

Revision of the genus *Hierodula* Burmeister (Mantodea: Mantidae) in China

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Abstract: The genus *Hierodula* Burmeister in China are revised in this paper. A key to species is provided. Three new species, *H. maculata* sp. nov., *H. pistillinota* sp. nov. and *H. macrodentata* sp. nov. are described. Another species, *H. grandis* Saussure, is newly recorded in China. Another species, *H. patellifera* (Audinet-Serville, 1838), is very variable in coloration, size, the number and shape of forecoxal verrucae and the forewing venation; based on the male genitalia, we propose that *H. yunnanensis* Wang, *H. xishaensis* Wang, *H. multispina* Wang and *H. daqingshanensis* Wang are junior synonyms of *H. patellifera* (Serville) through inspection of the original descriptions and type specimens. In addition, several misidentified species are revised.

Key words: praying mantis; taxonomy; morphology

中国斧螳属修订（螳螂目：螳科）

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摘要: 文章修订了中国斧螳属, 制定了种检索表, 记述了污斑斧螳 *H. maculata* sp. nov., 杵胸斧螳 *H. pistillinota* sp. nov. 和巨齿斧螳 *H. macrodentata* sp. nov. 3个新种, 以及中国新记录种巨斧螳 *H. grandis* Saussure。因为广斧螳 *H. patellifera* (Audinet-Serville, 1838) 在颜色、体型、前足基节疣突数量及形状、前翅翅脉上具有显著的种内差异, 基于雄性外生殖器特征的一致性, 我们提出云南斧螳 *H. yunnanensis* Wang, 西沙斧螳 *H. xishaensis* Wang, 多刺斧螳 *H. multispina* Wang 和大青山斧螳 *H. daqingshanensis* Wang 均是广斧螳 *H. patellifera* 的次异名。此外, 本文对前人研究中的几个错误的物种鉴定进行了订正。

关键词: 螳螂; 分类学; 形态学

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Introduction

The praying mantids (Mantodea) consist of over 2500 carnivorous insects distributed in tropical and subtropical habitats of the world. They play a very significant role in ecology (Patel & Singh 2016). However, the praying mantises remain a largely understudied group; the alpha and beta taxonomy of this order still have a long way to go before an adequate description of its diversity will be in sight (Schwarz *et al.* 2018). In recent years, new genera, new species and new synonyms have been reported (Rivera & Vergara-Cobian 2017; Kolnegari & Shoushtari 2018; Nisip *et al.* 2019; Vermeersch *et al.* 2019; Rivera *et al.* 2020).

The genus *Hierodula* Burmeister, 1838 is the largest genus in the order Mantodea. So far, 116 species and subspecies have been reported from all over the world and they are distributed in the southern Palearctic, the Oriental and northern Australian Realms (Patel & Singh 2016). In the past, several researchers focused on the Chinese species of *Hierodula* (Beier 1933; Tinkham 1937; Wang 1993; Wang & Dong 1993; Zhu *et al.* 2012). While examining a series of mantis specimens from Guangdong and Yunnan Provinces in southern China deposited in the Shanghai Entomological, three species we identified as new to science. In addition, *H. yunnanensis* Wang, *H. xishaensis* Wang, *H. multispina* Wang and *H. daqingshanensis* Wang are proposed as new synonyms of *H. patellifera* (Serville).

Patel and Singh (2016) have moved *H. brachynota* Wang & Dong, 1993 and *H. zhangii* Wang & Dong, 1993 to the genus *Rhombodera* in the checklist of Mantidae, so both are not included in this paper. So far, 8 species of the genus *Hierodula* were reported in China.

Material and methods

External morphology was observed using an Olympus SZX 10 microscope. Photos were taken by a NIKON D70S camera. The last 3–4 segments of the abdomen were soaked in a 10% KOH solution for about 24 hours or heated by an alcohol burner in a 10% KOH solution for about 10 minutes, then rinsed 2–3 times with distilled water and finally with 75% alcohol. External genitalia were then dissected in glycerol and then preserved individually in a 0.50 ml or 0.2ml Eppendorf tube (PCR tube) containing glycerol. The external genitalia were studied on slides with glycerol. Photos were taken using a Scientific Digital Micrography System equipped with an Auto-montage imaging system and a QIMAGING Retiga 4000R digital camera (CCD).

Morphological terminology follows Brannoch *et al.* (2017), but the male genital terminology follows Schwarz and Roy (2019). The following abbreviations are used for male genitalia (Fig. 1E): afa — anterior process of left phallomere = phalloid apophysis; aafa — anterior lobe of phalloid apophysis; bl — basal lobe of ventral phallomere; bm — dextral extension (right phallomere); fda — main posterior lobe (right phallomere); L1 — sclerite L1; L2 — sclerite L2; L4A — sclerite extending over the ventral wall (left phallomere); L4B — sclerite extending over the dorsal wall (left phallomere); loa — posteromesal (left phallomere); map — medial arm process; paa — posterior process (left phallomere) — apical process of left phall — mere — titillator; pafa — posterior lobe of phalloid apophysis; pda — posterior process (ventral phallomere); pia — process posterolateral to pva (right phallomere); pva — process anteromesal to pia (right phallomere); R3 — anteriorly extending sclerite (right

phallomere); sdp — secondary distal process; sdpl — lateral secondary distal process; sdpm — median secondary distal process.

Specimens examined are deposited in the following institutions and abbreviations used in the text are as follows: Shanghai Entomological Museum, Chinese Academy of Science, Shanghai, China (SEM); Entomological Museum, Northwest A&F University, Yangling, China (NWAFU).

Taxonomy

Order Mantodea Latreille, 1802

Family Mantidae Latreille, 1802

Subfamily Hierodulinae Brunner de Wattenwyl, 1893

Hierodula Burmeister, 1838

Hierodula Burmeister, 1838: 536; Type species: *Mantis (Hierodula) membranacea* Burmeister, 1838.

Ephierodula Giglio-Tos, 1912: 63; Type species: *Polyspilota heteroptera* Werner, 1906.

Parhierodula Giglio-Tos, 1912: 108; Type species: *Mantis venosa* Olivier, 1792.

Zopheromantis Tindale, 1924: 550; Type species: *Zopheromantis trimaculata* Tindale, 1924.

Diagnosis. Large, elongate, of the “common praying mantis” body type. Lower frons higher than or equal to width; no tubercle between eyes and antennae. Pronotum with a carina. In foreleg, coxae with internal apical lobes convergent, femora with 4 discoidal spines and 4 posteroventral femoral spines, tibial spur groove near the middle appearing a little basally situated. Middle and hind femora with rounded genicular lobes and apical spines. Anterior border of forewing smooth, costal area densely reticulated. Hindwing hyaline; discoidal vein with 2–4 branches. Supraanal plate transverse, triangular. For male genitalia, loa not elongate, sclerotized weakly; afa compact, the two lobes being less spaced apart and variable; sdpm and sdpl are often retained.

Key to species of *Hierodula* in China (males)

1. Pronotum comparatively long, metazona longer or equal to triple length of prozona..... 2
- Pronotum comparatively short, metazona shorter than triple length of prozona 6
2. Forecoxae with at least 15 premarginal spines gradually larger apically (Fig. 8B).....
..... *H. membranacea* (Burmeister)
- Forecoxae with premarginal spines less than 15..... 3
3. Both anterior lobe of phalloid apophysis (aafa) and posterior lobe of phalloid apophysis (pafa) end spiculate (Figs. 5H, 7J) 4
- Not as above (Figs. 3F, 6H) 5
4. Medial arm process (map) of right phallomere thumb-shaped, sclerotized remarkably (Fig. 5G).....
..... *H. chinensis* Werner
- Medial arm process (map) of right phallomere uplifted weakly (Fig. 7F)..... *H. grandis* Saussure
5. Secondary distal process (sdp) bifurcate at base; median secondary distal process (sdpm) and lateral secondary distal process (sdpl) unciform (Fig. 6E)..... *H. formosana* Giglio-Tos
- Secondary distal process (sdp) stocky, inflated at subterminal region; median secondary distal process (sdpm) and lateral secondary distal process (sdpl) bud-shaped (Fig. 3C)..... *H. pistillinota* **sp. nov.**
6. Forecoxae with premarginal spines; forefemur with a large black patch behind claw groove (Fig. 1C).....
..... *H. maculata* **sp. nov.**

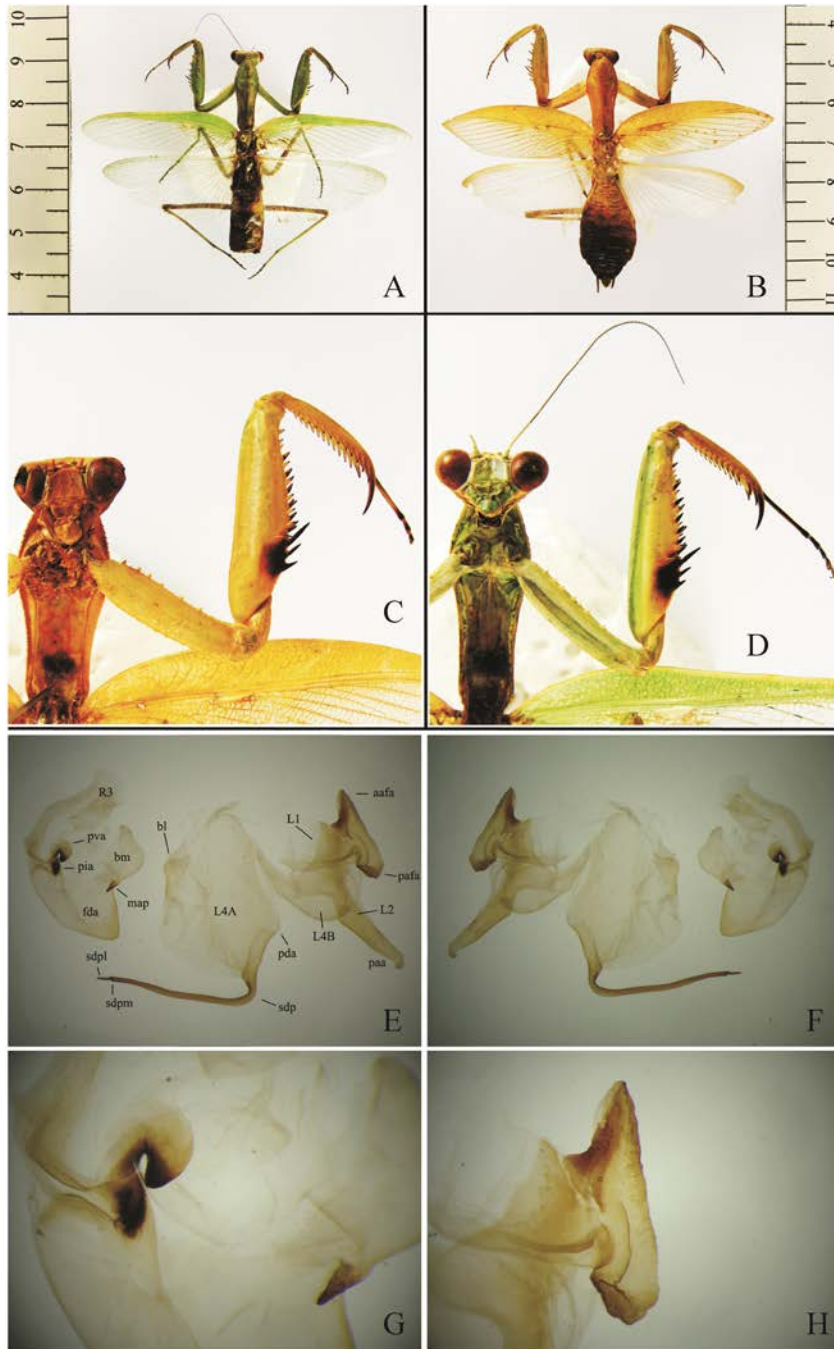


Figure 1. *Hierodula maculata* **sp. nov.** A. Male habitus, dorsal view; B. Female habitus, dorsal view; C. Male head, prothorax and foreleg, ventral view; D. Female head, prothorax and foreleg, ventral view; E. Male genitalia, ventral view of ventral phallomere and right phallomere, dorsal view of left phallomere; F. Male genitalia, dorsal view of ventral phallomere and right phallomere, ventral view of left phallomere; G. Process posterolateral to pva (pia), process anteromesal to pia (pva); H. Anterior process of left phallomere (afa). Abbreviations are listed in the materials and methods section.

Distribution: China (Guangdong, Sichuan).

Etymology. The specific epithet “*maculata*” denotes the black patch on the inner side of fore femur.

Remarks. This species is well distinguished from others in the genus by the black patch on the inner side of fore femur. It is very similar to *H. everetti* Kirby except: (1) the former is far smaller than the latter; (2) the female forecoxa of the former species with only 5–6 obtuse denticles, while the latter has 8–9 triangular denticles; (3) the former with a black patch behind the tibial spur groove, while in the latter it is before the tibial spur groove.

In addition, this species may have a close affinity with *H. patellifera* for due to the striking similarity between their male genitalia. However, it can be distinguished from the latter by the former afa being 3 times longer than width, while in the latter the afa is shorter than 3 times longer than width.

We also note that Tinkham (1937) and Wang (1993) misidentified this species as *H. chinensis* Werner.

2. *Hierodula macrodentata* sp. nov. (Fig. 2)

Male. Large size. Antenna filiform (Figs. 2A, 2C). Eyes oval in lateral view. Lower frons pentagonal and as wide as high, upper margin obtuse angled and center area sunk (Fig. 2C). Pronotum shortened ovally and compressed tenderly behind supra coxal dilation; metazone about 2.8 time as long as prozone; prozone with denticles on the lateral margin (Fig. 2A). Both fore- and hindwings exceeding the apex of abdomen; forewing with discoidal area translucent, but costal area opaque; stigma relatively long and narrow (Fig. 2A). Forecoxa slightly longer than metazone; front margin with 5–6 large obtuse denticles put forth from the inner submargin. Forefemur with 4 pvfs and 15 avfs; the pattern of internal spines ranged as iiiiIiIiIiIiI. Fore tibia with 10 pvts and 14 avts (Fig. 2C).

Coloration. General colored green. Ocelli yellow. Pronotum with black band on the posterolateral margin. Foretrochanter with a blackish spot near the apex. Forefemur with inner side of 1st small and all large avfs black or blackish; inner side of 1st, 2nd and 3rd discoidal spines black or blackish; only tip of other spines black; anteroventral margin with 3 small rufous spot. Inner side of distal part of metatarsus black. Prosternum with 2 transverse blackish or black bands at the base (Fig. 2C).

Male genitalia. Sclerite L4A approximatively rhombic; sdp bifurcated, elongated, and curved laterally at base; sdpl mondsichel (sickle) shaped; sdpm located at curve of sdp (Figs. 2E, 2F). Sclerite L4B spoon-shaped, sclerotized weakly. Sclerite L2 narrow, strongly curved like an “S” along its left edge and with a sclerotized apical process paa, and paa curved dorsally. Sclerite L1 triangular, simple (Figs. 2E, 2F). afa contorted, paw-shaped following L1, covered by numerous setae at tip; aafa bipinnatifid, with 2 sharpened processes; pafa elongated and curved (Fig. 2H). loa inflated, sclerotized weakly (Figs. 2E, 2F). Lobe fda more or less triangular, but elongated anteriorly to the left; map thumb-shaped, located at distal margin of fda, and covered by numerous setae at tip (Figs. 2E–G). Process pia narrow, pva strongly curved like a “C” (Fig. 2G).

Female. Body stronger while shorter than male. Pronotum with denticles on the lateral margin; metazone about 2.8 times as long as prozone (Fig. 2B). Forewing with discoidal area opaque. Pronotum without black band on the lateral margin of the base. Prosternum without

black band at the base. Other characteristics same as in male.

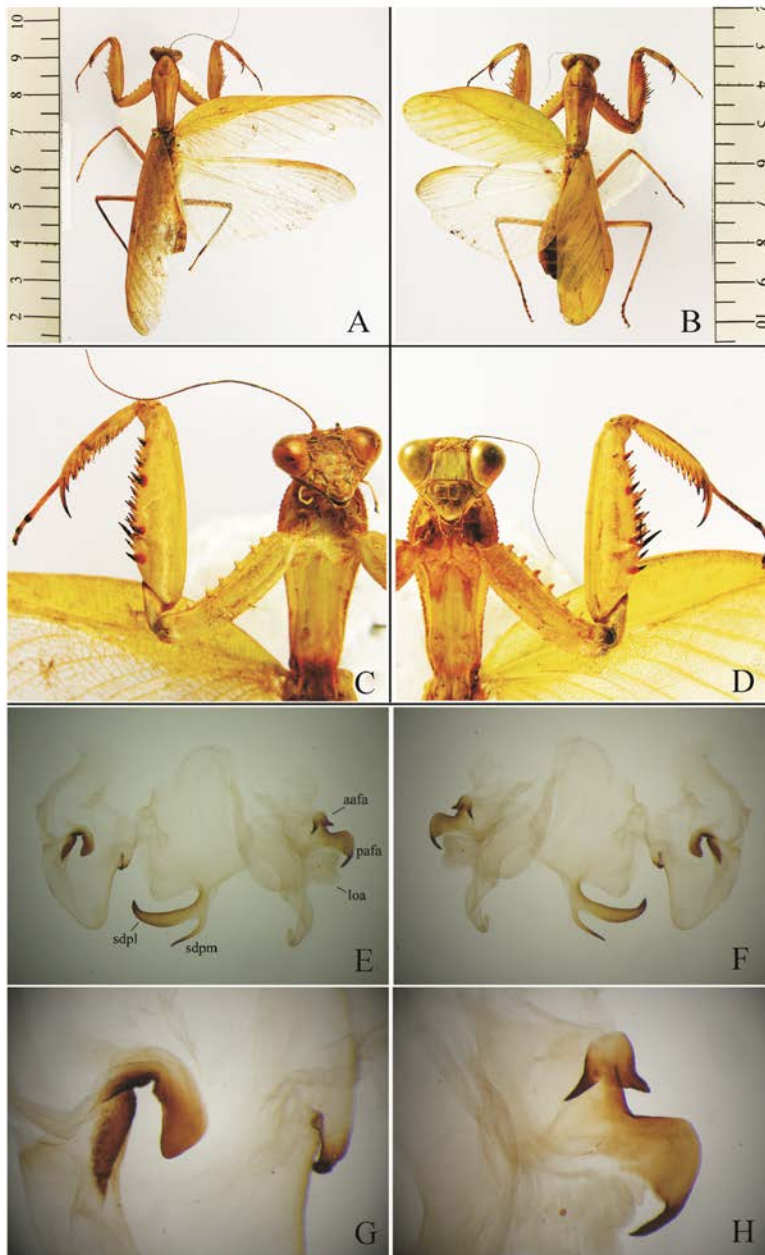


Figure 2. *Hierodula macrodentata* sp. nov. A. Male habitus, dorsal view; B. Female habitus, dorsal view; C. Male head, prothorax and foreleg, ventral view; D. Female head, prothorax and foreleg, ventral view; E. Male genitalia, ventral view of ventral phallomere and right phallomere, dorsal view of left phallomere; F. Male genitalia, dorsal view of ventral phallomere and right phallomere, ventral view of left phallomere; G. Process posterolateral to pia (pia), process anteromesal to pia (pva); H. Anterior process of left phallomere (afa). Abbreviations are listed in the materials and methods section.

Measurement (mm). Body length, ♂ 64.0, ♀ 63.0. Pronotum length, ♂ 19.5, ♀ 22.0. Pronotum width, ♂ 7.0, ♀ 9.0. Metazone length, ♂ 14.0, ♀ 16.0. Fore wing length, ♂ 54.0, ♀ 44.0.

Holotype. ♂, **China**, Yunnan (Jinghong Sanchahe), 11–22-XI-1995, coll. Wenhong XU, No. 08200648 (SEM). **Paratypes.** 1♂1♀, same as holotype, Nos. 08200649, 08200650 (SEM).

Distribution: China (Yunnan).

Etymology. The specific epithet “*macrodentata*” refers to 5–6 large obtuse denticles on the lower margin of forecoxa.

Remarks. This species is well distinguished from others in the genus by the right oval pronotum, 5–6 large obtuse denticles and forefemur anteroventral margin with 3 small rufous spots.

It is very similar to *Hierodula bhamoana* Giglio-Tos in spite of only the holotype of the female *H. Bhamoana* specimen being known, except that the new species is female: (1) far smaller than the latter; (2) forewing far shorter than the latter; (3) forecoxa with 5–6 obtuse denticles on the lower margin, while the latter with 4.

3. *Hierodula pistillinota* sp. nov. (Fig. 3)

Male. Large size. Antenna filiform and long (Fig. 3A). Eyes oval in lateral view. Lower frons pentagonoid and approximately as high as wide; upper margin obtuse angled and central area somewhat flat. Pronotum elongated as a club, and compressed sharply behind and tenderly before supra coxal dilation; metazone about 3 times as long as prozone; prozone without obvious denticles on the lateral margin (Fig. 3A). Both fore- and hind wings exceeding the apex of abdomen; forewing with discoidal area transparent but costal area opaque; stigma relatively long and narrow, spindle-shaped (Fig. 3A). Forecoxa slightly shorter than metazone; lower margin with 6–7 sharp and large denticles put forth from top margin. Forefemur with 4 pvfs and 15 avfs; the pattern of avfs range as ililililililililil. Foretibia with 10–11 pvts and 13–14 avts (Fig. 3B).

Coloration. General colored green. Ocelli yellow. Forefemur with inner side of 1st and 3rd discoidal spines black; inner side of 1st, 2nd, 5th and 7th large avfs black or blackish; only tip of other spines black. Pronotum with black bands on the lateral margin of the base. Inner side of foretarsus not black (Fig. 3B).

Male genitalia. Sclerite L4A irregularly rhomboidal, sdp stocky, inflated at subterminal region, and curved laterally at base; sdpm and sdpl bud-shaped (Figs. 3C, 3D). Sclerite L4B spoon-shaped, sclerotized weakly. Sclerite L2 inflated in the middle, curved like an “S” along its left edge and with a sclerotized apical process paa, and paa curved dorsally. Sclerite L1 triangular, simple (Figs. 3C, 3D). afa elongated, covered by numerous thick setae at two end; aafa acute; pafa stocky, curved, end truncated (Fig. 3F). Lobe fda more or less triangular, elongated anteriorly to the left and dilated at the end of this elongation; map underdeveloped, but posterolateral margin of fda sunken and sclerotized strongly (Figs. 3C, 3D). Process pia curved like a “C”, anterior end blunt, posterior end acute; pva olecranon-shaped (Fig. 3E).

Female. Unknown.

Measurement (mm). Body length, ♂ 73.0. Pronotum length, ♂ 23.0. Pronotum width, ♂ 6.8. Metazone length, ♂ 17.5. Forewing length, ♂ 61.0.

Holotype. ♂, **China**, Yunnan (Jinghong Rezuosuo), 11-IX-1991, coll. Zuyao LIU, Tianqi WANG & HaiSheng YIN, No. 08200081 (SEM); **Paratype.** 1♂, **China**, Yunnan (Xishuangban-na), 545 m, 14–25-V-1974, coll. Yao ZHOU & Feng YUAN (NWFU).

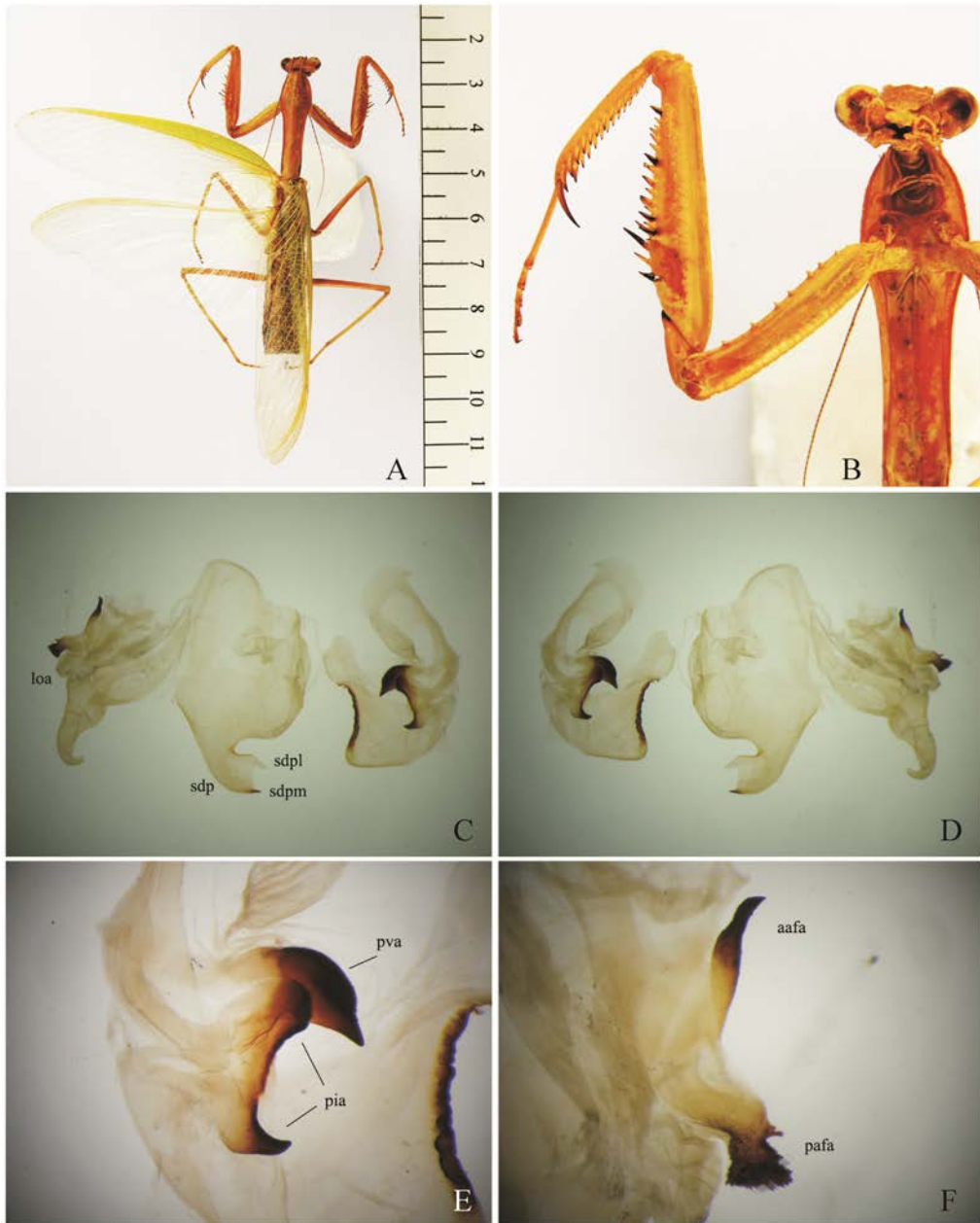


Figure 3. *Hierodula pistillinota* sp. nov. A. Male habitus, dorsal view; B. Male head, prothorax and foreleg, ventral view; C. Male genitalia, ventral view of ventral phallomere and right phallomere, dorsal view of left phallomere; D. Male genitalia, dorsal view of ventral phallomere and right phallomere, ventral view of left phallomere; E. Process posterolateral to pia (pia), process anteromesal to pia (pva); F. Anterior process of left phallomere (afa). Abbreviations are listed in the materials and methods section.

Distribution: China (Yunnan).

Etymology. The specific epithet “*pistillinota*” denotes the club-shaped pronotum of this species.

Remarks. This species is well distinguished from others in the genus by the following morphologic combination: (1) the club-shaped pronotum; (2) the forefemur with inner side of 1st and 3rd discoidal spines and 1st, 2nd, 5th and 7th large internal spines black or blackish; (3) map underdeveloped, but posterolateral margin of fda sunken and sclerotized strongly (Figs. 3C–D); (4) Process pia curved like a “C”, anterior end blunt, posterior end acute (Fig. 3E); (5) sdp stocky, inflated at subterminal region, sdpm and sdpl bud-shaped (Figs. 3C–D). This species is close to *H. grandis* Saussure, but conspicuously differentiable by the pronotum shape and male genitalia.

4. *Hierodula chinensis* Werner, 1929 (Figs. 4, 5)

Hierodula chinensis Werner, 1929: 75.

Hierodula (Hierodula) chinensis: Beier, 1933: 330.

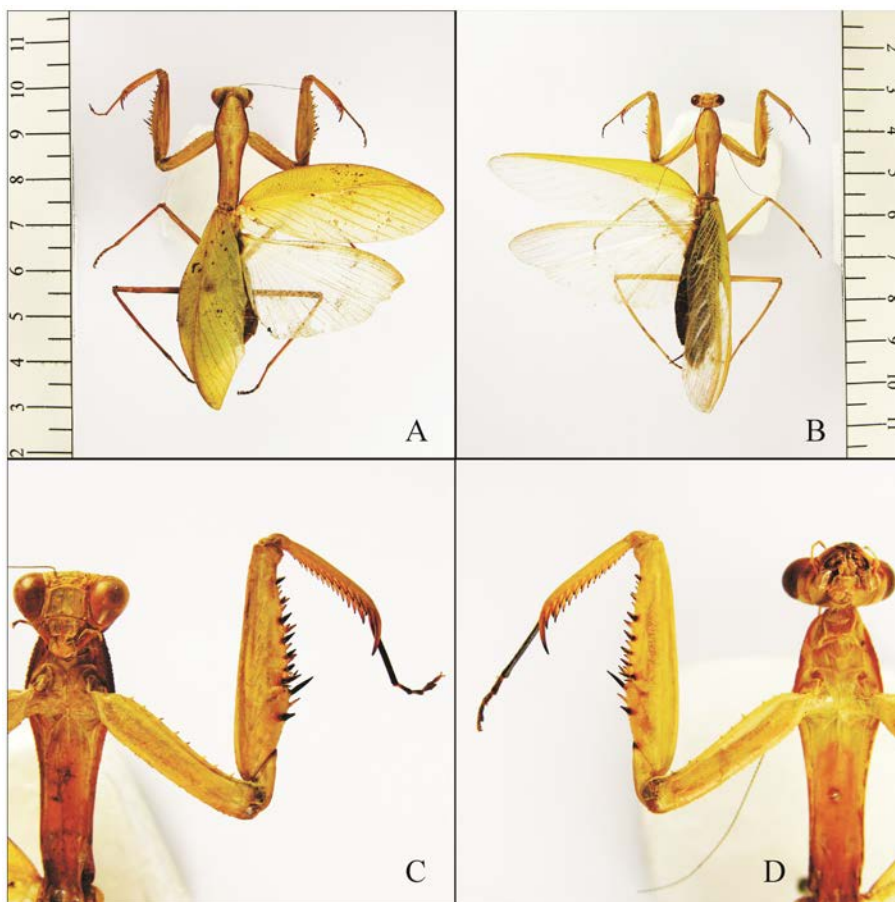


Figure 4. *Hierodula chinensis* Werner, 1929. A. Male habitus, dorsal view; B. Female habitus, dorsal view; C. Male head, prothorax and foreleg, ventral view; D. Female head, prothorax and foreleg, ventral view.

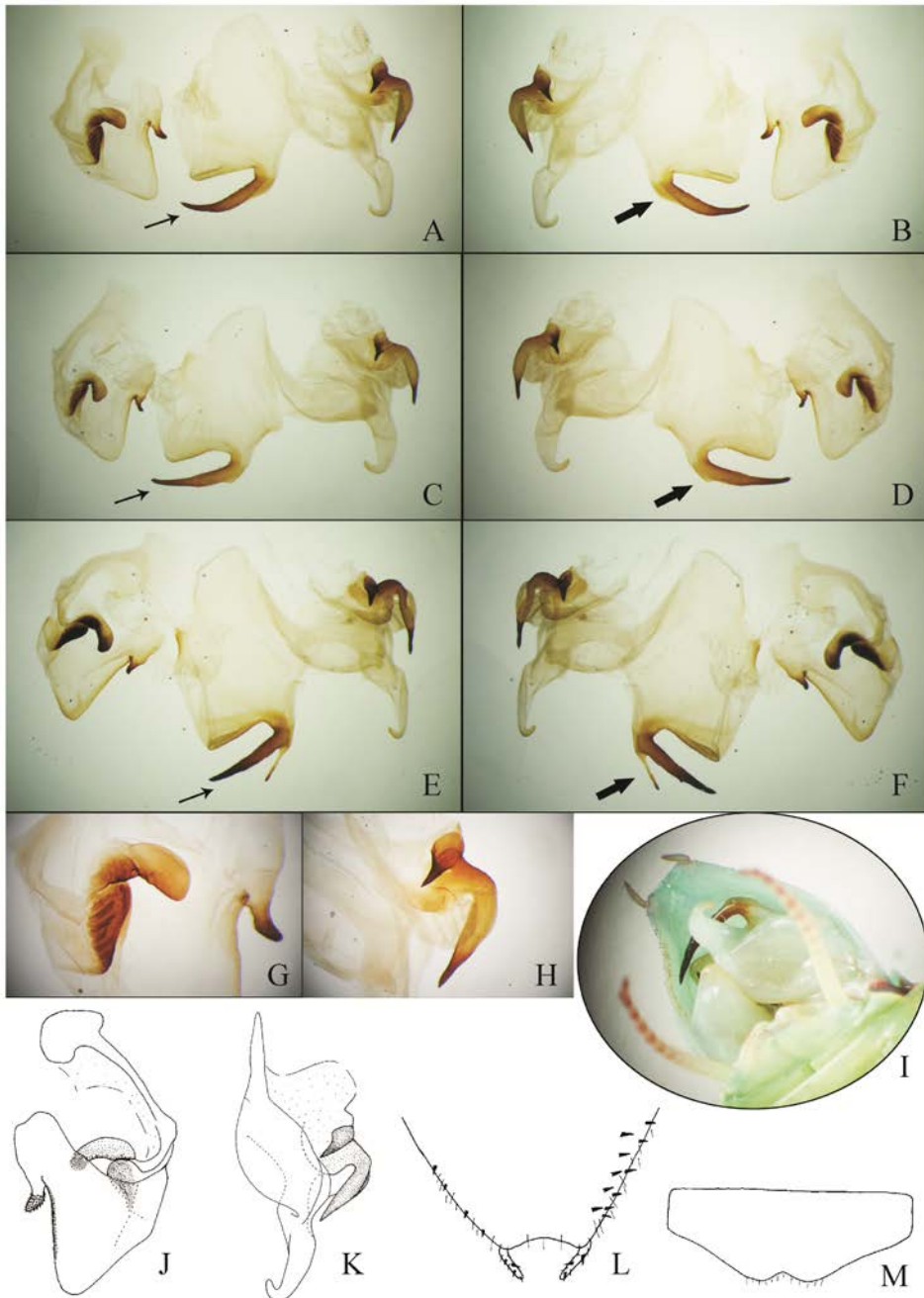


Figure 5. *Hierodula chinensis* Werner, 1929. A, C, E. Male genitalia, ventral view of ventral phallomere and right phallomere, dorsal view of left phallomere; B, D, F. Male genitalia, dorsal view of ventral phallomere and right phallomere, ventral view of left phallomere; G. Process posterolateral to pva (pia), process anteromesal to pia (pva); H. Anterior process of left phallomere (afa); I. Apex of male abdomen, dorsal view; J. Right phallomere, dorsal view; K. Left phallomere, dorsal view; L. Subgenital plate, dorsal view; M. Supraanal plate, dorsal view. Thick arrows denote a variation of sdpm, thin arrows denote a variation of sdpl.

Remarks. This widespread species is very similar to *H. grandis* Saussure except that it: (1) is smaller overall than the latter; (2) map of right phallomere thumb-shaped, while the latter undeveloped (Figs. 5G, 7E). Simultaneously, this species shows a wide variation on the sdpm of L4A (Figs. 5A–F, thick arrows pointed).

We note that *H. chinensis* Werner was misidentified as *Hierodula membranacea* (Burmeister) by Tinkham (1937) and Wang (1993).

Specimens examined. China, 5♂5♀, Sichuan (Qingcheng Mountain), 06-X-1991, coll. Zuyao LIU, Tianqi WANG & Haisheng YIN, Nos. 08200430, 08200431, 08200425, 08200425, 08200426, 08200427, 08200428, 08200429, 08200435, 08200432; 15♂, Sichuan (Emei Mountain), 01-X-1991, coll. Zuyao LIU, Tianqi WANG & Haisheng YIN, Nos. 08200434, 08200340, 08200344, 08200349, 08200345, 08200353, 08200354, 08200357, 08200333, 08200342, 08200339, 08200334; ♂, Sichuan (Ya'an), XI-1991, coll. Feng YAN, 08200646; ♂, Guizhou (Xishui Sanchahe), 1100 m, 21–25-X-2006, collector unknown, No. 08200710; 1♂2♀, Guizhou (Chishui Asophila National Nature Reserve), 300 m, 19–20-X-2006, coll. Xianwei LIU, Dingjie ZHANG & Shun ZHOU, Nos. 08200699, 08200696; 5♂, Hunan (Dayong Zhangjiajie), 11-IX-1988, coll. Xianwei LIU, Nos. 08200235, 08200291; 2♂, Yunnan (Lunan Shilin), 29-VIII-1991, coll. Tianqi WANG, Nos. 08200084; ♂, Hunan (Heng Mountain), 18-IX-1986, coll. Xianwei LIU, No. 08000730; 4♂1♀, Henan (Shangcheng Jingangtai), 550 m, 25-IX-1986, coll. Jianguang XIAO, Nos. 08200461, 08200456, 08200458, 08200455; 1♂1♀, Henan (Shangcheng Jingangtai), 450 m, 24-IX-1986, coll. Xiujiang ZHANG, Nos. 08200454, 08200453; ♂, Henan (Xinyang Lijiazhai), 30-VIII-1985, coll. Dongsheng LI, No. 08200644; ♀, Jiangxi (Jiulian mountain), 17-X-1986, coll. Jianzhong ZHENG, No. 08000723; ♂, Anhui (Huo Mountain), 27-IX-1964, coll. Gentao JIN, Nos. 08000019; 1♂2♀, Guangxi (Shengtang Mountain), 500–700 m, 20-X-1981, coll. Jin & Li, Nos. 08000419, 08000527; 3♀, Guangxi (Guilin), 14-XII-1985, coll. Xia & Bi, Nos. 08000673, 08000650; ♂, Guangxi (Jinxu), 950 m, 27-IX-1981, coll. Jin & Li, No. 08000421; ♀, Zhejiang (Hangzhou), 19-X-1980, coll. Ming CAO, No. 08000418; ♂, Zhejiang (Taishun), 29-VIII-1987, coll. Zuyao LIU & Gentao JIN, Nos. 08000747, 08000745; ♀, Zhejiang (Tiammu Mountain), 11–13-X-1999, coll. Xianwei LIU & Haisheng YIN, No. 08200460; ♀, Anhui (Huangshan), 670–1100 m, 27-VIII-1983, collector unknown, No. 08000739. Above specimens are deposited in SEM.

Distribution: China (Sichuan, Guizhou, Hunan, Yunnan, Henan, Anhui, Guangxi, Zhejiang, Beijing).

5. *Hierodula formosana* Giglio-Tos, 1912 (Fig. 6)

Hierodula formosana Giglio-Tos, 1912: 77.

Hierodula (*Hierodula*) *formosana* Giglio-Tos, 1927: 440.

Remarks. This species is widespread in southern China. It may be confused with *H. membranacea* (Burmeister) for their subtle differences. In fact, Tinkham (1937) and Wang (1993) wrongly identified it as *H. membranacea* (Burmeister). This wrong identification is also mentioned and was revised by Zhu *et al.* (2012).

In addition, this species is different from *H. membranacea* (Burmeister) in having only 8–10 small spines on the lower margin of forecoxa, while the latter has at least 15. The male genitalia is conspicuously different between both species.

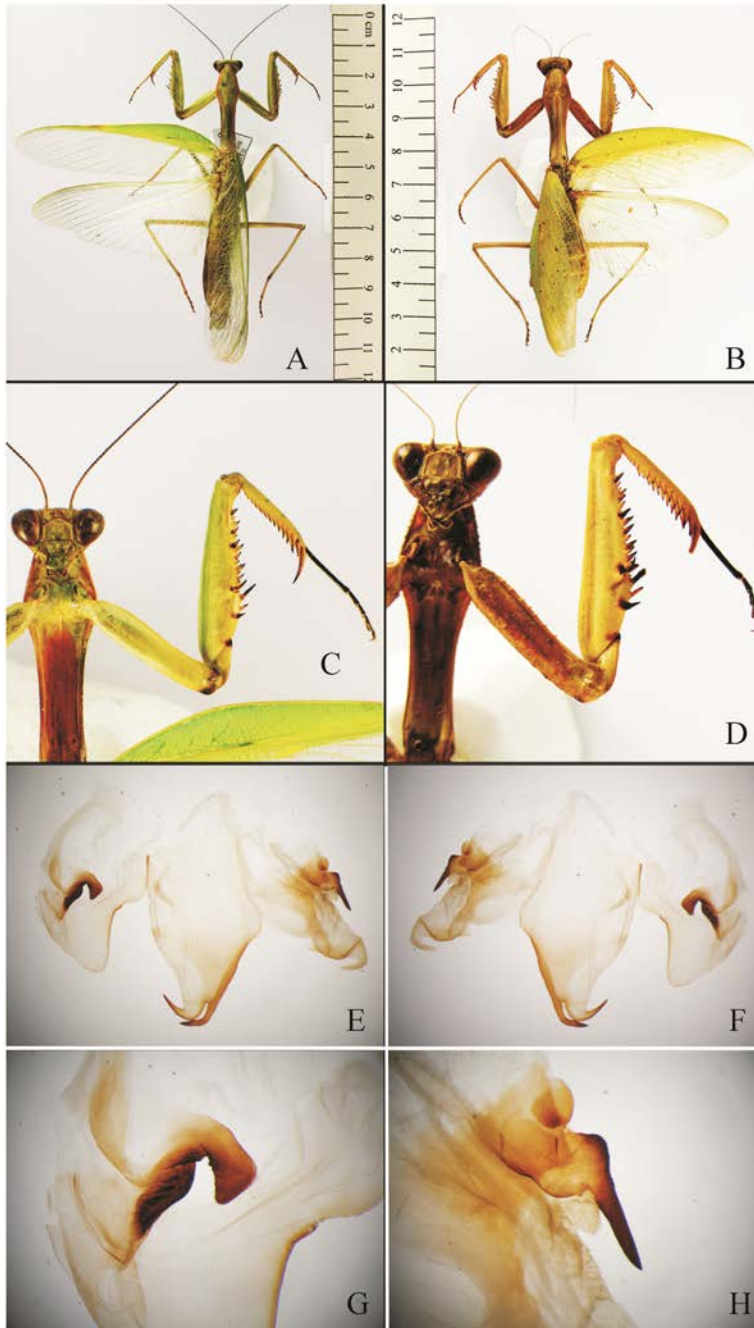


Figure 6. *Hierodula formosana* Giglio-Tos, 1912. A. Male habitus, dorsal view; B. Female habitus, dorsal view; C. Male head, prothorax and foreleg, ventral view; D. Female head, prothorax and foreleg, ventral view; E. Male genitalia, ventral view of ventral phallomere and right phallomere, dorsal view of left phallomere; F. Male genitalia, dorsal view of ventral phallomere and right phallomere, ventral view of left phallomere; G. Process posterolateral to pva (pia), process anteromesal to pia (pva); H. Anterior process of left phallomere (afa).

Specimens examined. **China**, 14♂, Hainan (Jianfengling), 13–18-X-1992, coll. Zuyao LIU, Tianqi WANG & Haisheng YIN, Nos. 08200450, 08200328, 08200449, 08200437, 08200438, 08200440, 08200443, 08200446, 08200439, 08200441, 08200457, 08200448, 08200451, 08200444, 08200445, 08200447; 3♂, Hainan (Tongshen), 28–31-X-1992, coll. Tianqi WANG & Haisheng YIN, Nos. 08200355, 08200337, 08200359; ♀, Zhejiang (Qingyuan), 550 m, 20-VII-1963, coll. Gentao JIN, No. 08000100; ♀, Zhejiang (QingYuan), 12–02-VIII-1996, coll. Xingbao JIN & Weinian ZHANG, No. 08200436; ♀, Zhejiang (Kaihua), 29-VII-1985, coll. Zuyao LIU & Jianzhong ZHENG, No. 08200289; 3♂, Guizhou (Maolan), 600–650 m, 19–20-VI-2006, coll. Zaihua YANG, Nos. 08200624, 08200625, 08200651; ♀, Guangdong (Nanling), 500 m, 07–09-VIII-2006, coll. Zaihua YANG, No. 08200652; ♀, Guangxi (Longzhou), 18–23-VIII-1995, Xianwei LIN, coll. Xingbao JIN & Weinian ZHANG, No. 08200623. Above specimens are deposited in SEM.

Distribution. China (Zhejiang, Sichuan, Guizhou, Guangxi, Guangdong, Hainan, Taiwan); Malaysia; Sumatra; Sunda Island.

6. *Hierodula grandis* Saussure, 1870 n. rec. to China (Fig. 7)

Hierodula grandis Saussure, 1870: 233.

Hierodula (Hirodula) grandis Giglio-Tos, 1927.

Specimens examined. **China**, 2♂4♀, Xizang (Motuo Beibeng), 940–960 m, 17-XI–6-X-1979, coll. Gentao JIN & Jianyi WU, Nos. 08200050, 08000462, 082000048, 08000460, 08200003; ♀, Xizang (Motuo Didong), 1120 m, 27-XI-1979, coll. Gentao JIN & Jianyi WU, No. 08200053; 2♂1♀, Xizang (Motuo), 1200–1310 m, 16–23-IX-1979, coll. Gentao JIN & Jianyi WU, Nos. 08200007, 08200021, 08200018. Above specimens are deposited in SEM.

Distribution: China (Xizang); Bangladesh; India; Myanmar.

Remarks. This species shows a variation on the sdpm of L4A (Figs. 7E, 7G, thick arrows pointed).

7. *Hierodula membranacea* (Burmeister, 1838) (Fig. 8)

Mantis (Hierodula) membranacea Burmeister, 1838: 536.

Mantis (Mantis) membranacea Burmeister: De Haan 1842: 68.

Stagmatoptera veneratoria Saussure, 1870: 232.

Hierodula membranacea (Burmeister): Saussure, 1871: 84.

Hierodula birivia (Stoll): Saussure, 1871: 89.

Specimens examined. **China**, ♂, Yunnan (Menglun Tropical Botanical Gardens), 18–21-VII-1995, coll. Xianwei LIU, Weinian ZHANG & Xingbao JIN, No. 08200825.

Distribution: China (Yunnan); Java; Nepal; Sri Lanka; Thailand.

8. *Hierodula patellifera* (Serville, 1839) (Fig. 9)

Mantis patellifera Serville, 1839: 185.

Mantis bipapilla Serville, 1839: 188.

Mantis (Mantis) patellifera Serville: De Haan, 1842: 70.

Mantis (Mantis) bipapilla Serville: De Haan, 1842: 70.

Hierodula manillensis Saussure, 1870: 233.

Hierodula bipapilla (Serville): Saussure, 1871: 79.

Hierodula patellifera (Serville): Stål, 1877: 57.

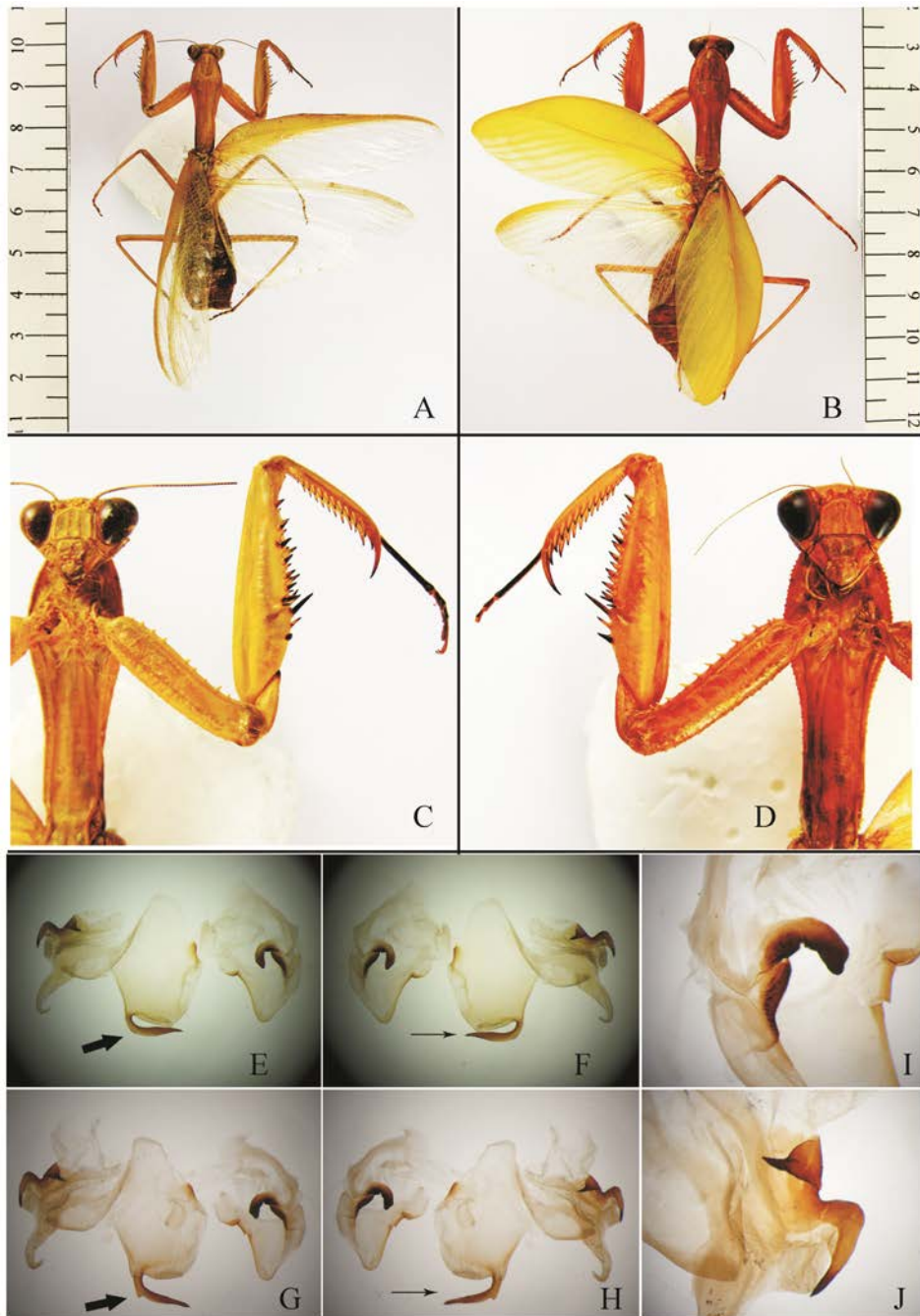


Figure 7. *Hierodula grandis* Saussure, 1870 n. rec. A. Male habitus, dorsal view; B. Female habitus, dorsal view; C. Male head, prothorax and foreleg, ventral view; D. Female head, prothorax and foreleg, ventral view; E, G Male genitalia, ventral view of ventral phallomere and right phallomere, dorsal view of left phallomere; F, H. Male genitalia, dorsal view of ventral phallomere and right phallomere, ventral view of left phallomere; I. Process posterolateral to pva (pia), process anteromesal to pia (pva); J. Anterior process of left phallomere (afa). Thick arrows denote a variation of sdpm, thin arrows denote a variation of sdpl.

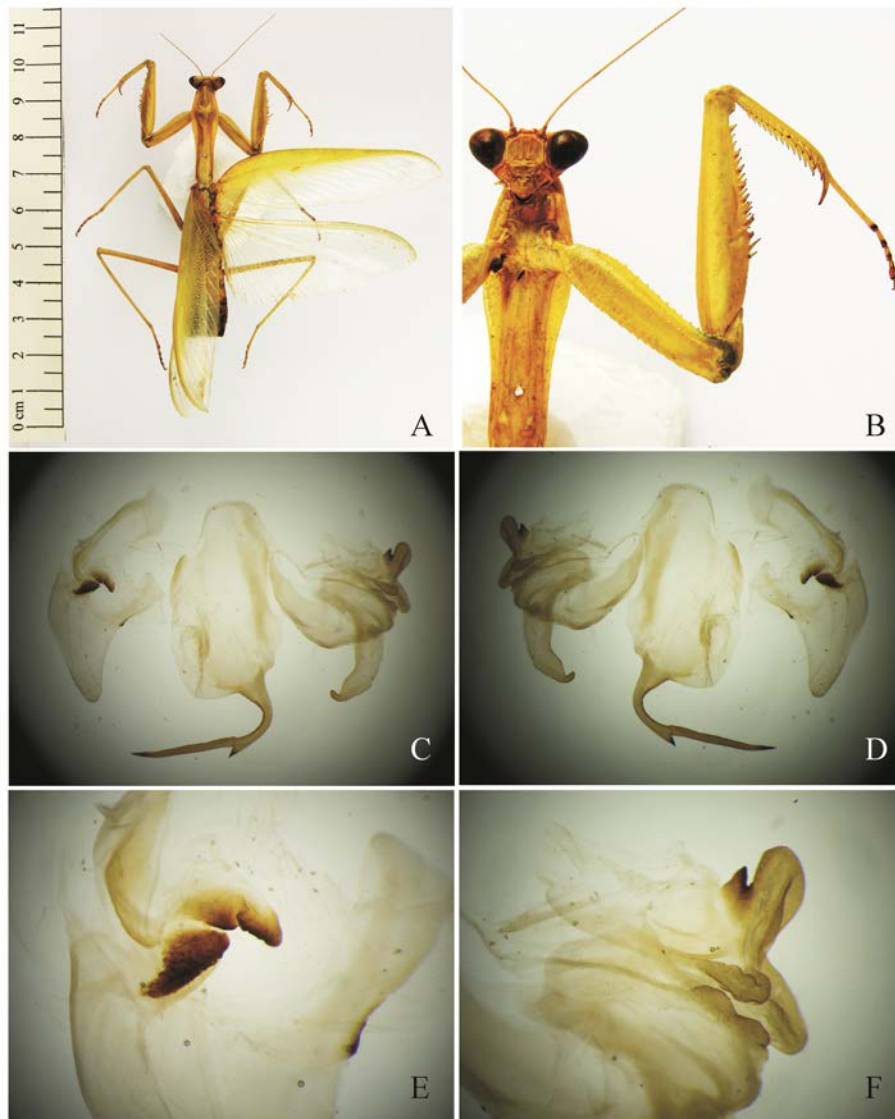


Figure 8. *Hierodula membranacea* (Burmeister, 1838). A. Male habitus, dorsal view; B. Male head, prothorax and foreleg, ventral view; C. Male genitalia, ventral view of ventral phallomere and right phallomere, dorsal view of left phallomere; D. Male genitalia, dorsal view of ventral phallomere and right phallomere, ventral view of left phallomere; E. Process posterolateral to pva (pia), process anteromesal to pia (pva); F. Anterior process of left phallomere (afa).

Hierodula raptorial Stål, 1878: 38.

Hierodula dispar Kirby, 1900: 146.

Hierodula saussurei Kirby, 1904: 245.

Hierodula patellifera var. *manillana* Saussure: Giglio-Tos, 1912: 96.

Hierodula (Hierodula) patellifera (Serville): Giglio-Tos, 1927: 447.

Hierodula (Hierodula) saussurei (Kirby): Giglio-Tos, 1927: 447.

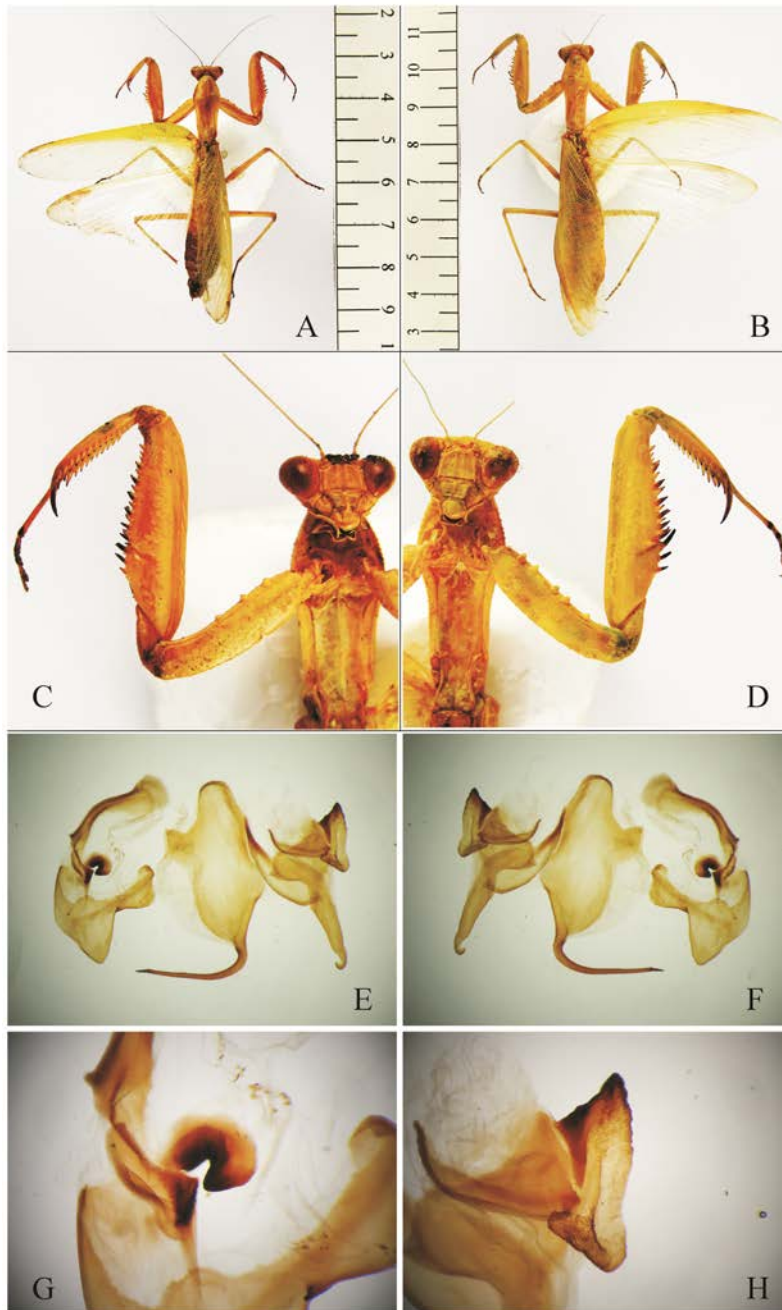


Figure 9. *Hierodula patellifera* (Serville, 1839). A. Male habitus, dorsal view; B. Female habitus, dorsal view; C. Male head, prothorax and foreleg, ventral view; D. Female head, prothorax and foreleg, ventral view; E. Male genitalia, ventral view of ventral phallomere and right phallomere, dorsal view of left phallomere; F. Male genitalia, dorsal view of ventral phallomere and right phallomere, ventral view of left phallomere; G. Process posterolateral to pia (pia), process anteromesal to pia (pva); H. Anterior process of left phallomere (afa).

Hierodula (Hierodula) manillana Giglio-Tos, 1927: 448.

Hierodula (Hierodula) bipapilla (Serville): Giglio-Tos, 1927: 448.

Hierodula yunnanensis Wang, 1993: 137 **Syn. n.**

Hierodula xishaensis Wang, 1993: 140 **Syn. n.**

Hierodula multispina Wang, 1993: 142 **Syn. n.**

Hierodula daqingshanensis Wang, 1993: 141 **Syn. n.**

Specimens examined. China, 1♂1♀ (Holotype & Paratype of *H. yunnanensis* Wang), Yunnan (Yiliang), 29-X-1958, coll. Daoying BI & Zunyi REN, Nos. 08000569, 08000570; 2♀ (Allotype & Paratype of *H. yunnanensis* Wang), Yunnan (Jianshui), 19-X-1958, coll. Daoying BI & Zunyi REN, Nos. 08000568, 08000567; 1♂1♀ (Holotype & Allotype of *H. xishaensis* Wang), Xisha Islands (Yongxing Island), 12-XII-1984, coll. Gentao JIN & Zuyao LIU, Nos. 0800068, 08000681; 2♂3♀ (Paratype of *H. xishaensis* Wang), Xisha Islands (Yongxing & Dong Island), 11–21-XII-1984, coll. Gentao JIN & Zuyao LIU, Nos. 08000683, 08000703, 08000702, 08000688, 08000080; 1♂ (Holotype of *H. multispina* Wang), Yunnan (Funing), 09-X-1958, coll. Daoying BI, No. 08000611; 2♀ (Allotype & Paratype of *H. multispina* Wang), Yunnan (Jinghong), 24-VI-1973, coll. Gentao JIN, Nos. 08000641, 08000640; ♂ (Paratype of *H. multispina* Wang), Yunnan (Xishuangbanna), V-1983, coll. Yunchang SHEN, No. 08200343; 1♀ (Paratype of *H. multispina* Wang), Yunnan (Jinghong), 05-IX-1991, coll. Zuyao LIU, Tianqi WANG & Haisheng YIN, No. 08200306; 1♀ (Holotype of *H. daqingshanensis* Wang), Guangxi (Daqing Mountain), 02-XII-1983, coll. Xingbao JIN & Daoying BI, No. 08000556; 4♂1♀, Hainan (Tongshen), 13–31-X-1992, collector unknown, Nos. 08200442, 08200817, 08200819, 08200820, 08200730; 1♂, Hubei, VIII-1974, collector unknown, no. 08000444; 3♂6♀, Jiangsu (Dong Mountain), 29–31-VIII-1959, coll. Qinying JIN, Nos. 08000086, 08000080, 08000075, 08000076, 08000081, 08000264, 08000262, 08000079, 08000082; 8♀, Anhui (Huo mountain), 150 m, 25–27-IX-1964, coll. Gentao JIN, Nos. 08000067, 08000030, 08000032, 08000029, 08000028, 08000026, 08000039, 08000027; 2♀, Shanghai, 19-X-1956, Nos. 08000225, 08000226; 1♂3♀, Zhejiang (Hangzhou), 09-VIII-1961, collector unknown, Nos. 08000704, 08000705, 08000573, 08000575; 3♂3♀, Henan (Tongbai Mountain), 11-IX-2000, coll. Xianwei LIU & Weinian ZHANG, Nos. 08200283, 08200286, 08200311, 08200296, 08200294, 08200295; 2♂, Shangdong (Shi island), 11-IX-1962, coll. Gentao JIN, Nos. 08000240, 08000242; 1♀, Beijing, IX-1985, coll. Yingmei LI, No. 08200281; 4♀, Sichuan (Ya'an), X–XII-1991, coll. Yan FENG, Nos. 08200401, 08200399, 08200350, 08200400; 1♀, Guizhou (Hua Xi), 28-IX-2006, coll. Zaihua YANG, No. 08200638; ♀, Jiangxi (Jiulian Mountain), 12-IX-1986, coll. Zheng & Gan, No. 08200722; 2♀, Fujian (Zhangzhou), 14-IX-1963, coll. Gentao JIN, Nos. 08000654, 08000658; 1♀, Hongkong (Dayu Mountain), 06-IX-1991, coll. Xiusong HE, no. 08200640; ♀, Guangzhou (Baiyun Mountain), 18-XI-1984, coll. Xingbao JIN, No. 08000653. Above specimens are deposited in SEM.

Distribution: China (Beijing, Hebei, Shangdong, Shaanxi, Zhejiang, Jiangsu, Shanghai, Sichuan, Guizhou, Fujian, Hubei, Guangdong, Hainan, Jiangxi, Anhui, Guangxi, Henan, Xizang, Hongkong, Taiwan); Japan; Java; Philippines; Hawaii; India; Korea; New Guinea; Vietnam; Sumba.

Remarks. This species, which is widespread in East Asia, Southeast Asia and South Asia, is variable in size, number and shape of the verrucae on the lower margin, and also in possession of transverse bands from 0 to 2 on the base of the prosternum. It has five synonyms

listed by Otte & Spearman (2005) and six by Ehrmann (2002). Tinkham (1937) also suggests that *H. unimaculata* (Olivier) is the synonym of this species. *H. patellifera* is one of most widespread praying mantids in China. It can be found from north (Beijing) to south (Yunnan, Hainan) China, and their color is variable from green to brown. The southern individuals are generally bigger than northern in size (Zhu *et al.*, 2012). As we know, *H. patellifera* has a variable number of black spines on the apex of the subgenital plate. Even for the same specimen, the number and shape of forecoxal verrucae are variable between left wing and right wing, and the venation is also variable.

Wang (1993) described *H. yunnanensis*, *H. multispina*, *H. daqingshanensis* and *H. xishaensis* Wang, 1993 as supposedly closely allied to *H. patellifera*. According to Wang (1993), they are mainly different in (1) number and shape of the verrucae on the lower margin of forecoxa; (2) the width among forecoxal marginal verrucae; (3) number of the black spines on the apex of subgenital plate; and (4) the dense venation around forewing stigma. But considering *H. patellifera* is a very variable species, it looks as if all of these diagnostic characteristics are not reliable. Shcherbakov and Anisyutkin (2018) discussed this taxonomic problem, and suggested that *H. yunnanensis* and *H. xishaensis* are synonyms of *H. patellifera*.

Investigating the type specimens of *H. yunnanensis*, *Hierodula multispina*, *Hierodula daqingshanensis* and *H. xishaensis*, and comparing them to *H. patellifera*, we found that the male genitalia are considerably consistent among them. The minute difference is the curved degree of sdP, but this is not obvious. We therefore propose that *H. yunnanensis* Wang, *H. xishaensis* Wang, *H. multispina* Wang and *H. daqingshanensis* Wang are junior synonyms of *H. patellifera* (Serville) in this paper.

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