Saint-Fargeau, 1835 (Bolton 2022). Colonies are frequently small, typically with several dozen to a few hundred workers, and up to about 1300 individuals (Bengston & Dornhaus 2013). Nests

are found in decomposing wood within small, often already formed cavities; or within and under cracks in stone; or within hallowed seeds and nuts for epigaeic species; or under twigs, or tree bark for arboreal species. The genus is recorded from a variety of habitats including deserts, grasslands, scrubland, as well as from lowland to montane cloud rainforests (Prebus 2017). Due to their small colonies, wide nesting habits and easy husbandry, members of the genus are frequently utilised as model organisms to study behavioural ecology and sociobiology under field and laboratory conditions (Sendova-Franks & Franks 1994; Mallon *et al*. 2001; El-Shehaby *et al.* 2012).

The distribution of *Temnothorax* species is predominately Holarctic, extending further south into subtropical regions and more rarely into tropical climates. The genus is particularly diverse in the Caribbean and Mediterranean regions, where numerous endemic species reside (Csősz *et al.* 2015; Guénard *et al.* 2016; Prebus 2017; Schifani *et al.* 2022). Within the Sino-Japanese and Oriental Realms however, the species richness of *Temnothorax* is comparatively poor. In the whole of mainland China, Taiwan, Japan, and the Korean Peninsula, 48 species were known prior to this study, whereas there are around 200 species and subspecies known from the Mediterranean basin (Radchenko 2004; Zhou *et al.* 2010; Borowiec 2014; Janicki *et al.* 2016; Guénard *et al*. 2017; Schifani *et al.* 2022). Within this region, *Temnothorax* displays high levels of cryptism with many species sharing overlapping morphological characters often requiring various methodological disciplines, such as genetic and detailed morphometric evidence, integrated together to delimit species (Csősz *et al*. 2014, 2015; González 2021; Schifani *et al.* 2022). In Asia, species are mostly recorded from northern regions with progressively fewer species known from southern subtropical and tropical regions (Terayama 2009; Eguchi 2011; Janicki *et al.* 2016). Currently, there is no evidence to suggest the extreme high levels of crypticism shown in the *Temnothorax* of the Mediterranean region are apparent in Asia. Taxonomic studies of the genus have relied upon assessment of qualitative morphological characters and basic linear morphometry (Terayama & Onoyama 1999; Chang & He 2001; Radchenko 2004; Terayama 2009; Zhou *et al*. 2010). However, the knowledge of Asian *Temnothorax* remains fragmentary with sampling efforts certainly not equal to the Mediterranean. The genus *Temnothorax* of mainland China was reviewed by Zhou *et al.* (2010) comprising 27 species, providing descriptions for eight new species, several new species records and a taxonomic key. Our research, based on recent sampling, provides the first record of the genus in Hong Kong Special Administrative Region (SAR) and describes two new species based on qualitative morphological characters and linear morphometrics. An updated distributional checklist of the genus for mainland China as well as an adapted key from Zhou *et al.* (2010), including the novel species, is included.

Material and methods

Measurements

In this study we use the core linear measurements from recent taxonomic studies (Csősz & Fisher 2015; Seifert & Csősz 2015; Prebus, 2021a, 2021b) with the addition of the Abdominal Tergite Length (ATL) and Total Length (TL). A schematic figure outlining many of the measurements used here can be seen in Prebus (2021b). All measurements are given in millimetres (mm). Measurements were taken using a Leica M205 C dissecting microscope and Leica Application Suite ver. 4.5 software. Specimens were positioned in the same plane as camera lens for accurate measurements. Final publication images were collected using Leica M205 C stereo microscope with a DMC5400 Camera stacked in LASX (ver. 3.7.4.23463). Images were edited for stacking artefacts using Adobe Photoshop (23.0.2 20211119.r.101). Morphological qualitive characters follows definitions by Harris (1979).

Abbreviations

ATL = Gaster segment one length. Maximum length of gastral tergite one in lateral view, taken with a diagonal line between the anteriormost and posteriormost visible points of the tergite.

CI = Cephalic index. CW / CL × 100
CL = Cephalic length. Length of head in full face view from anterior clypeal margin to posterior head margin
CW = Cephalic width. Maximum width of head including the eyes
CWb = Cephalic width b. Width of head without eyes, measured immediately posterior of eye margin
HS = Head size. CL + CW / 2
PEH = Petiole height. Maximum height of petiole in lateral view from ventral petiole margin to the highest point of the petiole node
PEL = Petiole length. The diagonal length of the petiolar peduncle and node, measured in lateral view from postero-dorsal corner of petiole node to sub-petiolar process. If subpetiolar process absent, measured just anterior to propodeal petiole articulation
PEW = Petiolar node width. Maximum width of the petiole measured in dorsal view
PLI = Petiole length index. PEL / PPL × 100
PPH = Postpetiole height. Maximum height of postpetiole in lateral view from ventral postpetiole margin to the highest point of the postpetiole node
PPL = Postpetiole length. Maximum length of the postpetiole measured in lateral view
PPW = Postpetiole width. Maximum width of post-petiolar node measured in dorsal view
PSI = Propodeal spine length index. SPST / WL × 100
PW = Pronotum width. Maximum width of the pronotum in dorsal view
PWI = Postpetiole width index. PPW / PEW × 100
SBI = Propodeal spine base index. SBPA / CW × 100
SBPA = Minimum propodeal spine distance. The minimum distance at the lateral bases of propodeal spines measured in antero-dorsal view
SI = Scape index. SL / CW × 100
SL = Scape length. Maximum length of scape, excluding antennal condyle
SPST = Propodeal spine length. Measured in lateral view from the tip of the propodeal spine to the propodeal spiracle
SPTI = Apical propodeal spine distance. Distance between the apicalmost points of the propodeal spines measured in dorsal view
TL = Total length. CL + WL + PEL + PPL+ ATL
WL = Webers length. Distance between the anterior-most point of the pronotal declivity and the posteriormost point of the propodeal lobe

Species concept

Within this study, we follow Tozetto *et al*. (2022) and (although not specifically stated) previous taxonomic studies of Asian *Temnothorax* (Terayama & Onoyama 1999; Radchenko 2004; Terayama 2009; Zhou *et al*. 2010) in using the morphological species concept, or 'gap' criterion, whereby species share core morphological characters but have distinct enough structural aspects in morphology to be considered as new. Although access to physical type material was limited here, we compared our material to descriptions and images of all known *Temnothorax* in East Asia. A suite of distinct and diagnosable characters that substantially differed to nearest congeneric species were observed allowing descriptions of new species.

Institutional abbreviations

HKBM = Hong Kong Biodiversity Museum, University of Hong Kong, Hong Kong SAR, China
IBBL = Insect Biodiversity and Biogeography Laboratory, The University of Hong Kong, Hong Kong SAR, China
ZRC = Zoological Reference Collection, Lee Kong Chian Natural History Museum, Singapore

Results

Two species of *Temnothorax* are newly recorded for Hong Kong, both are considered new to science. Here we provide a comprehensive as possible list of numerous distinct morphological and morphometric characters that substantially and categorically differentiate them relative to the congeneric species known from mainland China. Detailed descriptions are provided, with comments on each species morphology and natural history presented. An adapted key and distributional checklist to the mainland Chinese species of *Temnothorax* are also provided.

Species descriptions

Class Insecta Linnaeus, 1758
Order Hymenoptera Linnaeus, 1758
Family Formicidae Latreille, 1809
Subfamily Myrmicinae Lepeletier de Saint-Fargeau, 1835
Genus *Temnothorax* Mayr, 1861

Temnothorax barrettoi Hamer & Guénard sp. nov.
urn:lsid:zoobank.org:act:0FD13BA5-2E10-4CF1-A1EC-CC6E12311736
Figs 1–2, 5

Diagnosis

Lateral head margin in full face view subparallel; clypeus with longitudinal carinae only in the anterior half; head dorsum with areolate-rugose sculpture; scapes of medium length, not reaching occipital head margin; promesonotum convex; mesosoma dorsal margin straight in lateral view; metanotal groove absent; head, mesosoma and gaster covered in erect, stout setae.

Etymology

The name '*barrettoi*' is a masculine noun in the genitive case. Named after the stewards of Tai Po Kau Headland, the Barretto family, who have cared for the headland for several generations and kindly provided us sampling access to their property. Their determined ecological conservation efforts for the site and Hong Kong in general are an example to all.

Material examined

Holotype

CHINA • worker; Hong Kong SAR, New Territories (Tai Po), Tai Po Kau Headland; 22°26′06.0″ N, 114°11′35.52″ E; 70 m a.s.l.; 19–26 Aug. 2022; Matthew T. Hamer and André Ibáñez leg.; leaf litter collected in a line transect of 5 samples each 0.25 m² with silftrate extracted in a Winkler for 7 days; ZRC ANTWEB1010973 [TPK1T2W1-21].

Description

Measurements. Holotype: CL 0.525; CW 0.486; CWb 0.440; SL 0.331; WL 0.641; SPST 0.271; PEL 0.28; PPL 0.137; PEH 0.18; PPH 0.17; PW 0.333; SPBA 0.187; SPTI 0.227; PEW 0.132; PPW 0.216; ATL 0.658; HS 0.483; SI 75.2; CI 83.8; SBI 42.5; PSI 42.3; PWI 163.6; PLI 204.4; TL 2.241

Head. In full face view, head longer than broad (CI 83.8), reaching maximum width just anterior to occipital corner curvature. Occipital corners rounded; occipital margin broadly convex. Lateral margins of head subparallel, diverging from anterior head margin in full face view. Clypeus widely inserted between antennal lobes; anterior margin strongly convex and angulate medially. In lateral view, clypeus projecting anteriorly forming a shelf above mandibles. In full face view, epistomal sulcus indistinct,

slight cuticular impression only. Mandible broadly triangular; masticatory margin with five teeth; apical most tooth larger than preceding teeth. Frontal carina extending just posterior of frontal lobes; thin costae extends beyond forming dorsal scrobe margin feebly impressed anterior to occiput where they terminate. Frontal lobes present; projecting dorso-laterally and obscuring antennal condyle in full face view; anterior portion of frontal lobe broadly circular. Antenna with 12 segments terminating in an incrassate three-segmented club: apical segment longer and broader than following segments. Scape of medium length (SI 75.2), terminating before posterior corners of the head. Eye convex; located medially on head and extending laterally beyond the cephalic capsule. In lateral view, eyes composed of 7–8 ommatidia across the longest width. Scrobe present but feebly impressed. In dorsal view, occipital carina present.

Mesosoma. Mesosoma in dorsal view widest at the anterior most portion of pronotum. In dorsal view, pronotum broadly convex anteriorly; humeri rounded. Mesosoma tapering posteriorly, reaching a minimum width at the anterior part to propodeum where is subsequently expands outwards but less than maximum pronotum width. Promesonotal suture absent dorsally but present laterally; metanotal groove absent. In lateral view, promesonotum convex, remaining mesosoma dorsal margin straight; anterior of propodeum with small protuberance; propodeal spiracle circular; propodeal lobe round; propodeal spines well-developed, longer than the distance between their bases (SPST 0.271; SBPA 0.187). In dorsal view, spines initially diverge postero-laterally and abruptly curving to become parallel apically, forming a 'U' shape. In lateral view, spines acute, thin and slightly downcurved, not beyond mesosoma lateral outline and acute. In lateral view, propodeal declivity subtly concave.

Metasoma. In lateral view, petiole longer than high; anterior face of petiole distinctly longer than posterior face; postpetiole short, its dorsal margin convex, with lateral carina. In dorsal view, postpetiole distinctly wider than long, widest in anterior third; at its widest point, postpetiole margins meeting at a subtlety obtuse angle; lateral margins converging posteriorly in dorsal view. Gaster wider than postpetiole anteriorly in dorsal view; first gastral tergite long, as long as mesosoma; anterolateral corners obtusely angled. Basigastral costulae present extending $^{1}/_{6}$ of gaster.

Setae. In full face view, mandible dorsum with well-spaced sub-decumbent pilosity. Anterior clypeal margin with two long and tapering setae either side of clypeal median; several sub-erect setae present on anterior clypeal margin, directed towards clypeal median; clypeal dorsum with many erect and stout setae. Cephalic dorsum as well as occiput also with many stout and erect setae which arise from within areolae formed by the surface rugosities (see sculpturing); erect setae arise along frontal carina, roughly spaced roughly equidistant. Scapes and subsequent antennal segments with sub-decumbent to semi-erected pilosity only. In lateral view, ventral part of head with erect to semi-erect pilosity, noticeably different to stout-erect hairs on cephalic dorsum. Mesosoma, with long, erect setae arranged in series of transverse rows; base of propodeal spines also with a single pair of setae. Posterior face of petiole dorsum with a single pair of long erect setae, directed postero-dorsally. Postpetiole with erect setae of varying lengths, dorsally with short, erect setae and laterally with longer setae, in particular a pair of setae in dorsal view arising from area of maximum width of postpetiole. Numerous, short and appressed pubescence present on posterior post petiole surface. Gastral tergite with numerous erect stout setae arranged in loose rows; setae of varying lengths but are particularly long in posterior fifth. Setae on subsequent tergites not visible.

Sculpture. Mandibles smooth, other than setae insertions. Majority of clypeus dorsum smooth other than short, longitudinal carinae that begin at the clypeal anterior border. Dorsum of head from clypeus to posterior head corners areolate-rugose. Head laterally also with areolate-rugose sculpturing. Scrobe in lateral view punctate, noticeably different to the sculpture of head dorsum and surrounding lateral sculpture. Pronotum dorsum areolate-rugose, with rugosities subtly more embossed than on head

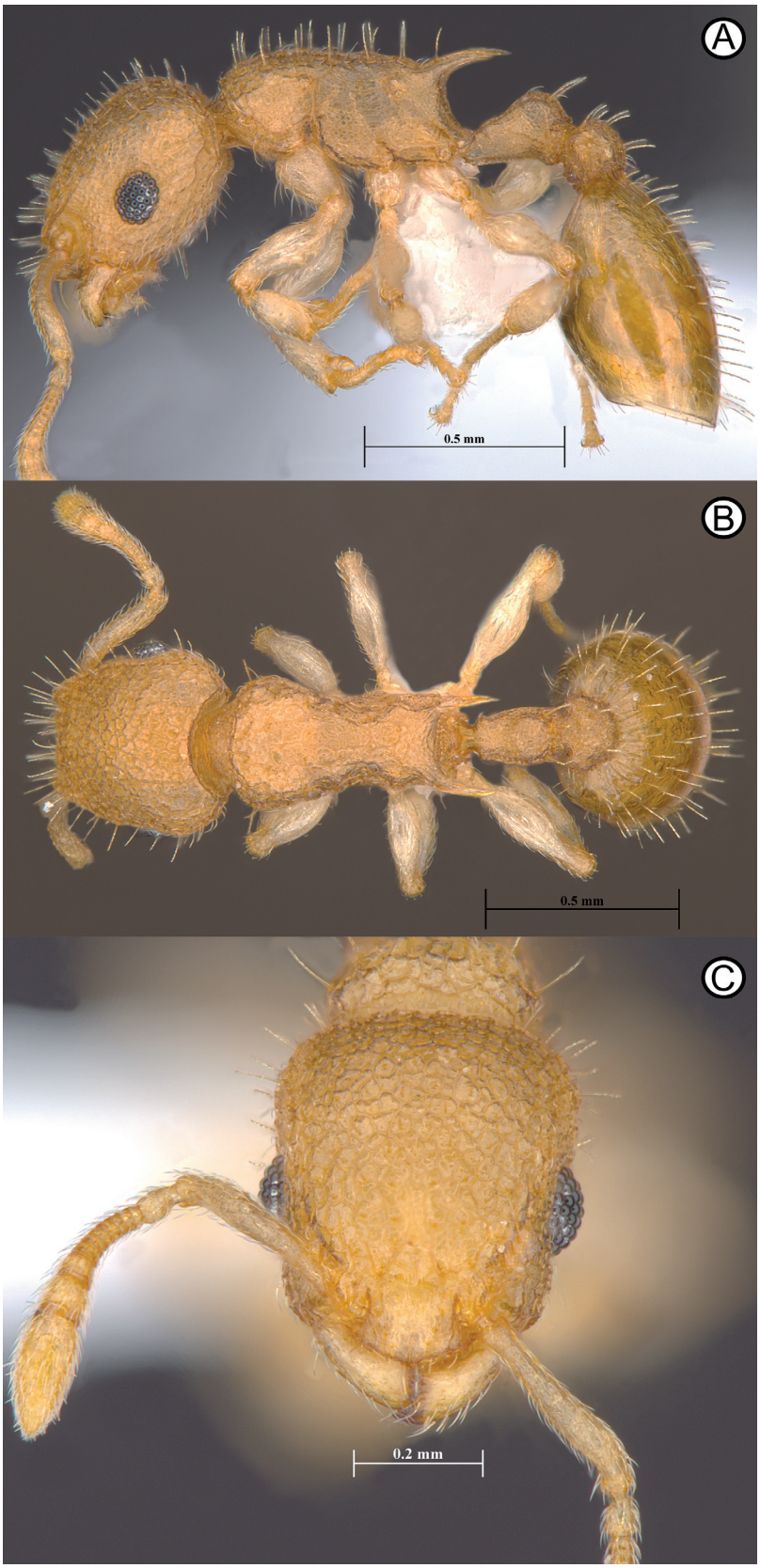

Fig. 1. *Temnothorax barrettoi* Hamer & Guénard sp. nov., holotype (ANTWEB1010973). **A**. Lateral view. **B**. Dorsal view. **C**. Full face view.

dorsum. Remaining dorsal mesonotum and propodeum more indistinctly rugose, lacking dense areolae. The mesonotum with underlying punctae within areolae, which eventually merges into the punctuate propodeal declivity. The mesonotum with underlying punctae within areolae. Posterior mesonotum punctuation merges into the punctuate propodeal declivity. Lateral pronotum densely punctuate overlain with faint rugosities; mesopleuron also punctuate but with less dense and with larger punctae; the space between punctae distinctly larger. Metapleuron with more pronounced rugosities; punctuation faint. Ventral metapleuron and metapleural gland bulla with several distinct carinae. Propodeum laterally, dorsally, and posteriorly (= declivital surface) densely punctuate; punctae small. Petiole dorsally and laterally punctate. Postpetiole with punctae overlain by faint areolate-rugose sculpturing both dorsally and laterally. Anterior area of gaster with basigastral costulae extending $^{1}/_{6}$ of the surface length. Remaining gaster comparatively smooth and shining, with faint micro-reticulations at high magnifications alongside setae punctation. Sculpture on subsequent tergites not visible.

Colour. Core body concolourous ochreous yellow, appendages conspicuously lighter yellow. Setae across whole of body yellowish white.

Comments

Temnothorax barrettoi sp. nov. would key out to *T. zhejiangensis* Zhou *et al.*, 2010 within Zhou *et al.* (2010) and shares several morphological characters. Such characters include the presence of erect

Fig. 2. *Temnothorax barrettoi* Hamer & Guénard sp. nov., holotype (ANTWEB1010973), morphological characters. **A**. Petiole and postpetiole in lateral view. **B**. Petiole and postpetiole in dorsal view. **C**. Mesosoma in dorsal view. **D**. First gastral tergite in dorsal view.

setae on the mesosomal dorsum; a pair of long slightly downcurved propodeal spines; humeri rounded in dorsal view; a short petiole peduncle and a petiole that is longer than high. However, a series of substantially and categorically differing morphological characters are present that delimit both species well even without access to type material of *T. zhejiangensis*. Though our study has this limitation, we justify describing this specimen from Hong Kong as new to science due the considerable uniqueness of the qualitative characters below in comparison to it nearest morphological congeneric species (*T. zhejiangensis*). Such unique characters include the dorsal head sculpture, being distinctly areolate-rugose in *T. barrettoi* rather than densely punctate in *T. zhejiangensis*. Punctuae are entirely absent on the dorsal head sculpturing of *T. barrettoi* and the areolate-rugose sculpturing is unique within Chinese *Temnothorax*; the head sculpturing in *T. zhejiangensis* also has "fine striations indistinct but present on frons" (Zhou *et al.* 2010), striations are entirely absent on the head of *T. barrettoi*; the sculpture of the mesosoma dorsum also differs with *T. zhejiangensis* being "densely punctuate" whereas the sculpture in *T. barrettoi* is more complex, grading from areolate-rugose anteriorly to more rugose posteriorly, with a gradual increase in punctuation towards the propodeum but not only densely punctuate throughout like *T. zhejiangensis*; the lateral head margins are subparallel in *T. barrettoi*, converging anteriorly and at the occipital corners, whereas the head margins of *T. zhejiangensis* are weakly convex throughout; the scapes are shorter and distinctly fail to reach the occipital border in *T. barrettoi* (SL 0.331) but are long and reach the occipital border in *T. zhejiangensis* (SL 0.39–0.48); in lateral view *T. barrettoi* has a flat mesosoma dorsum rather than a convex mesosoma dorsum in *T. zhejiangensis*. *Temnothorax barrettoi* may also be mistaken for *T. ruginosus* Zhou *et al.* (2010). However, both species can be differentiated by the smaller size of *T. barrettoi* being less than half the size of *T. ruginosus* (*T. barrettoi* WL 0.641; *T. ruginosus* WL (ML in Zhou *et al*. 2010) 1.80–1.84), as well as the head dorsum sculpture being areolate-rugose rather than coarsely longitudinally rugose in *T. ruginosus*. Moreover, the lateral head margins are subparallel converging at occipital corners in *T. barrettoi* but are convex throughout in *T. ruginosus*.

Here, we provide an exhaustive description and numerous high-resolution images of *T. barrettoi* sp. nov. for workers on Southeast Asian *Temnothorax* to consult in the future. We believe further differing characters are likely present between *T. barrettoi* and *T. zhejinagensis* but due to rather limited image quality and non-exhaustive species descriptions within Zhou *et al*. (2010) we judged these characters too speculative to include our delimitation. These speculative differing characters are as follows; form of the clypeal carinae, presence or absence of standing hairs on the clypeus, presence or absence of basigastral costulae, differing lengths of the terminal funicular segments and the differing shape of the petiolar node. All speculative character should be checked against *T. ruginosus* as well. Species descriptions and images of species of *Temnothorax* outside of mainland China were also reviewed but no species of *Temnothorax* resembled this specimen in terms of morphological characters as did *T. ruginosus* and *T. zhejiangensis*. Although the lack of additional material makes it impossible to examine any intraspecific variation, we believe that the characters (particularly the cephalic sculpture) here are fundamentally and categorically different enough to not show enough variation to overlap with other *T. zhejiangensis* or *T. ruginosus*.

It was initially thought that this specimen might be a *Vombisidris* Bolton, 1991, due to the superficial resemblance with *V. freyae* General, 2020, a species known from the Philippines. Closer examination showed an alternative dental array and the absence of a subocular groove. The high similarity (at least superficially) between this specimen and *V. freyae* however are initially convincing. Both species share the same head shape, eye positioning and type of sculpture (particularly on the head dorsum), as well as the numerous stout and erect setae across head, mesosoma and metasoma dorsum. Due to the absence of apomorphic characters encountered in *Vombisidris*, such as the peculiar dental composition and subocular groove, we resulted in the determination of *Temnothorax* for this specimen instead.

Natural history

Temnothorax barrettoi sp. nov. was collected from Tai Po Kau Headland, a Site of Special Conservation Interest owing to the presence of natural lowland coastal woodland, which has had a long history of post-World War II reforestation with minimal human disturbance (Kendrick & Barretto 2006). Moreover, the presence of an old pre-war Feng Shui relict woodland also makes the site unique due to the long history of human disturbance elsewhere in Hong Kong (Kendrick & Barretto 2006). One worker of *T. barrettoi* was found in a leaf litter sample within a patch of secondary forest approximately 250 meters away from the location of the relict forest. Further sampling using winkler extractors and vegetation beating was conducted within the collection site to acquire further specimens of *T. barrettoi* sp. nov. but resulted in no additional specimens. More information of the site can be found in Kendrick & Barretto (2006).

Temnothorax haveni Lee, Hamer & Guénard sp. nov.
urn:lsid:zoobank.org:act:D5640CE1-BA4A-469B-959B-444695F094C3
Figs 3–5

Diagnosis

Head subquadrate; lateral margins of head subparallel in full face view; clypeus with longitudinal carinae extending only in the anterior half; scapes not reaching occipital head margin; in lateral view promesonotum convex, followed by a concave mesopropodeal depression at the junction with the propodeum; promesonotal suture visible in lateral view only; metanotal groove absent; propodeal spines well-developed with thick base, long and curved pointing backwards; head and mesosoma glabrate; head, mesosoma and gaster covered with scarce erect, stout setae. Core body concolorous ochreous-yellow.

Etymology

The specific epithet 'haveni' is a noun in English. This was the first species of *Temnothorax* recorded in Hong Kong, one of the most urbanized cities but with 40% of the land designated as protected areas for biodiversity conservation, providing havens for countless species and those awaiting discovery.

Material examined

Holotype

CHINA • worker; Hong Kong SAR, Hong Kong Island, Aberdeen Reservoir; 22°15′32.04″ N, 114°9′34.56″ E; 190 m a.s.l.; 27 Jun. 2017; Roger H. Lee and Yuet Yin Ling leg.; ground baiting; ZRC RHL03433.

Paratypes (n = 8)

CHINA – **Hong Kong SAR** • 1 worker; Mui Wo (Lantau Trail); 22°15′41.76″ N, 114°0′6.84″ E; 38 m a.s.l.; 15 Aug. 2022; André Ibáñez and Matthew T. Hamer leg.; Winkler; HKBM ANTWEB1010974 [MW1T1W4-5] • 1 worker; Hong Kong Island, Lung Fu Shan; 22°16′45.48″ N, 114°8′13.92″ E; 231 m a.s.l.; 14 Apr. 2022; Matthew T. Hamer leg.; hand collection on ground; HKBM ANTWEB1010976 • 1 worker; Hong Kong Island, Aberdeen Reservoir; 22°15′32.04″ N, 114°9′34.20″ E; 192 m a.s.l.; 27 Jun. 2017; Roger H. Lee leg.; ground baiting; HKBM RHL03467 [RHL5265] • 1 worker; Hong Kong Island, The Peak; 22°16′24.96″ N, 114°8′20.04″ E; 391 m a.s.l.; 11 Jul. 2017; Roger H. Lee leg.; hand collection; HKBM RHL03474 [RHL5272] • 1 worker; Tai Po Kau Nature Reserve; 22°25′12.72″ N, 114°10′35.76″ E; 349 m a.s.l.; 23 Aug. 2022; Shaolin Han leg.; arboreal baiting, 20 meters high; IBBL ANTWEB1010993 [TPK_S1_T3] • 1 worker; Fanling, Fanling Golf Course; 22°29′25.44″ N, 114°6′37.08″ E; 48 m a.s.l.; 23 May 2022; Matthew T. Hamer and André Ibáñez leg.; ground baiting; IBBL ANTWEB1010975 [FGE1T2B2-1] • 1 worker; Girl Guides Pok Hong Campsite; 22°22′16.68″ N, 114°11′46.68″ E; 84 m a.s.l.; 24 Jun.–1 Jul. 2022; Matthew T. Hamer and André Ibáñez leg.; flight

interception vane trap; IBBL ANTWEB1010987 [GGPH2V2-1] • 1 worker; Tsing Yi, Tsing Yi Peak; 22°20′35.16″ N, 114°5′59.64″ E; 244 m a.s.l.; 16 Mar. 2018; R. Cheung and M. Law leg.; Winkler; IBBL ANTWEB1016704 [TYP S1-R].

Description

Measurements (n = 9). Holotype (n = 1); CL 0.55; CW 0.54; CWb 0.50; SL 0.4; WL 0.65; SPST 0.23; PEL 0.29; PPL 0.15; PEH 0.16; PPH 0.16; PW 0.34; SPBA 0.12; SPTI 0.17; PEW 0.13; PPW 0.18; ATL 0.62; HS 0.52; SI 80.6; CI 91.58; SBI 23.2; PSI 35.02; PWI 145.6; PLI 194.63; TL 2.26. Paratypes (n = 8); HL 0.51–0.55; CW 0.5–0.55; CWb 0.44–0.5; SL 0.35–0.41; WL 0.61–0.69; SPST 0.23–0.29; PEL 0.25–0.32; PPL 0.12–0.17; PEH 0.14–0.18; PPH 0.15–0.16; PW 0.3–0.34; SPBA 0.1–0.17; SPTI 0.11–0.18; PEW 0.11–0.12; PPW 0.16–0.18; ATL 0.46–0.58; HS 0.47–0.53; SI 75.71–87.67; CI 86.22–92.04; SBI 21.1–37.66; PSI 36.99–41.84; PWI 140.16–151.35; PLI 160–229.41; TL 1.99–2.22.

Head. In full face view, head subquadrate, longer than broad (CI 86.22–92.04), with weakly convex sides and occipital margin, rounded occipital corners. Clypeus widely inserted between antennal lobes; anterior margin weakly convex and angulate medially; three clypeal carinae present. Mandible broadly triangular, masticatory margin with five teeth, apical most tooth larger than preceding teeth. Frontal carinae weak but moderately long, extends from the antennal insertions to the area of the vertex; frontal lobes present. Antenna with 12 segments terminating in an incrassate three-segmented club; apical segment longer and broader than following segments. Scape of medium length (SI 78.57–87.67), terminating before posterior corners of the head. Eye convex; located medially on head and extending laterally beyond the cephalic capsule. In lateral view, eyes composed of 9–10 ommatidia across the longest width. In dorsal view, occipital carina present but weakly developed.

Mesosoma. In dorsal view, mesosoma widest at the middle portion of pronotum; humeri widely rounded; mesosoma weakly tapering posteriorly, reaching a minimum width at the anterior part to propodeum. Promesonotal suture absent dorsally but present laterally. Metanotal groove absent. In lateral view, promesonotum convex and follow by a distinct concavity at mesonotum, forming a weak promesonotal dome. Propodeal spiracle circular. Propodeal lobe round. Propodeal spines well-developed, long, and slightly downward curved toward the end; spines longer than the distance between their bases (SPST 0.23–0.29; SBPA 0.10–0.17), spines feebly diverge postero-laterally from the dorsal view. In lateral view, propodeal declivity subtly concave.

Metasoma. In lateral view, petiole subtriangular, longer than high. Anterior face of petiole distinctly longer than posterior face; node with acute apex. Postpetiole short and convex. In dorsal view, postpetiole subquadrate; distinctly wider than petiole. Gaster wider than postpetiole; first gastral tergite long, as long as mesosoma; anterolateral corners obtusely angled.

Setae. In full face view, mandible dorsum with well-spaced sub-decumbent pilosity; anterior clypeal margin with two long and tapering setae on either side of clypeal median. Several sub-erect setae present on anterior clypeal margin, directed towards clypeal median. From clypeal dorsum to cephalic dorsum, covered with sparse, stout and erect setae that are spaced roughly equidistantly. Scapes and subsequent antennal segments with sub-decumbent to semi-erected pilosity. In lateral view, ventral part of head with scare erect to semi-erect pilosity, intertwined with stout-erect setae. Mesosoma with long, erect setae arranged in series of transverse rows, normally not more than five pairs. Mesosoma dorsum also with sparse, short decumbent and appressed setae between the long, erect, setae pairs; of propodeal spines also with a single pair of setae sub-apically. Posterior face of petiole dorsum with a few pairs of erect setae, anterior face lacking setae. Postpetiole dorsum with a few pairs of erect setae. Gastral tergite

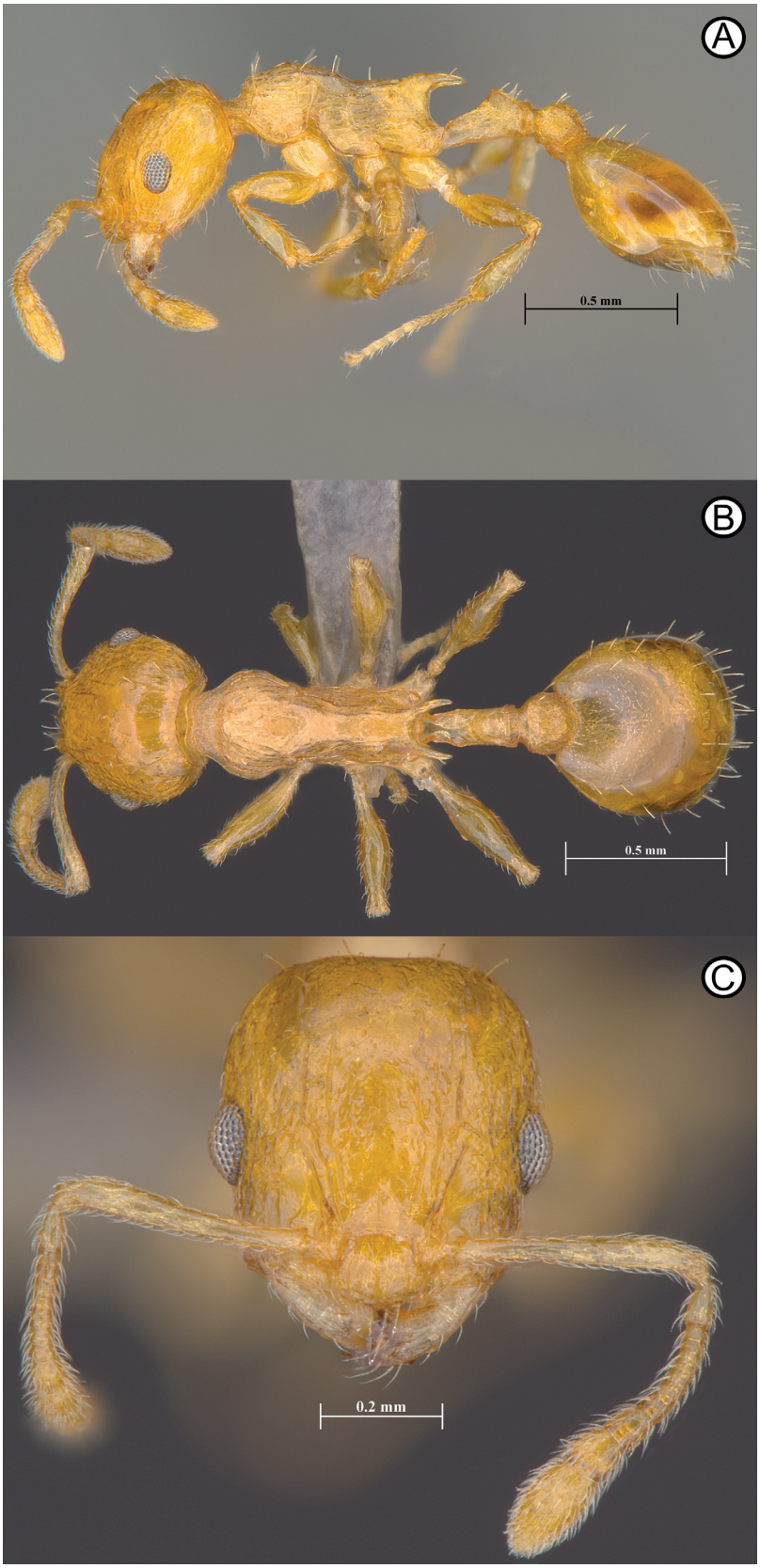

Fig. 3. *Temnothorax haveni* Lee, Hamer & Guénard sp. nov., holotype (RHL03433). **A**. Lateral view. **B**. Dorsal view. **C**. Head in full face view.

with scarce erect stout setae in varying length arranged in loose rows. Femur and tibia with short and appressed pubescence.

Sculpture. In full face view, mandibles overlain by very weak lateral striae. Majority of clypeus dorsum smooth other than short, longitudinal carinae that begin at the clypeal anterior border. Dorsum of head, from clypeus to posterior head corners, glabrate. Dorsal pronotum, mesonotum and propodeum glabrate. Pronotum, mesonotum and propodeum overlain with faint but weak lateral striae laterally. Petiole and postpetiole dorsally and laterally weekly punctate-recticulate. Gaster comparatively smooth and shining.

Colour. Core body concolorous ochreous-yellow. Setae across whole of body yellowish white. Gaster with dark brown patches laterally from dorsal and lateral view.

Comments

Temnothorax haveni sp. nov. would key out to *T. zhejiangensis* in Zhou *et al.* (2010) and shares several morphological characters. These characters include the presence of erect setae on the mesosomal dorsum, a pair of long slightly downcurved propodeal spines, humeri rounded in dorsal view, a short petiole peduncle and a petiole that is longer than high in lateral view. However, various characters differ, including the sculpture on the head dorsum, lateral and dorsum mesosoma being predominately glabrate in *T. haveni* rather than punctate in *T. zhejiangensis*. The mesosomal outline differs greatly between both

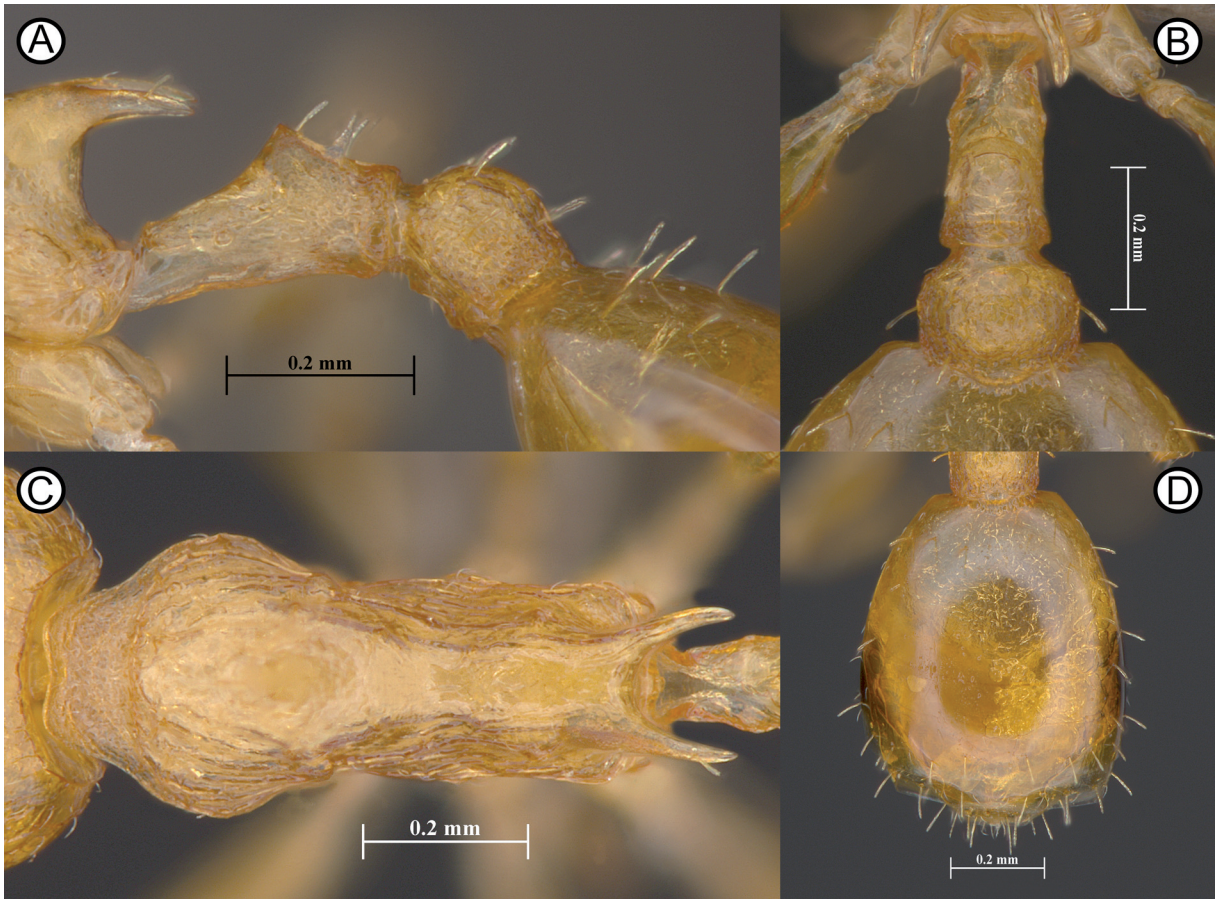

Fig. 4. *Temnothorax haveni* Lee, Hamer & Guénard sp. nov., holotype (RHL03433), morphological characters. **A**. Petiole and postpetiole in lateral view. **B**. Petiole and postpetiole in dorsal view. **C**. Mesosoma in dorsal view. **D**. First gastral tergite in dorsal view.

species with a convex promesonotum followed by a distinct concavity forming a weak promesonotal dome in *T. haveni* but only slightly convex across its whole length in *T. zhejiangensis*. The petiole peduncle is narrower and slightly longer in *T. haveni* than in *T. zhejiangensis* being broader and shorter. The petiole node in *T. haveni* has an acute dorsal apex within *T. zhejiangensis* is subtriangular with a narrowly rounded dorsum. Similarly, *T. haveni* might be mistaken for *T. ruginosus* both species can be differentiated by size (*T. haveni* WL 0.61–0.69; *T. ruginosus* WL (ML in Zhou *et al*. (2010)) 1.80–1.84), as well as head and mesosomal sculpturing and the mesosomal outline. *Temnothorax haveni* may also be mistaken for *T. barrettoi* sp. nov., however, both species can be differentiated by the glabrate sculpture and more scarce erect stout setae over the body of *T. haveni.* We believe the above characters distinctly differentiate *T. haveni* from its congeneric species due to their uniqueness and consistency across all specimens examined. In fact, the lack of sculpture, particularly on the head, combined with distinct mesopropodeal depression, makes *T. haveni* morphologically distinct amongst Chinese *Temnothorax*. Further description of species of *Temnothorax* from other regions of Southeast Asia were examined with no species satisfying all characters.

Natural history

Temnothorax haveni sp. nov. has been collected from semi-open to closed canopy secondary forests throughout the territory of Hong Kong. Specimens are mostly found within leaf litter samples but have also been attracted to ground baiting. One worker of *T. haveni* was collected twenty metres above the ground in a tree from an arboreal bait sample within a secondary forest. An additional specimen was hand collected along a waist high handrail and another from a flight interception trap (vane trap) hung from a

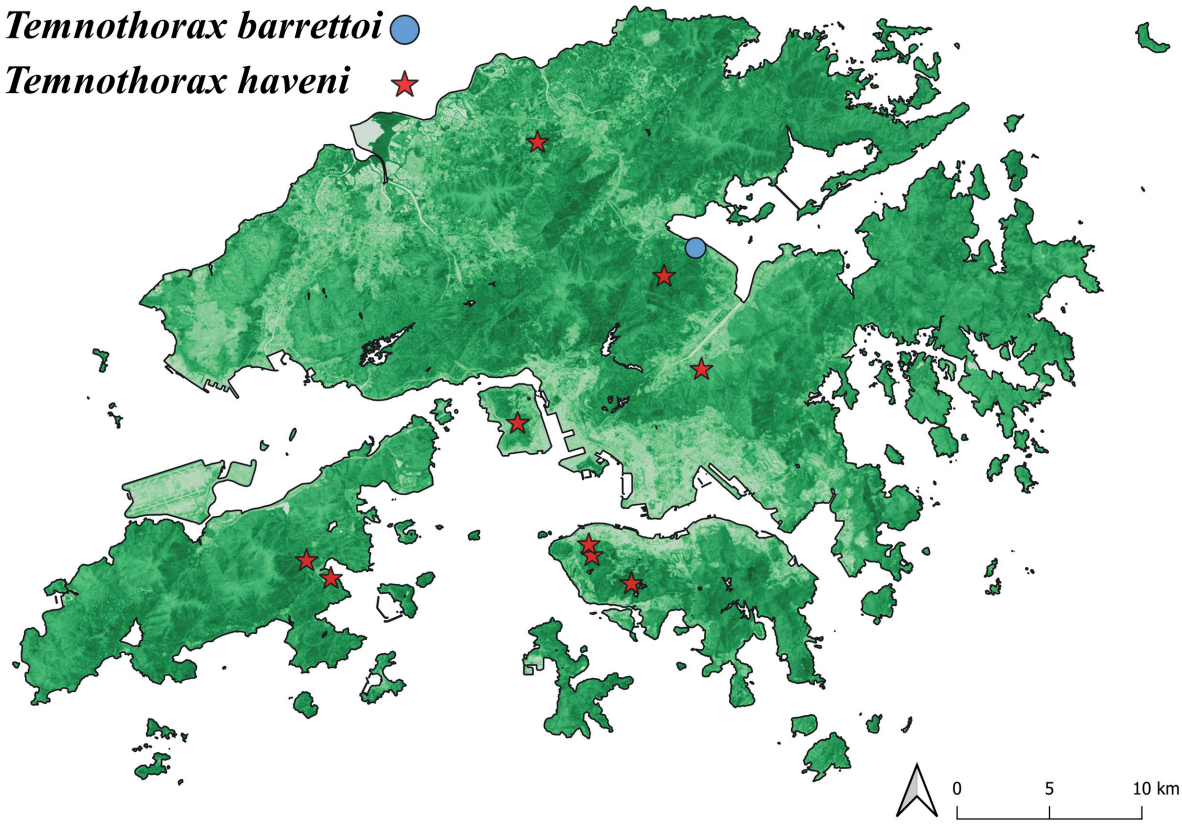

Fig. 5. Distribution map of *Temnothorax* Mayr, 1861 records from Hong Kong. The darker the green areas, the greater the tree canopy cover.

tree at head height. These samples may indicate *T. haveni* forages on shrubs or understorey vegetation, as well as within trees and could therefore be a predominately arboreal species, which may also forage occasionally on the forest floor. However, it is difficult to rule out individuals falling from plants due to unintentional vegetation interaction by samplers, which may explain specimens from Winkler samples and ground hand collection. Moreover, the lack of any whole nest samples from the mostly ground based sampling effort in Hong Kong (e.g., Winklers), indicates this species may not nest in leaf litter, with only singletons found and no reproductive caste thus far collected.

While infrequently collected within Hong Kong, perhaps due to limited sampling towards arboreal species at this point, the species appears relatively widespread, being found on most larger islands and continental parts of the SAR (Fig. 5). *Temnothorax haveni* sp. nov. is thus expected to be found in the nearby province of Guangdong which shares a similar climate and habitats as Hong Kong.

Adapted key to Temnothorax of China

Here, we adapt couplet 15 from Zhou *et al.* (2010), where both new species from Hong Kong key to, and introduce more characters to differentiate new species. Subsequent couplets within Zhou *et al.* (2010) are not affected.

Couplet 15. from Zhou *et al.* (2010);

15a. Dorsum of head and mesosoma predominately glabrate; mesosoma outline with mesopropodeal depression present and conspicuous (Hong Kong) ..... ***Temnothorax haveni*** Lee, Hamer & Guénard sp. nov.

– Dorsum of head and mesosoma not predominately glabrate; mesopropodeal depression absent 15b

15b. Size larger, WL > 1.5; dorsum of head and mesosoma longitudinally rugose or striate (Hunan) .... ***Temnothorax ruginosus*** Zhou *et al*., 2010

– Size smaller, WL < 1.0; dorsum of head and mesosoma not longitudinally rugose or striate ….15c

15c. Dorsum of head densely punctuate; mesosoma dorsum densely punctuate (Zhejiang) ..... ***Temnothorax zhejiangensis*** Zhou *et al*., 2010

– Dorsum of head areolate-rugose; mesosoma dorsum scarcely punctuate, few punctae scattered between areolae (Hong Kong) ..... ***Temnothorax barrettoi*** Hamer & Guénard sp. nov.

Discussion

In total, two new species of *Temnothorax* are recorded and described from Hong Kong, increasing the number of species of *Temnothorax* on the Chinese mainland to 27 (Table 1) and to 50 species in East Asia (mainland China, Taiwan, Japan, and the Korean Peninsula). The species of *Temnothorax* in Hong Kong are associated with forested habitats, having been collected within Winkler (leaf litter) samples, on vegetation as well as high up in a tree. Based on our collection evidence, *T. haveni* sp. nov. is likely an arboreal species, but we lack definitive proof at this point (e.g., targeted nest collection is needed). Similarly, the true ecology of *T. barrettoi* sp. nov. currently eludes us. The only specimen available, taken from a leaf litter sample, was collected in a densely vegetated sampling plot. We cannot exclude, however, the possibility of samplers inadvertently knocking the specimen into the sample from the surrounding plants. Limited knowledge and sampling efforts on arboreal ants in Hong Kong, as well as the secretive nature of the genus, could be reasons for the overall lack of records of *Temnothorax*. Greater sampling effort targeted toward the arboreal stratum may help to produce further records in Hong Kong and within mainland Chinese provinces.

Table 1 (continued on next page). Distributional checklist of the species of *Temnothorax* Mayr, 1861 of mainland China and Hong Kong.

Species	Anhui	Beijing	Fujian	Guangdong	Gansu	Guangxi	Guizhou	Henan	Hubei	Hebei	Hainan	Hong Kong	Heilongjiang	Hunan	Jilin	Jiangxi	Jiangsu	Liaoning	Inner Mongolia	Ningxia	Qinghai	Sichuan	Shandong	Shaanxi	Shanxi	Yunnan	Zhejiang	Total
T. angulohumerus Zhou *et al*., 2010						✓								✓												✓		**3**
T. argentipes (Wheeler, 1928)		✓	✓			✓		✓		✓						✓		✓		✓				✓				**9**
T. barrettoi Hamer & Guénard sp. nov.												✓																**1**
T. brevispinus (Chang & He, 2001)																				✓	✓							**2**
T. congruus (Smith, 1874)		✓				✓																				✓		**3**
T. eburneipes (Wheeler, 1927)																✓												**1**
T. fultonii (Forel, 1902)									✓																			**1**
T. hengshanensis (Huang *et al*., 2004)														✓												✓		**2**
T. haveni Lee, Hamer & Guénard sp. nov.												✓																**1**
T. koreanus (Teranishi, 1940)									✓																			**1**
T. leyeensis Zhou *et al*., 2010						✓																						**1**
T. maoerensis Zhou *et al*., 2010						✓																						**1**
T. mongolicus (Pisarski, 1969)										✓																		**1**
T. nassonovi (Ruzsky, 1895)		✓			✓								✓		✓			✓	✓	✓	✓	✓	✓	✓		✓		**12**
T. opaciabdomin (Chang & He, 2001)																				✓	✓							**2**
T. orchidus Zhou *et al*., 2010						✓																✓				✓		**3**
T. pisarskii Radchenko, 2004										✓			✓					✓						✓				**4**

Table 1 (continued).

Species	Anhui	Beijing	Fujian	Guangdong	Gansu	Guangxi	Guizhou	Henan	Hubei	Hebei	Hainan	Hong Kong	Heilongjiang	Hunan	Jilin	Jiangxi	Jiangsu	Liaoning	Inner Mongolia	Ningxia	Qinghai	Sichuan	Shandong	Shaanxi	Shanxi	Yunnan	Zhejiang	Total
T. reduncus (Wang & Wu in Wang *et al.*, 1988)			✓		✓				✓													✓						**4**
T. reticulatus (Chang & He, 2001)																				✓	✓							**2**
T. ruginosus Zhou *et al.*, 2010							✓							✓										✓			✓	**4**
T. shannxiensis Zhou *et al.*, 2010																								✓				**1**
T. spinosior (Forel, 1901)	✓	✓		✓		✓		✓	✓	✓			✓	✓						✓		✓	✓	✓	✓		✓	**15**
T. striatus Zhou *et al.*, 2010								✓	✓											✓		✓				✓		**5**
T. taivanensis (Wheeler, 1929a)			✓	✓		✓					✓			✓														**5**
T. wui (Wheeler, 1929b)		✓								✓				✓								✓				✓		**5**
T. xanthos Radchenko, 2004																	✓											**1**
T. zhejiangensis Zhou *et al.*, 2010																											✓	**1**
Total per province	**1**	**5**	**3**	**2**	**2**	**8**	**1**	**3**	**5**	**5**	**1**	**2**	**3**	**6**	**1**	**2**	**1**	**3**	**1**	**7**	**4**	**6**	**2**	**6**	**1**	**7**	**3**	

The fauna of *Temnothorax* of Hong Kong currently comprises of newly described species only, but lacks species described and recorded from mainland China. Both neighbouring Guangxi and Guangdong harbour a total 8 species (8 and 2 respectively), none of which have been collected in Hong Kong (Janicki *et al.* 2016). Even widespread species such as *T. argentipes* (Wheeler, 1928), *T. spinosior* Zhou *et al.*, 2010 and *T. taivanensis* (Wheeler, 1929), which are either widespread in subtropical China or are recorded from higher palaearctic northern to subtropical Chinese provinces, have not yet been found in Hong Kong. In Taiwan and the lower latitudinal Chinese provinces, various species of *Temnothorax* are recorded from high elevations (Terayama 2009; Zhou *et al.* 2010; Fontanilla *et al.* 2019; Liu *et al.* 2020). The lack of high elevations in Hong Kong (the highest being Tai Mo Shan at 957 m a.s.l.) and associated habitats, however, may be a possible explanation for the limited diversity of species of *Temnothorax*. In contrast, sampling effort towards lower elevations in neighbouring Chinese provinces is comparatively low and thus may yet reveal additional records of *Temnothorax*, including the new species described here.

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