



Article

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Notes on the genera *Sinophasma* Günther, 1940 and *Pachyscia* Redtenbacher, 1908 (Phasmatodea: Diapheromeridae: Necrosiinae), with the description of four new species from China

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Abstract

A list and key to the species of *Sinophasma* Günther, 1940 and *Pachyscia* Redtenbacher, 1908 are provided. Four new species, *Sinophasma bii* sp. nov., *S. daoyingi* sp. nov., *S. guangdongensis* sp. nov. and *Pachyscia heishidingensis* sp. nov., from China are described and illustrated. One new synonym and one new combination are established: *Sinophasma rosarum* Chen & He, 2008 is shown to represent the female of *S. jinxiuense* Chen & He, 2008 (syn. nov.); and *Pachyscia longicauda* (Bi, 1990) (comb. nov.) is transferred from *Sinophasma*. The male of *Pachyscia dilatata* (Chen & He, 2004) is described for the first time.

Key words: Necrosiinae, *Sinophasma*, *Pachyscia*, *Sinophasma bii*, *Sinophasma daoyingi*, *Sinophasma guangdongensis*, *Pachyscia heishidingensis*, China, new species, new synonym, new combination, description of unknown sex, key

Introduction

The genus *Sinophasma* was established by Günther (1940: 240) for four newly described Chinese species. The major revisionary work was provided by Chen and He (2008). *Sinophasma* is mainly distributed over China, and Taiwan (Hennemann *et al.* 2008; Chen & He 2008) and *S. vietnamense* Chen & Chen, 1999 from North Vietnam is the only species known from outside China. This paper describes three new species, *S. bii* sp. nov., *S. daoyingi* sp. nov. and *S. guangdongensis* sp. nov., found in the Yunnan, Zhejiang and Guangdong Provinces, China. The former species is the first *Sinophasma* known from Yunnan which extends the distribution of the genus further to the southwestern part of China. Further material examined revealed one synonym: *S. rosarum* Chen & He, 2008 is shown to represent the female of *S. jinxiuense* Chen & He, 2008 (syn. nov.). Currently twenty-five species are recognized in *Sinophasma* and a list and key to the species of *Sinophasma* is provided.

Pachyscia Redtenbacher, 1908 is a small genus of Necrosiinae Brunner von Wattenwyl, 1893. The range of distribution is from Guizhou of China [the most northern distribution] to the tropics of Vietnam in the Oriental region. This paper describes one new species, *P. heishidingensis* sp. nov., from China and a new combination, *P. longicauda* (Bi, 1990) (comb. nov.) which is transferred from *Sinophasma* Günther. A first description is given for the male of *P. dilatata* (Chen & He, 2004). A list and key to all species of the genus is provided.

The type specimens and material mentioned in this study are deposited in China Agricultural University, Beijing, China (CAU), Institute of Zoology, Chinese Academy of Sciences, Beijing, China (IZCAS), Shanghai Entomological Museum, Chinese Academy of Sciences, Shanghai, China (SEM), Shanghai Normal University, Shanghai, China (SNU), Museum of Biology, Zhongshan (Sun Yat Sen) University, Guangzhou, Guangdong, China (ZSU) and the private collection of Ho Wai-Chun George, Hong Kong, China (GH). Measurements of the new taxon are only given to the Holotype (HT) and selected Paratype (PT).

For the distribution of each species in the checklist, the Chinese provinces, certain metropolitan areas, administrative regions and Taiwan have been abbreviated as follows:

CQ: Chongqing. FJ: Fujian.
 GD: Guangdong. GX: Guangxi.
 GZ: Guizhou. HeN: Henan.
 HK: Hong Kong. HN: Hainan.
 HuB: Hubei. HuN: Hunan.
 JX: Jiangxi. SC: Sichuan.
 TW: Taiwan. YN: Yunnan.
 ZJ: Zhejiang.

Genus *Sinophasma* Günther, 1940

Type-species. *Sinophasma klapperichi*, Günther, 1940: 240, by original designation.

Diagnosis. This genus is characterized by elongate, thickened and swollen ninth abdominal tergum, and specialization of cerci in male and enlarged, and exposed gonapophyses in female.

Notes. While only one species occurs in Vietnam, all other twenty-four known species are endemic to China. This genus is recorded for the first time from Yunnan Province. The key is adapted from Chen and He (2008: 132). *S. longicauda* Bi, 1990 is transferred to *Pachyscia* Redtenbacher based on morphological features and discussed in the section of the genus in this paper.

Species included:

1. *Sinophasma angulatum* Liu, 1987: 2, figs. 3–4. [*Sinophasma angulata*] [China (GD, JX & ZJ)]
2. *Sinophasma atratum* Chen & He, 2000: 18, figs. 3–4. [China (GX)]
3. *Sinophasma bii* Ho **sp. nov.** [China (YN)]
4. *Sinophasma daoyingi* Ho **sp. nov.** [China (ZJ)]
5. *Sinophasma biacuminatum* Chen & He (in Chen, He & Xu), 2006: 96, figs. 5: 1–2. [China (GZ)]
6. *Sinophasma brevipenne* Günther, 1940: 244, figs. E, L & G. [China (GX, GZ, HuB, HuN, JX & ZJ)]
7. *Sinophasma curvatum* Chen & He, 1994: 124, figs. 1–2. [China (CQ)]
8. *Sinophasma furcatum* Chen & He, 1993: 38, figs. 9–10. [China (GX)]
9. *Sinophasma guangdongensis* Ho **sp. nov.** [China (GD)]
10. *Sinophasma hainanensis* Liu, 1987: 1, figs. 1–2. [China (HN)]
 = *Sinophasma conicum* Chen & He, 1995a: 328, fig. 1. [China (HN)]
11. *Sinophasma hoenei* Günther, 1940: 243, figs. D & M. [*Sinophasma hönei*] [China (ZJ)]
12. *Sinophasma jinxiuense* Chen & He, 2008: 134, 402, figs. 98 a–c. [China (GX)]
 = *Sinophasma rosarum* Chen & He, 2008: 136, 403, figs. 100 a–b. **syn. nov.** [China (GX)]
13. *Sinophasma klapperichi* Günther, 1940: 240, figs. B, K, F & N. [China (FJ, GX & HuN)]
14. *Sinophasma largum* Chen & Chen, 1998: 47, figs. 1–4. [China (GX, GZ, HuB, HuN & SC)]
15. *Sinophasma latisectum* Chen & Chen, 1997a: 124, figs. 1–3. [China (GX)]
16. *Sinophasma maculicruralis* Chen, 1986: 85, figs. 1–4. [China (GX)]
17. *Sinophasma mirabile* Günther, 1940: 242, figs. C & J. [China (FJ, GD, GX, HK, HuN & ZJ)]
 = *Sinophasma crassum* Chen & He, 1995b: 65, fig. 6. [China (ZJ)]
18. *Sinophasma obvium* (Chen & He, 1995a: 65, fig. 7). [*Sipyloidea obvius*] [China (ZJ)]
19. *Sinophasma pseudomirabile* Chen & Chen, 1996: 88, figs. 1 a–b. [China (GX)]
20. *Sinophasma rugicollis* Chen, 1991: 450, figs. 1–2. [China (GZ)]
21. *Sinophasma striatum* Chen & He (in Chen, He & Xu), 2006: 96, figs. 6: 1–2. [China (GZ)]
22. *Sinophasma trispinosum* Chen & Chen, 1997b: 93, figs. 1–3. [China (GD)]
23. *Sinophasma truncatum* (Shiraki, 1935: 82, figs. 8–9, pl. 9: 8–10, pl. 10: 3–4.) [China (HeN & TW)]
 [*Sipyloidea truncata*]
24. *Sinophasma unispinosum* Chen & Chen, 1997b: 95, figs. 4–7. [China (GD)]
25. *Sinophasma vietnamense* Chen & Chen, 1999: 300, figs. 1–3. [Vietnam]

Key to females of *Sinophasma* Günther:

1. Eighth abdominal tergum extended and dilated into a broad rounded lobe postero-laterally. 2.
- Eighth abdominal tergum not extended and dilated into a broad rounded lobe postero-laterally 5.
2. Praeopercular organ absent on seventh sternum *S. hainanensis*
- Praeopercular organ present on seventh sternum 3.
3. Praeopercular organ furcated posteriorly *S. unispinosum*
- Praeopercular organ not furcated posteriorly 4.
4. Cerci cylindrical *S. brevipenne*
- Cerci strongly narrowing at posterior half *S. hoenei*
5. Cerci non-cylindrical 6.
- Cerci cylindrical 8.
6. Anal region of alae pale white. *S. guangdongensis* sp. nov.
- Anal region of alae pink or rose 7.
7. Hind margin of anal segment slightly emarginated *S. mirabile*
- Hind margin of anal segment deeply emarginated *S. daoyingi* sp. nov.
8. Apex of subgenital plate reaching to the anterior area of ninth tergum, gonapophyses projecting over the hind margin of ninth tergum 9.
- Apex of subgenital plate reaching to the middle of ninth tergum, gonapophyses reaching to the middle or hind area of ninth tergum 13.
9. Anal region of alae light yellow 10.
- Anal region of alae rose 11.
10. Head longer than wide, mesonotum lacking longitudinal band, gonapophyses convex *S. furcatum*
- Head rounded, as long as wide, mesonotum with brownish longitudinal band, gonapophyses rhomboid *S. maculicruralis*
11. Hind margin of anal segment deeply concave. *S. jinxiuense*
- Hind margin of anal segment shallowly or indistinctly concave 12.
12. Alae reaching to anterior area of fifth tergum *S. atratum*
- Alae reaching to the sixth tergum *S. bii* sp. nov.
13. Both sides of pronotum with black markings *S. largum*
- Both sides of pronotum lacking black marking *S. klapperichi*

Key to males of *Sinophasma* Günther:

1. Cerci non-cylindrical 2.
- Cerci cylindrical 7.
2. Ninth tergum 2 x length of eighth tergum. *S. mirabile*
- Ninth tergum as long as or 1.5 x length of eighth tergum. 3.
3. Apices of cerci broadened *S. obvium*
- Apices of cerci pointed 4.
4. Cerci tapering posteriorly 5.
- Cerci furcated 6.
5. Hind margin of poculum rounded *S. hainanensis*
- Hind margin of poculum elongate posteriorly *S. daoyingi* sp. nov.
6. Anal segment triangularly emarginated at hind margin, cerci strongly furcated, exterior bifurcation as long as interior bifurcation *S. guangdongensis* sp. nov.
- Anal segment shallowly emarginated at hind margin, cerci lightly furcated, exterior bifurcation 2 x length of interior bifurcation *S. pseudomirabile*
7. Anal segment with one to three spines 8.
- Anal segment lacking spine. 9.
8. Anal segment with one spine *S. unispinosum*
- Anal segment with three spines. *S. trispinosum*
9. Ninth tergum helmet-shaped in dorsal view, ninth tergum larger than eighth tergum and larger than anal segment 10.
- Ninth tergum not helmet-shaped, ninth tergum longer than eighth tergum and larger than anal segment 13.
10. Ninth tergum parallel to anal segment 11.
- Ninth tergum with anal segment vertical 12.
11. Femora and anterior portions of alae spotted *S. hoenei*
- Femora and anterior portions of alae not spotted *S. striatum*
12. Anal segment rather broad, apex not furcated. *S. brevipenne*
- Anal segment rather long, apex furcated. *S. angulatum*
13. Hind margin of eighth tergum widest among the apical three tergites 14.
- Hind margin of ninth tergum widest among the apical three tergites or ninth tergum as wide as eighth tergum 17.

14.	Ninth tergum with anal segment at obtuse angle	15.
-	Ninth tergum with anal segment nearly vertical	16.
15.	Hind margin of anal segment slightly emarginated	<i>S. curvatum</i>
-	Hind margin of anal segment triangularly emarginated	<i>S. vietnamense</i>
16.	Hind margin of anal segment shallowly cleft	<i>S. klapperichi</i>
-	Hind margin of anal segment deeply cleft	<i>S. latisectum</i>
17.	Ninth tergum with anal segment at obtuse angle	18.
-	Ninth tergum with anal segment at straight angle	21.
18.	Poculum lacking processes	<i>S. truncatum</i>
-	Poculum with two asymmetrical processes	19.
19.	Anal segment short, poculum broad	<i>S. maculicruralis</i>
-	Anal segment elongate, poculum with clavate apex	20.
20.	Apex of poculum not reaching end of abdomen	<i>S. biacuminatum</i>
-	Apex of poculum reaching end of abdomen	<i>S. rugicollis</i>
21.	Anal segment nearly rectangular, hind margin truncate	22.
-	Anal segment short widely, nearly at straight angle downward	23.
22.	Process of poculum horn-shaped distally	<i>S. largum</i>
-	Process of poculum valvular distally	<i>S. atratum</i>
23.	Lateral angles of anal segment square-shaped	<i>S. bii</i> sp. nov.
-	Lateral angles of anal segment pointed	24.
24.	Lateral angles of anal segment flat and broad	<i>S. furcatum</i>
-	Lateral angles of anal segment slender and long	<i>S. jinxiuense</i>

Sinophasma bii sp. nov.

(Figs. 1–5)

Type-material. Holotype ♂, 850 m., Wengdang, Mengla, Jinping, Yunnan Province, China, 26.V.2009, Liu Xianwei *et al.*, 12001012 (SEM); Paratypes 2♀♀, 850 m., Wengdang, Mengla, Jinping, Yunnan Province, China, 26.V.2009, Liu Xianwei *et al.*, 12001015 & 12001017 (SEM).

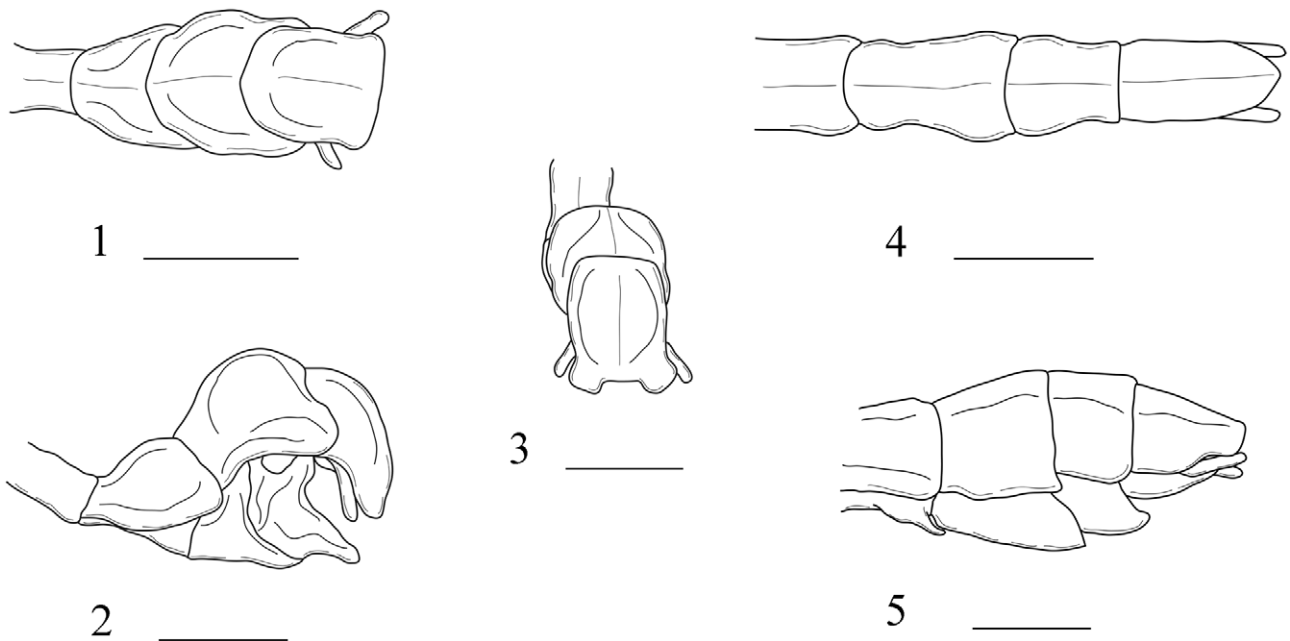
Diagnosis. Medium *Sinophasma*. Closely related to *S. jinxiuense* Chen & He, 2008 [Guangxi, China] but *S. bii* sp. nov. [Yunnan, China] is well distinguished by broadly emarginated hind margin of the anal segment of male, which has the postero-lateral angles square in shape, and with elongate praeopercular organ on seventh sternum in female. Also closely related to *S. atratum* Chen & He, 2000 [Guangxi, China] but *S. bii* sp. nov. [Yunnan, China] can be separated by the postero-lateral angles of ninth tergum rounded in male and gonapophyses reaching to the base of anal segment and alae reaching to sixth tergum in female.

Description. Male (Figs. 1–3). Body slender and elongate. General colouration of body, legs, tegmina and costal region of alae brown. Smaller and more slender than the female.

Head: Brown, slightly darker along the median furrow. Oval, longer than wide, smooth. Vertex flat, with two small oval depressions between the bases of antennae. Occiput slightly convex. Median and lateral furrows indistinct. Eyes small, oval and protruding, brown, with a black transverse stripe. Antennae brown dorsally and dark brown ventrally, exceeding the end of anal segment; the first segment cylindrical, constricted at base, 2 x length of second segment.

Thorax: Brown as body, with granulations. Pronotum with three blackish longitudinal stripes, covered with very few granules, rectangular, shorter than head, anterior margin curved inward, posterior margin rounded, longitudinal sulcus and transverse sulcus crossing before middle. Mesonotum with a blackish medio-longitudinal band running from anterior margin to the hind margin, parallel-sided, 3.3 x length of pronotum, densely covered with irregular sizes of small granules, medially carinate, with two longitudinal carinae being closely laterad of the lateral margins. Mesopleurum less granulated than mesonotum, with a lateral carina. Mesosternum granulated, less distinct near posterior, with a thin dark brown longitudinal stripe. Metapleurum and metasternum indistinctly granulated.

Abdomen: Slender, brown, lacking granulation. Second to sixth tergites parallel-sided. Seventh tergum and eighth tergum expanded posteriorly. Ninth tergum strongly convex medially, as long as anal segment, deeply curved inward at hind margin, postero-lateral angles broadened and rounded. Anal segment longer than eighth tergum, decurved downward vertically, with a rounded depression medially, median carina indistinct, hind margin broadly emarginated, lateral angles square-shaped. Poculum strongly convex, goose-bill shaped in lateral view, almost reaching end of anal segment. Cerci brown, cylindrical, straight, apices rounded, not exceeding postero-lateral angles of the anal segment.



FIGURES 1–5. *Sinophasma bii* Ho **sp. nov.** [scale bar 3 mm]. **1.** Male, apex of abdomen, dorsal view. **2.** Male, apex of abdomen, lateral view. **3.** Male, apex of abdomen, posterior view. **4.** Female, apex of abdomen, dorsal view. **5.** Female, apex of abdomen, lateral view.

Legs: Very elongate. Brown as body, with dark brown stripe along all carinae of femora and tibiae. All tibiae and tarsi dark brown at the apex. Dorsal and ventral carinae of all femora and tibiae smooth, lacking armature. Profemora curved basally, longer than mesothorax. Mesofemora almost as long as mesotibiae. Metafemora slightly shorter than metatibiae.

Wings: Tegmina brown at anterior region, dark brown at posterior region, oval, rounded posteriorly, shorter than pronotum, elevated angle blunt and black, with a white longitudinal stripe being laterad of the black elevation. Alae long, reaching end of sixth tergum, costal region brown, posterior margin with a dark brown longitudinal band.

Female (Figs. 4–5). Generally similar to male, but larger and more robust.

Head: Rounded, almost as long as wide, 1.6 x length of pronotum. Brown, with eight faint and blackish longitudinal bands segregated by median and six lateral furrows. Occiput slightly convex. Eyes oval, with a black transverse stripe. Antennae long; the first segment 2 x length of second segment.

Thorax: Granulated. Pronotum with three thin blackish longitudinal stripes, longitudinal sulcus and transverse sulcus crossing before middle. Mesonotum 4 x longer than pronotum, densely granulated, granules slightly bigger along the blackish median carina, two lateral carinae distinct being laterad of lateral margins. Mesopleurum, mesosternum, metapleurum and metasternum indistinctly granulated.

Abdomen: Cylindrical and smooth. Tapering posteriorly. Segments gradually increase in length from second tergum to sixth tergum, the sixth tergum about 1.25 x length of second tergum. Seventh sternum with prominent praeopercular organ, elongate posteriorly, apex pointed. Anal segment as long as eighth tergum, longer than ninth tergum, hind margin pointed, truncate in lateral view. Supra-anal plate indistinct. Subgenital plate short, reaching half length of ninth tergum, apex slightly pointed. Gonapophyses exposed, reaching base of anal segment. Cerci long and straight, cylindrical, slightly exceeding end of the anal segment.

Legs: Broader than in male. Unarmed. With dark brown stripe on all carinae of femora and tibiae. Apex of all femora and tarsi dark brown. Mesofemora as long as mesotibiae.

Wings: Similar to the male. Tegmina oval and brown. Alae reaching sixth tergum, costal region brown, posterior margin with a dark brown longitudinal band.

Measurements in table 1.

Notes. This is the first *Sinophasma* known from Yunnan Province.

Distribution. Yunnan (Jinping), China.

Etymology. This new species is named in honour and memory of Prof. Bi Daoying for his contribution to the taxonomic study of Chinese Phasmatodea.

TABLE 1. Measurements of *Sinophasma bii* Ho sp. nov.

Lengths (mm)	Male (HT-12001012)	Female (PT-12001015)
Body	52	64
Head	3.5	5
Antennae	50	45
Pronotum	3	3
Mesonotum	10	12.5
Metanotum including median segment	6.5	6
Profemora	16	14
Mesofemora	11	10
Metafemora	17	15
Protibiae	14	12.5
Mesotibiae	12	10
Metatibiae	18	14
Tegmina	2.3	4
Alae	26	29

***Sinophasma daoyingi* sp. nov.**

(Figs. 6–9)

Type-material. Holotype ♂, 1050 m., Mt. Baishanzu, Qingyuan, Zhejiang Province, China, 22.VII.1963, Jin Gentao, 12000455 (SEM); Paratypes 1♂, 2♀♀, 1100 m., Mt. Baishanzu, Qingyuan, Zhejiang Province, China, 23.VII.1963, Jin Gentao, 12000365, 12000387 & 12000388 (SEM); Paratype ♀, 1000 m., Mt. Baishanzu, Qingyuan, Zhejiang Province, China, 15.X.1963, Jin Gentao, 12000386 (SEM).

Diagnosis. Medium *Sinophasma*. Closely related to *S. mirabile* Günther, 1940 [Type from Fujian, also found in Guangdong, Guangxi, Hong Kong, Hunan and Zhejiang, China] but well distinguished by broadly emarginated hind margin of the anal segment, which parallel to ninth tergum, flattened cerci, and posteriorly elongated hind margin of poculum in male and deeply emarginated hind margin of the anal segment in female.

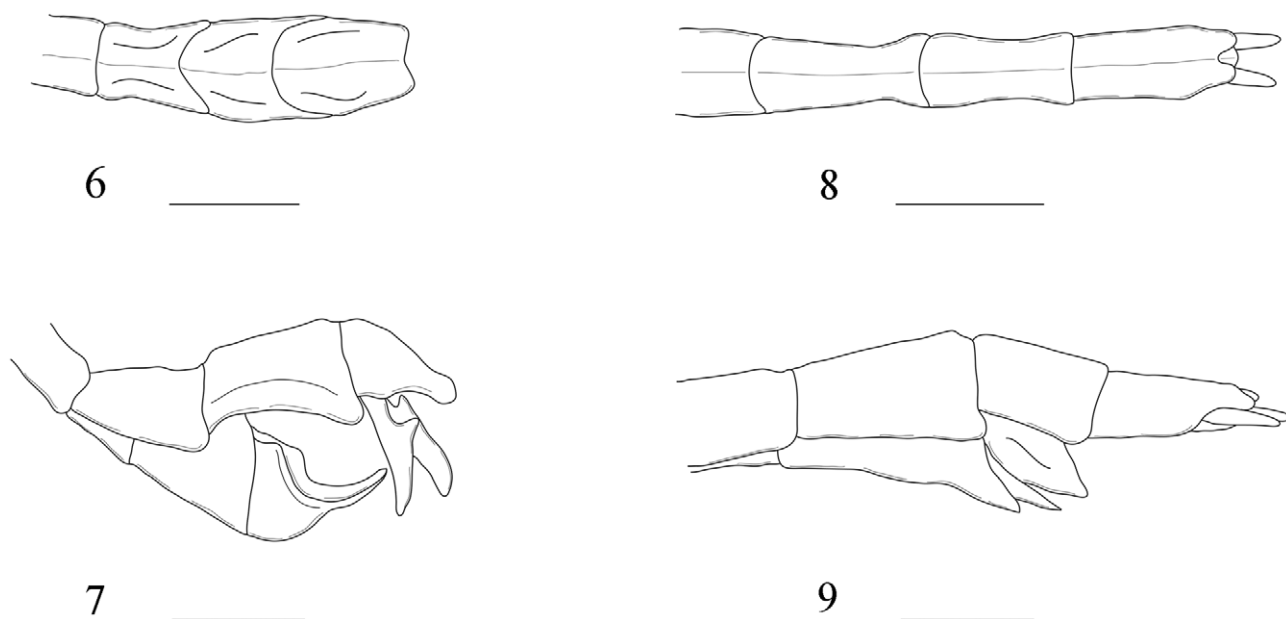
Description. Male (Figs. 6–7). Body slender and elongate. General colouration of body, legs, tegmina and costal region of alae brown. Smaller and thinner than the female.

Head: Brown, with a broad and dark brown longitudinal band along the median furrow, starting from the vertex to the back of head. Genae with a faint and dark brown postocular band. Also with a pale brown band along the lateral furrows between the occipital band and the postocular band. Head oval, longer than wide, longer than pronotum, smooth. Vertex flat, with small oval depression between the bases of antennae. Occiput slightly convex. Median and lateral furrows distinct. Eyes small, oval and protruding, brown, with a black transverse stripe. Antennae brown, filiform, reaching seventh abdominal tergum; the first segment cylindrical, slightly constricted at base, 1.5 x length of second segment, as long as third segment.

Thorax: Brown as body, with granulations. Pronotum with a broad and dark brown longitudinal band along the longitudinal sulcus, covered with very few granules, rectangular, shorter than head, anterior margin near truncate, posterior margin slightly rounded, longitudinal sulcus and transverse sulcus crossing before middle. Mesonotum slightly darker, slightly parallel-sided, 4 x length of pronotum, densely covered with irregular sizes of small and rounded brown granules, medially carinate, with two longitudinal carinae closely being laterad of lateral margins. Granulations indistinct on mesopleurum, mesosternum, metapleurum and mesosternum.

Abdomen: Slender, brown. Smooth. Second to seventh tergites parallel-sided. Eighth tergum expanded posteriorly. Ninth tergum elongate, strongly convex medially, 1.5 x length of anal segment, curved inward at hind margin, postero-lateral angles broadened and rounded projecting over the antero-lateral angle of the anal segment. Ninth tergum of uniform width. Anal segment almost as long as eighth tergum, parallel to ninth tergum, median

carina indistinct; hind margin broadly emarginated, u-shape, lateral angles rounded, with small teeth. Poculum strongly elongate posteriorly, lateral margins curved in lateral view, apex pointed, and reaching base of the anal segment. Cerci brown, longer than anal segment, generally flattened but cylindrical at base, dilated in one-fourth region, knife-shape, apices slightly rounded and curved inward, exceeding postero-lateral angles of the anal segment.



FIGURES 6–9. *Sinophasma daoyingi* Ho **sp. nov.** [scale bar 3 mm]. **6.** Male, apex of abdomen, dorsal view. **7.** Male, apex of abdomen, lateral view. **8.** Female, apex of abdomen, dorsal view. **9.** Female, apex of abdomen, lateral view.

Legs: Long and slender. Sparsely covered with bristles. Brown as body. Left foreleg, both midlegs and right hindleg lost in the solely known holotype male. Right profemur, right protibia, left metafemur and left metatibia with dark brown at the apex. Dorsal and ventral carinae of the legs lacking armature. Right profemora curved basally, longer than mesothorax. Left metafemur almost as long as the corresponding metatibia.

Wings: Tegmina brown, with dark brown to blackish brown at posterior region, oval, rounded posteriorly, shorter than head, elevated angle blunt and black, with a white longitudinal stripe being laterad of the black elevation. Alae short, reaching anterior of fifth tergum, light brown along the margin of costal region, other area of the costal region dark brown, veins light brown, anal region rose.

Female (Figs. 8–9). Generally similar to male, but larger and robust.

Head: Smooth. Brown, with a broad and dark brown longitudinal band along the median furrow as in the male. Genae with a thin postocular band. Oval, longer than wide, longer than pronotum. Occiput convex. Eyes oval, rufous brown, with a black transverse stripe. Antennae long, reaching end of alae; the first segment 1.5 x length of second segment.

Thorax: Granulated. Pronotum with a faint dark brown longitudinal band along the longitudinal sulcus, longitudinal sulcus and transverse sulcus crossing before middle, sparsely granulated. Mesonotum 5 x length of pronotum, brown, densely granulated, median line indistinct. Mesopleurum, mesosternum, metapleurum and metasternum indistinctly granulated.

Abdomen: Cylindrical and smooth. Tapering posteriorly. Seventh sternum lacking praeopercular organ. Anal segment as long as eighth tergum, longer than ninth tergum, medially carinate, hind margin with a deep u-shaped emargination, lateral angles rounded. Supra-anal plate small, apex slightly pointed, exceeding hind margin of the anal segment. Subgenital plate short, reaching half of ninth tergum, apex slightly pointed. Gonapophyses exposed, reaching base of the anal segment. Cerci long and straight, cylindrical, tapering posteriorly, apices pointed, projecting over end of the anal segment.

Legs: Thicker than the male. Unarmed. Generally brown, but left metafemur and left metatibia green in one paratype female. Profemora curved basally, longer than protibiae. Mesofemora longer than the corresponding tibiae. Metafemora slightly as long as mesonotum.

Wings: Similar to the male. Tegmina oval and brown. Alae short, reaching anterior region of fifth tergum, almost as long as the combined length of pronotum and mesonotum together, costal region brown, posterior margin with a dark brown longitudinal band.

Measurements in table 2.

TABLE 2. Measurements of *Sinophasma daoyingi* Ho **sp. nov.**

Lengths (mm)	Male (HT-12000455)	Female (PT-12000388)
Body	55	72
Head	4	5
Antennae	42	44
Pronotum	3	3.5
Mesonotum	13	17
Metanotum including median segment	7	7
Profemora	14 (Right profemur)	15
Mesofemora	-	11
Metafemora	17 (Left metafemur)	17
Protibiae	11 (Right protibia)	13
Mesotibiae	-	9
Metatibiae	17 (Left metatibia)	16
Tegmina	4	4
Alae	21	22

Notes. This is probably a green species in nature based on the green left metafemur and left metatibia of one paratype female. The colouration of most *Sinophasma* species is green on body, legs and part of wings, which is a colour that is easily lost due to the original collecting and preserving methods. The description of the colouration is based on the dried specimens.

Distribution. Zhejiang (Mt. Baishanzu), China.

Etymology. This new species is named in honour and memory of Prof. Bi Daoying for his contribution to the taxonomic study of Chinese Phasmatodea.

***Sinophasma guangdongensis* sp. nov.**

(Figs. 10–16)

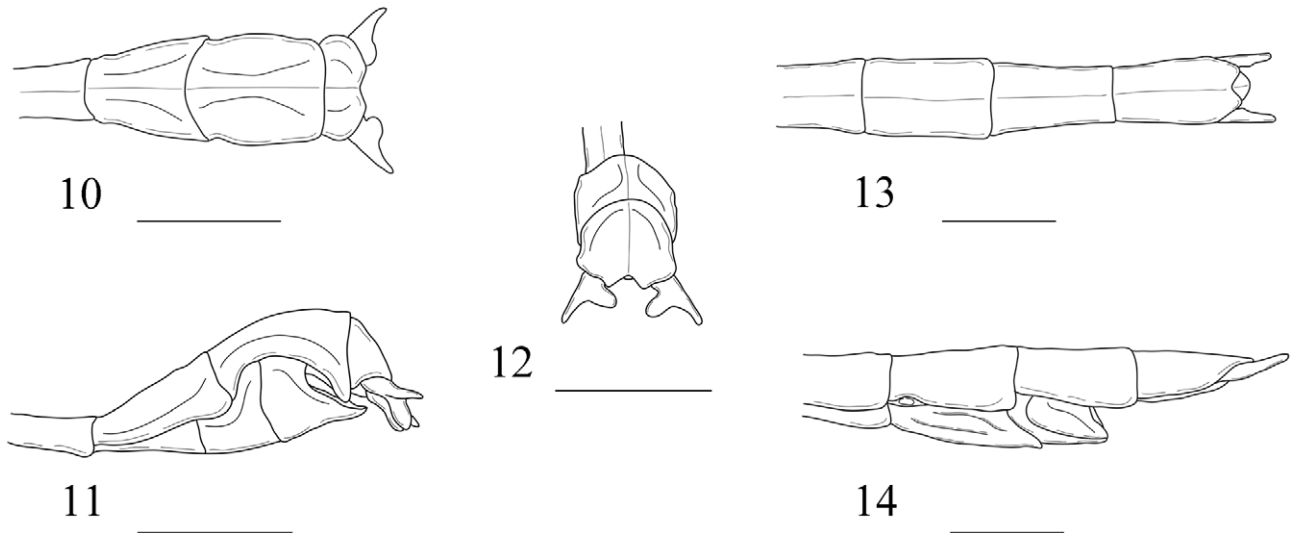
Chen & Chen, 1997: 97, figs. 8–9. [Identified as *S. pseudomirabile* Chen & Chen, 1996 based on specimens from Guangdong]

Type-material. Holotype ♂, Yueyun, Shaoguan, Guangdong Province, China, 20.VII.2008, Ho Wai-Chun George (SEM, ex coll. GH); Paratypes 3♂♂, 2♀♀, Yueyun, Shaoguan, Guangdong Province, China, 20.VII.2008, Ho Wai-Chun George (SEM, ex coll. GH & GH).

Diagnosis. Medium *Sinophasma*. This new species is similar to *S. pseudomirabile* Chen & Chen, 1996 [Guangxi, China] but differs by the strongly furcate cerci and triangularly emarginated hind margin of the anal segment in male. The female is similar to *S. mirabile* Günther, 1940 [Type from Fujian, also Guangdong, Guangxi, Hong Kong, Hunan and Zhejiang, China] but differs by pale white anal region of alae.

Description. Male (Figs. 10–12, 15). Body very slender and slim, more slender than the female. General colouration of body, legs, tegmina and costal region of alae green.

Head: Green. Smooth, oval, longer than wide, dorsal-ventrally flattened. Occiput flat. Median furrow distinct. Eyes dark brown, oval, longer than the first antennal segment. Antennae brown, long, exceeding apices of forelegs; the first segment almost as long as third segment.



FIGURES 10–14. *Sinophasma guangdongensis* Ho **sp. nov.** [scale bar 3 mm]. **10.** Male, apex of abdomen, dorsal view. **11.** Male, apex of abdomen, lateral view. **12.** Male, apex of abdomen, posterior view. **13.** Female, apex of abdomen, dorsal view. **14.** Female, apex of abdomen, lateral view.

Thorax: Green. Pronotum rectangular, shorter than head, with transverse and longitudinal sulcus crossing before middle, granulations indistinct. Mesonotum long and slender, parallel-sided, 4.8 x length of pronotum, sparsely covered with small granules, medially carinate, with one distinct lateral carina. Mesopleurum, mesosternum and metasternum with few mini granules. Metapleurum with few granules along lateral carina. Metanotum 1.3 x longer than median segment.

Abdomen: Green, with brownish longitudinal band. Smooth. Slender and long. Parallel-sided from second tergum to seventh tergum. Eighth tergum gradually expanded posteriorly, hind margin incurved. Ninth tergum slightly as long as eighth tergum, postero-lateral angles elongate and projecting over the antero-lateral angles of the anal segment. Anal segment slightly broader than ninth tergum, with triangular notch at hind margin, lateral angles of hind margin rounded. Poculum elongate, exceeding beyond base of the anal segment, apex pointed. Cerci orange brown, flattened, strongly furcate, antler-shaped composed by two equal-length tines, apex of interior bifurcation rounded, and exterior bifurcation pointed.

Legs: All femora and tibiae uniformly green. All coxae pale orange. Very slender and long. Unarmed, but with sparse bristles.

Wings: Tegmina oval and green, longer than pronotum, elevated angle blunt and black, with bright yellow longitudinal stripe being laterad of the elevation. Alae reaching anterior margin of sixth tergum, costal region uniformly green, anal region pale white.

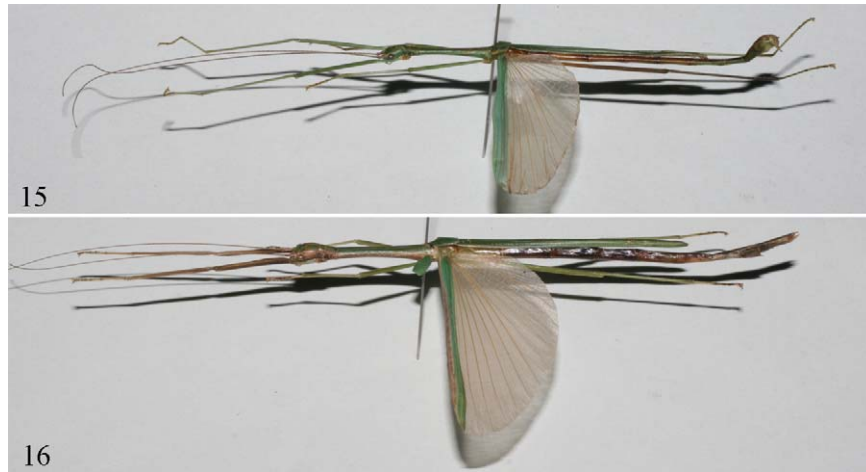
Female (Figs. 13–14, 16). Longer and broader than the male. Green with brown abdomen.

Head: Green, genae with broad pinkish postocular band reaching back of head. Oblong, longer than wide, smooth. Occiput slightly convex. Eyes oval, dark brown. Antennae brown, long, reaching end of fourth abdominal tergum.

Thorax: Lateral margins of pronotum and mesonotum along with a pinkish longitudinal band. Pronotum rectangular, 1.5 x longer than wide. Mesonotum densely granulated, median carina distinct. Mesosternum brown, with darker markings, densely granulated. Metapleurum grassy green, with indistinct granulations. Metasternum brown, with darker markings, granules indistinct.

Abdomen: Brown, with darker markings. Smooth. Narrowing posteriorly. From second tergum to fifth tergum almost equal in length. The apical three tergites equal in length. Anal segment notched at hind margin, lateral angles rounded. Supra-anal plate distinct, apex rounded, projecting over the lateral angles of anal segment. Subgenital plate short, reaching base of ninth tergum. Gonapophyses exposed, reaching middle of ninth tergum. Cerci straight, non-cylindrical, broad at base, tapering towards the apex, slightly constricted medially.

Legs: All femora ad tibiae green. Coxae brown. Unarmed. Profemora curved basally, as long as metafemora. Sparsely covered with brownish bristles.



FIGURES 15–16. Habitus of *Sinophasma guangdongensis* sp. nov. **15.** *S. guangdongensis* Ho sp. nov., HT male (SEM, ex coll. GH). **16.** *S. guangdongensis* Ho sp. nov., PT female (SEM, ex coll. GH).

Wings: Tegmina short, longer than pronotum, generally green with pinkish markings. Alae reaching anterior of sixth tergum, costal region green with broad pinkish longitudinal band at anterior margin, anal region pale white.

Measurements in table 3.

TABLE 3. Measurements of *Sinophasma guangdongensis* Ho sp. nov.

Lengths (mm)	Male (HT)	Female (PT)
Body	53	77
Head	2.5	4.5
Antennae	47	48
Pronotum	2	3
Mesonotum	9.5	14
Metanotum including median segment	7	10
Profemora	14	15
Mesofemora	10	10
Metafemora	16	15
Protibiae	13	13
Mesotibiae	9	8
Metatibiae	16	13
Tegmina	3	5
Alae	28	37

Notes. Chen and Chen (1997: 97) provided a description for the female of *S. pseudomirabile* Chen & Chen, 1996 based on specimens from Guangdong. These however represent a distinct species here recognized as *S. guangdongensis* sp. nov.

Distribution. Guangdong (Shaoguan), China.

Etymology. This new species is named after the type locality, the Guangdong Province.

Sinophasma jinxiuense Chen & He, 2008

Sinophasma jinxiuense, Chen & He, 2008: 134, 402, figs. 98 a–c.

Type-material. Holotype ♂, Dayaoshan, Jinxiu, Guangxi Autonomous Region, China, 13.VI.1982, Li Fashen (CAU, not traced), assessed by Chen & He's figures.

= *Sinophasma rosarum* Chen & He, 2008: 136, 403, figs. 100 a–b. [Holotype ♀, 900–1900 m., Shengtangshan, Jinxiu, Guangxi Autonomous Region, China, 29.VI.2000, Li Wenzhu (IZCAS, not traced), assessed by Chen & He's figures.] **syn nov.**

Other material examined. 2♂♂, Shengtangshan, Jinxiu, Guangxi Autonomous Region, China, 27.VII.2011, Hu Jiayao (SNU); 2♂♂, 1♀, Lianhuashan, Jinxiu, Guangxi Autonomous Region, China, 30.VII.2011, Hu Jiayao & Peng Zhong (SNU).

Diagnosis. Medium *Sinophasma*. It is characterized by the clavate lateral angles of the anal segment and deeply concave hind margin of the poculum in male and small praeopercular organ on seventh sternum in female.

Notes. *S. rosarum* Chen & He, 2008 is shown to represent the previously unknown female of *S. jinxiuense* Chen & He, 2008 and hence is here synonymised with the latter.

Distribution. Guangxi (Jinxiu), China.

Genus *Pachyscia* Redtenbacher, 1908

Type-species. *Pachyscia plagiata* Redtenbacher, 1908: 530, by subsequent designation of Zompro, 2004: 316.

Diagnosis. This genus is characterized by spoon-shape or duckbill-shape anal segment in male and subapically lobed metafemora in female.

Notes. A total of six species are currently recognized from this small genus. Four and two species are respectively known from China and Vietnam.

Species included:

- | | |
|--|------------------------|
| 1. <i>Pachyscia bipunctata</i> Redtenbacher, 1908: 531. | [Vietnam] |
| 2. <i>Pachyscia dilatata</i> (Chen & He, 2004: 49, figs. 5 a–c). [<i>Asceles dilatatus</i>] | [China (GX)] |
| 3. <i>Pachyscia heishidingensis</i> sp. nov. | [China (GD)] |
| 4. <i>Pachyscia longicauda</i> (Bi, 1990: 151, figs. 1–3). [<i>Sinophasma</i>] comb. nov. | [China (HuN, GX & GZ)] |
| 5. <i>Pachyscia plagiata</i> Redtenbacher, 1908: 531. | [Vietnam] |
| 6. <i>Pachyscia quadriguttatus</i> (Chen & He, 1996: 41, figs. 1–2). [<i>Asceles</i>] | [China (HN & YN)] |

Key to females of *Pachyscia* Redtenbacher:

- 1. Anal segment narrowing posteriorly in second half *P. longicauda*
- Anal segment sinuately dilated into a rounded lobe in second half 2.
- 2. Tegmina lacking small yellow spot at the base, alae with distinct pale markings *P. plagiata*
- Tegmina with yellow spot at base, alae with obscure markings or uniformly coloured 3.
- 3. Mesonotum with more than two pairs of spines *P. dilatata*
- Mesonotum with one to two pairs of spines *P. bipunctata*

Key to males of *Pachyscia* Redtenbacher:

- 1. Mesonotum with spine-like tubercles *P. longicauda*
- Mesonotum with granules 2.
- 2. Apices of cerci bifurcate 3.
- Apices of cerci cylindrical *P. quadriguttata*
- 3. Mesonotum parallel-sided, slightly dilated into a rounded lobe in second half of the anal segment *P. heishidingensis* **sp. nov.**
- Mesonotum broadly emarginated medially, strongly dilated into a rounded lobe in second half of the anal segment *P. dilatata*

***Pachyscia dilatata* (Chen & He, 2004)**

(Figs. 17–18)

Asceles dilatatus, Chen & He, 2004: 49, fig. 5 a–c.

Hennemann, Conle & Zhang, 2008: 19.

Chen & He, 2008: 117, figs. 82 a–c.

Type-material. Holotype ♀, 350–1400 m., Daqingshan, Guangxi Autonomous Region, China, 16.IX.1958, Fang Yiguang (ZSU), examined.

Other material examined. 3♂♂, 1♀, Daqingshan, Guangxi Autonomous Region, China, 16.IX.1958, Fang Yiguang (ZSU).

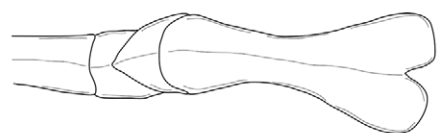
Diagnosis. The male of this specie is similar to *P. heishidingensis* sp. nov. [Guangdong, China] but differs by olive brown colouration, small size, slimmer body, broadly emarginated mesonotum medially, shorter cerci and strongly dilated anal segment.

Description. Male (Figs. 17–18). General colouration of body, legs, tegmina and costal region of alae olive brown. Body slender and slim.

Head: Chocolate brown. Genae with a yellow postocular band reaching back of head. Oblong, 1.5 x longer than wide. Smooth. Vertex slightly with a flattened elevation between the bases of antennae. Occiput flat. Eyes prominent and rounded, rufous brown. Antennae long, but not projecting over end of abdomen, some segments ringed; the first segment cylindrical, 1.5 x length of second segment.

Thorax: Olive brown, with a yellow oval spot at the posterior of mesopleurum. Granulated. Pronotum almost as long as head, anterior margin gently curved inward, and with two mini granules, transverse and longitudinal sulcus crossing before middle. Mesonotum broadly emarginated medially, posterior margin about 1.5 x wider than anterior margin, sparsely covered with small granules, median carina distinct. Mesopleurum and mesosternum with very few granules. Metapleurum smooth, with a yellow spot.

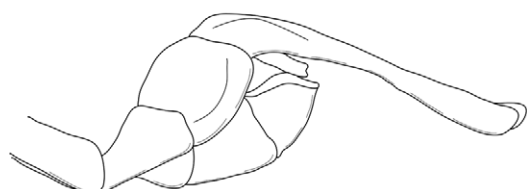
Abdomen: Brown, with short setae. Very slender. Second to fifth tergites equal in length. Parallel-sided from second to sixth tergites. Seventh tergum expanded posteriorly after middle. Ninth tergum as long as eighth tergum, with a white spot near the posterior. Anal segment elongate, almost 4 x length of ninth tergum, hind margin with deep triangular emargination, median carina distinct; broad at base, constricted medially, broadened in second half and strongly dilated into a rounded lobe postero-laterally, hind margin of the lobes truncate. Poculum cup-shape, hind margin rounded. Cerci cylindrical, short and straight, broad at base, tapering posteriorly, not projecting over the end of poculum, with lightly furcate apices.



17



19



18



20

FIGURES 17–20. *Pachyscia* spp. [scale bar 5 mm]. 17. *P. dilatata* (Chen & He, 2004), male, apex of abdomen, dorsal view. 18. *P. dilatata* (Chen & He, 2004), male, apex of abdomen, lateral view. 19. *P. heishidingensis* Ho **sp. nov.**, male, apex of abdomen, dorsal view. 20. *P. heishidingensis* Ho **sp. nov.**, male, apex of abdomen, lateral view.

Legs: Brown to olive brown, all femora and tibiae with dark tip. The base of all tibiae yellow. All tarsi light brown. Lacking distinct armature. With long bristles. Medio-ventral carina of metafemora slightly with a flattened lobe at base. Profemora as long as protibiae, curved at base. Mesotibiae as long as mesonotum.

Wings: Tegmina chocolate brown, short and oval, truncate at hind margin, with a yellow spot at base and another yellow spot near the hind margin. Alae brown, reaching sixth tergum, with a yellow spot and a broad yellow stripe near the base of the costal region.

Measurements in table 4.

TABLE 4. Measurements of *Pachyscia dilatata* (Chen & He, 2004)

Lengths (mm)	Female (HT)	Male
Body	87	67
Head	6	3
Antennae	70	70
Pronotum	5	3
Mesonotum	16	12
Metanotum including median segment	11	8
Profemora	22	20
Mesofemora	13	13
Metafemora	20	20
Protibiae	22	20
Mesotibiae	14	12
Metatibiae	20	18
Tegmina	6	3
Alae	40	34

Notes. A full measurement of the holotype female is given (Table 4). Detailed description of the female was provided by Chen and He (2008: 117). The male is described for the first time.

Distribution. Guangxi (Daqingshan), China.

***Pachyscia heishidingensis* sp. nov.**

(Figs. 19–20)

Type-material. Holotype ♂, Heishiding, Fengkai, Guangdong Province, China, 25.V.1986, Lan Dean (ZSU); Paratype subadult ♂, Heishiding, Fengkai, Guangdong Province, China, 27.VII.2011, Ho Wai-Chun George (GH).

Diagnosis. This species is similar to *P. dilatata* Chen & He, 2004 [Guangxi, China] but can be differentiated by dark brown colouration, bigger size, parallel-sided mesonotum, gently dilated anal segment and longer cerci.

Description. Male (Figs. 19–20). Medium and slender species. General colouration of body, legs, tegmina and costal region of alae dark brown.

Head: Dark brown, with blackish markings. Genae with a pale postocular band between two thin blackish stripes, constricted at the posterior. Oval, longer than wide, smooth. Vertex flat, with a small depression between the bases of antennae. Occiput slightly convex, median furrow distinct. Eyes rounded, dark brown. Ocellus very small, placed above the eyes. Antennae dark brown in the basal three segments, other segments brown, some segments with light brown ring, reaching end of the anal segment; the first segment cylindrical, shorter than third segment.

Thorax: Dark brown as body. Pronotum rectangular, anterior margin and posterior margin near truncate, slightly shorter than head, lacking granulation. Mesonotum parallel-sided, 4.3 x length of pronotum, with very few small granules, median line distinct. Mesopleurum smooth, with a short carina and a pale spot. Metapleurum pale

buff, with a black triangular marking and a short carina. Mesosternum and metasternum lacking granule, with distinct median line.

Abdomen: Brown and slender. Second to seventh tergites parallel-sided. Seventh tergum and eighth tergum expanded posteriorly. Ninth tergum longer than eighth tergum. Anal segment 3 x length of ninth tergum, hind margin broadly emarginated, median carina distinct; slightly constricted medially, broadened in second half and gently dilated into a lobe postero-laterally, hind margin of the lobes pointed. Poculum cup-shape, hind margin rounded. Cerci long and straight, cylindrical and thick at base, projecting over the end of poculum, apices furcated.

Legs: Rufous brown. Unarmed. Right foreleg, both midlegs and left hindleg lost. Left profemur as long as right metafemur, curved basally, with dark tip. The metafemur longer than the combined length of head, pronotum and mesonotum together, with dark tip. Left protibia and right metatibia with light brown at base and dark tip.

Wings: Tegmina dark brown, small and oval, truncate at hind margin, with a pale yellow spot at base and another pale yellow spot near the hind margin. Alae dark brown, reaching sixth tergum, with a pale yellow spot at base and a broad brown stripe near the base of costal region.

Measurements in table 5.

TABLE 5. Measurements of *Pachyscia heishidingensis* Ho **sp. nov.**

Lengths (mm)	Male (HT)
Body	75
Head	4
Antennae	80
Pronotum	3
Mesonotum	13
Metanotum including median segment	8
Left profemur	22
Mesofemora	-
Right metafemur	22
Left protibia	22
Mesotibiae	-
Right metatibia	23
Tegmina	3
Alae	41

Notes. Female is unknown. Measurement is only given to the adult holotype male.

Distribution. Guangdong (Heishiding), China.

Etymology. This new species is named after the type locality, the Heishiding Nature Reserve.

***Pachyscia longicauda* (Bi, 1990) comb. nov.**

Sinophasma longicauda, Bi, 1990: 151, figs. 1–3.

Chen & He, 1992: 44, fig. 126. [Female description and illustration]

Bi, Chen & He, 1992: 67.

Chen, 1993: 87, figs. 1–3.

Wang, Chen & He, 1995: 66. [First record from Guangxi]

Hua, 2000: 31.

Otte & Brock, 2005: 315.

Xu, 2006: 61, fig. 4. [Egg illustration]

Hennemann, Conle & Zhang, 2008: 37.

Asceles longicauda, Chen & He, 1996: 41.

Chen & Wang, 1998: 16.

Chen, He & Xu, 2006: 94.

Chen & He, 2008: 118, figs. 83 a–e.

Type-material. Holotype ♂, Suoxiyu, Cili, Hunan Province, China, 31.VIII.1988, Liu Xianwei (SEM); Paratype ♂, Zhangjiajie, Dayong, Hunan Province, China, 28.IX.1986, Liu Xianwei (SEM), examined.

Other material examined. ♂, 520–560 m., Fanjingshan, Guizhou Province, China, 14.VII.1988, Yuan Decheng (IZCAS); ♂, 500–950 m., Fanjingshan, Guizhou Province, China, 3.VIII.2001, Zhao Fang (CAU); ♀, Zhangjiajie, Dayong, Hunan Province, China, 16.VII.2005, Li & Zhao (SNU); 2♂♂, 882–950 m., 16 km., Jinxiu, Guangxi Autonomous Region, China, 29.VII.2011, Peng Zhong (SNU); ♂, Gaozhai, Xing'an, Guangxi Autonomous Region, China, 24.VII.2012, Ho, G.W.C. (GH).

Diagnosis. This species is readily distinguished from all other *Pachyscia* species by tuberculate mesonotum in male and posteriorly narrowing anal segment in female.

Notes. Bi (1990) originally placed this species in *Sinophasma* Günther, 1940. Chen and He (1996: 41) later transferred this species to *Asceles* Redtenbacher, 1908 based on *Asceles quadriguttatus* Chen & He, 1996 [= *Pachyscia quadriguttata*]. Actually, the elongate and posteriorly notched anal segment in male and subapically lobed mesofemora in female shows the characters of the genus *Pachyscia* and therefore here transferred. First description and illustration of female was provided by Chen and He (1992: 44).

Distribution. Hunan (Suoxiyu and Zhangjiajie), Guizhou (Fanjingshan) and Guangxi (Longsheng, Jinxiu and Xing'an), China.

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