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Taxonomic revision of the genus *Phyllothelys* Wood-Mason (Mantodea: Hymenopodidae) from China

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Summary. The genus *Phyllothelys* Wood-Mason (Mantodea: Hymenopodidae: Phyllothelyinae) includes 18 species in the world, among which 12 species were recorded in China. However, most *Phyllothelys* species have been described only for a single sex, and previous taxonomic characters are mainly based on the vertex prolongation of head, which leads to taxonomic confusion within the genus. Here, after raising and observing large amounts of males and females *Phyllothelys*, collected in the same localities, we find that several species which were described based on a single male or female are conspecific, and that there are significant differences between the males and females for some species. Then, we propose other stable taxonomic characters within species and provide for the first time a systematic review of the *Phyllothelys* species in China. We propose that *Phyllothelys* Wood-Mason should be divided into four species groups. Seven new species, *P. cancongi* **n. sp**., *P. tianfuense* **n. sp**., *P. tengchongense* **n. sp**., *P. xiezhi* **n. sp**., *P. jiazhii* **n. sp**., *P. dulongense* **n. sp**. and *P. chuangtsei* **n. sp**., are described. *Phyllothelys hepaticum* (Zhang) and *P. wuyiense* (Yang & Wang) are proposed as synonyms of *P. werneri* Karny. *Phyllothelys robustum* (Niu & Liu) is transferred to *P. sinense robustum* (Niu & Liu) **n. stat**. Life history, necessary illustrations and ecological images of *Phyllothelys* species from China are presented. The distribution of the genus *Phyllothelys* species is discussed and mapped.

Résumé. Révision taxonomique du genre *Phyllothelys* Wood-Mason (Mantodea : Hymenopodidae) en Chine. Le genre *Phyllothelys* Wood-Mason (Mantodea : Hymenopodidae : Phyllothelyinae) comprend 18 espèces dans le monde, dont 12 espèces recensées en Chine. Cependant, la plupart des espèces de *Phyllothelys* n'ont été décrites que pour un seul sexe, et les caractères taxonomiques utilisés jusqu'ici sont principalement basés sur l'allongement du vertex de la tête, ce qui a conduit à des confusions taxonomiques au sein du genre. Ici, après avoir élevé et observé de grandes quantités de mâles et de femelles, collectés dans les mêmes localités, nous constatons que plusieurs espèces décrites sur la base d'un seul mâle ou femelle sont conspécifiques, et qu'il existe des différences significatives entre les mâles et les femelles pour certaines espèces. Nous proposons d'autres caractères taxonomiques stables au sein des espèces et donnons pour la première fois une révision des espèces de *Phyllothelys* en Chine. Nous proposons que le genre *Phyllothelys* soit divisé en quatre groupes d'espèces. Sept nouvelles espèces, *P. cancongi* **n. sp**., *P. tianfuense* **n. sp**., *P. tengchongense* **n. sp**., *P. xiezhi* **n. sp**., *P. jiazhii* **n. sp**., *P. dulongense* **n. sp**. et *P. chuangtsei* **n. sp**., sont décrites. *Phyllothelys hepaticum* (Zhang) et P. wuyiense (Yang & Wang) sont proposés comme synonymes de *P. werneri* Karny. *Phyllothelys robustum* (Niu & Liu) est considéré comme une sous-espèce de *P. sinense : P. sinense robustum* (Niu & Liu) n. stat. L'histoire naturelle, les illustrations et l'écologie des espèces de *Phyllothelys* de Chine sont présentées. La distribution des espèces du genre *Phyllothelys* est discutée et cartographiée.

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Keywords: Dictyoptera; taxonomy; revision; new species; new synonyms; oriental region

The genus *Phyllothelys* Wood-Mason, 1876 belongs to the tribe Phyllothelyini of the subfamily Phyllothelyinae, including 18 species in the world. *Phyllothelys* is widely distributed in southern, eastern and southeastern Asia, only has one closely related genus, *Ceratocrania* Westwood, 1889 which is only found in Malay. Most species of *Phyllothelys* were described for a single sex, which caused taxonomic confusion, also awaiting further revision (Ehrmann & Roy 2009). *Kishinouyeum* Ôuchi, 1938 was proposed as synonym of *Phyllothelys*, together with detailed statement on taxonomic history of the genus *Phyllothelys* (Ehrmann & Roy 2009). However, *Kishinouyeum* was resurrected from synonymy with *Phyllothelys* (Svenson et al. 2015). Nonetheless, Schwarz & Roy (2019) indicated that the variability of the utilized characters in Svenson et al. (2015) is unrepresentative and did not agree with Svenson et al. (2015) about the resurrection of the genus *Kishinouyeum*. In addition, we note

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that the figure of the female *Phyllothelys* (Svenson et al. 2015, figure 25D) for comparison among the three closely related genera (*Ceratocrania, Phyllothelys* and *Kishinouyeum*) is erroneous and should be a dorsal habitus image of a male.

In China, 12 species have been recorded for the genus *Phyllothelys*, of which only one species was originally described within the genus *Phyllothelys*, namely *P. werneri* Karny, 1915 described on both sexes from Taiwan. The other 11 species were originally described within *Kishinouyeum*, among which nine species were described for a single sex, except *K. shaanxiense* Yang, 1999 described on both sexes from Nanzheng in Shaanxi Province. Afterwards, Zhu et al. (2012) provided a list of 11 species of *Phyllothelys* from China, among which five species were provided with illustration of both sexes. The male of *Phyllothelys breve* (Wang), originally described on two males from Yunnan Province (Wang 1993b), has also been reported from Southeast Vietnam, with illustrations (Shcherbakov & Anisyutkin 2018). In summary, the taxonomic confusion due to the fact that a species has been described based on only one sex is important for the Chinese species of *Phyllothelys*. The fact that many species of *Kishinouyeum* were originally described in China also allowed us to clarify the validity of the genus.

After raising large amounts of both sexes of *Phyllothelys* insects, which were collected in the same localities, and observing their pairing, we find that several species which were described based on a single male or female are conspecific, and there are significant differences between the males and females of certain species. It is problematic that the vertex prolongation of head was considered as the sole or main taxonomic character. Based on selected stable characters, we provide for the first time detailed records of all species of *Phyllothelys* from China, divide the genus into four species groups, describe seven new species and provide new status and synonyms. In total, *Phyllothelys* includes 22 species for the world and 16 species for China. Regarding the *Phyllothelys* species outside of China, we also make a few comments, hoping that they inspire further research.

Materials and methods

In this study, many characters are incorporated to describe and diagnose the species, among which the crown process is also described, but not as a main or unique trait. The other characters are: body size, absence or presence and shape (if not absent) of lateral pronotal expansions, length ratio between the prothoracic leg and the pronotum, comparison between the metathoracic femurs and the metazone of the pronotum, shape and staining of spots on the anterointernal surface of the profemurs, staining of the hind wings, absence or presence and shape (if not absent) of prominent lateral lobes on the tergite or sternite, and external genitalia.

The classification system follows Schwarz & Roy (2019). Descriptive terminology for adult morphology and male genitalia follows Brannoch et al. (2017) and Schwarz & Roy (2019). The specimens were collected during the day through careful observation, or by light trap (males). The genitals were dissected in 10% KOH solution, clarified with pure water, and finally stored in 70% ethanol in Eppendorf tubes for further research. All measurements are based on the specimens studied by the authors, as well as on measurements reported in the literature. Photos were taken with a Nikon D7100 digital camera.

Specimens studied in this research are deposited in the following collections:

IZCAS, Institute of Zoology, Chinese Academy of Sciences, Beijing, China.
SEM, Shanghai Entomological Museum, Chinese Academy of Sciences, Shanghai, China.
CAU, China Agricultural University, Beijing, China.
SYSU, Sun Yat-sen University, Guangdong, China.
DTCY, Department of Biology, Dali Teachers College, Yunnan, China.
NAUJ, Nanjing University of Forestry, Nanjing, China.
BFU, Beijing Forestry University, Beijing, China.
HBU, College of Life Science and Museum, Hebei University, Hebei, China.
SMNK, State Museum of Natural History Karlsruhe, Germany.
CJZ, Collection of Jia-Zhi Zhang, Shanghai, China.
CWC, Collection of Chao Wu, Beijing, China.

The holotypes of the new species are deposited in Insect Collection of Institute of Zoology, Chinese Academy of Sciences, Beijing, China (IZCAS).

Results

Family Hymenopodidae Giglio-Tos, 1915
Subfamily Phyllothelyinae Brunner de Wattenwyl 1893
Tribe Phyllothelyini Brunner de Wattenwyl, 1893

Genus *Phyllothelys* Wood-Mason, 1876

Phyllothelys Wood-Mason 1876, pp. 506–507, 1885, pp. 206–210. Syn. *Kishinouyeum* Ôuchi, 1938, pp. 23–26; Ehrmann & Roy 2009, pp. 67–76 (syn.).

Type species

Phyllocrania westwoodi Wood-Mason, 1876.

Diagnosis

Medium-sized, brown or moss-colored, mimicking-branch mantis.

Head. Triangle; eyes rounded, anteriorly protruding; vertex prolongation flat ventrally; dorsally with inflated base and a median keel; length of process of vertex prolongation 1 to 10 mm in males and about 10 to 20 mm in females; lower frons sub-pentagonal, about as high as

wide, with smooth surface, with prominent top and with obtuse-angle upper margin; clypeus wider than high, with median keel. Ocellar tubercle flat, higher than compound eyes; ocelli elliptical, reddish brown, larger in males and smaller in females; central ocellus with same size as lateral ocelli. Antennae filiform, dark brown; scape inflated; antennae thick and long in males, longer than pronotum, but not exceeding body length; antennae thin and rather short in females, shorter than pronotum.

Pronotum and prosternum. Pronotum elongate, stick-like; cross section of metazona triangular; dorsal surface of metazona keeled along its midline; lateral margin of pronotum with small, spine-like, blunt tubercles; supracoxal dilation with small lateral pronotal expansion, lateral margins of supracoxal dilation with spine-like blunt tubercles; metazona about twice longer than prozona. Prosternum flat, light brownish, with black spots.

Prothoracic legs. Elongate; coxae shorter than pronotum, with a series of sparsely arranged denticles on anterior margin; femora a little longer than coxae; tibial spur groove located almost medially or a little behind, with crenature on external edge; femora with 4 posteroventral femoral spines, 4 discoidal spines and 14–17 anteroventral femoral spines, among which the first anteroventral femoral spine at the distal end is larger than other spines; tibiae often with 12–17 posteroventral tibial spines, except that only 8 posteroventral tibial spines are present in *Phyllothelys jiazhii* **n. sp**. (Figure 8A); tibiae with 11–18 anteroventral tibial spines. Tarsus nearly as long as or shorter than tibia, first joint of tarsi as long as or a little longer than combined length of the remaining segments. Black areas present at base, in middle, and at apex on interior margins of femora, among which the former two black areas united, except that in *Phyllothelys cornutum* species group, black areas at base and that in middle are disjunctive.

Meso- and metathoracic legs. Generally short, but elongate in *Phyllothelys cornutum* species group; coxae more or less elongate. Posteroventral metafemoral lobe on femora divided into basal and distal parts, but united together in *Phyllothelys westwoodi* species group; genicular spur short; tibiae basally inflated, becoming slender apicad. Tarsus as long as tibia, first joint of tarsi often shorter than combined length of the remaining segments, except for *Phyllothelys cornutum* species group (Figure 1).

Wings. Forewings long, narrow, translucent in males and opaque in females, longer than abdomen in males but almost as long as or little shorter than abdomen in females. Forewings with a narrow costal area, subcostal and median veins well separated from the radial vein; stigma absent, completely reduced; anterior analis short, smoky and translucent. Hind wings wide, more or less smoky, with darker areas, often more light-colored in males than in females, but usually colorless in *Phyllothelys westwoodi* species group.

Abdomen. Flat, with more or less prominent lateral lobes on tergites 4 to 6, and more in the *Phyllothelys cornutum* species group; abdomen long and narrow in males and wide in females. Supraanal plate transverse, with a median carina and a rounded posterior edge; cerci hairy, short, slightly flat, with conical terminal joint. Male subgenital plate about as long as wide, with short styli. Apical lobe of

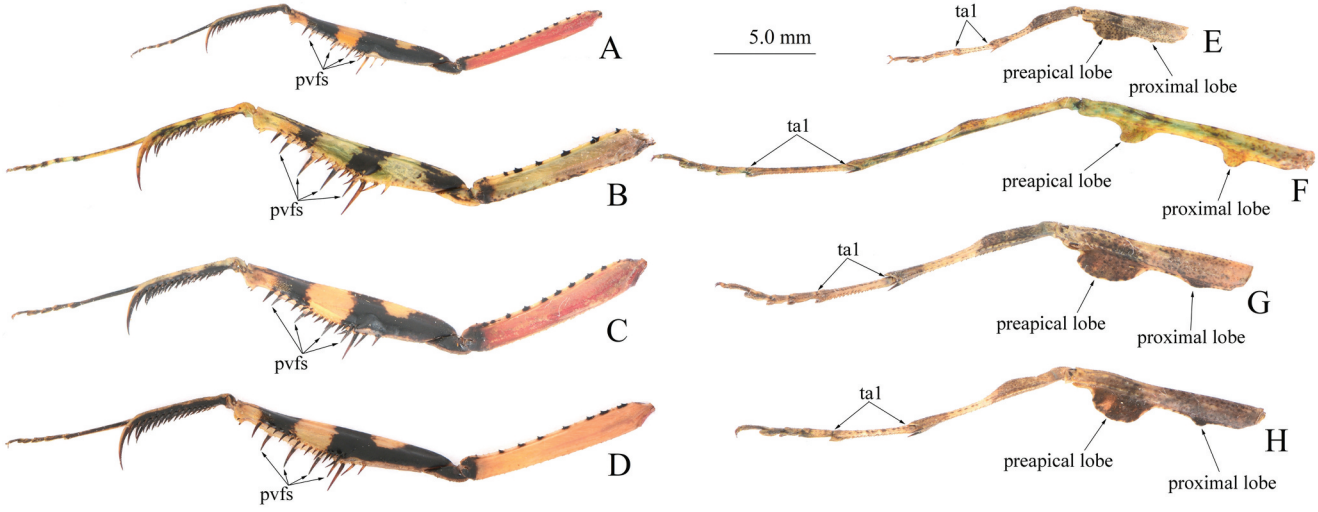

Figure 1. Prothoracic legs and metathoracic legs of male *Phyllothelys* spp. from the four species groups, ventral view. **A, E**, *P. breve*; **B, F**, *P. cornutum*; **C, G**, *P. sinense sinense*; **D, H**, *P. werneri*; **A-D**, prothoracic legs; **E–H**, metathoracic legs. Abbreviations: pvfs = posteroventral femoral spines; ta1 = tarsomere 1.

gonapophysis of females rather long, extending beyond cerci (Figure 10).

External genitalia. Ventral phallomere wide, more or less pigmented on its left edge, with a small spiny posterior process on its terminus, with numerous tubercles; in left phallomere, phalloid apophysis ossification, large and spiny; apical process of left phallomere very short, obtuse; right phallomere without great peculiarities.

Ootheca. Usually small, with smooth surface, clinging to the branches. Usually 10–30 eggs present in one ootheca (Figure 14).

Habitat and life history

The genus *Phyllothelys* is mainly distributed in the forest habitats of east-central and southern China, between 200 m and 2500 m altitude. The species of *Phyllothelys*, as well as the species of the genera *Odontomantis* Saussure, 1871 and *Arria* Stål, 1877, are the only Mantodea distributed at 2500 m altitude in China, apart from *Didymocorypha libaii* Wu & Liu, 2020 with limited distribution in Tibet, in the Himalayas.

Phyllothelys are sexually dimorphic. Completely different appearances and behaviors can be observed between males and females. The male adults have extreme phototaxis; in contrast, the females are not attracted by lights. The majority of the specimens collected were males and rarely females.

Different patterns of life histories were shown among the species from different habitats. In the tropical regions of China, significant generational differences were not discovered in the *Phyllothelys* species, and the adults can be observed throughout the whole year. In the high-altitude temperate regions, development stops around the 5–6th stages at the beginning of the winter, when the nymphs hide under the fallen leaves or the gaps between the rocks. Next year, the nymphs reach adulthood around June, and nymphs of the new generations can be observed around August.

Distribution

East, South, South-East Asia. The *Phyllothelys* species are distributed in southern Asia to eastern Asia and Malay, the northernmost distribution is in Shaanxi, Qinling Mt. region, to the latitude of about 34°N in China.

Comments

In this study, 10 nominal species within *Kishinouyeum* are carefully examined, with enough specimens of both sexes, although most of them were originally described on a single sex. Based on our review and the original description, the 11 nominal species of *Kishinouyeum* are divided into four different species groups. For all of these species, there are no suitable characters that could be used for separation with the genus *Phyllothelys*. We therefore reconfirm that *Kishinouyeum* should be synonymous with *Phyllothelys*, supporting the opinion of Ehrmann & Roy (2009) and that of Schwarz & Roy (2019).

Taxonomy

We divided *Phyllothelys* into four species groups, based on body size, ratio of length between prothoracic leg and pronotum, comparison between metathoracic femora and metazone of pronotum length, shape of spots on inner side of profemora, and coloration of hind wings. Those are *P. westwoodi* species group, *P. cornutum* species group, *P. sinense* species group, and *P. werneri* species group. Within the same species group, species can be distinguished according to the ratio of pronotum length to supracoxal dilation width and male genitalia. The vertical process of head should not be used as the main basis; however, whether there are extensions and tooth processes on the vertical process of head, and the ratio of the vertical process to the length of the head, are relatively stable within the species.

***Phyllothelys westwoodi* species group**. Including seven species, distributed in South to Southeast Asia. Body small- to medium-sized, brownish and slender. Vertical process of head usually very short in male adults; rarely, males of one species from India with elongate vertical process. Prothoracic legs elongated. Basal and middle dark spots merging on basal half of interior surface of prothoracic femora (Figure 1A). Meso- and metathoracic legs very short; metafemora shorter than the metazona, first joint of tarsi shorter than combined length of the remaining segments (Figure 1E). Hind wings transparent and colorless in males.

Species included: *Phyllothelys westwoodi* (Wood-Mason, 1876), *P. paradoxum* Wood-Mason, 1884, *P. taprobanae* Wood-Mason, 1889, *P. mitratum* Rehn, 1903, *P. decipiens* Giglio-Tos, 1915, *P. bakeri* Werner, 1922, *P. breve* (Wang, 1993b).

Phyllothelys cornutum *species group*. Including two species, distributed from Central to Southeast China. Body large-sized, robust, green and mossy. Prothoracic legs normal; interior surface of forefemora possessing three disjunctive black bands (Figure 1B). Meso- and metathoracic legs elongate, metathoracic femora nearly as long as pronotum, posteroventral metafemoral lobe divided into two disjunctive parts; first joint of tarsi longer than combined length of the remaining segments (Figure 1F). Male hind wings colored.

Species included: *Phyllothelys cornutum* (Zhang, 1988), *P. cancongi* **n. sp.**

***Phyllothelys sinense* species group**. Including seven species and one subspecies, distributed from Central China to North Indochina peninsula. Medium- to large-sized, robust, brownish. Prothoracic legs normal; posteroventral femoral spines normal, tilted, not bending backwards, shorter than width of the femora. The inside of the prothoracic legs, basal and middle dark spots merging on base half of interior surface of prothoracic femora (Figure 1C). Metathoracic femora shorter than pronotum, but longer than metazona; first joint of tarsi shorter than combined length of the remaining segments (Figure 1G). Male hind wings colored.

Species included: *Phyllothelys sinense* (Ôuchi, 1938), *P. shaanxiense* (Yang, 1999), *P. tianfuense* **n. sp.**, *P. cangshanense* (Mao, 2001), *P. parvulum* (Xu & Mao, 2004), *P. tengchongense* **n. sp.**, *P. xiezhi* **n. sp.**

***Phyllothelys werneri* species group**. Including six species, distributed in South China. Body large-sized, slender, brownish. Prothoracic legs extremely elongate; posteroventral femoral spines elongate, vertical, with apex slightly bent backwards; its length almost equal to width of femora. Basal and middle dark spots merging on base half of interior surface of prothoracic femora (Figure 1D). Metathoracic femora shorter than pronotum, as long as or shorter than metazona of pronotum; first joint of tarsi shorter than combined length of the remaining segments (Figure 1H). Male hind wings colored.

Species included: *Phyllothelys werneri* Karny, 1915, *P. jianfenglingense* (Hua, 1984), *P. stigmosum* (Zhou & Zhou, 2004), *P. jiazhii* **n. sp.**, *P. dulongense* **n. sp.**, *P. chuangtsei* **n. sp.**

Phyllothelys westwoodi species group

Phyllothelys breve (Wang, 1993)

(Figures 1A, E; 2A, B; 6A; 7A; 9A; 10A; 11A; 15A–C; 16C; 17A; 18A; 20C; 21)

Kishinouyeum breve Wang 1993b, pp. 4–6; Ehrmann 2002, p. 198; Otte & Spearman 2005, p. 304.
Phyllothelys breve: Ehrmann & Roy 2009, p. 73; Zhu et al. 2012, pp. 174–176; Shcherbakov & Anisyutkin 2018, pp. 135–136.

Type locality

Yunnan, Damenglong.

Material examined

China. Holotype ♂, Yunnan, Xishuangbanna, Damenglong; 30.VII.1958; Yi-Ran Zhang leg. (SEM). Paratypes: 1♂, Yunnan, Jinghong, Menglun; 4.IX.1991; Zu-Yao Liu et al. leg. (SEM) (Figure 16C). 3♂, Guangxi, Chongzuo, Nonggang; 22°30′04″N, 106°57′23″E; 200 m; 28.IX.2014; Chao Wu leg. (IZCAS). 4♂, Yunnan, Ruili, Nongdao; 23°57′35″N, 97°37′21″E; 700 m; 17.IX.2012; Chao Wu leg (IZCAS). 3♂, 1♀, Yunnan, Mengla, Bubeng; 21°35′58″N, 101°33′55″E; 800 m; 15.X.2014; Chao Wu leg. (CWC). 6♂, 2♀, Yunnan, Jinghong, Menglun; 21°59′28″N, 101°10′13″E; 800 m; 18.IX.2017; Chao Wu leg. (CWC). 8♂, Yunnan, Yingjiang, Nabang; 300 m; V.2017; Xiao-Dong Yang leg. (CWC).

Laos. 3♂, Prov. Vientiane, Ban Viang Khan, 15 km S Phou Khoun; 19°15′N, 102°15′E; 950 m; 28.IX.2003; Th. Ihle leg. (SMNK) (Figure 15C).

Myanmar. 1♂, 1♀, Bagan, Bagan Nyaung Oo Golfclub, 180 km SW Mandalay; 16°49′57.612″N, 94°23′51.004″E; 15.VII–15.VIII.2013; Luise & Markus Löwe leg. (SMNK) (Figure 15A, B).

Redescription

Small-sized and slender *Phyllothelys*.

Head. In males, vertical process very short, with a soft and shrunken apical part (Figure 6A); in nymph, vertical process developed; in females, vertical process very long, about 3 times longer than head, with obtuse apex; lateral margin of vertical process without teeth, narrowed towards top.

Pronotum. Very slender, without obviously lateral pronotal expansion; lateral margin with densely arranged black large grainy spines, interleaved with small ones (Figure 7A). Ratio of pronotum length to supracoxal dilation width about 6.75 in males and 7.17–7.18 in females.

Prothoracic legs. Exaggerated elongate; coxae slender, with a series of denticles on anterior margin; femora with 13–14 anteroventral femoral spines; tibiae with 15–17 posteroventral and 15–16 anteroventral tibial spines (Figure 1A).

Meso- and metathoracic legs. Very short, uncoordinated, posteroventral metafemoral lobe merged, edge broken; tibiae short, basal part of tibiae inflated, swollen, first joint of tarsi shorter than combined length of the remaining segments (Figure 1E).

Wings. In males: forewings narrow, longer than abdomen; costal area opaque, brown; discoidal area nearly transparent, light brown, with some small spots (Figure 9A); hind wings transparent, only dark at apex, with brownish radial veins and pellucid cross-veins. In females: front half of forewing opaque, and other areas transparent, with brown spots; hind wings translucent, smoky, with rather dark

areas, yellowish base, brownish radial veins and light-colored cross veins.

Abdomen. Narrow, basically without spots. In males: prominent lateral lobes on tergites absent; ventral sternal lobe short, blunt; subgenital plate and cerci light colored (Figure 10A). In females: tergites 5 to 6 wide, with small prominent lateral lobes.

External genitalia. Ventral phallomere wide, cello-shaped, edges with deep concavity, of which posterior process slightly prominent, with numerous tubercles; apical process of left phallomere short, wide, with sclerotized margin; phalloid apophysis strongly sclerotized, saddle-shaped, covered with numerous spines (Figure 11A).

Measurements (length in mm)

Body (head to wings): male 45.54–45.85, female 51.04–52.85; pronotum: male 15.78–16.02, female 17.89–18.24; fore coxae: male 9.25–9.64, female 10.28–10.86; fore femora: male 10.02–10.18, female 10.78–11.02; fore tibiae: male 5.98–6.02, female 6.68–7.05; middle femora: male 3.75–3.97, female 3.81–4.12; hind femora: male 4.81–4.95, female 5.64–5.98; forewings: male 26.72–27.05, female 22.08–22.37; hind wings: male 23.40–23.86, female 20.02–22.45.

Discussion

Among the *Phyllothelys* distributed in China, *P. breve* is easy to identify, but we should note that the description of the female *P. westwoodi* (India, Assam) is very similar to that of *P. breve* (see figures in Wood-Mason 1885), and their distribution areas are not far from each other. Similarly, the relationship between *P. paradoxum* (Myanmar), *P. mitratum* (Thailand, Trang), both of which were established for nymph types (Svenson 2014), and *P. breve* is also worth reconsidering. All of these species should belong to *Phyllothelys westwoodi* species group. *Phyllothelys taprobanae* (Sri Lanka), *P. bakeri* (Philippines) and *P. decipiens* (India) should also belong to this species group.

We have inspected some specimens from central India. Males of these specimens have elongate vertical process on head, and the females are similar to *Phyllothelys breve*, but are not the same species (Figure 2C, D). We think the elongate vertical process on the head should be the true characteristic of the male of *P. decipiens*, while the males with short vertex specimens from Java and Borneo listed by Giglio-Tos (1915) as the male of *P. decipiens* are obviously other species. We have not inspected any Java specimens, but the male specimens of Borneo maybe represent a new species, different from the species based on the short-vertex male from Indochina. It is worth mentioning that we examined a female specimen from

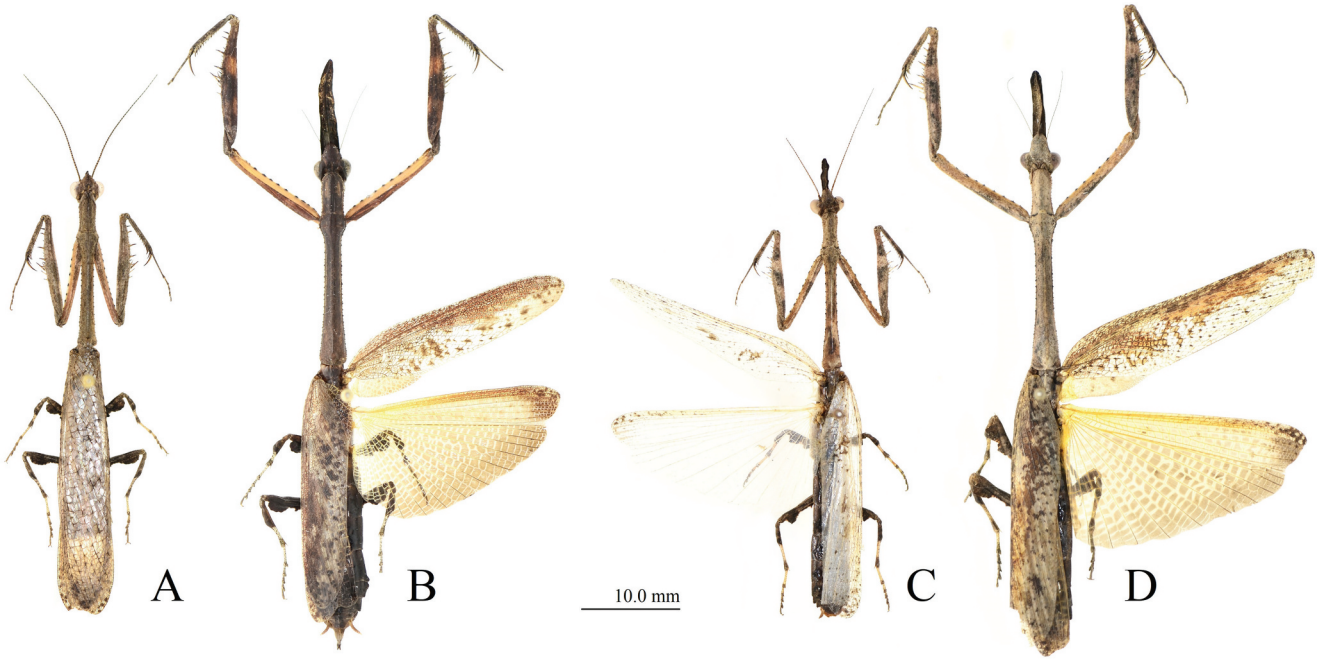

Figure 2. *Phyllothelys* spp. of *P. westwoodi* species group, body in dorsal view. **A, B**, *P. breve*; **C, D**, *P. decipiens*; **A, C**, male; **B, D**, female.

Philippines (Luzon) in the collection of Jia-Zhi Zhang (Shanghai, China). It may be the female of *Phyllothelys bakeri*; this specimen is similar to a robust *P. breve*, but is very unique in the absence of black bands on inner surface of the prothoracic femora.

It is worth considering that there is no significant difference in the head characteristics of females between examined specimens from central India and the illustrations of the head of *P. taprobanae* provided by Wood-Mason (1889), although we have not examined any specimens from Sri Lanka.

For the specimens collected from the Indochina Peninsula, we examined male specimens with short vertex in Thailand, Myanmar, Vietnam and Laos and we think they are conspecific. After observing the illustrations of males from Southeast Vietnam (Shcherbakov & Anisyutkin 2018) and the photos from the Assam region of India, there is no obvious difference between those male specimens from Southeast Vietnam, from Assam region and from Yunnan. Therefore, we believe that the relationship between *P. breve, P. paradoxum, P. mitratum* and *P. westwoodi* should be reconsidered. In particular, it is important to note that through the breeding of *P. breve* in Yunnan, we determine that the male nymphs possess elongate vertical process on the head. Some nymphs have large teeth on the lateral margin of vertical process, but sudden atrophy of the vertical process happened when they became adults. This may be adaptation to flying. Therefore, the nymph's vertical process on head cannot be used to identify species.

Distribution

South Yunnan, South-West Guangxi.

Phyllothelys cornutum species group

Phyllothelys cornutum (Zhang, 1988)

(Figures 1B, F; 3A, B; 6B; 7B; 9B; 10B; 11B; 17C, D; 19; 21)

Kishinouyeum cornutum Zhang 1988, pp. 301–304; Wang 1993, p. 68; Yang & Wang 1999, p. 87; Otte & Spearman 2005, p. 304.
Kishinouyeum cornuta: Ehrmann 2002, p. 198.
Phyllothelys cornutum: Ehrmann & Roy 2009, p. 69; Zhu et al. 2012, p. 177.

Type locality

Fujian, Chong'an.

Material examined

China. 1♀, Fujian, Wuyishan, Sangang; 27°44′54″N 117° 40′39″E; 900 m; 3.X.2018; Cai-Yi Liang leg. (CWC). 1♂, Fujian, Wuyishan, Dazhulan; 27°41′44″N 117°28′22″E; 1200 m; 6.IX.2020; Chao Wu leg. (IZCAS). 1♂, Fujian, Wuyishan, Guadun; 27°44′02″N 117°35′36″E; 1200 m; 15.X.2020; Zhao-Nan Xia leg. (CWC). 1♂, Fujian, Wuyishan, Sangang; 950 m; IX.2018; Zhuo-Qing Zhu leg. (CJZ). 2♂, Taiwan, Hualian; 1200 m; VIII.2010 (CWC).

Redescription

A very unusual *Phyllothelys*, green and moss-colored. This species is very rare, and females especially are difficult to find (Figures 17C, D and 19).

Head. Vertical process with sharp apex. In males: vertical process short, thin, about as long as head, with 2–4 sharp teeth on lateral margin (Figure 6B). In females: vertical process very exaggerated, long, wide, about 2 times longer than head, with 3–4 conspicuous large obtuse teeth on lateral margin (Figure 3A).

Pronotum. Robust, lateral pronotal expansion angle-shaped; lateral margin of pronotum with sparsely arranged black large grainy spines, interleaved with small ones (Figure 7B). Ratio of pronotum length to supracoxal dilation width about 3.13 in males and 2.59–2.60 in females.

Prothoracic legs. Cross-section of fore coxae triangular; dorsal margin with 6–7 spine-like darkened tubercles; interior surface of fore coxae yellowish-brown, distally positioned with black area. Interior surface of fore femora yellowish-brown, with three disjunctive black bands; dorsal margin of fore femora flat; femora with 11–12 anteroventral femoral spines. Tibiae bearing 10–11 posteroventral and 12–13 anteroventral small and inclined tibial spines. First joint of tarsi longer than combined length of the remaining segments (Figure 1B).

Meso- and metathoracic legs. Slender and elongate, green; femora with disjunctive proximal and preapical lobes; semicircular proximal lobe slightly smaller than fin-like preapical lobe. Tibiae elongate, very slender, middle of tibiae inflated, becoming slender apicad; first joint of tarsi longer than combined length of the remaining segments (Figure 1F).

Wings. In males: forewings narrow, longer than abdomen; costal area opaque, green; discoidal area translucent, light brown and mottled green, with some large stains (Figure 9B); hind wings translucent, smoky with darker areas, with yellowish base, with brownish radial veins and light-colored cross veins. In females: forewings similar to males, but shorter, opaque, and more stained; hind wings rich in color (Figure 3A).

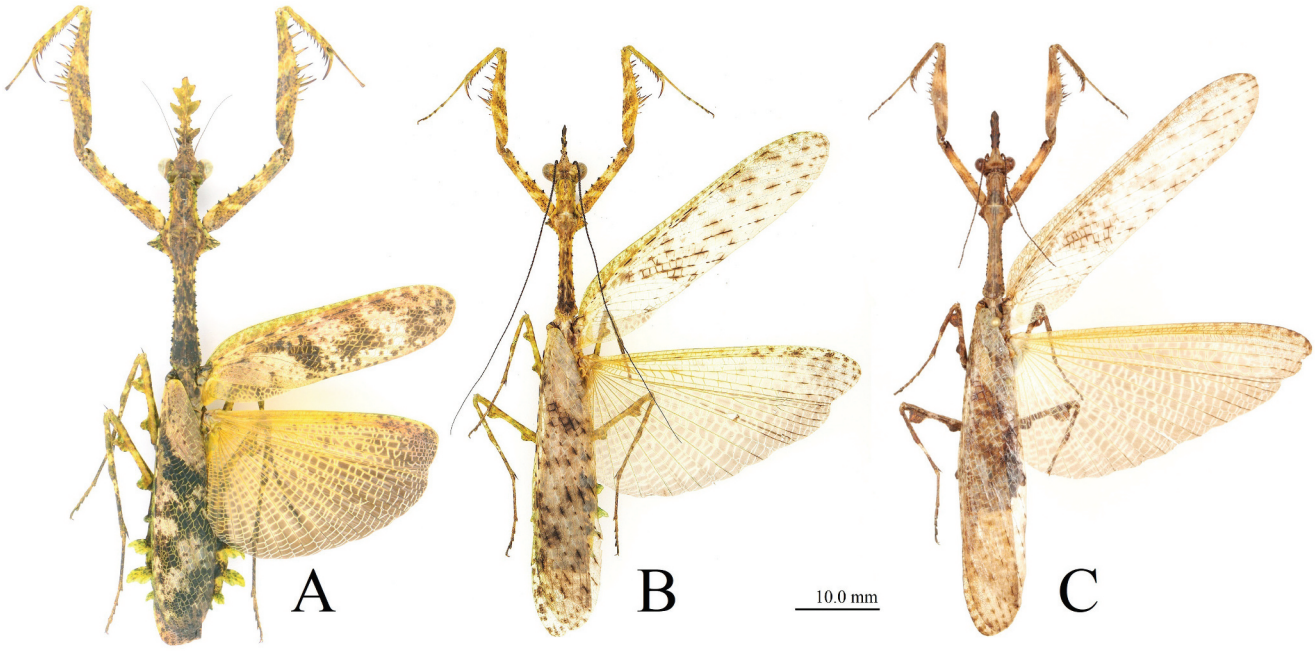

Figure 3. *Phyllothelys* spp. of *P. cornutum* species group, body in dorsal view. **A, B**, *P. cornutum*; **C**, *P. cancongi* **n. sp.**, paratype; **A**, female; **B, C**, male.

Abdomen. Yellow-green, with yellowish-brown spots, flat; long and narrow in males and wide in female; lateral lobes on tergites 3 to 8 prominent, leaf-like, bright green, with sharp tip, among which the lateral lobes of tergites 4–6 are comparatively large and prominent; ventral sternal lobe sharp, green. Male subgenital plate yellowish-brown and cerci light colored (Figure 10B).

External genitalia. Ventral phallomere wide, rhombus-shaped, deep concave in left edge, posterior process slightly prominent, small and blunt, covered with numerous tubercles; apical process of left phallomere short and wide, margin sclerotized; phalloid apophysis strongly sclerotized, saddle-shaped, covered with numerous tubercles (Figure 11B).

Measurements (length in mm)

Body (head to wings): male 61.02–62.85, female 61.98; pronotum: male 16.85–16.98, female 20.68; fore coxae: male 10.68–10.88, female 13.70; fore femora: male 11.95–12.05, female 15.33; fore tibiae: male 8.18–8.34, female 9.98; middle femora: male 9.76–9.98, female 11.95; hind femora: male 11.42–11.67, female 13.34; forewings: male 36.69–37.02, female 28.42; hind wings: male 31.58–31.95, female 25.37.

Distribution

Fujian, Taiwan.

Phyllothelys cancongi n. sp.
(Figures 3C; 6C; 7C; 8C, D; 9C; 10C; 11C; 17B; 21)

Type material

Holotype. ♂, China, Sichuan, Ya'an, Tianquan; 29°57′48″N 103°02′13″E; 1650 m; 10.VIII.2019; Chao Wu leg. (IZCAS).

Paratypes. 2♂, China, Sichuan, Ya'an, Er'langshan Mt.; 30°06′48″N 102°41′58″E; 1900 m; 13.VIII.2019; Chao Wu leg. (IZCAS). 2♂, same data (CWC and CJZ).

Description of male

Similar to *Phyllothelys cornutum*. Brownish green, large-sized, robust, mottled *Phyllothelys* (Figure 17B).

Head. Triangle, eyes rounded. Vertical process elongate, about 1.5 times longer than head, with 3–4 obtuse teeth on lateral margin; apex obtuse, wide. Ocelli rounded, lateral ocellus same as central ocellus. Lower frons subpentagonal, wider than high; upper margin obtuse-angled, nearly smooth. Antenna filiform, long, slightly shorter than body, brownish (Figure 6C).

Pronotum. Long and robust; lateral pronotal expansion obtuse without sharp tip; lateral margin of pronotum with sparsely arranged black large grainy spines, interleaved with small ones. Ratio of pronotum length to supracoxal dilation width about 3.65 (Figure 7C).

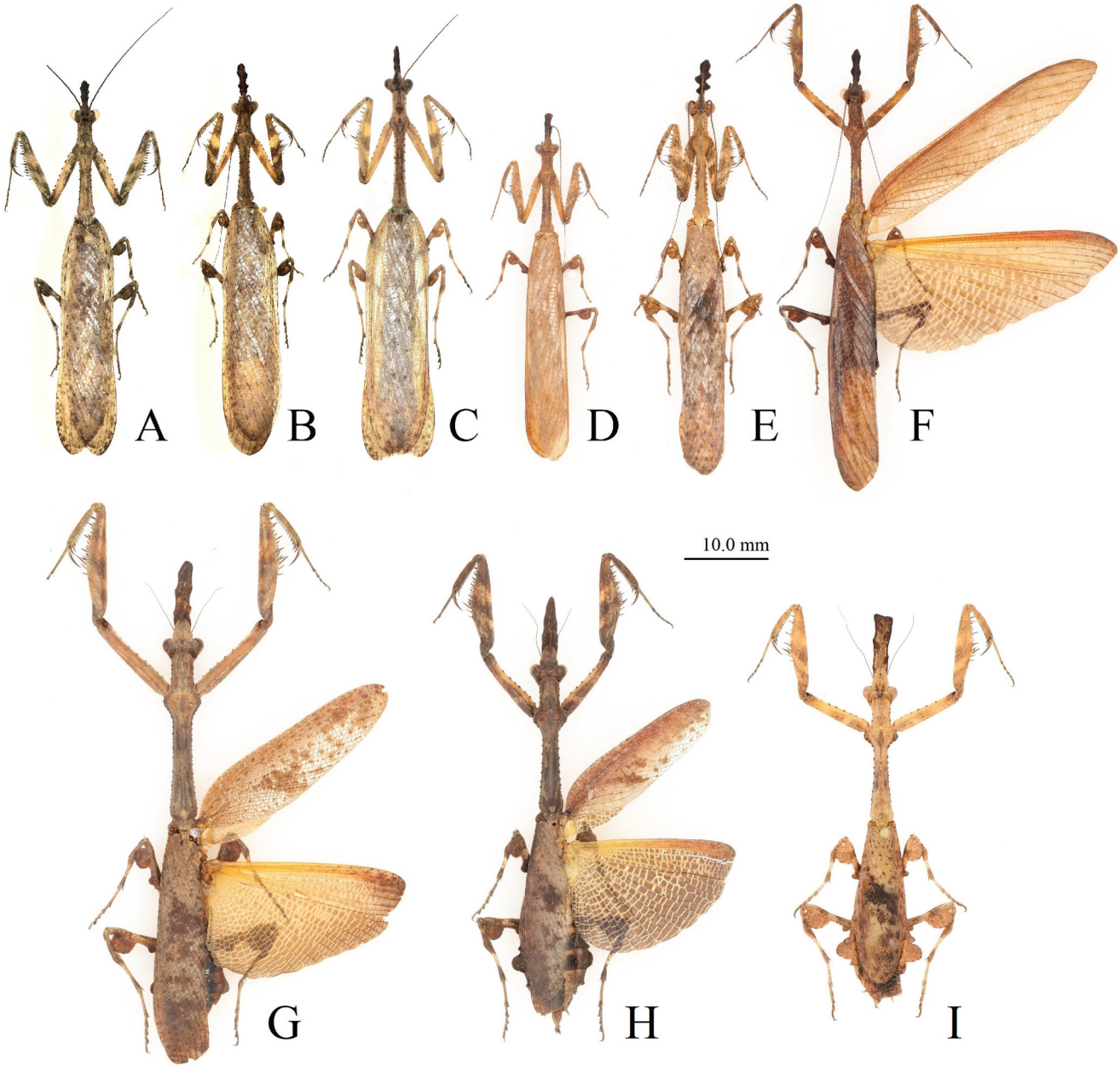

Figure 4. *Phyllothelys* spp. of *P. sinense* species group, body in dorsal view. **A, G**, *P. sinense sinense*; **B**, *P. shaanxiense*; **C**, *P. tianfuense* **n. sp**., holotype; **D, H**, *P. cangshanense*; **E**, *P. tengchongense* **n. sp**., paratype; **F**, *P. xiezhi* **n. sp**. paratype; **I**, *P. parvulum*; **A–F**, male; **G–I**, female.

Prothoracic legs. Cross-section of fore coxae triangular; dorsal margin with 7–9 spine-like darkened tubercles; interior surface of fore coxae reddish brown, distally positioned with black area. Interior surface of fore femora yellowish-brown, with three disjunctive black bands; dorsal margin of fore femora flat; femora with 13–14 anteroventral femoral spines. Tibiae bearing 10–11 posteroventral and 12–13 anteroventral inclined small tibial spines. First joint of tarsi longer than combined length of the remaining segments (Figure 8C, D).

Meso- and metathoracic legs. Slender, brownish; femora with disjunctive proximal and preapical lobes; semicircular proximal lobe smaller than wide preapical lobe. Tibiae elongate, very slender, middle of tibiae inflated, becoming slender apicad; first joint of tarsi longer than combined length of the remaining segments.

Wings. Forewings narrow, much longer than abdomen; costal area opaque, brown green; discoidal area translucent, light brown, with some densely arranged large stains,

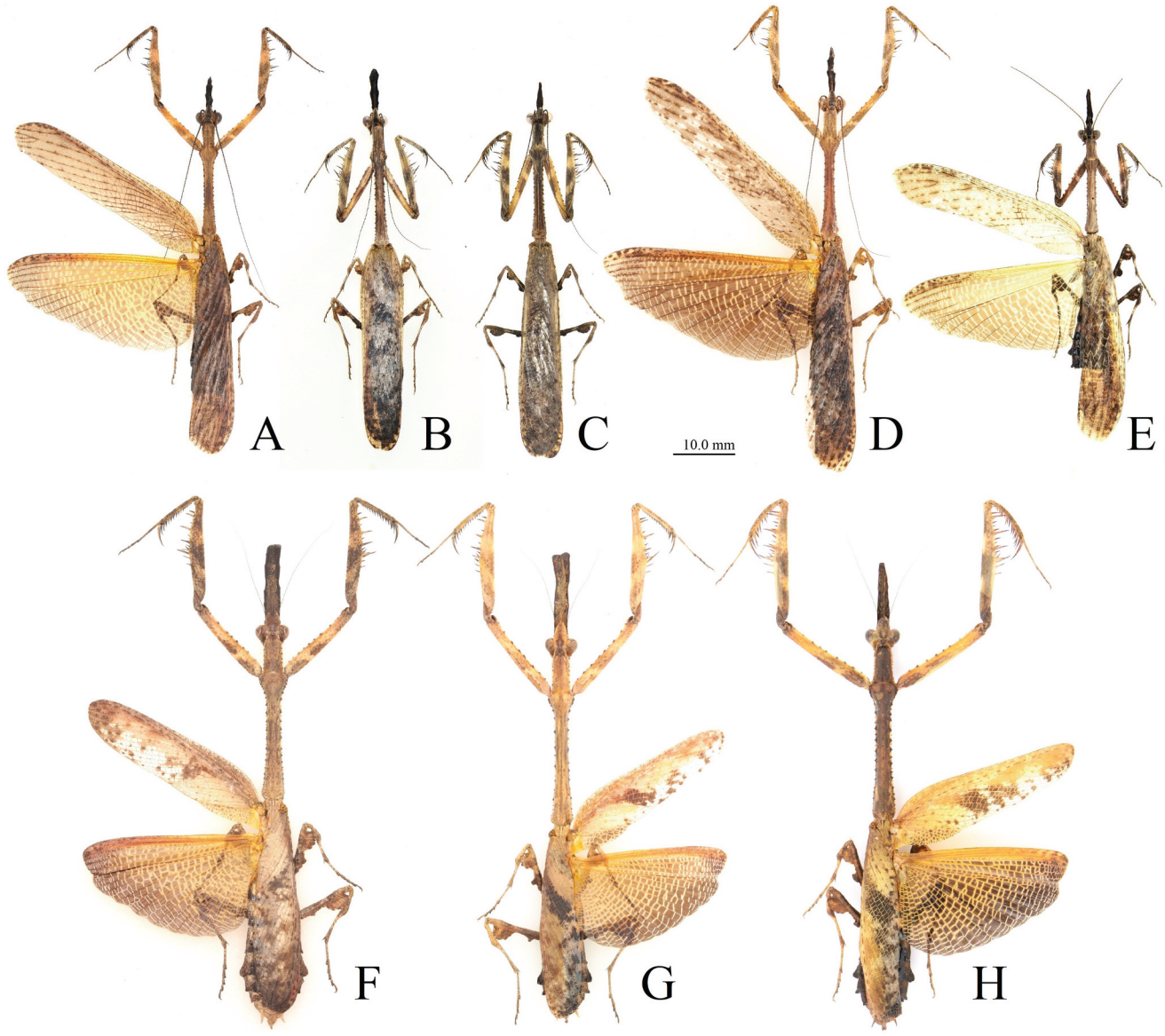

Figure 5. *Phyllothelys* spp. of *P. werneri* species group, body in dorsal view. A, F, *P. werneri*; B, G, *P. jianfenglingense*; C, H, *P. jiazhii* **n. sp.,** paratypes; D, *P. dulongense* **n. sp.,** paratype; E, *P. chuangtsei* **n. sp.,** holotype; A–E, male; F–H, female.

which are connected into a piece (Figure 9C). Hind wings translucent, smoky with darker areas, with yellowish base, brownish radial veins and light-colored cross veins.

Abdomen. Yellowish-brown, with brown spots; long and narrow, flat, with prominent brownish lateral lobes on tergites 4 to 7, among which the lateral lobes of tergum 5 are comparatively large, prominent and blunt; ventral sternal lobe short, sharp, brownish. Male subgenital plate yellowish-brown and cerci light colored (Figure 10C).

External genitalia. Ventral phallomere wide, rhombus-shaped; its posterior process slightly prominent, small with blunt tip but without thorns; apical process of left phallomere short and wide, with sclerotized margin; phalloid apophysis strongly sclerotized, small and hill-shaped, covered with numerous tubercles (Figure 11C).

Measurements (length in mm)

Body (head to wings): 60.95–63.45; pronotum: 16.41–17.12; fore coxae: 10.58–11.18; fore femora: 11.55–12.63; fore tibiae: 8.03–8.92; middle femora: 9.44–9.96; hind femora: 11.13–11.58; forewings: 36.85–37.78; hind wings: 31.86–32.53.

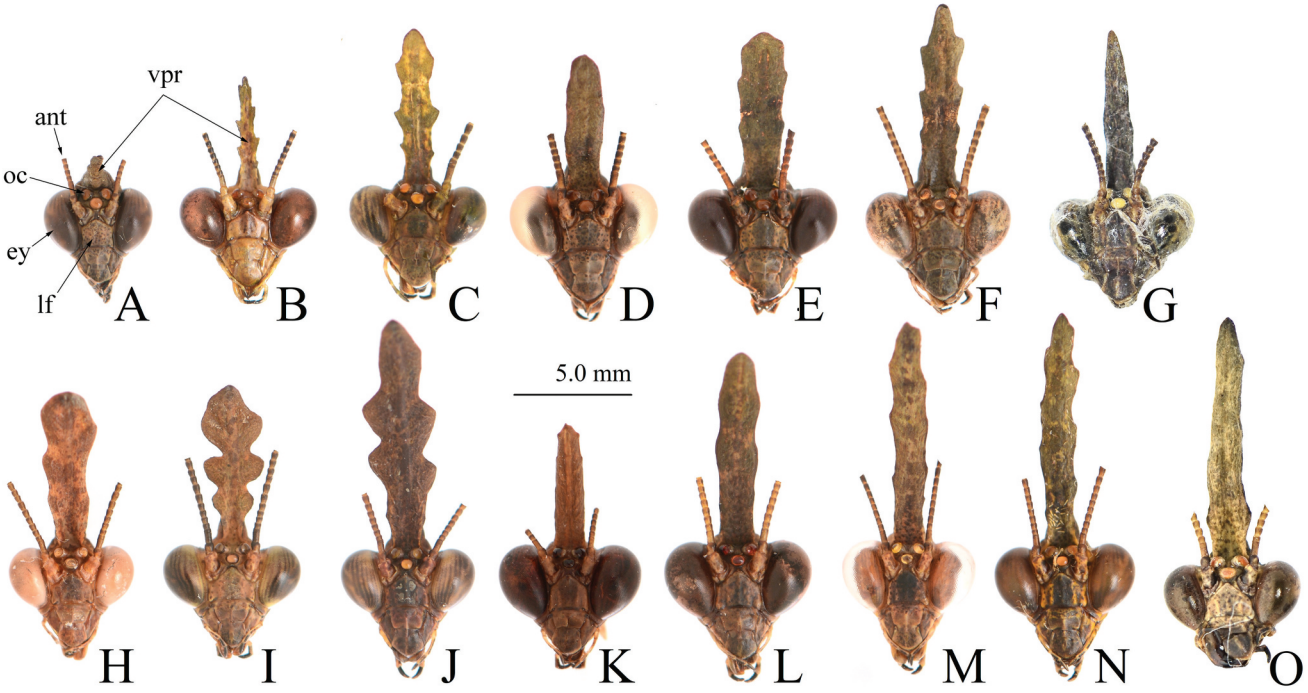

Figure 6. Head of male *Phyllothelys* spp., anterior view. **A**, *P. breve*; **B**, *P. cornutum*; **C**, *P. cancongi* **n. sp.; D**, *P. sinense sinense*; **E**, *P. sinense robustum*; **F**, *P. shaanxiense*; **G**, *P. tianfuense* **n. sp.; H**, *P. cangshanense*; **I**, *P. tengchongense* **n. sp.; J**, *P. xiezhi* **n. sp.; K**, *P. jiazhii* **n. sp.; L**, *P. werneri*; **M**, *P. jianfenglingense*; **N**, *P. dulongense* **n. sp.; O**, *P. chuangtsei* **n. sp**. Abbreviations: ant = antenna; ey = compound eye; lf = lower frons; oc = ocellus; vpr = vertical process.

Distribution

Sichuan.

Etymology

The new species is named after Can Cong, the first King of Bashu area (Sichuan Province now).

Phyllothelys sinense species group

Phyllothelys sinense sinense (Ôuchi, 1938)

(Figures 1C, G; 4A, G; 6D; 7D; 9D; 10D; 11D; 14A, B; 15D–F; 16B; 17E, F; 20A; 21)

Kishinouyeum sinensis Ôuchi 1938, pp. 23–26; Zhang 1988, pp. 301–302; Zhou & Shen 1992, p. 65; Wang 1993a, p. 69; Ehrmann 2002, p. 198; Otte & Spearman 2005, p. 304.
Phyllothelys sinense: Ehrmann & Roy 2009, p. 69; Zhu et al. 2012, pp. 166–168.

Type locality

Zhejiang, Tianmushan Mt.

Material examined

China. Allotype: ♀, Tiemnnshan; 27.VIII.1936. (SEM) (Figure 16B). 3♂, Zhejiang, Linan, Tianmushan Mt.; 30° 20′24″N 119°30′04″E; 1000 m; VII.2019; Wen-Xuan Bi leg. (CWC). 1♂, 1♀, Fujian, Wuyishan, Sangang; 27°44′ 54″N 117°40′39″E; 900 m; 6.IX.2020; Chao Wu leg. (IZCAS). 1♂, same data; Yu-Chen Zheng leg. (IZCAS). 12♂, 1♀, Jiangxi, Shang'rao, Yejiachang; 27°50′54″N 117°43′22″E; 1150 m; 27.VII.2010; Chao Wu leg. (CWC). 1♀, Zhejiang, Lin'an, Tianmushan Mt.; 950 m; 27.VIII.2001; Jia-Yao Hu leg. (CWC). 1♀, Zhejiang, Qingyuan, Fengyangshan Mt.; 1550 m; 1.VIII.2008; Wen-Xuan Bi leg. (CWC); 1♂, 1♀; Fujian (= Fukien), Kuatun; 27°24′N 117°24′E; 2300 m; X.1965; F. Hoffmüller leg. (SMNK).

Redescription

Head. In males: vertical process of head short, flat, wide, about as long as head, with toothless lateral margin and obtuse apex (Figure 6D). In females: vertical process of head about 1.6–1.8 times longer than head, with sharp

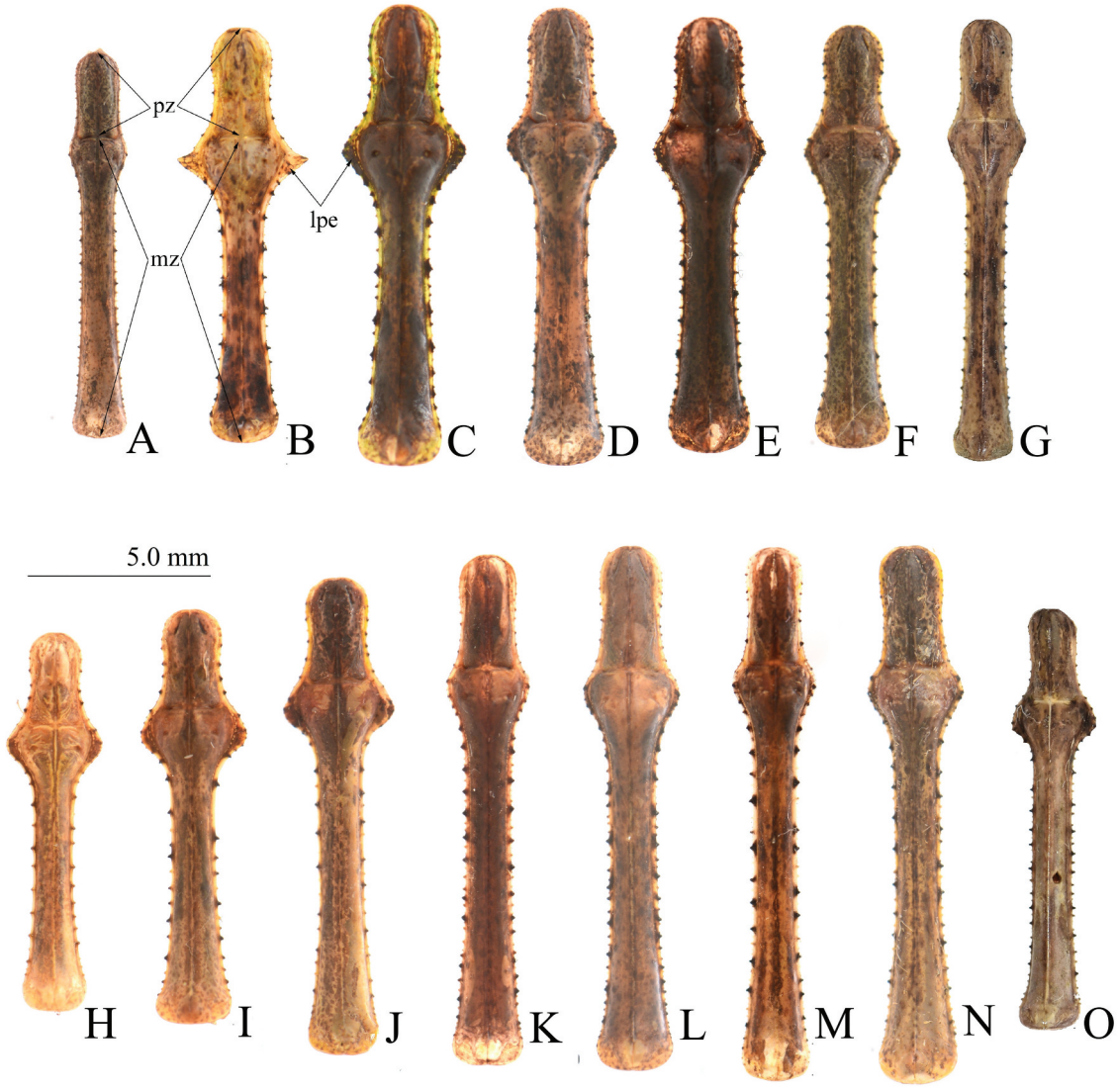

Figure 7. Pronotum of male *Phyllothelys* spp., dorsal view. **A**, *P. breve*; **B**, *P. cornutum*; **C**, *P. cancongi* **n. sp.; D**, *P. sinense sinense*; **E**, *P. sinense robustum*; **F**, *P. shaanxiense*; **G**, *P. tianfuense* **n. sp.; H**, *P. cangshanense*; **I**, *P. tengchongense* **n. sp.; J**, *P. xiezhi* **n. sp.; K**, *P. jiazhii* **n. sp.; L**, *P. werneri*; **M**, *P. jianfenglingense*; **N**, *P. dulongense* **n. sp.; O**, *P. chuangtsei* **n. sp**. Abbreviations: lpe = lateral pronotal expansion; mz = metazone; pz = prozone.

apex; lateral margin of vertical process with obtuse teeth, narrowed towards top.

Pronotum. Long; lateral pronotal expansion small, obtuse, without sharp tip; lateral margin of pronotum with sparsely arranged black large grainy spines, interleaved with small ones (Figure 7D). Ratio of pronotum length to supracoxal dilation width about 3.98–4.1 in male and 4.38 in female.

Prothoracic legs. Femora with 13–15 anteroventral femoral spines, tibiae with 12–13 posteroventral and 12–14 anteroventral tibial spines.

Wings. In males: forewings narrow, longer than abdomen; costal area opaque and brown; discoidal area translucent, brown, with some stains (Figure 9D). In females: forewings slightly shorter and wider than those in males, more intensely colored. Hind wings translucent, smoky with darker areas, with yellowish base, brownish radial veins and light-colored cross veins.

Abdomen. Flat, brown; long and narrow in males and comparatively wide in females. Prominent lateral lobes on tergum 5 small, obtuse; ventral sternal lobe sharp, brown. Male subgenital plate brownish and cerci light colored (Figure 10D).

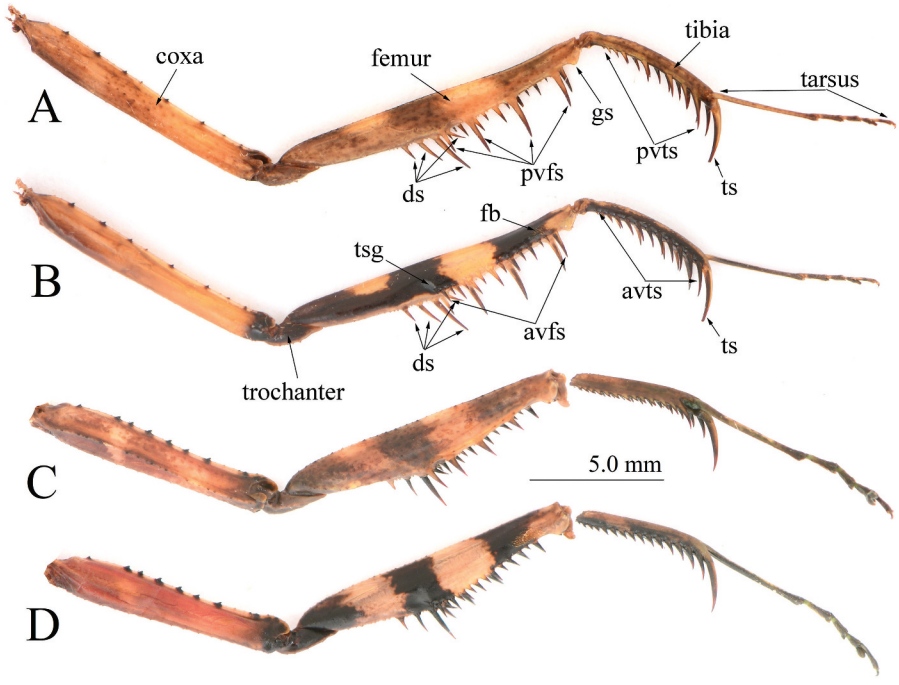

Figure 8. Prothoracic legs of male *Phyllothelys* spp. **A, B**, *P. jiazhii* **n. sp.; C, D**, *P. cancongi* **n. sp. A, C**, dorsal view; **B, D**, ventral view. Abbreviations: avfs = anteroventral femoral spines; avts = anteroventral tibial spines; ds = discoidal spines; fb = femoral brush; gs = genicular spur; pvfs = posteroventral femoral spines; pvts = posteroventral tibial spines; ts = tibial spur; tsg = tibial spur groove.

External genitalia. Ventral phallomere wide, cello-shaped, edges with deep concavity; posterior process of ventral phallomere finger-shaped, small and blunt, covered with numerous tubercles; apical process of left phallomere short and wide, with sclerotized margin; phalloid apophysis strongly sclerotized, saddle-shaped, covered with numerous tubercles (Figure 11D).

Measurements (length in mm)

Body (head to wings): male 56.55–58.86, female 64.32–66.25; pronotum: male 13.56–14.45, female 21.68–22.45; fore coxae: male 8.02–8.79, female 13.22–13.98; fore femora: male 8.83–9.36, female 14.36–14.95; fore tibiae: male 5.87–6.18, female 8.52–8.88; middle femora: male 6.05–6.63, female 9.01–9.32; hind femora: male 6.98–7.18, female 9.98–10.12; forewings: male 33.05–34.88, female 30.83–31.25; hind wings: male 31.53–32.56, female 28.84–29.12.

Note

The specimens' labels preserved in SMNK indicate that those specimens were collected from Kuatun (= Guadun, Fujian), at 2300 m in altitude (Figure 15D–F); but Guadun is about 1300 m high, and the highest elevation of Fujian Province is only 2158 m (Huang'gang Mt.).

Distribution

Zhejiang, Jiangxi, Jiangsu, Fujian, Hunan, Hubei.

***Phyllothelys sinense robustum* (Niu & Liu, 1998) n. stat. (Figures 6E; 7E; 21)**

Kishinouyeum robusta Niu & Liu 1998, pp. 14–16; Ehrmann 2002, p. 198; Otte & Spearman 2005, p. 304.
Phyllothelys robustum: Ehrmann & Roy 2009, p. 69; Zhu et al. 2012, p. 169.

Type locality

Henan, Neixiang.

Material examined

China. 4♂, 1♀, Henan, Nanyang, Neixiang; 32°48′52″N 111°23′07″E; 1200 m; 10.VIII.2015 (IZCAS).

Diagnosis

Niu & Liu (1998) described *Kishinouyeum robusta* from a female specimen collected from Neixiang in Henan Province, together with illustrations of the head and the anterior part of pronotum. The original description of *K. robusta* shows that the vertical process of the head is angular at apex, with notched sides. After examining numerous *Phyllothelys*

Figure 9. Forewings of male *Phyllothelys* spp., dorsal view. **A**, *P. breve*; **B**, *P. cornutum*; **C**, *P. cancongi* **n. sp.; D**, *P. sinense sinense*; **E**, *P. shaanxiense*; **F**, *P. tianfuense* **n. sp.; G**, *P. cangshanense*; **H**, *P. tengchongense* **n. sp.; I**, *P. xiezhi* **n. sp.; J**, *P. jiazhii* **n. sp.; K**, *P. werneri*; **L**, *P. jianfenglingense*; **M**, *P. dulongense* **n. sp.; N**, *P. chuangtsei* **n. sp.**

specimens including those from Neixiang, we think that there is no significant difference in the vertical process of the head or in the male external genitalia between *K. robusta* and *Phyllothelys sinense* (Ôuchi). Moreover, *Phyllothelys robustum* in the north of Yangtze River is smaller and more robust than *P. sinense* in the south of Yangtze River. The Yangtze River can be considered as geographical separation between the populations of the north and those of the south. Then, we keep *P. robustum* as a subspecies of *P. sinense*. In *P. sinense robustum* (Niu & Liu) **n. stat**., the ratio of pronotum length to supracoxal dilation width is about 3.94–3.95 in males (Figure 7E) and 4.31–4.32 in females, slightly different from those in *P. sinense sinense*.

Measurements (length in mm)

Body (head to wings): male 55.15–55.88, female 64.24; pronotum: male 13.98–14.05, female 22.05; fore coxae male 8.42–8.57, female 13.32; fore femora: male 8.95–9.04, female 14.75; fore tibiae: male 6.02–6.10, female 8.63; middle femora: male 6.13–6.33, female 9.12; hind femora: male 6.96–7.02, female 10.05; forewings: male 33.65–33.95, female 30.95; hind wings: male 31.64–32.04, female 28.93.

Distribution

Henan.

Phyllothelys shaanxiense (Yang, 1999)

(Figures 4B; Figures 6F; 7F; 9E; 10E; 11E; 16D; 18B, C; 21)

Kishinouyeum shaanxiense Yang 1999, p. 30.
Phyllothelys shaanxiense: Ehrmann & Roy 2009, p. 70.

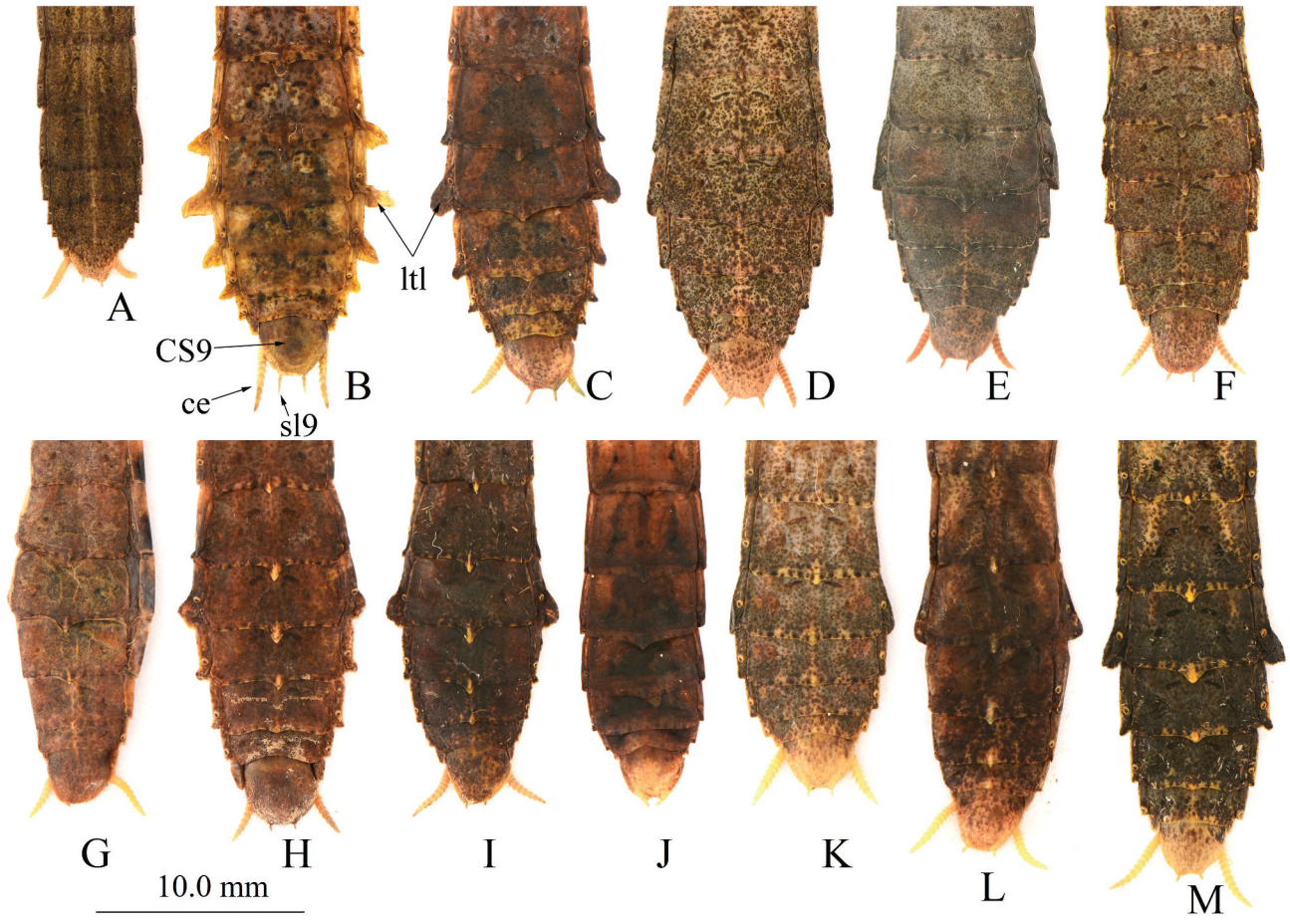

Figure 10. Abdomen of male *Phyllothelys* spp., ventral view. **A**, *P. breve*; **B**, *P. cornutum*; **C**, *P. cancongi* **n. sp.; D**, *P. sinense sinense*; **E**, *P. shaanxiense*; **F**, *P. tianfuense* **n. sp.; G**, *P. cangshanense*; **H**, *P. tengchongense* **n. sp.; I**, *P. xiezhi* **n. sp.; J**, *P. jiazhii* **n. sp.; K**, *P. werneri*; **L**, *P. jianfenglingense*; **M**, *P. dulongense* **n. sp**. Abbreviations: ce = cercus; CS9 = ♂ coxosternite; ltl = lateral tergal lobe; sl9 = stylus.

Type locality

China: Shaanxi, Nanzheng.

Material examined

China. Holotype. ♂, Shaanxi, Nanzheng; 1500 m; 15. VIII.1979 (CAU) (Figure 16D). 5♂, 1♀, Shaanxi, Hanzhong, Huayang; 33°34′08″N 107°33′37″E; 1400 m; 9. VI.2016; Chao Wu leg. (CWC). 4♂, Shaanxi, Hanzhong, Zhouzhi; 34°03′36″N 107°59′51″E; 1400 m; 11.VIII.2011; Chao Wu leg. (IZCAS).

Redescription

Similar to *Phyllothelys sinense* but slender.

Head. Vertical process elongate, about 1.7 times (in males) or 2.0 times (in females) longer than head, with 3–4 obtuse teeth on lateral margin and sharp apex (Figure 6F). In females, vertical process about 2 times the length of the head, lateral margin with obtuse teeth, narrow to the top; apex sharp.

Pronotum. Long, robust; lateral pronotal expansion small, obtuse, without sharp tip; lateral margin of pronotum with sparsely arranged black large grainy spines, interleaved with small ones (Figure 7F). Ratio of pronotum length to supracoxal dilation width about 4.53–4.54 in males and 4.45–4.48 in females.

Prothoracic legs. Similar to *Phyllothelys sinense*; femora with 13–15 anteroventral femoral spines, tibiae with 12–13 posteroventral and 12–14 anteroventral tibial spines.

Wings. Forewings longer than abdomen; hind wings shorter than forewings, translucent, smoky with brownish radial veins and light-colored cross veins. In males: forewings narrow; costal area opaque, brown; discoidal

area almost transparent, light smoky, with some inconspicuous stains (Figure 9E); hind wings also with darker areas. In females: forewings opaque except for brownish hind margin scattered with black stains; hind wings with yellowish-brown areas.

Abdomen. Flat, brown; long and narrow in males and wide in females. Prominent lateral lobes on tergum 5 small, obtuse; ventral sternal lobe sharp, brown. Male subgenital plate brownish and cerci light colored (Figure 10E).

External genitalia. Similar to *Phyllothelys sinense*, but posterior process of ventral phallomere comparatively long (Figure 11E).

Measurements (length in mm)

Body (head to wings): male 58.12–58.88, female 65.85–66.27; pronotum: male 14.34–14.48, female 22.37–23.14; fore coxae male 8.72–8.85, female 13.56–14.00; fore femora: male 9.28–9.38, female 14.67–15.12; fore tibiae: male 6.14–6.25, female 8.76–9.08; middle femora: male 6.64–6.78, female 9.14–9.21; hind femora: male 7.12–7.29, female 10.21–11.03; forewings: male 34.78–35.46, female 32.50–33.85; hind wings: male 32.14–33.02, female 30.08–31.74.

Distribution

Shaanxi.

Phyllothelys tianfuense n. sp. (Figures 4C; 6G; 7G; 9F; 10F; 11F; 21)

Type locality

China: Sichuan, Ya'an.

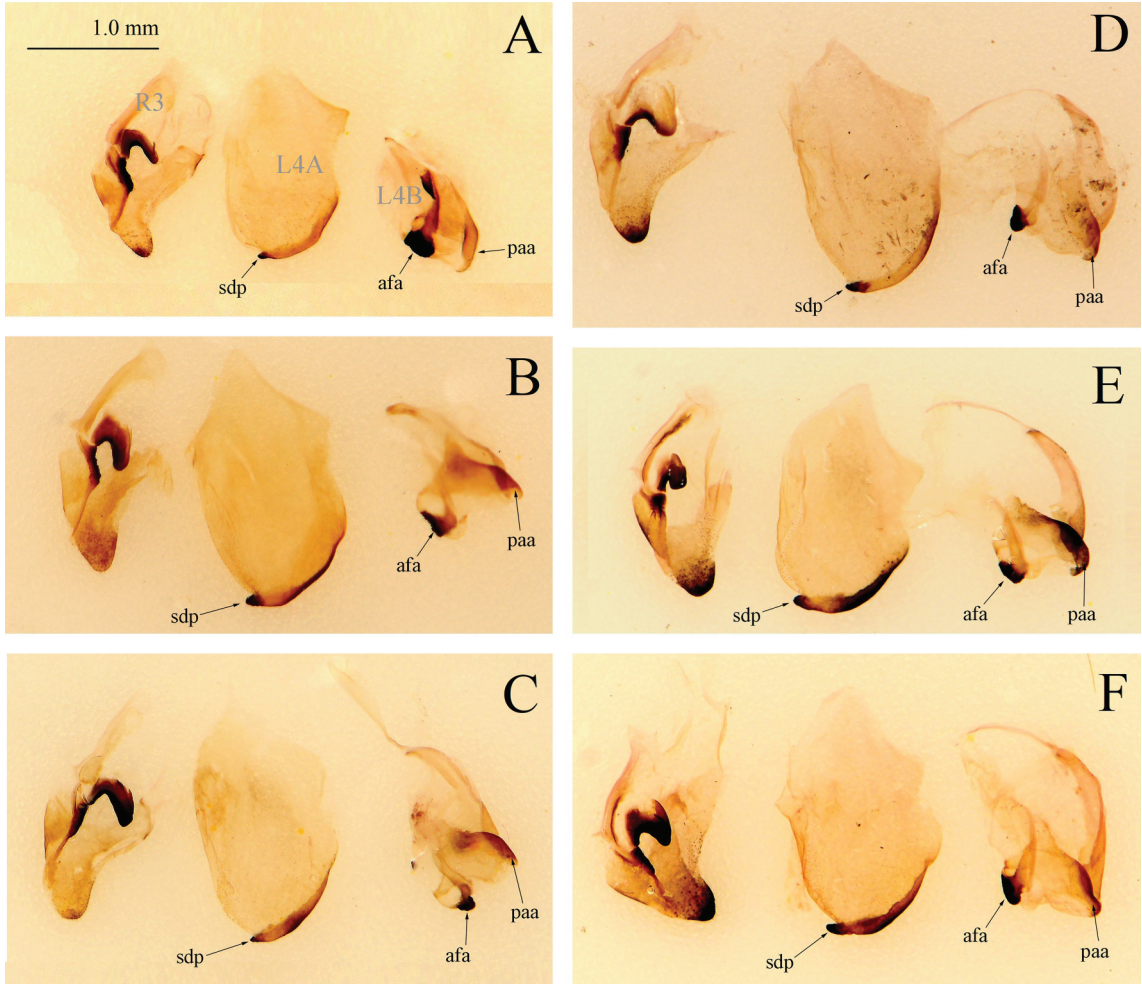

Figure 11. Male genitalia of *Phyllothelys* spp., disarticulated genital complex, ventral view. **A**, *P. breve*; **B**, *P. cornutum*; **C**, *P. cancongi* **n. sp.; D**, *P. sinense sinense*; **E**, *P. shaanxiense*; **F**, *P. tianfuense* **n. sp**. Abbreviations: L4A = sclerite extending over the ventral wall of left phallomere; L4B = sclerite extending over the dorsal wall of left phallomere; R3 = anteriorly extending sclerite of right phallomere; sdp = secondary distal process; afa = anterior process (left phallomere); paa = posterior process (left phallomere).

Type material

Holotype. ♂, China, Sichuan, Ya'an, Tianquan; 30°03′53″N 102°45′17″E; 1650 m; 10.VIII.2019; Chao Wu leg. (IZCAS).

Paratypes. 2♂, China, Sichuan, Ya'an, Tianquan; 30°03′ 53″N 102°45′17″E; 1650 m; 10.VIII.2019; Chao Wu leg. (IZCAS).

Description of male

Similar to *Phyllothelys shaanxiense* but very slender. Difference from other congeners is that there is no spot or stain in forewings (Figure 4C).

Head. Vertical process long, narrow, sharp, about 1.3 times longer than head, with simple toothless lateral margin and sharp apex (Figure 6G).

Pronotum. Slender; lateral pronotal expansion small, obtuse, without sharp tip; lateral margin of pronotum with sparsely arranged black large grainy spines, interleaved with small ones. Ratio of pronotum length to supracoxal dilation width about 5.58–5.59 (Figure 7G).

Prothoracic legs. Femora with 14–15 anteroventral femoral spines, among which distal one is longer than the others; tibiae with 12 posteroventral and 12–13 anteroventral tibial spines.

Meso- and metathoracic legs. A marked posteroventral keel on femora shaping into two evident lobes, i.e. small proximal and large preapical ones; tibiae shorter than femora, basal part of tibiae inflated; tarsus nearly as long as tibia, first joint of tarsi shorter than combined length of the remaining segments.

Wings. Long, narrow, longer than abdomen; costal area opaque, brown; discoidal area translucent, brownish, clean, concolorous, spotless (Figure 9F). Hind wings translucent, smoky, with yellowish-brown areas, brownish radial veins and light-colored cross veins.

Abdomen. Brown; long, narrow, flat; prominent lateral lobes on tergum 5 small, obtusely angular; ventral sternal lobe sharp, brown. Male subgenital plate brownish and the cerci light color (Figure 10F).

External genitalia. Ventral phallomere wide, cello-shaped, edges with deep concavity, of which posterior process is finger-shaped, similar to that in *Phyllothelys sinense*, but comparatively long, covered with numerous tubercles; apical process of left phallomere short, wide, with sclerotized margin; phalloid apophysis strongly sclerotized, saddle-shaped, covered with numerous tubercles (Figure 11F).

Measurements (length in mm)

Body (head to wings): 58.02–58.88; pronotum: 18.46–18.62; fore coxae: 10.96–11.02; fore femora: 12.16–12.25; fore tibiae: 7.58–7.84; middle femora: 7.56–7.75; hind femora: 9.51–9.88; forewings: 35.46–36.65; hind wings: 32.82–33.23.

Distribution

Sichuan.

Etymology

The new species is named after the type locality, Tianfu, another name for Sichuan Province.

Phyllothelys cangshanense (Mao, 2001) (Figures 4D, H; 6H; 7H; 9G; 10G; 12A; 20B; 21)

Kishinouyeum cangshanensis Mao 2001, pp. 505–506.
Phyllothelys cangshanense: Ehrmann & Roy 2009, p. 69; Zhu et al. 2012, p. 177.

Type locality

China: Yunnan, Dali.

Material examined

China. Holotype. ♀, Yunnan, Dali, W-Cangshan Mt.; 2500 m; 23.VIII.1995; En-Yao Chen leg. (DTCY). 1♀, 2♂, Yunnan, Chuxiong; 24°53′59″N 101°23′05″E; 1960 m; 20.VIII.2014 (CJZ). 1♀, 1♂, Yunnan, Kunming, Xishan Mt.; 25°02′37″N 102°34′13″E; 2100 m; 15. IX.2011 (CWC). 3♂, Yunnan, Yuxi; 24°10′30″N 101°59′ 13″E; 1700 m; IX.2016 (IZCAS). 1♂, Yunnan, Dali, Weishan Mt.; 2238 m; 14.VII.2016; Xiao-Dong Yang leg. (CWC). 1♀, Yunnan, Qujing, Bole; 2000 m; 20. VII.2016 (CWC).

Redescription

Small- or medium-sized, robust *Phyllothelys*; proportion of male wing length to body length much greater than that in other congeners; female wings shorter than abdomen (Figure 4D, H). External genitalia unique, posterior process of ventral phallomere slightly prominent.

Head. In males: vertical process elongate, about 1.6 times longer than head, with blunt apex; toothless lateral margin of vertical process lightly wavy, gradually widened towards top (Figure 6H). In females: vertical process about 2.5 times longer than head, with sharp apex; lateral

margin of vertical process, narrowed towards top, without or with obtuse teeth.

Pronotum. Robust, much shorter than that in other congeners; lateral pronotal expansion obtuse, without sharp tip; lateral margin of pronotum with sparsely arranged brownish large grainy spines, interleaved with small ones (Figure 7H). Ratio of pronotum length to supracoxal dilation width about 3.94 in male, about 4.05–4.08 in female.

Prothoracic legs. Femora with 12–14 anteroventral femoral spines, among which the distal one is longer than the others; tibiae with 12–13 posteroventral and 12–13 anteroventral tibial spines.

Meso- and metathoracic legs. A marked posteroventral keel on femora shaping into two evident lobes, i.e. small proximal and preapical ones; tibiae shorter than femora, basal part of tibiae inflated; tarsus nearly as long as tibia, first joint of tarsi shorter than combined length of the remaining segments.

Wings. In males: forewings very long, narrow, much longer than abdomen; costal area opaque, brown; discoidal area translucent, yellowish-brown, concolorous, spotless (Figure 9G); hind wings translucent, smoky, with yellowish-brown areas, brownish radial veins and light-colored cross veins. In females: forewings shorter than or nearly as long as abdomen; forewings opaque except for brownish hind margin scattered with large black stains; hind wings shorter than forewings, smoky, with yellowish-brown areas, brownish radial veins and light-colored cross veins.

Abdomen. Brown, without spots; long, narrow in males and wide in females, flat; prominent lateral lobes on tergites 5 to 6 absent in males (Figure 10G), but obvious and large in females; ventral sternal lobe short, blunt, dark. Male subgenital plate dark, but cerci light colored.

External genitalia. Ventral phallomere wide, rhombus-shaped, posterior process slightly prominent, with a series of thorns; apical process of left phallomere short, wide, with sclerotized margin; phalloid apophysis strongly sclerotized, saddle-shaped, posterior lobe prominent, covered with numerous tubercles (Figure 12A).

Measurements (length in mm)

Body (head to wings): male 50.12–50.88, female 54.28–55.13; pronotum: male 11.88–12.04, female 17.88–18.02; fore coxae: male 7.32–7.56, female 12.12–12.46; fore femora: male 7.88–8.02, female 12.64–12.95; fore tibiae: male 5.14–5.22, female 8.37–8.58; middle femora: male 5.86–5.98, female 8.63–8.86; hind femora: male 7.42–7.86, female 9.82–9.98; forewings: male 31.42–33.04, female 24.18–24.85; hind wings: male 29.58–31.02, female 21.88–22.46.

Distribution

Yunnan, Sichuan.

Phyllothelys parvulum (Xu & Mao, 2004) (Figures 4I; 21)

Kishinouyeum parvula Xu & Mao 2004, pp. 8–10.
Phyllothelys parvula: Ehrmann & Roy 2009, p. 69; Zhu et al. 2012, p. 177.

Type locality

China: Yunnan, Er'yuan.

Material examined

China. 1♀, Yunnan, Zhaotong; 27°10′04″N 103°20′05″E; 2100 m; IX.2015 (CWC).

Diagnosis

Xu & Mao (2004) described *Kishinouyeum parvula* from one female specimen collected in Er'yuan, Yunnan. The original pictures (Xu & Mao 2004) illustrate the vertical process of head with truncate apex, the pronotum, and part of the abdomen. A table was included for comparison of the new species with *K. jianfenglingensis* and *K. cangshanensis*. Judging from the original description, this species is slightly different from *P. cangshanense* in the vertical process of head with truncated apex and comparatively small body size. However, there is variation about the apex of vertical process of head within a species, which might be truncate or sharp. The same situation is also found in *P. werneri* and *P. jianfenglingense*. The relationship between this species and *P. cangshanense* needs to be clarified through examining the male specimens from type locality (Figure 4I). We have examined a small-sized female of *Phyllothelys* collected near the type locality, which is not enough to answer the taxonomic question.

Measurements (length in mm)

Female. Body (head to wings): 50.18; pronotum: 16.22; fore coxae: 11.34; fore femora: 11.68; fore tibiae: 7.75; middle femora: 7.76; hind femora: 8.68; forewings: 22.95; hind wings: 20.32.

Distribution

Yunnan.

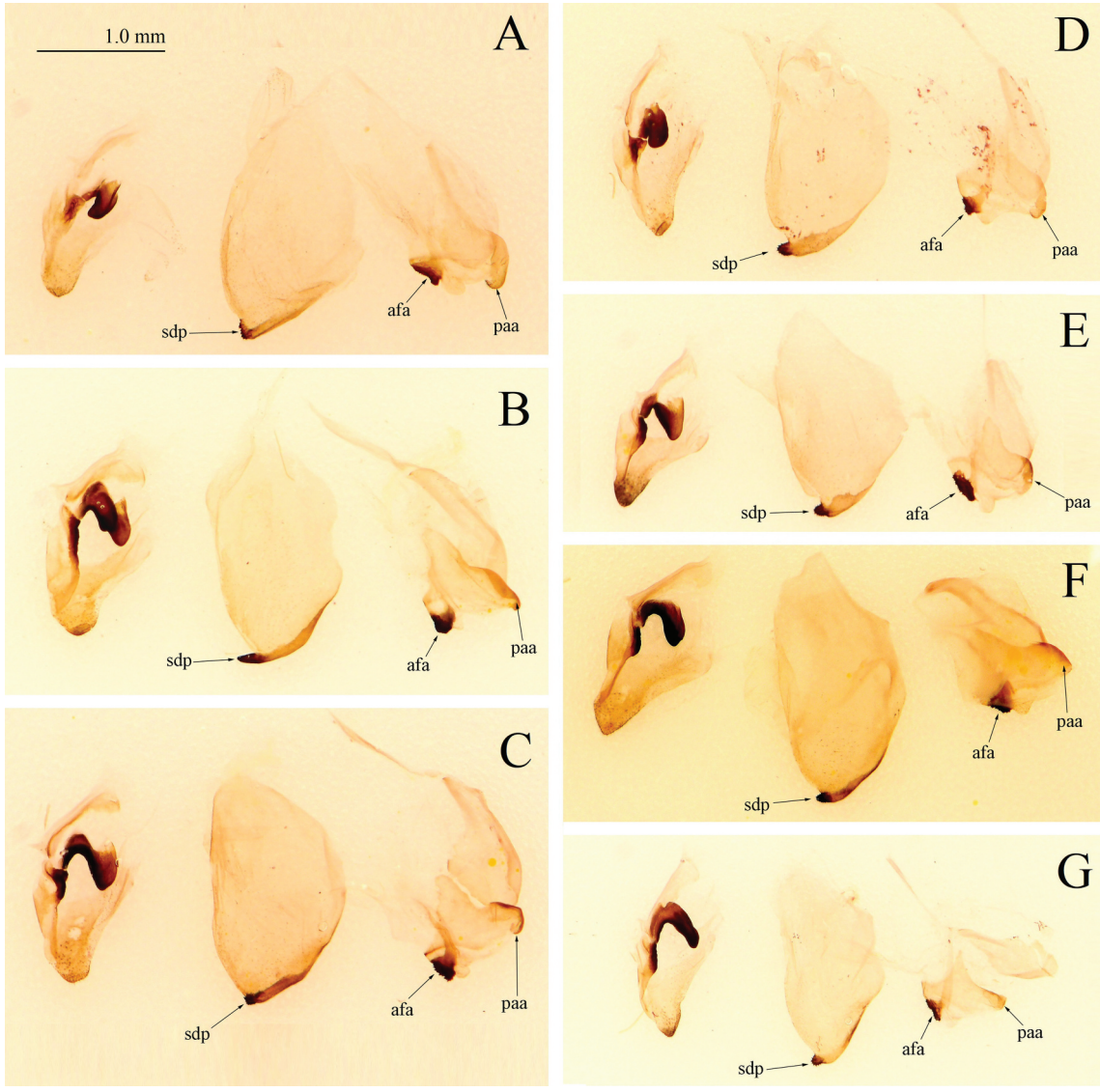

Figure 12. Male genitalia of *Phyllothelys* spp., disarticulated genital complex, ventral view. **A**, *P. cangshanense*; **B**, *P. tengchongense* **n. sp.; C**, *P. xiezhi* **n. sp.; D**, *P. werneri*; **E**, *P. jianfenglingense*; **F**, *P. dulongense* **n. sp.; G**, *P. jiazhii* **n. sp**. Abbreviations: sdp = secondary distal process; afa = anterior process (left phallomere); paa = posterior process (left phallomere).

Phyllothelys tengchongense n. sp.
(Figures 4E; 6I; 7I; 9H; 10H; 12B; 21)

Type material

Holotype. ♂, China, Yunnan, Tengchong, Houqiao; 25°21′ 29″N 98°07′13″E; 2200 m; 12.IX.2018; Chao Wu leg. (IZCAS).

Paratype. 4♂, China, Yunnan, Tengchong, Houqiao; 25° 21′29″N 98°07′13″E; 2200 m; 12.IX.2018; Chao Wu leg. (IZCAS). 2♂, same data (CWC).

Diagnosis

Similar to the *Phyllothelys cangshanense*, but body comparatively large-sized and slender, forewings with large stains, different prominent lateral lobes of abdomen and male external genitalia.

Description of male

Head. Vertical process elongate, about 1.7 times longer than head, with blunt tip and 3–4 wide lobes on strongly wavy lateral margin; lateral margin of vertical process gradually widened towards top (Figure 6I).

Pronotum. Long, robust; supracoxal dilation wide, lateral pronotal expansion obtuse, without sharp tip; lateral margin of pronotum with sparsely arranged brownish large grainy spines, interleaved with small ones. Ratio of pronotum length to supracoxal dilation width about 3.97 (Figure 7I).

Prothoracic legs. Femora with 13–14 anteroventral femoral spines, among which the distal-most one is longer than the others; tibiae with 12–13 posteroventral and 13–14 anteroventral tibial spines.

Meso- and metathoracic legs. A marked posteroventral keel on femora shaping into two evident lobes, i.e. small proximal and large preapical ones; tibiae shorter than femora, basal part of tibiae inflated; tarsus nearly as long as tibia, first joint of tarsi shorter than combined length of the remaining segments.

Wings. Forewings narrow, longer than abdomen; costal area opaque, brown; discoidal area almost transparent, some sub-areas colorless, and some sub-areas with some densely arranged stains connected into a single stretch (Figure 9H). Hindwings translucent, smoky, with rather dark areas, yellowish base, brownish radial veins and light-colored cross veins.

Abdomen. Brown, long, narrow, flat, with prominent lateral lobes on tergites 4 to 7; lateral lobes on tergum 5 large, prominent, nearly semicircular; others small, not obvious; ventral sternal lobe sharp, yellowish-brown. Male subgenital plate brownish and cerci light colored (Figure 10H).

External genitalia. Ventral phallomere wide, with deep concavity on left edge, posterior process of which stretching out like a finger, with small thorns; apical process of left phallomere short, narrow, with contracted apex and sclerotized margin; phalloid apophysis with posterior lobe strongly sclerotized, blunt, covered with numerous tubercles, and with anterior lobe weakened (Figure 12B).

Measurements (length in mm)

Body (head to wings): 52.88–53.26; pronotum: 13.41–13.48; fore coxae: 7.94–8.02; fore femora: 9.70–9.81; fore tibiae: 5.92–5.98; middle femora: 7.01–7.11; hind femora: 8.32–8.48; forewings: 33.95–34.12; hind wings: 30.18–31.65.

Distribution

WN-Yunnan.

Etymology

The new species is named after the type locality, Tengchong.

Phyllothelys xiezhi n. sp.
(Figures 4F; 6J; 7J; 9I; 10I; 12C; 18D; 20D; 21)

Type material

Holotype. . ♂, China, Yunnan, Lvchun, Huanglianshan Mt.; 22°53′35″N 102°18′21″E; 1900 m; 26.VIII.2019; Chao Wu leg. (IZCAS).

Paratype. 4♂, China, Yunnan, Lvchun, Huanglianshan Mt.; 22°53′35″N 102°18′21″E; 1900 m; 26.VIII.2019; Chao Wu leg. (IZCAS). 2♂, same data (CWC). 1♂, China, Yunnan, Jinping, Daweishan Mt.; 22°55′07″N 103°39′54″E; 1500 m; 28.VIII.2017 (CJZ).

Description of male

Similar to *Phyllothelys tengchongense* **n. sp**., but different in male external genitalia.

Head. Vertical process very elongate, about 2.2 times longer than head, with blunt tip and 2–3 obtuse angular lobes on wavy lateral margin (Figure 6J).

Pronotum. Long, robust; supracoxal dilation wide, lateral pronotal expansion obtuse, without sharp tip; lateral margin of pronotum with sparsely arranged brownish large grainy spines, interleaved with small ones. Ratio of pronotum length to supracoxal dilation width about 4.29 (Figure 7J).

Prothoracic legs. Femora with 13–15 anteroventral femoral spines, distal one longer than the others; tibiae with 12–13 posteroventral and 13–14 anteroventral tibial spines.

Meso- and metathoracic legs. A marked posteroventral keel on femora shaping into two evident lobes, i.e. small proximal and large preapical ones; tibiae shorter than femora, basal part of tibiae inflated; tarsus nearly as long as tibia, first joint of tarsi shorter than combined length of the remaining segments.

Wings. Forewings narrow, longer than abdomen; costal area opaque, brown; discoidal area translucent, brownish, without obvious stains. Hind wings translucent, smoky, with rather dark areas, yellowish base, brownish radial veins and light-colored cross veins (Figure 9I).

Abdomen. Brown; long, narrow, flat, with prominent lateral lobes on tergites 4 to 7, the ones on tergum 5 large and prominent, nearly semicircular, the others not obvious,

small; ventral sternal lobe sharp, yellowish-brown. Male subgenital plate brownish and cerci light colored (Figure 10I).

External genitalia. Ventral phallomere wide, rhombus-shaped, posterior process of which slightly prominent, with large thorns; apical process of left phallomere short, wide, margin sclerotized; phalloid apophysis strongly sclerotized, saddle-shaped, posterior lobe of which prominent, covered with numerous spines (Figure 12C).

Measurements (length in mm)

Body (head to wings): 60.22–62.45; pronotum: 15.38–15.46; fore coxae: 8.91–9.02; fore femora: 10.05–10.22; fore tibiae: 6.34–6.43; middle femora: 6.08–6.12; hind femora: 7.81–7.94; forewings: 36.04–36.86; hind wings: 31.94–32.65.

Distribution

Southeast Yunnan.

Etymology

The new species is named after the Unicorn in Chinese mythology, Xiezhi.

Phyllothelys werneri species group

Phyllothelys werneri Karny, 1915 (Figure 1D, H; 5A, F; 6L; 7L; 9K; 10K; 12D; 21)

Phyllothelys werneri Karny 1915, pp. 106–107; Giglio-Tos 1927, pp. 531–533; Tinkham 1937, p. 564; Beier 1940, p. 92 (erroneous identification); Wang 1993a, pp. 51–52; Ehrmann 2002, p. 198; Otte & Spearman 2005, p. 290; Ehrmann & Roy 2009, p. 70; Zhu et al. 2012, pp. 170–171.

Kishinouyeum hepatica Zhang 1988, pp. 301–304, **n. syn**.; Wang 1993a, p. 70; Yang & Wang 1999, p. 87; Ehrmann 2002, p. 193.

Kishinouyeum hepaticus: Otte & Spearman 2005, p. 304.

Phyllothelys hepaticum: Ehrmann & Roy 2009, p. 69; Zhu et al. 2012, p. 177.

Kishinouyeum wuyiense Yang & Wang 1999, p. 88, **n. syn.**

Phyllothelys wuyiense: Ehrmann & Roy 2009, p. 73; Zhu et al. 2012, p. 177.

Type locality

Taiwan-Kosempo (now Jiasian).

Examined specimens

China. 8♂, Guangxi, Wuming, Damingshan Mt.; 23°30′51″N 108°25′52″E; 1200 m; 22.VIII.2017; Yan-Quan Lu leg. (CWC). 1♂, Guangxi, Longsheng, Huaping; 25°31′32″N 109°51′54″E; 1050 m; 24.IX.2014; Chao Wu leg. (IZCAS). 1♀, 1♂, Guangdong, Shaoguan, Nanling Mt.; 24°55′53″N 113°00′08″E; 1600 m; VIII.2011; Xiao-Yu Zhu leg. (IZCAS). 1♀, 2♂, Taiwan, Nantou; 23°59′43″N 121°01′02″E; 1300 m; 18.X.2014 (CWC). 1♂, Guizhou, Tongren, Wanshan; 27°50′28″N 108°41′24″E; 1100 m; 25.IX.2015; Chao Wu leg. (CWC). 3♂, Fujian, Wuyishan, Sangang; 27°44′54″N 117°40′39″E; 900 m; VIII.2017; Hai-Tian Song leg. (IZCAS). ♂ holotype of *K. wuyiense*, Fujian, Wuyishan, Sangang; 6.VIII.1985; Jia-She Wang & Yi Jiang leg. (CAU). 1♂, Guangxi, Rongshui; X.2009 (HBU).

Redescription

Slender and large-sized *Phyllothelys*.

Head. Vertical process elongate, narrow, with toothless lateral margin, and, sharp or obtuse apex (Figure 6L). Vertical process about 1.7 times (in males) or about 2.6 times (in females) longer than head.

Pronotum. Slender, without obviously lateral pronotal expansion; lateral margin with sparsely arranged black large grainy spines, interleaved with small ones; area around large spines on lateral margin black (Figure 7L). Ratio of pronotum length to supracoxal dilation width about 5.5–5.6 in male and 5.95–6.00 in female.

Legs. Prothoracic legs elongate, femora with 14–16 anteroventral femoral spines, among which the distal-most one is longer than the others; tibiae with 12–13 posteroventral and 12–14 anteroventral tibial spines (Figure 1D). Meso- and metathoracic femora with two evident unconnected lobes; proximal lobe small; preapical lobe large, fan-shaped, longer than wide (Figure 1H).

Wings. Hind wings shorter than forewings, translucent, smoky, with yellowish-brown areas, brownish radial veins and light-colored cross veins (Figure 5A,F). In males: forewings long, narrow, longer than abdomen; costal area opaque, brown; discoidal area translucent, brownish, with some stains; base usually comparatively light (Figure 9K). In females: forewings shorter than or nearly as long as abdomen; forewings opaque except for brownish hind margin scattered with some black stains.

Abdomen. Brown, with black spots; long, narrow in males and wide in females, flat; prominent lateral lobes on tergites 5 to 6 small and not obvious in males, but large in females; ventral sternal lobe short, blunt, light colored. Male subgenital plate and cerci light color (Figure 10K).

External genitalia. Ventral phallomere wide, rhombus-shaped, posterior process of which protuberant, with large spines; apical process of left phallomere short and

wide, with sclerotized margin; posterior lobe of phalloid apophysis strongly sclerotized, saddle- shaped, covered with numerous spines (Figure 12D).

Measurements (length in mm)

Body (head to wings): male 62.52–64.15, female 73.85–76.43; pronotum: male 18.18–18.85, female 26.14–27.20; fore coxae: male 11.12–11.36, female 14.97–16.38; fore femora: male 12.02–12.14, female 16.34–17.42; fore tibiae: male 7.28–7.42, female 8.58–9.47; middle femora: male 7.68–7.82, female 7.98–9.03; hind femora: male 8.48–8.70, female 11.06–12.24; forewings: male 36.42–37.55, female 26.16–28.14; hind wings: male 31.16–31.88, female 24.85–26.43.

Discussion

Comparison between specimens of *Phyllothelys werneri* from Taiwan, the holotype of *Kishinouyeum hepatica* (based on the pictures) and the holotype of *K. wuyiense*, reveals that there are no striking differences in the shape of the genitalia among these species, only little variation in linear morphometric measurements. *Phyllothelys hepaticum* and *P. wuyiense* have the same type locality; thus, we conclude that *P. hepaticum* and *P. wuyiense* are junior synonyms of *P. werneri*. In Fujian, Mount Wuyishan, *P. werneri, P. sinense* and *P. cornutum* are sympatric, but *P. cornutum* is only found in moss clumps. This is the only place in China where three species of *Phyllothelys* can be seen at the same time.

Distribution

Fujian, Guangdong, Hunan, Guizhou, Taiwan, Guangxi. This species is widely distributed in southern China, sympatric with *Phyllothelys cornutum* and *P. sinense*.

Phyllothelys jianfenglingense (Hua, 1984) (Figures 5B, G; 6M; 7M; 9L; 10L; 12E; 14C; 16A; 18E; 21)

Kishinouyeum jianfenglingensis Hua 1984, pp. 29–30; Wang 1993a, p. 69; Ehrmann 2002, p. 198; Yang 2002, p. 60; Otte & Spearman 2005, p. 304.

Phyllothelys jianfenglingense: Ehrmann & Roy 2009, p. 72; Zhu et al. 2012, p. 172.

Type locality

China: Hainan, Mount Jianfengling.

Examined specimens

China. Holotype: ♀, Hainan, Jianfengling, Wufenqu; 28. VI.1981; Li-Zhong Hua leg. (SYSU) (Figure 16A). 12♂, Hainan, Ledong, Jianfengling Mt.; 18°45′22″N 108°50′58″E; 900 m; 25.V.2020; Chao Wu leg. (CWC). 1♂, Hainan, Ledong, Jianfengling Mt.; V.2010; Wei-Wei Zhang leg. (CWC). 4♂, Hainan, Ledong, Jianfengling Mt.; 18°45′22″N 108°50′58″E; 900 m; 27.V.2020; Chao Li leg. (IZCAS). 2♀, Hainan, Ledong, Jianfengling Mt.; 850 m; 22. VI.2014 (CWC).

Redescription

Similar to *Phyllothelys werneri*, but much thinner and more slender, the male forewings with large stain; endemic species of Hainan Island.

Head. In males: vertical process elongate, about 2.2 times longer than head, with sharp apex and inconspicuous teeth on lateral margin (Figure 6M). In females: vertical process about 3.2 times longer than head, with obtuse apex; toothless lateral margin of vertical process slightly widened towards top (Figure 5G).

Pronotum. Very slender, without obviously lateral pronotal expansion; lateral margin with sparsely arranged black large grainy spines, interleaved with small ones, black area around large spines on lateral margin triangular (Figure 7M). Ratio of pronotum length to supracoxal dilation width about 6.52–6.53 in male and 6.66–6.67 in female.

Prothoracic legs. Elongate, femora with 15–16 anteroventral femoral spines, among which distal-most one is longer than the others; tibiae with 12–13 posteroventral and 12–14 anteroventral tibial spines.

Meso- and metathoracic legs. A marked posteroventral keel on femora shaping into two evident lobes, i.e. small proximal and large fan-shaped preapical ones; tibiae shorter than femora, basal part of tibiae inflated; tarsus nearly as long as tibia, first joint of tarsi shorter than combined length of the remaining segments.

Wings. Hind wings shorter than forewings, smoky, with yellowish-brown areas, brownish radial veins and light-colored cross veins. In males: forewings narrow, longer than abdomen; costal area opaque, brownish green; discoidal area almost transparent, some sub-areas colorless, and some sub-areas with densely arranged large stains connected into a single stretch (Figure 9L). In females: forewings shorter than or nearly as long as abdomen; forewings opaque except for brownish hind margin scattered with large black stains.

Abdomen. Flat, brown, with black spots; long, narrow in males and wide in females, with prominent lateral lobes on tergites 5 to 6, the ones on tergum 5 large, with blunt tip; ventral sternal lobe sharp, light colored. Male subgenital plate and cerci with light color (Figure 10L).

External genitalia. Ventral phallomere wide with rather sharp tip; posterior process of ventral phallomere protuberant, with large spines; apical process of left phallomere short, wide, with sclerotized margin; posterior lobe of phalloid apophysis strongly sclerotized, long, wide, covered with numerous spines; the spines much larger than those in *Phyllothelys werneri* (Figure 12E).

Measurements (length in mm)

Body (head to wings): male 60.58–61.54, female 75.52–76.48; pronotum: male 18.48–18.62, female 27.22–27.87; fore coxae: male 11.02–11.14, female 16.15–16.42; fore femora: male 12.38–12.51, female 17.36–17.48; fore tibiae: male 6.70–6.76, female 9.46–9.52; middle femora: male 6.22–6.28, female 9.02–9.08; hind femora: male 8.65–8.72, female 12.28–12.36; forewings: male 31.98–32.12, female 27.64–27.92; hind wings: male 27.04–27.85, female 25.07–25.32.

Distribution

Hainan Island.

Phyllothelys jiazhii Wu, n. sp. (Figures 5C, H; 6K; 7K; 8A, B; 9J; 10J; 12G; 13A; 18F; 21)

Type material

Holotype. ♂, China, Hainan, Ledong, Jianfengling Mt., Mingfenggu; 18°44′75″N 108°50′28″E; 950 m; VII.2013; Jia-Zhi Zhang leg. (IZCAS).

Paratypes. 1♀, China, Hainan, Ledong, Jianfengling Mt., Mingfenggu; 18°44′75″N 108°50′28″E; 950 m; VII.2013; Jia-Zhi Zhang leg. (IZCAS). 1♀, 2♂, same data (CJZ). 1♂, China, Hainan, Ledong, Jianfengling Mt.; 18°45′22″N 108°50′58″E; 900 m; 16.XI.2016; Chao Wu leg. (IZCAS). 2♂, China, Hainan, Ledong, Jianfengling Mt., Tianchi; 18°44′25″N 108°51′37″E; 900 m; 15.XI.2016; Chao Wu leg. (IZCAS). 2♂, China, Hainan, Ledong, Jianfengling Mt.; X.2010; Xiao-Yu Zhu leg. (IZCAS). 1♀, 3♂, China, Hainan, Baisha, Shuiman, Wuzhishan Mt.; 18°53′17″N 109°40′01″E; 750 m; 28.VII.2017; Chao Wu leg. (CWC). 1♂, same data (BFU).

Description of male

Slender and large-sized *Phyllothelys*. Vertical process of head short. Posteroventral tibial spines long, sparsely arranged and erective.

Head. Vertical process short, narrow, sharp, about as long as head, with simple toothless lateral margin and sharp apex; the proportion of diameter of compound eyes to head height much larger than that in other congeners (Figure 6K).

Pronotum. Slender, without obviously lateral pronotal expansion; lateral margin with grainy sparsely arranged black large spines, interleaved with small ones; area around large spines on lateral margin black. The ratio of pronotum length to supracoxal dilation width about 6.21–6.22 (Figure 7K).

Prothoracic legs. Elongate; posteroventral tibial spines sparsely arranged, erective, longer than those in other congeners; femora with 14–15 anteroventral femoral spines, distal one longer than the others; tibiae with 8–9 posteroventral and 12–13 anteroventral tibial spines (Figure 8A, B).

Meso- and metathoracic legs. A marked posteroventral keel on femora shaping into two evident lobes, i.e. small proximal and large preapical ones; tibiae shorter than femora, basal part of tibiae inflated; tarsus nearly as long as tibia, first joint of tarsi shorter than combined length of the remaining segments.

Wings. Forewings long, narrow, longer than, abdomen; costal area opaque brown; discoidal area translucent, brownish, with some small stains. Hind wings translucent, smoky, with yellowish-brown areas, brownish radial veins and light-colored cross veins (Figure 9J).

Abdomen. Brown, without spots; long, narrow, flat, without prominent lateral lobes on tergites 5 to 6; ventral sternal lobe short, blunt, dark. Male subgenital plate and cerci light colored (Figure 10J).

External genitalia. Ventral phallomere wide, with deep concavity in left edge, of which posterior process is protuberant, small, with large spines; apical process of left phallomere short, wide, with sclerotized margin; posterior lobe of phalloid apophysis strongly sclerotized, saddle-shaped, covered with numerous spines (Figures 12G and 13A).

Description of female

Large-sized, slender *Phyllothelys*. Front part of body very slender. Vertical process of head very long, about 3.3 times longer than head, with sharp apex; toothless lateral margin narrowed towards top. Pronotum and legs similar to those in males, but comparatively robust; ratio of pronotum length to supracoxal dilation width about 5.94. Prothoracic legs elongated; femora with 15 anteroventral femoral spines; tibiae with 7–8 posteroventral and 13–14 anteroventral tibial spines. Forewings long, narrow, but slightly shorter than or nearly as long as

abdomen; forewings opaque except for brownish hind margin with some black stains. Hind wings shorter than forewings, smoky, with yellowish-brown areas, brownish radial veins and light-colored cross veins (Figure 5H). Abdomen flat, wide, with prominent lateral lobes on tergites 5 to 6.

Measurements (length in mm)

Body (head to wings): male 56.20–56.98, female 68.65–69.42; pronotum: male 16.69–16.85, female 25.54–25.88; fore coxae: male 10.92–11.05, female 16.34–16.85; fore femora: male 11.63–11.75, female 17.42–17.95; fore tibiae: male 6.34–6.42, female 9.22–9.46; middle femora: male 6.05–6.14, female 8.21–8.47; hind femora: male 7.84–7.92, female 9.68–9.88; forewings: male 30.08–31.65, female 28.60–28.95; hind wings: male 28.36–28.88, female 24.35–24.58.

Discussion

Phyllothelys jiazhii is similar to *P. werneri* and *P. jianfenglingense*, but the features of the protibiae are unique, different from other *Phyllothelys* species. In Hainan, *P. jiazhii* **n. sp**. and *P. jianfenglingense* are sympatric.

Distribution

Hainan Island.

Etymology

The new species is named after its discoverer, Mr Jia-Zhi Zhang, who provided much help for this research.

Phyllothelys dulongense n. sp. (Figures 5D; 6N; 7N; 9M; 10M; 12F; 21)

Type material

Holotype. ♂, China, Yunnan, Gongshan, Dulongjiang; 27° 40′54″N 98°16′52″E; 1570 m; 10–15.VIII.2015; Xiao-Dong Yang leg. (IZCAS).

Paratypes. 2♂, China, Yunnan, Gongshan, Dulongjiang; 27°40′54″N 98°16′52″E; 1570 m; 10–15.VIII.2015; Wen-Xuan Bi leg. (CWC). 4♂, same data; Xiao-Dong Yang leg. (IZCAS). 1♂, same data (BFU).

Description of male

Similar to the *Phyllothelys werneri*, but very large, black brownish, the male forewings with large stain.

Head. Orange spots on face; vertical process elongate, about 2.2–2.4 times longer than head, with sharp apex and inconspicuous teeth on lateral margin (Figure 6N).

Pronotum. Slender, without obviously lateral pronotal expansion; lateral margin with sparsely arranged black large grainy spines, interleaved small ones; area around large spines on lateral margin black. Ratio of pronotum length to supracoxal dilation width about 5.68 (Figure 7N).

Prothoracic legs. Elongate; posteroventral tibial spines densely arranged, inclined; femora with 13–14 anteroventral femoral spines, distal one curved backwards and longer than others; tibiae with 12–13 posteroventral and 12–13 anteroventral tibial spines.

Meso- and metathoracic legs. A marked posteroventral keel on femora shaping into two evident lobes, i.e. small proximal and large fan-shaped preapical ones; tibiae

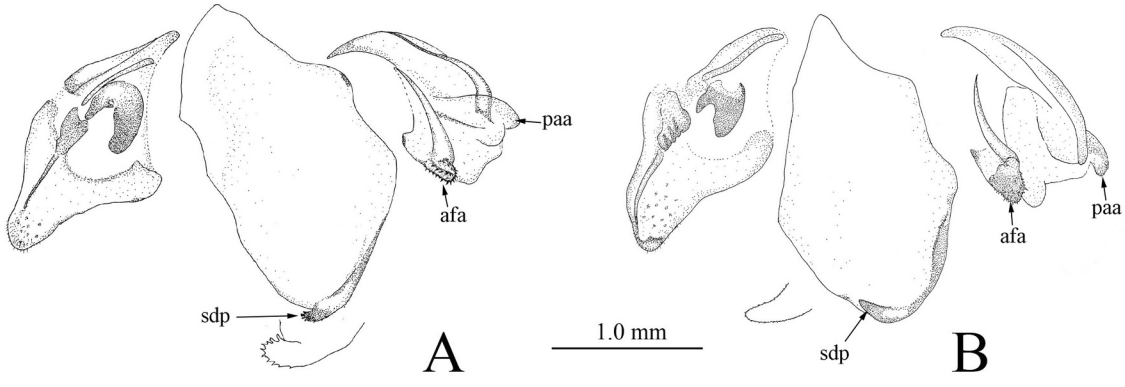

Figure 13. Male genitalia of *Phyllothelys* spp., disarticulated genital complex, ventral view. **A**, *P. jiazhii* **n. sp.; B**, *P. chuangtsei* **n. sp**. Abbreviations: sdp = secondary distal process; afa = anterior process (left phallomere); paa = posterior process (left phallomere).

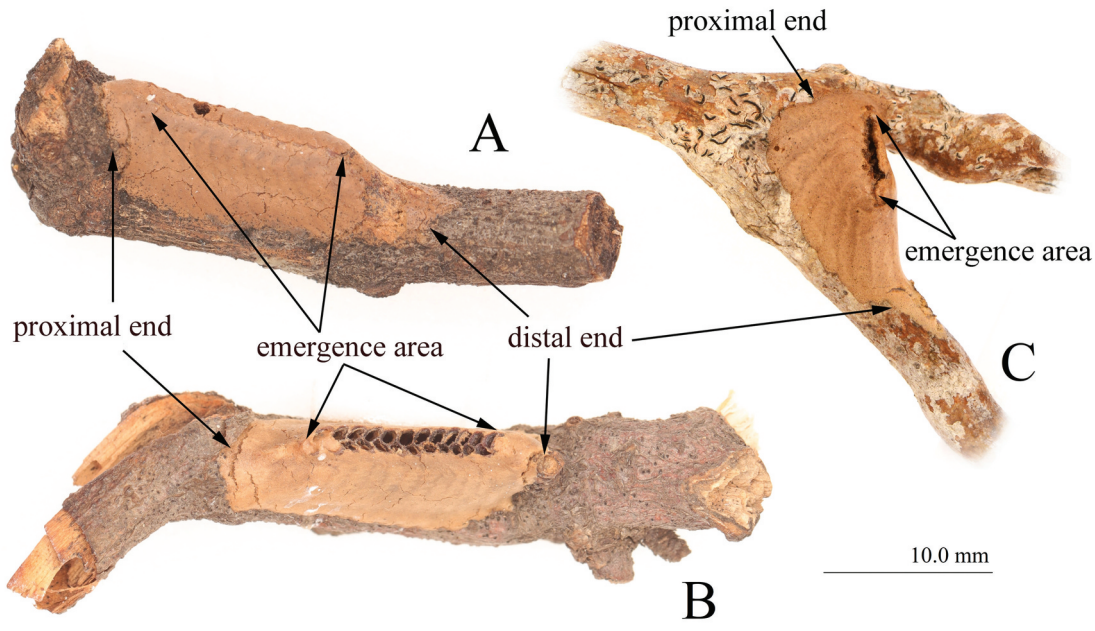

Figure 14. The ootheca of *Phyllothelys* spp. **A, B**, *P. sinense*; **C**, *P. jianfenglingense.*

shorter than femora, basal part of tibiae inflated; tarsus as long as tibia, first joint of tarsi shorter than length of combined remaining segments.

Wings. Forewings very long, narrow, much longer than abdomen; costal area opaque, brown; discoidal area translucent, smoky, brown, with some densely arranged large stains connected into a single stretch. Hind wings opaque, richly colored, smoky black, with yellowish base of costal area, brownish radial veins and yellowish cross veins (Figure 9M).

Abdomen. Dark brown, with black spots; long, narrow, flat, with prominent lateral lobes on tergites 5 to 6, the ones on tergum 5 large and prominent, with blunt tip; ventral sternal lobe sharp, yellowish-brown. Male subgenital plate and cerci light colored (Figure 10M).

External genitalia. Ventral phallomere wide, rhombus-shaped, posterior process of which protuberant, with numerous spines; apical process of left phallomere short, wide, with sclerotized margin; posterior lobe of phalloid apophysis strongly sclerotized, short, wide, covered with numerous spines (Figure 12F).

Measurements (length in mm)

Body (head to wings): 67.5–69.5; pronotum: 19.18–19.27; fore coxae: 10.81–10.95; fore femora: 12.20–12.42; fore tibiae: 7.05–7.11; middle femora: 7.72–7.83; hind femora: 9.54–9.62; forewings: 37.41–38.05; hind wings: 33.32–34.50.

Discussion

Phyllothelys dulongense is very slender and large-sized, dark brownish. The prominent lobes of the tergites extend considerably. This species is perhaps the largest of all the species of *Phyllothelys*.

Distribution

Yunnan: Dulongjiang.

Etymology

The new species is named after the type locality, Dulongjiang.

Phyllothelys chuangtsei n. sp.
(Figures 5E; 6O; 7O; 9N; 13B; 21)

Type material

Holotype. ♂, China, Tibet, Medog, Bo'nong'gong; 29°39′ 18″N 95°29′11″E; 2200 m; 13.VIII.2012; Xiao-Dong Yang leg. (IZCAS).

Description of male

Similar to the *Phyllothelys dulongense* **n. sp.**, but body comparatively small-sized, pale, lateral pronotal expansion of pronotum comparatively large and leaned backwards.

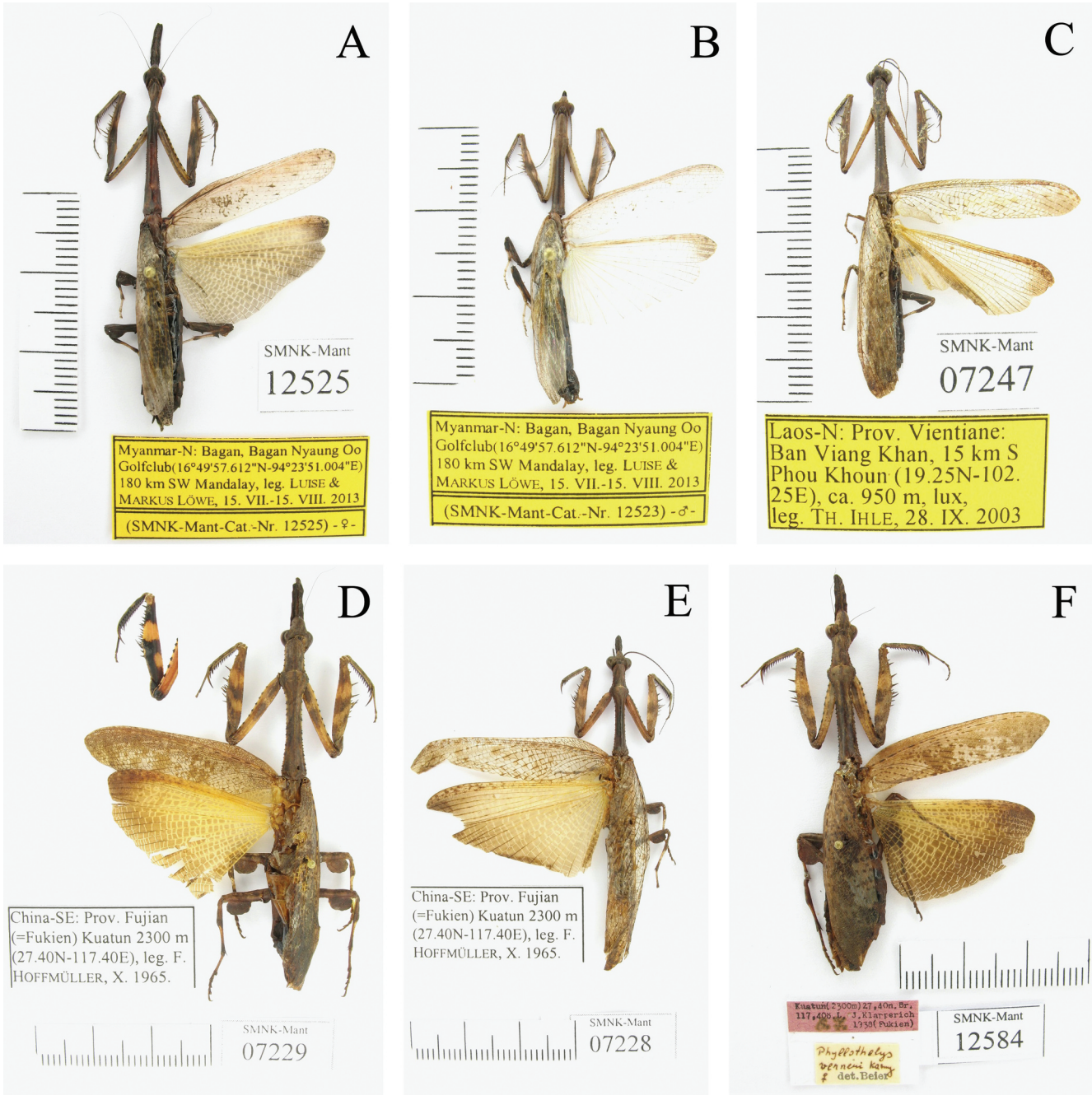

Figure 15. The *Phyllothelys* spp. specimens preserved in SMNK. Photo R. Ehrmann, © SMNK, published with permission. **A–C**, *P. breve*; **D–F**, *P. s. sinense*; **A, D, F**, female; **B, C, E**, male.

Head. Without orange spots on face; vertical process elongate, narrow, about 2 times longer than head, with toothless lateral margin and sharp apex (Figure 6O).

Pronotum. Slender; lateral pronotal expansion obtuse, slightly leaning backwards, without sharp tip; lateral margin with densely arranged black large grainy spines, interleaved with small ones; area around large spines on lateral margin black. Ratio of pronotum length to supracoxal dilation width about 4.85 (Figure 7O).

Prothoracic legs. Elongate; posteroventral tibial spines densely arranged, inclined; femora with 14 anteroventral femoral spines, distal one longer than the others; tibiae with 12 posteroventral and 12 anteroventral tibial spines.

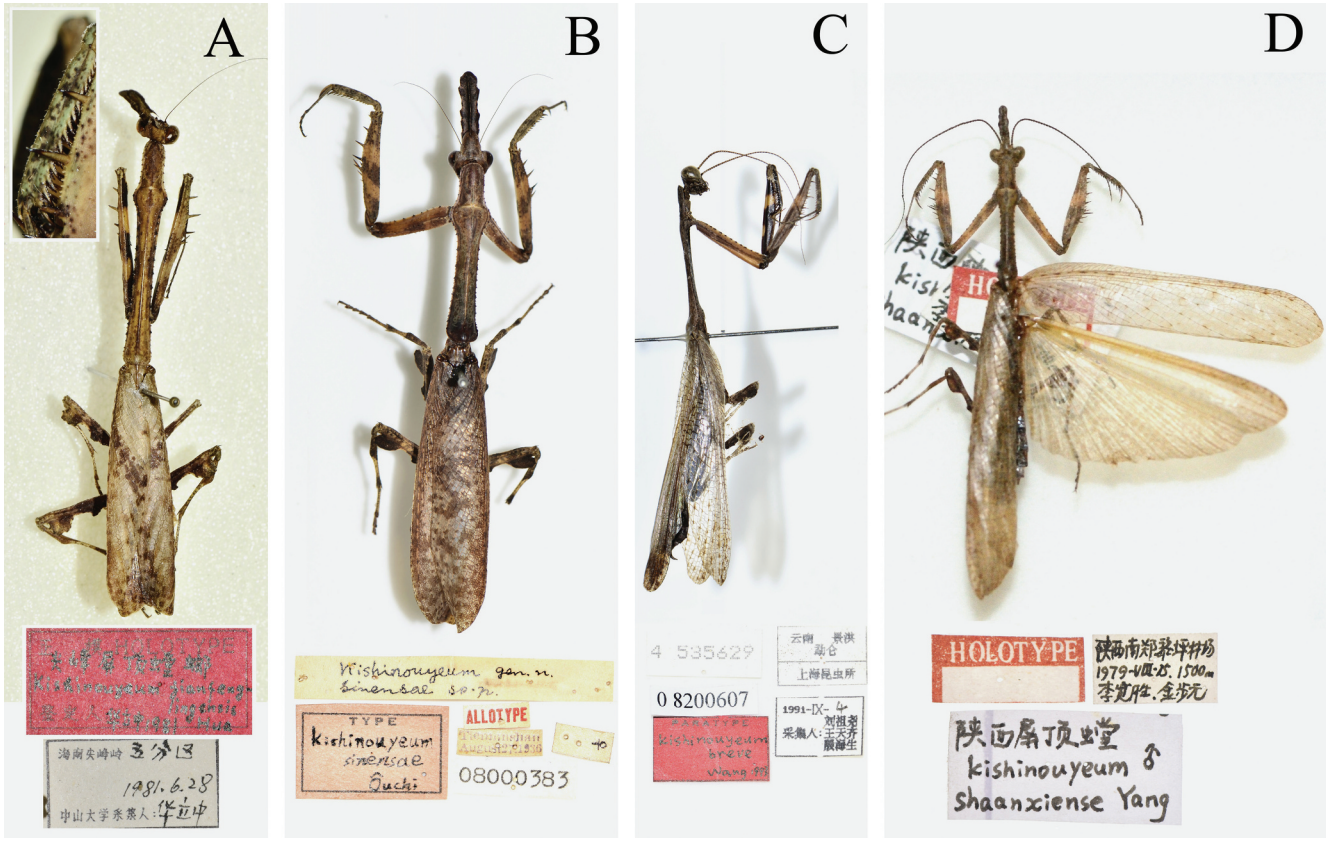

Figure 16. Types of *Phyllothelys* spp. from China. **A**, *Kishinouyeum jianfenglingensis* Hua, 1984 (SYSU), holotype; **B**, *K. sinensis* Ôuchi, 1938 (SEM), allotype; **C**, *K. breve* Wang, 1993, paratype (SEM); **D**, *K. shaanxiense* Yang, 1999, holotype (CAu

Meso- and metathoracic legs. A marked posteroventral keel on femora shaping into two evident lobes, i.e. small proximal and large fan-shaped preapical ones; tibiae shorter than femora, basal part of tibiae inflated; tarsus nearly as long as tibia, first joint of tarsi shorter than combined length of the remaining segments.

Wings. Forewings long, narrow, longer than abdomen; costal area opaque, brown; discoidal area translucent, smoky brown, without stains. Hind wings translucent, smoky, with rather dark areas, yellowish base, brownish radial veins and light-colored cross veins (Figure 9N).

Abdomen. Brown, with dark spots; long, narrow, flat; prominent lateral lobes on tergites 5 to 6 small, with blunt tip; ventral sternal lobe sharp. Male subgenital plate and cerci light colored.

External genitalia. Figure 13B. Similar to that in *Phyllothelys dulongense* **n. sp.**; ventral phallomere wide, rhombus-shaped, the posterior process protuberance with numerous spines; apical process of left phallomere short and wide, margin sclerotized; posterior lobe of phalloid apophysis strongly sclerotized, short and wide, covered by numerous spines (Figure 13B).

Measurements (length in mm)

Body (head to wings): 56.85; pronotum: 16.24; fore coxae: 8.75; fore femora: 9.63; fore tibiae: 5.92; middle femora: 6.15; hind femora: 8.16; forewings: 31.95; hind wings: 30.02.

Discussion

Phyllothelys chuangtsei is similar to the *P. dulongense* **n. sp**. *P. chuangtsei* **n. sp**., but differs from other species in this species group by its smaller body size and larger lateral pronotal expansion of pronotum. The structure of the pronotum in this species is very unusual within the *Phyllothelys*.

Distribution

Tibet: Medog.

Etymology

The new species is named after the great thinker in Chinese history, Chuang Tse.

Figure 17. Adult of *Phyllothelys* spp. in natural habitat. **A**, *P. breve*, male; **B**, *P. cancongi* **n. sp**., male; **C, D**, *P. cornutum* (**C**, male; **D**, female); **E, F**, *P. sinense sinense* (**E**, male; **F**, female).

Phyllothelys stigmosum (Zhou & Zhou, 2004) (Figure 21)

Kishinouyeum stigmosus Zhou & Zhou 2004, pp. 161–163.
Phyllothelys stigmosum: Ehrmann & Roy 2009, p. 69; Zhu et al. 2012, p. 177.

Type locality

China: Guizhou, Xishui.

Diagnosis

Zhou & Zhou (2004) described *Kishinouyeum stigmosus* based on a female specimen from Guizhou, Xishui, and provided a comparison with *Kishinouyeum sinensis*. The original description indicates that the antennae are as long as the forewings. Also, considering the ratio of pronotum length to forewings length and the illustration of the pronotum, we think the type is a male, not a female. It is a pity that we have only collected one male specimen of *Phyllothelys werneri*, which corresponds to the original measurements, in the type locality of *Phyllothelys stigmosum*. We did not examine the type of *Kishinouyeum stigmosum* Zhou & Zhou. It is hoped that this problem will be resolved in future research.

Distribution

Guizhou.

Discussion

This was a difficult and ongoing study for us; specimen collection and imperfect historical research are the main difficulties. Based on the morphological characteristics, we divide the genus *Phyllothelys* into four species groups (Figure 1). Within each the species group, different species could be easily separated through the morphological features of the pronotum as well as the ratios of the pronotum, although

Figure 18. Adult and nymph of *Phyllothelys* spp. in natural habitat. **A**, *P. breve*, nymph; **B, C**, *P. shaanxiense*, female; **D**, *P. xiezhi* **n. sp**., male; **E**, *P. jianfenglingense*, male; **F**, *P. jiazhii* **n. sp**., female.

differences in the morphology and external genitalia between species are relatively minor.

Throughout a comprehensive morphological review on the four species groups, we do not suggest to consider them as different genera or subgenera. This is mainly because the morphological characters show a continuous variation among these four species groups. If only the two extreme examples are considered, the *P. westwoodi* species group and the *P. cornutum* species group, they could arguably be considered as two completely different genera because they show significant differences in their morphology. In addition, the external genitalia of these four species groups share a similar type of structure, only with few minor alterations. Therefore, before including any evidence from molecular phylogenetic studies on this genus, there should be no nomenclature adjustment, either at the subgenus level or even at the genus level. Comprehensive phylogenetic works on this genus are strongly recommended, integrating the results of both morphological and molecular studies; this might clearly reveal the relationship between these groups.

The genus *Ceratocrania* from Malay region is closely related to *Phyllothelys*, and they are considered to be sister group with each other, together forming the tribe Phyllothelyini. According to the previous study by Schwarz & Roy (2019), the Parablepharini were included in the Phyllothelyini (subfamily Phyllothelyinae). This may be controversial. The Parablepharini is a monotypic tribe and genus; the only species it contains is *Parablepharis kuhlii* (De Haan, 1842). Considering the morphological characteristics of the ootheca, the external genitalia, the appearance of both nymphs and adults of *P. kuhlii*, and their behavior, the genus of *Parablepharis* may be more closely related to the subfamily Acromantinae instead of being the sister group of *Ceratocrania* and *Phyllothelys* within the Phyllothelyini.

According to specimen records, although there may be three species living in the same place, the distribution of different species belonging to the same species groups

Figure 19. Female nymph of *Phyllothelys cornutum* from Fujian, Wuyishan. **A**, in natural habitat; **B**, head, anterior view.

Figure 20. The ecological habitat of *Phyllothelys* spp. in China. **A**, *P. sinense sinense*, Fujian, Wuyishan; **B**, *P. cangshanense*, Yunnan, Yuxi; **C**, *P. breve*, Yunnan, Jinghong; **D**, *P. xiezhi* **n. sp**., Yunnan, Luchun.

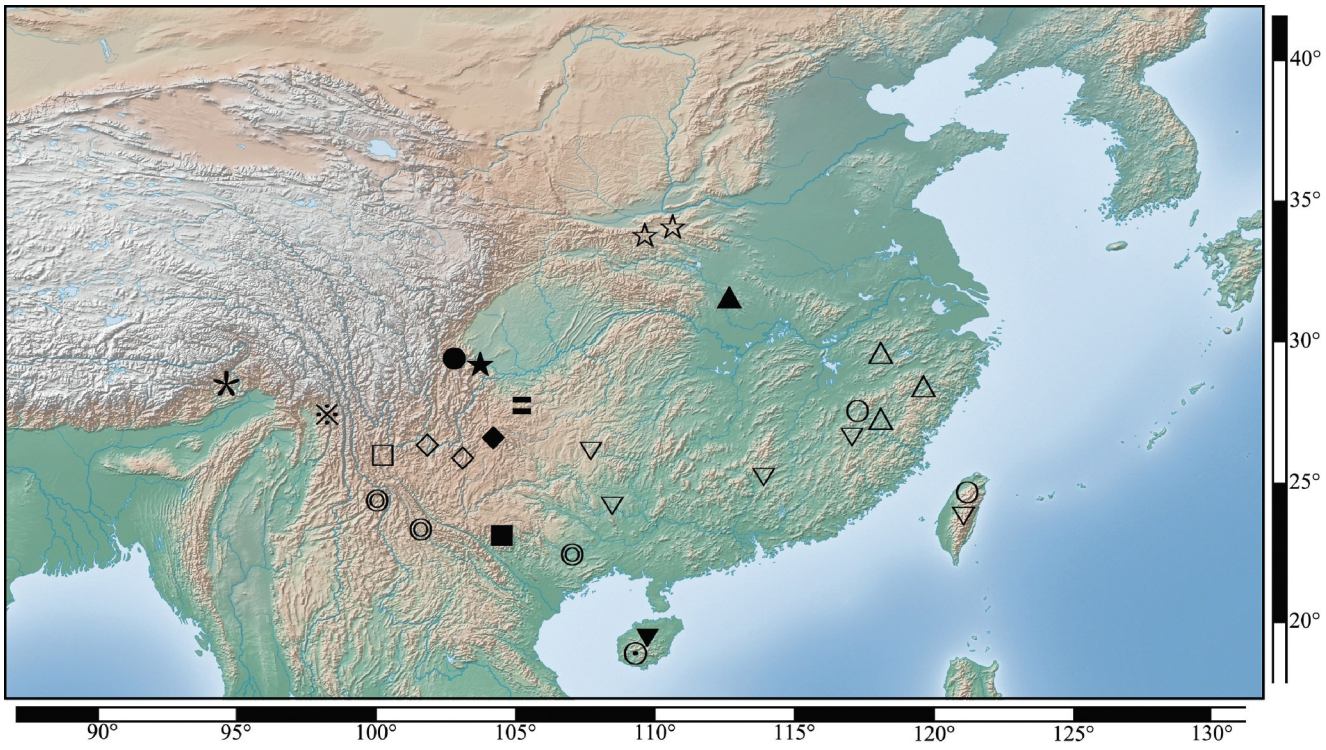

Figure 21. Distribution map of *Phyllothelys* spp. in China. ⊚, *P. breve*; ○, *P. cornutum*; ●, *P. cancongi* **n. sp.**; Δ, *P. sinense sinense*; ▲, *P. sinense robustum*; ☆, *P. shaanxiense*; ★, *P. tianfuense* **n. sp.**; ◇, *P. cangshanense*; ◆, *P. parvulum*; □, *P. tengchongense* **n. sp.**; ■, *P. xiezhi* **n. sp.**; ▽, *P. werneri*; ▼, *P. jianfenglingense*; ⊙, *P. jiazhii* **n. sp.**; ※, *P. dulongense* **n. sp.**; *, *P. chuangtsei* **n. sp.**; 〓, *P. stigmosum.*

rarely overlaps. The only case of two species within the same species group having an overlapping distribution is documented in the island of Hainan, where *Phyllothelys jianfenglingense* and *P. jiazhii* **n. sp**. can be observed in the same place at the same time. The genus *Phyllothelys* is most diverse in the mountain ranges of southwestern China, these high mountains having formed physical barriers that accelerated speciation events. On the other hand, in the eastern mountain ranges, which are less elevated and therefore in the absence of these barriers, the species are less diverse but with wider distributions.

Phyllothelys cangshanense is a very unusual species within the whole genus as it can live in the dry and hot valley of central Yunnan to southwestern Sichuan (Figure 20B); it is the only known species which can adapt to such environments. All other *Phyllothelys* species are found in damp forest.

As species of the genus *Phyllothelys* are camouflaged, there are still lots of mysteries about their life history and habits. Females are much less documented than males. More than half of Chinese species of *Phyllothelys* lack female specimens, which is also the limit of this research. An efficient way to collect females has not yet been found; we hope that progress will be made in further investigations.

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No potential conflict of interest was reported by the author(s).

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References

Beier M. 1940. Über die von Klapperich 1938 in Süd–China erbeuteten Mantodeen. Decheniana (B). 99:91–92.

Brannoch SK, Wieland F, Rivera J, Klass KD, Béthoux O, Svenson GJ. 2017. Manual of praying mantis morphology, nomenclature and practices (Insecta, Mantodea). ZooKeys. 696:1–100.

Ehrmann R. 2002. Mantodea, Gottesanbeterinnen der Welt. Münster: Natur und Tier Verlag GmbH; p. 519.

Ehrmann R, Roy R. 2009. Taxonomy and synonymy of *Phyllothelys* Wood-Mason (Dictyoptera: Mantodea). Annales de la Société entomologique de France (N.S.). 45 (1):67–76. doi:10.1080/00379271.2009.10697590

Giglio-Tos E. 1915. Mantidi esotici VIII. Acromantinae. Bolletino dei Musei di Zoologia ad Anatomia comparata della Reale Università di Torino. 702:XXX:1–16.

Giglio-Tos E. 1927. Orthoptera Mantidae. Das Tierreich 50. Berlin & Leipzig: Walter de Gruyter & Co; p. XL + 707.

Hua LZ. 1984. A new species of the genus *Kishinouyeum* (Mantodea: Mantidae: Vatinae). Entomotaxonomia. 6 (1):29–30. [in Chinese with abstract in English].

Karny H. 1915. H. Sauter's Formosa-Ausbeute. Orthoptera et Oothecaria. Supplementa Entomologica:104–108. herausgegeben auf Kosten der Jagor-Stiftung von Deutschen Entomologischen Museum Berlin-Dahlem. 4:56–108.

Mao BY. 2001. A new species *Kishinouyeum* Ôuchi from Yunnan (Mantodea: Vatidae). Acta Zootaxonomica Sinica. 26(4):505–506. [in Chinese with abstract in English].

Niu Y, Liu BD. 1998. A new species of *Kishinouyeum* from Mt. Funiu, Henan, China (Mantodea, Vatidae). Fauna and Taxonomy of Insects in Henan. 2:14–16. [in Chinese with abstract in English].

Otte D, Spearman L. 2005. Mantida species file. Catalog of the Mantids of the world. Philadelphia: Association of the Insects Diversity; p. 489.

Ôuchi Y. 1938. A new soothsayer from Eastern China (Ortho., Mantidae). The Journal of the Shanghai Science Institute (Section III). 4:23–26.

Rehn JAG. 1903. Studies in old world Mantidae (Orthoptera). Proceedings of the Academy of Natural Sciences of Philadelphia. 1903:701–718.

Schwarz CJ, Roy R. 2019. The systematics of Mantodea revisited: an updated classification incorporating multiple data sources (Insecta: Dictyoptera). Annales de la Société entomologique de France (N. S.). 55(2):101–196.

Shcherbakov E, Anisyutkin L. 2018. Update on the praying mantises (Insecta: Mantodea) of South-East Vietnam. Annales de la Société entomologique de France (N. S.). 54 (2):119–140. doi:10.1080/00379271.2018.1447394

Svenson GJ. 2014. The type material of Mantodea (praying mantises) deposited in the National Museum of Natural History, Smithsonian Institution, USA. ZooKeys. 433:31–75. doi:10.3897/zookeys.433.7054.

Svenson GJ, Hardy NB, Cahill Wightman HM, Wieland F. 2015. Of flowers and twigs: phylogenetic revision of the plant-mimicking praying mantises (Mantodea: Empusidae and Hymenopodidae) with a new suprageneric classification. Systematic Entomology. 40(4):789–834. doi:10.1111/syen.12134

Tinkham ER. 1937. Studies in Chinese Mantidae (Orthoptera). Lingnan Science Journal. 16(4):551–572.

Wang TQ. 1993a. Synopsis on the classification of Mantodea from China. Shanghai: Shanghai Scientific and Technological Literature Publishing House; p. 177. [in Chinese with abstract in English].

Wang TQ. 1993b. A new species of *Kishinouyeum* from China (Mantodea Vatidae). Entomological Journal of East China. 2(2):4–6. [in Chinese with abstract in English].

Werner F. 1922. Philippine mantids, or praying insects. The Philippine Journal of Science. 21(2):147–159, 1 pl.

Westwood JO. 1889. Revisio Insectorum familiae Mantidarum. London: Gurney & Jackson; p. 54 + III, XIV pl.

Wood-Mason J. 1876. On some remarkable species of Mantidae. Annals and Magazine of Natural History. 18(4):506–507. doi:10.1080/00222937608682086

Wood-Mason J. 1885. *Phyllothelys*, a remarkable genus of Mantodea from the oriental region. Journal of the Asiatic Society of Bengal. 53. 2(3):206–210. [pl; XII].

Wood-Mason J. 1889. Monograph of *Phyllothelys*, a genus of Mantodes peculiar to the oriental region. Annals and Magazine of Natural History. 4(6):365–368. doi:10.1080/00222938909460543

Xu JS, Mao BY. 2004. A new species of the genus *Kishinouyeum* Ôuchi (Mantodea: Vatidae) from Hengduan mountain region of Western Yunnan, China. Entomotaxonomia. 26(1):8–10. [in Chinese with abstract in English].

Yang CK. 1999. Mantodea. In: Chen S C, editor. Pictorial handbook of rare and precious insects in China. Beijing: China Forestry Publishing House; p. 30.

Yang CK. 2002. Mantodea. In: Huang F S, editor. Forest insects of Hainan. Beijing: Science Publishing House; p. 58–65.

Yang CK, Wang JS. 1999. Mantodea. In: Huang B K, editor. Fauna of insects in Fujian province of China. Vol. I. Fuzhou: Fujian Scientific and Technological Literature Publishing House; p. 74–106.

Zhang GZ. 1988. Two new species of the genus *Kishinouyeum* (Mantodea: Vatinae). Entomotaxonomia. 10(3–4):301–304. [in Chinese with abstract in English].

Zhou WB, Shen SG. 1992. Study of Mantodea fauna in Zhejiang and Yunnan provinces and two new species. Journal of Shanghai Teachers, Natural Sciences. 21(1):62–68. [in Chinese with abstract in English].

Zhou X, Zhou WB. 2004. A new species of the genus *Kishinouyeum* (Mantodea: Vatinae). Entomotaxonomia. 26(3):161–163, 2 figs. [in Chinese with abstract in English].

Zhu XY, Wu C, Yuan Q. 2012. Mantodea in China. Beijing: Xiyuan Publishing House; p. 331.